STRESS TESTS: 14 OPTICAL CHARACTER READERS Page 220 APRIL 1991

BYTE

A McGRAW-HILL PUBLICATION

Taming A Sea of Paper
Page 156

An insider's look at computing in the troubled U.S.S.R.

Soviet Computing

Intel Speaks:
–the "Micro 2000" Project page 131
–a first look at a 100-MHz i486 page 27
Mac Video Revealed
Under SPARC's Hood
How to Network Windows 3.0
Pournelle's Annual Awards

PLUS
3 Laptop Pointing Devices
5 Object-Oriented Script Languages
ALR's Six i486 Multiprocessors
IBM's Speedy i486-Based Portable
GeoWorks:
Windows for the Rest of Us?
SPC's "InfoAlliance"

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

CompuAdd®

Customer driven, by design.

It's the advantage of buying direct

More and more companies are turning to CompuAdd's philosophy of purchasing PCs direct. And when they do, they're more than delighted with the result. They've found that CompuAdd offers a combination of high-value pricing and high-capability technology. Since CompuAdd designs and manufactures its PC systems, buying direct gives you the added benefit of a close, direct relationship with the PC manufacturer.

CompuAdd customers have found that we offer superb service. In fact, a recent independent customer service survey found that CompuAdd led the PC industry in commitment to its customers and in value/price performance. When you consider that CompuAdd's international sales growth has doubled over the last year, it's easy to see that CompuAdd offers the way ahead for the 1990s.

It's e
perf

When we designed our 486 PC, we made no compromis
that commitment has paid off handsomely. *Personal Co*
magazine recently judged the CompuAdd 425 486/25MH
Best Power User System in a competition that included t
Compaq SystemPro, Dell 433 and the NeXT Dimension
The judges for the *Personal Computer* competition comm
that the CompuAdd 425 is "just about the fastest 25MHz
tried." This award proves CompuAdd's advanced manuf
capabilities and points out that, when you purchase dire
CompuAdd, you needn't compromise on technological c

We've mentioned the CompuAdd 425's processing speed
But there's much more. The system is standard with 4MB
of memory that's expandable to 8MB on the motherboar
or 16MB on the system bus. And even though this is a low-profile system that occupies 30% less desk space, there's room for five expansion slots. The 425 offers plenty of power to act as a technical workstation but also provides the flexibility to run all the usual 286 and 386 PC software.

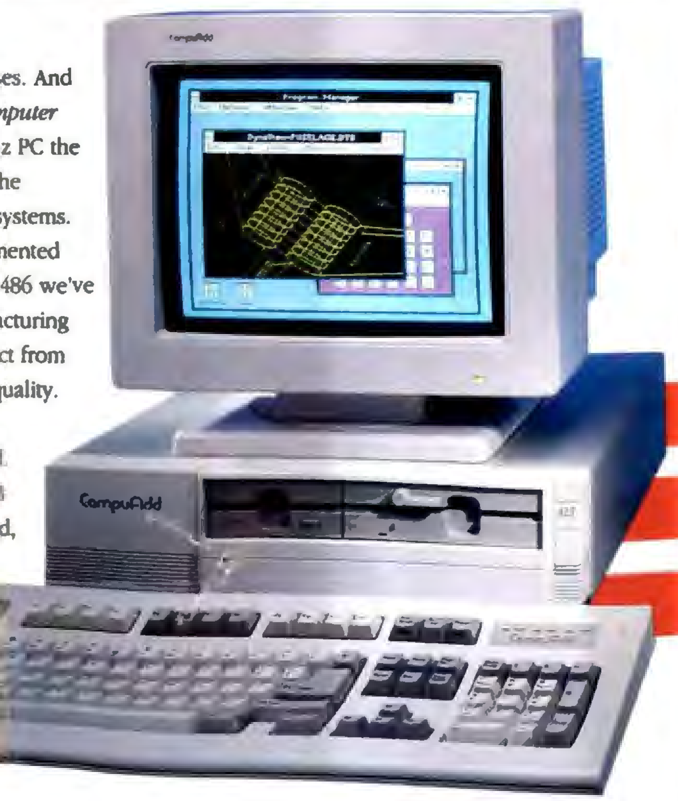
Standard system wit

xceptional
formance

It's exceptional pricing

es. And
nputer
z PC the
he
ystems.
nented
486 we've
cturing
ct from
uality.

l
s
d,



h 4MB RAM, 80MB hard drive, CVGA monitor, mouse, DOS 4.01, Windows 3.0.

Because we've combined industry leading technology with our direct sales philosophy, you have access to tomorrow's generation of personal computing at prices that are simply remarkable. And consider that we also offer a free lifetime support hotline, a one-year warranty and our money-back undertaking. So call today and join CompuAdd on the way ahead for the 1990s.

Fr 40,500
France
Free #: **05-222-333**
Long Distance #: **33-1-40364949**

DM 10,649
Germany
Free#: **0130-6009**
Long Distance #: **49-6181-91010**

£3849
United Kingdom
Free #: **0-800-525-295**
Long Distance #: **44-272-254-789**

CompuAdd®

Customer driven, by design.
12303 Technology Austin, Texas, USA 78727

800-387-3266 95-800-010-0401 0800-373535 0130-6009 1-40364949

It's more than you expected.

Circle 332 on Inquiry Card.

Gateway 2000 Systems

12MHZ 286VGA

- 80286-12 Processor
- 1 MB RAM
- 1.2 MB 5.25" Drive
- 1.44 MB 3.5" Drive
- 40 MB 17ms IDE Drive with 32K Cache
- 16 Bit VGA with 512K
- 14" Gateway Crystal Scan 1024 Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

$1495.00

GATEWAY 386SX

- 4 MB RAM
- 1.2 MB 5.25" Drive
- 1.44 MB 3.5" Drive
- 40 MB 17ms IDE Drive with 32K Cache
- 16 Bit VGA with 512K
- 14" Gateway Crystal Scan 1024 Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01
- MS WINDOWS 3.0

$1895.00

25MHZ 386™ VGA

- 4 MB RAM
- 1.2 MB 5.25" Drive
- 1.44 MB 3.5" Drive
- 80 MB 17ms IDE Drive with 32K Cache
- 16 Bit VGA with 1 MB
- 14" Gateway Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01
- MS WINDOWS 3.0

$2395.00

25MHZ 386CACHE

- 64K Cache RAM
- 4 MB RAM
- 1.2 MB 5.25" Drive
- 1.44 MB 3.5" Drive
- 80 MB 17ms IDE Drive with 32K Cache
- 16 Bit VGA with 1 MB
- 14" Gateway Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01
- MS WINDOWS 3.0

$2695.00

33MHZ 386VGA

- 64K Cache RAM
- 4 MB RAM
- 1.2 MB 5.25" Drive
- 1.44 MB 3.5" Drive
- 200 MB 15ms IDE Drive with 64K Multi-Segmented Cache
- 16 Bit VGA with 1 MB
- 14" Gateway Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01
- MS WINDOWS 3.0

$3195.00

25MHZ 486™ VGA

- 64K Cache RAM
- 8 MB RAM
- 1.2 MB 5.25" Drive
- 1.44 MB 3.5" Drive
- 200 MB 15ms IDE Drive with 64K Multi-Segmented Cache
- 16 Bit VGA with 1 MB
- 14" Gateway Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01
- MS WINDOWS 3.0

$3995.00

33MHZ 486VGA

- Same configuration as the 25 MHz 486.

$4395.00

BEST BUY

- Same features as our 33 MHz 386 VGA system except this machine has an 80 MB 17ms IDE Drive instead of the 200 MB 15ms IDE Drive.

$2795.00

STANDARD FEATURES & SERVICES

- Microsoft® WINDOWS™ and Mouse with all 386 and 486 systems
- 30-day money-back guarantee
- One-year warranty on parts and labor
- Leasing options now available
- Toll-free technical support for the life of the machine
- Free on-site service to most locations in the nation
- Replacement parts sent via overnight shipping free of charge
- Free bulletin board technical support
- New sales hours: 7am-10pm CST M-F 9am-4pm CST Saturdays

NEW CRYSTAL SCAN 1024NI

- Our new 14" Gateway Crystal Scan 1024NI color VGA monitor comes standard with all 386 DX and 486 systems. This monitor is non-interlaced for a flawless, flicker-free display. 1024 x 768 @ 60 Hz. 800 x 600 @ 72 Hz. 28 D.P.

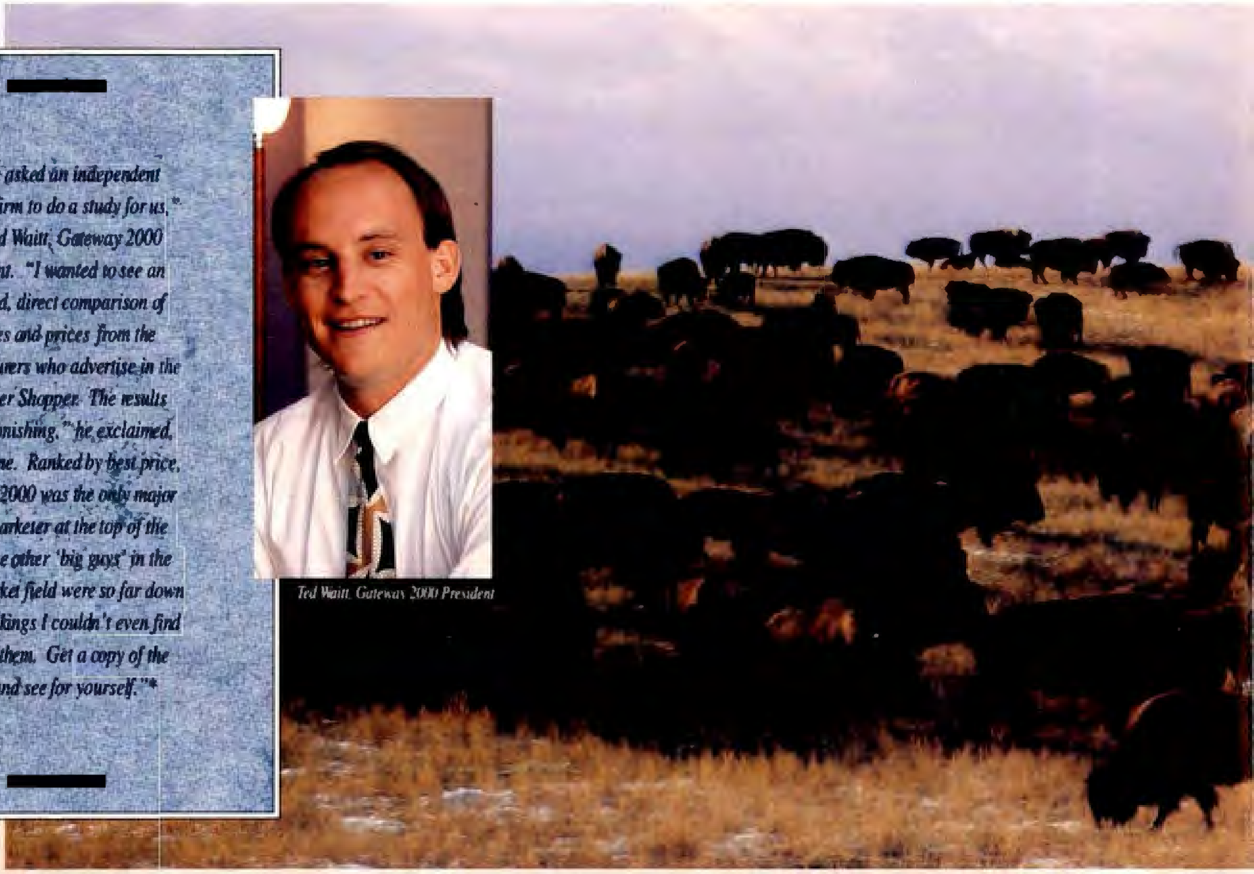
We custom-build each Gateway 2000 computer to customer specifications. We'll gladly provide you with a quote on your configuration. 386 and 486 are trademarks of Intel Corporation.
Due to the volatility of the DRAM market, all prices are subject to change. Prices do not include shipping.

GATEWAY2000

800-523-2000

610 Gateway Drive • N. Sioux City, SD 57049 • 605-232-2000 • Fax 605-232-2023

...Like South Dakota, Where
Saved $10,747,17



"We asked an independent research firm to do a study for us," said Ted Waitt, Gateway 2000 President. "I wanted to see an unbiased, direct comparison of features and prices from the manufacturers who advertise in the Computer Shopper. The results were astonishing," he exclaimed, "even to me. Ranked by best price, Gateway 2000 was the only major direct marketer at the top of the lists. The other 'big guys' in the direct market field were so far down in the rankings I couldn't even find some of them. Get a copy of the study and see for yourself."*

Ted Waitt, Gateway 2000 President

Computer buyers who purchased Gateway 2000 systems in January saved an average of $697 per system. This figure comes from a comparison of 132 computer manufacturers' advertised prices in the January 1991 issue of Computer Shopper. That means Gateway customers shared a total savings of $10,747,179 on 15,427 systems in one month alone.

No matter where you look, that's the best value you're going to find in this industry.

Providing The Best Value Starts With Values

"Whenever I'm asked," continued Ted, "why Gateway 2000 is so successful, my answer is: *value*. When you buy a Gateway 2000 computer, you're getting the best price, best quality and features, best service, all from a very strong, healthy company. That's value. Then I'm asked how we provide value," Ted remarked, "and the answer is almost the same. It's *values*. The values of the people at Gateway 2000 give our product its value," said Ted. "People who grow up in the Midwest value frugality, quality, resourcefulness, hard work, strength, and most of all, integrity and honesty in all dealings with other people. Providing value in our products starts with these values."

We Value Quality

Only the highest quality components go into a Gateway 2000 computer. Midwestern pride in workmanship and quality is demonstrated by every one of nearly 100 skilled asser technicians. These technicians build complete system one at a time.

We Value Strength

A company's strength is measured balance sheet. As independent sourc confirm, Gateway 2000 has an envia sheet coupled with strong growth. I Magazine listed Gateway as the seco fastest-growing private company in during 1990. Financial strength is cr you. What good are warranties, gua promises of lifetime technical suppo

**Call our t this informat*

Gateway 2000 Customers
9 In One Month.

ibly
your

by its
s will
le balance
c.
d
merica
cial to
ntees or
if the

company that sold you the computer goes out of business?

We Value Integrity

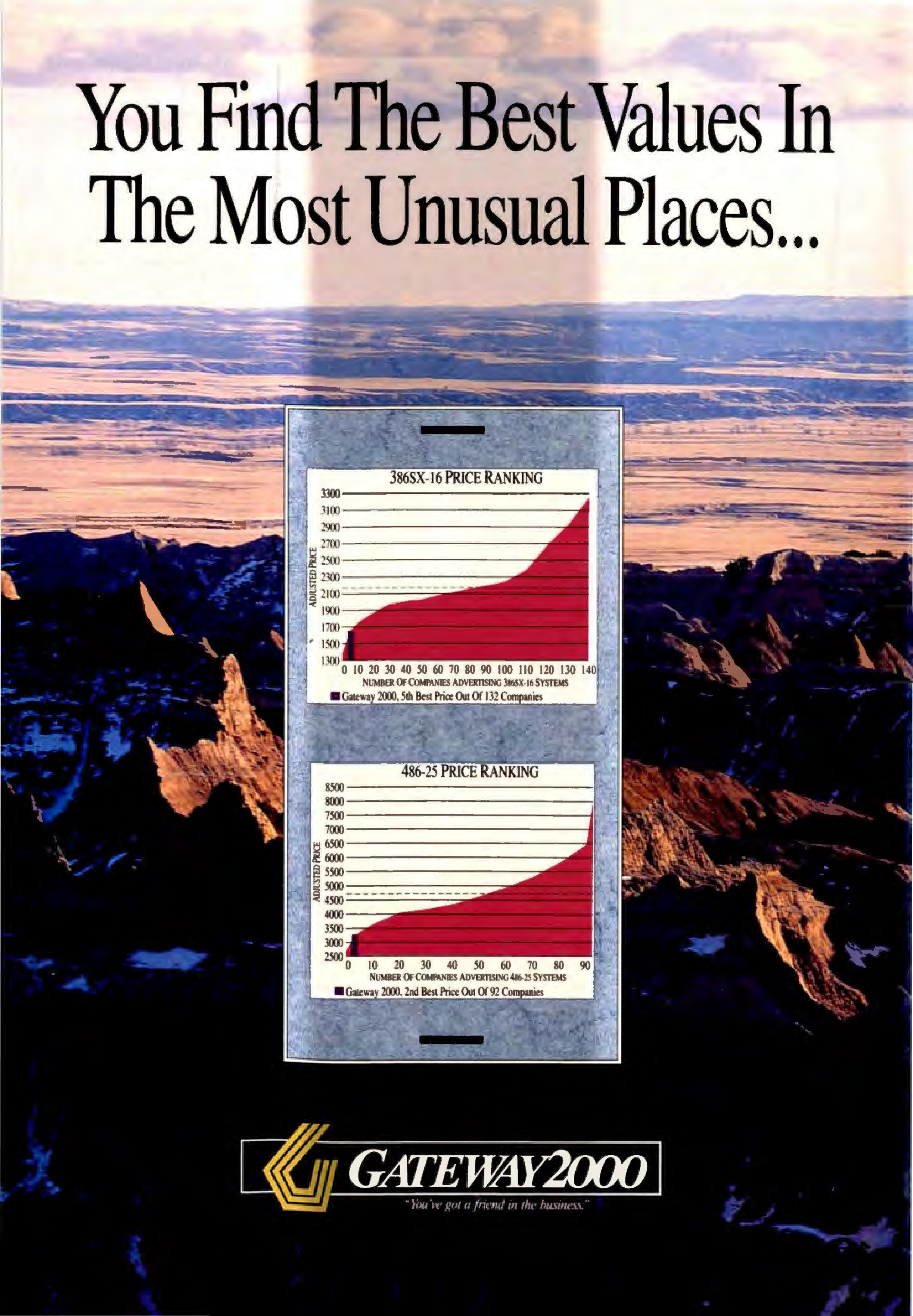
Integrity is the fundamental value without which any organization is doomed. At Gateway 2000, you'll find integrity throughout the company, most visibly in sales and customer support. Gateway salespeople honestly represent the company and its products. Each person you deal with in customer support, during and after the sale, has a personal commitment to make sure you're completely satisfied.

ll-free number for your free copy of
ve study of computer industry prices.

We Value You

Gateway customer Robert C. True, Jr., writes: "We on the East Coast have become so accustomed to surly, uninformed and disinterested...staff, that working with your group may have induced an element of 'Culture Shock.' Every person in your organization operates as if there is only one customer in the world – the one they are talking to at the moment."

"You've got a friend in the business" is more than a slogan. It's our way of life here at Gateway.



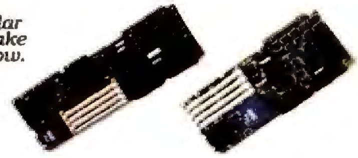
You Find The Best Values In
The Most Unusual Places...
386SX-16 PRICE RANKING
ADJUSTED PRICE
3300
3100
2900
2700
2500
2300
2100
1900
1700
1500
1300
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140
NUMBER OF COMPANIES ADVERTISING 386SX-16 SYSTEMS
Gateway 2000, 5th Best Price Out Of 132 Companies
486-25 PRICE RANKING
ADJUSTED PRICE
8500
8000
7500
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
0 10 20 30 40 50 60 70 80 90
NUMBER OF COMPANIES ADVERTISING 486-25 SYSTEMS
Gateway 2000, 2nd Best Price Out Of 92 Companies
GATEWAY2000
"You've got a friend in the business."

There's An Double Your

Introducing The ALR POWERPRO

CRN
EDITORS' CHOICE

With the POWERPRO's advanced modular system architecture, the choices you make today won't limit your options tommorrow.



Just Upgrade the CPU!™

Strapping two traditional PCs together won't give you the dual processing power you need to keep pace with today's growing networks and multi-user environments, but the new ALR®POWERPRO will. It's the affordable, high-performance alternative to the COMPAQ® SYSTEMPRO™.

Whether you need a system for single or multiple users, CAD/CAM, office automation, manufacturing management systems, shared databases or a host of other applications, there's a POWERPRO that delivers. Choose between one or two 33-MHZ i486 processors and up to 1-MB of cache for performance ranging from 14.7 to 40 VAX™ MIPS. Single CPU models can be quickly and easily upgraded to dual processing.

Additionally, all models will be able to accommodate future, faster, processors. With 49-MBs of possible RAM, twelve expansion slots, and accommodations for up to 2.5-GB of internal storage (up to 10-GB of total storage utilizing an external ALR expansion chassis), the POWERPRO has the expandability needed to keep pace with your future needs. The POWERPRO also incorporates a 32-bit EISA bus, so you'll have maximum compatibility with cutting-edge enhancement products while enjoying the affordability of today's low-cost "AT" compatible hardware.

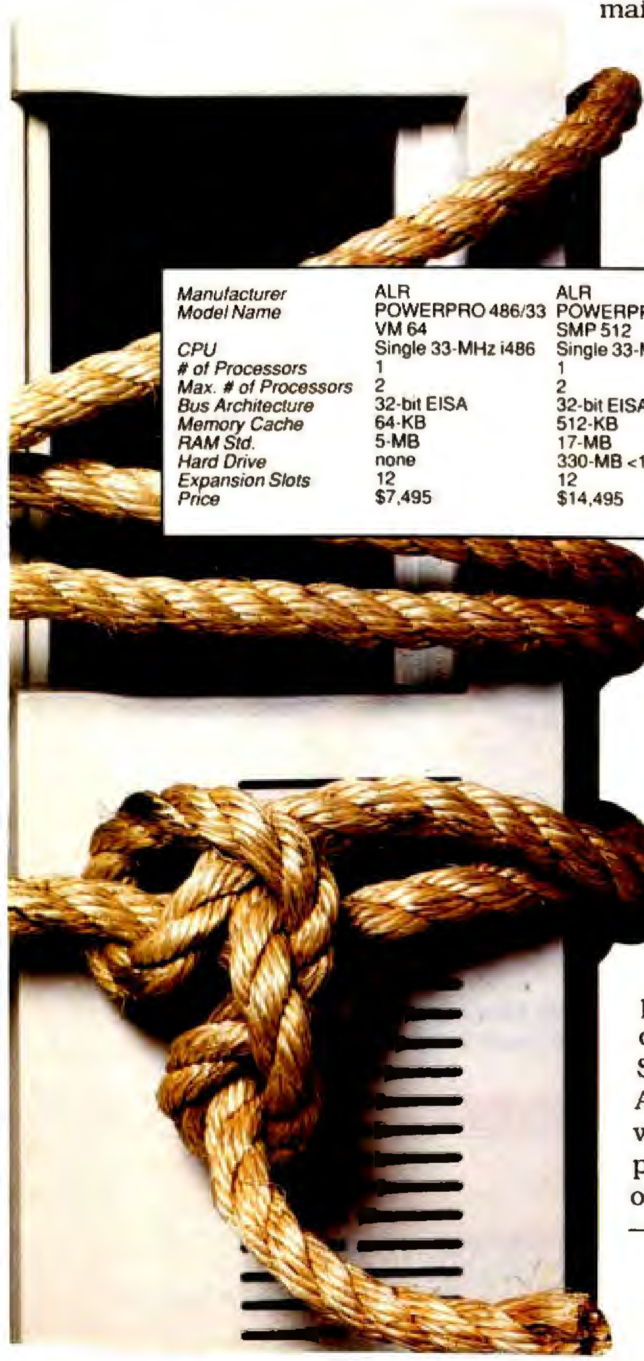
SUPERIOR CACHE

The POWERPRO uses. ALR's proprietary

Easier Way To Processing Power.

Single or Dual Processing Performance with Prices Starting at $7495

BANYAN SMP Certified



PROCACHE scalable cache memory architecture. This mainframe-like read-and-write-back design is more efficient than the standard write-through architecture found on the SYSTEMPRO.

Manufacturer	ALR	ALR	Compaq
Model Name	POWERPRO 486/33 VM 64	POWERPRO 486/33 SMP 512	SYSTEMPRO 486/33
CPU	Single 33-MHz i486	Single 33-MHz i486	Single 33-MHz i486
# of Processors	1	1	1
Max. # of Processors	2	2	2
Bus Architecture	32-bit EISA	32-bit EISA	32-bit EISA
Memory Cache	64-KB	512-KB	512-KB
RAM Std.	5-MB	17-MB	8-MB
Hard Drive	none	330-MB <18ms	240-MB <19ms
Expansion Slots	12	12	11
Price	$7,495	$14,495	$20,995

More importantly, this scalable architecture allows you to equip the POWERPRO with up to 1–MB of cache.

ADVANCED DISK PERFORMANCE AND SECURITY

Yet the POWERPRO's performance edge doesn't stop there. Selected models use ALR's SCSI SDA (Software Disk Array) to provide the capabilities of hardware disk arrays — including disk striping, spanning and mirroring — with greater flexibility and higher performance. ALR's SDA protects your data while helping to eliminate hard disk bottlenecks.

OFF THE SHELF COMPATIBILITY

The SYSTEMPRO-compatible ALR POWERPRO runs off the shelf dual-processing versions of SCO® UNIX™ with SCO MPX as well as Banyan® Vines™ SMP. And it's positioned for use with future dual processing versions of Novell® NetWare™, OS/ 2™ and LAN Manager 2.0™.

Only ALR can deliver a dual-processing system that's more powerful than the COMPAQ SYSTEMPRO for a price that's up to 30% less.

For more information call ALR now;

1-800-444-4ALR

ALR®
Advanced Logic Research, Inc.

9401 Jeronimo Irvine, CA 92718
(714) 581-6770 FAX: (714) 581-9240

Available at these selected resellers: ALR Power Partner Resellers

Connecting Point COMPUTER CENTERS   ENTRE   CBC

Prices based on U.S. Dollars.

Circle 15 on Inquiry Card (RESELLERS: 16).

BYTE

April 1991 *Volume 16, Number 4*

COVER STORY

Computing in the U.S.S.R.

PAGE 120

NEWS

FEATURES

STATE OF THE ART

REVIEWS

HANDS ON

BYTE (ISSN 0360-5280/91) is published monthly with an additional issue in October by McGraw-Hill, Inc. U.S. subscriber rate $29.95 per year. In Canada and Mexico, $34.95 per year. Single copies $3.50 in the U.S., $4.50 in Canada. Executive, Editorial, Circulation, and Advertising Offices: One Phoenix Mill Lane, Peterborough, NH 03458. Second-class postage paid at Peterborough, NH, and additional mailing offices. Postage paid at Winnipeg, Manitoba. Registration number 9321. Printed in the United States of America. **Postmaster:** Send address changes, USPS Form 3579, and fulfillment questions to BYTE Subscriptions, P.O. Box 551, Hightstown, NJ 08520

OPINIONS

PROGRAM LISTINGS
From BIX: Call (800) 227-2983
From BYTEnet: Call (617) 861-9764
On disk: See card after **122**

INSIDE BYTE

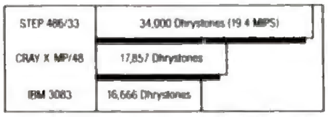
INTERNATIONAL SECTION begins after page 90

The Joneses.

EVEREX STEP

Check out the benchmarks. When it comes to speed, pure and simple, mainframes are no longer the main attraction.

Introducing the Everex STEP 486/33 and STEP 486/25. Along with the STEP 486*is*, they give you desktop performance that was previously unheard of.



There are two reasons. The first, of course, is the 486™ chip. The other is AMMA™ Everex's proprietary Advanced Memory Management Architecture.

AMMA uses "write-back" cache technology instead of the "write-through" technologies used in most PC's. The write-back cache was developed for mainframes. Everex was the pioneer in developing it for the PC. And in doing so, opened a whole new dimension in desktop performance.

With AMMA, you can write directly to the STEP 486's cache in nearly all cases. With write-through techniques, on the other hand, you lose most of the performance benefit of the cache.

BYTE

EDITOR IN CHIEF
Frederic S. Langa

MANAGING EDITOR
Anne Fischer Lent

NEWS
New York: *Managing Editor* Rich Malloy
News Editor Andrew Reinhardt
Peterborough: *Senior Editor, Microbytes* D. Barker, *Senior Editor, New Products* Stan Miastkowski
Associate News Editors, What's New: David Andrews, Martha Hicks, Carol Swartz
Editorial Assistant Amanda Waterfield
San Francisco: *Senior News Editor* Owen Linderholm
Associate News Editor Ellen Ullman
Editorial Assistant: David Silverman

BYTE LAB
Managing Editor Michael Nadeau
Technical Director Rick Grehan
Senior Editor Dennis Allen
Technical Editors Alan Joch, Robert Mitchell, Tom Yager
Testing Editors/Engineers Stephen Apiki, Stanford Diehl, Howard Eglowstein, Stanley Wszola

STATE OF THE ART
Senior Editor Jane Morrill Tazelaar
Technical Editor Robert M. Ryan

FEATURES
Senior Editor Kenneth M. Sheldon
Technical Editors: Janet J. Barron, Ben Smith

SENIOR EDITORS, AT LARGE
Tom Thompson, Jon Udell

SPECIAL PROJECTS
Senior Editor Gene Smarte

SENIOR CONTRIBUTING EDITOR
Jerry Pournelle

CONTRIBUTING EDITORS
Don Crabb, David Fiedler, Hugh Kenner, Mark J. Minasi, Wayne Rash Jr

CONSULTING EDITORS
Jonathan Amsterdam, Nick Baran, Laurence H. Loeb, Trevor Marshall, Dick Pountain, Phillip Robinson, Peter Wayner

COPYEDITING
Chief Copy Editor Lauren A. Stickler
Copy Administrator Cathy Kingery
Copy Editors Ellen Bingham, Susan Colwell, Jeff Edmonds, Tom Kevan, Margaret A. Richard, Warren Williamson

EDITORIAL ASSISTANTS
Office Manager Peggy Dunham
Assistants Linda C. Ryan, June Sheldon

DESIGN CONSULTANT
Ken Silvia

ART
Director Nancy Rice
Assistant Director Joseph A. Gallagher
Art Assistant: Jan Muller
Technical Artist Alan Easton

PRODUCTION
Director David R. Anderson
Senior Editorial Production Coordinator Virginia Reardon
Editorial Production Coordinators Barbara Busenbark, Denise Chartrand

TYPOGRAPHY
Systems Manager Sherry Fiske
Applications Manager Donna Sweeney
Typesetter Christa Patterson

ADVERTISING SERVICES (603) 924-6448
Assistant Christine W. Tourgee
Customer Service Supervisor Linda Fluhr
Senior Account Coordinator Lyda Clark
Account Coordinator Dale J. Christensen
Materials Coordinator Karen Cilley
Advertising Assistant Roxanne Hollenbeck
Creative Services Manager Susan Kingsbury
Production Artist Lillian J. Wise
Quality Control Manager Wai Chiu Li
Production Coordinator Rod Holden

ADMINISTRATION
Publisher's Assistant Donna Nordlund

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

FINANCIAL SERVICES
Director of Finance Claudia Flowers
Business Manager Kenneth A. King
Assistants Marilyn Parker, Diane Henry, JoAnn Walter, Jeanne Gatcombe, Jaime Huber, Agnes Perry

CIRCULATION
Director Glyn Standen
Subscriptions Manager Paul Ruess
Assistant Manager, Subscriptions Margaret Liszka
Subscriptions Assistant Holly Zilling
Newsstand Manager Vicki Weston
Distribution Coordinator Karen Desroches
Back Issues Louise Menegus
Direct Accounts Coordinator Ellen Dunbar
Direct Accounts Telephone Sales Representative Karen Carpenter

BUILDING SERVICES
George Clarke, Cliff Monkton, Gary Graham, Ed Codman

PERSONNEL
Human Resources Administrator Patricia Burke, *Human Resources Assistant* Fran Wozniak, *Receptionist* Beverly Goss

PUBLISHER
Ronald W. Evans

ADVERTISING SALES
Associate Publisher, Vice President of Marketing Steven M. Vito

Administrative Assistant Carol Cochran

Eastern Advertising Director
Arthur H. Kossack (312) 616-3341
Sales Assistant Julie Watson
Western Advertising Director
Jennifer L. Bartel (214) 701-8496
Sales Assistant Mary Lynn Heinritz

NEW ENGLAND
ME, NH, VT, MA, RI, CT, ONTARIO, CANADA, & EASTERN CANADA
Daniel D. Savage (617) 860-6344

EAST COAST
NY, NYC, NJ, DE, PA
Kim Norris (212) 512-2645
Ariane Casey (212) 512-2368

SOUTHEAST
NC, SC, GA, FL, AL, TN, VA, MS, AR, LA, DC, MD, WV, KY
John Schiller (404) 843-4782

MIDWEST
IL, MO, KS, IA, ND, SD, MN, WI, NE, IN, MI, OH
Kurt Kelley (312) 616-3328

SOUTHWEST, ROCKY MOUNTAIN
CO, OK, TX
Alison Keenan (214) 701-8496

SOUTH PACIFIC
SOUTHERN CA, AZ, NM, LAS VEGAS, UT
Ron Cordek (714) 753-8140
Alan El Faye (213) 480-5243

NORTH PACIFIC
HI, WA, OR, ID, MT, NORTHERN CA, WY, NORTHERN NV, WESTERN CANADA
Bill McAfee (408) 879-0381
Roy J. Kops (415) 954-9728
Leslie Hupp (408) 879-0381

INSIDE ADVERTISING SALES
Director: Liz Coyman
Administrative Assistant Susan Boyd
Sales Secretary Vivian Bernier

NATIONAL ADVERTISING SALES
Mary Ann Goulding (603) 924-2664
Patricia Payne (603) 924-2654
Jon Sawyer (603) 924-2665
Scott Gagnon (603) 924-2651

BYTE BITS (2x3)
Mark Stone (603) 924-2695

THE BUYER'S MART (1x2)
Brian Higgins (603) 924-2656

CATALOG SHOWCASE/INT'L CARDS
Ellen Perham (603) 924-2598

REGIONAL ADVERTISING SECTIONS
James Bail (603) 924-2533
Barry Echavarria (603) 924-2574
Larry Levine (603) 924-2637

BYTE DECK
Ed Ware (603) 924-2598

INTERNATIONAL ADVERTISING SALES STAFF
See listing on page 379.

BIX BYTE INFORMATION EXCHANGE

DIRECTOR
Stephen M. Laliberte

MANAGING EDITOR
Tony Lockwood

MICROBYTES DAILY
Coordinator D. Barker *Peterborough*, Rich Malloy *New York*, Nicholas Baran *Sandpoint, ID*, Jeffrey Bertolucci *San Francisco*, Laurence H. Loeb *Wallingford, CT*, Stan Miastkowski *Peterborough*, Wayne Rash Jr. *Washington, DC*, David Reed *Lexington, KY*, Andrew Reinhardt *New York*, Jan Ziff *Washington, DC*

EXCHANGE EDITORS
Macintosh Exchange Laurence H. Loeb, *IBM Exchange* Barry Nance, *User Group Exchange* David Reed, *Interactive Game Exchange* Richard Taylor, *Amiga Exchange* Joanne Dow, *Writers Exchange:* Wayne Rash Jr., *Tojerry Exchange* Jerry Pournelle, *Telecommunications Exchange* Stephen Satchell

BUSINESS AND MARKETING
Secretary Patricia Bausum, *Marketing Services Coordinator* Denise A. Greene, *Billing Services Coordinators* Tammy Burgess, Donna Healy, *Editorial Assistant* Brian Warnock

TECHNOLOGY
Programmer/Analyst John Spadafora, *Systems Consultant* Gary Kendall

EDITORIAL AND BUSINESS OFFICE:
One Phoenix Mill Lane, Peterborough, NH 03458, (603) 924-9281.
West Coast Branch Offices: 425 Battery St., San Francisco, CA 94111, (415) 954-9718; 15635 Alton Pkwy., Suite 290, Irvine, CA 92718, (714) 753-8140.
New York Branch Editorial Office: 1221 Avenue of the Americas, New York, NY 10020, (212) 512-3175.
BYTEnet: (617) 861-9764 (set modem at 8-1-N or 7-1-E; 300 or 1200 baud).
Editorial Fax: (603) 924-2550. **Advertising Fax:** (603) 924-7507.
SUBSCRIPTION CUSTOMER SERVICE: Outside U.S. (609) 426-7676; inside U.S. (800) 232-BYTE. For a new subscription—(800) 257-9402 U.S. only, or write to BYTE Subscription Dept., P.O. Box 555, 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, $34.95 for one year, $64.95 for two years, $87.95 for three years. In Europe, £29 (U.S. $50) for fast surface delivery, £41 (U.S. $70) for air delivery. All other countries, U.S. $150 for air mail delivery. Single copy price is $3.50 in the U.S. and its possessions, $4.50 in Canada. 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.

EDITORIAL CORRESPONDENCE:
Address editorial correspondence to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Unacceptable manuscripts will be returned if accompanied by sufficient postage. Not responsible for lost manuscripts or photos. Opinions expressed by the authors are not necessarily those of BYTE.

OFFICERS OF MCGRAW-HILL, INC:
Joseph L. Dionne, Chairman, President and Chief Executive Officer; Robert N. Landes, Executive Vice President, General Counsel and Secretary; Walter D. Serwatka, Executive Vice President; Frank D. Penglase, Senior Vice President, Treasury Operations; Robert J. Bahash, Executive Vice President and Chief Financial Officer; Thomas J. Sullivan, Executive Vice President, Administration; Mary A. Cooper, Senior Vice President, Corporate Affairs, and Executive Assistant to the Chairman; Ralph R. Schulz, Senior Vice President, Editorial.

Founder: James H. McGraw (1860–1948).

BYTE Topic Index and Author Guide

This index helps you find articles that contain information on each of the listed topics. (The topic list changes each month.) Combined with the table of contents (page 4) and the Editorial Index by Company (page 380), you can identify articles by type, subject, title, author, or product discussed.

THE RIGHT DECISION

Student Body Leader

TRI-STAR
TRI-CAD

Tri-CAD workstations are the hands-down choice of the world's leading CAD training schools and Universities. Schools such as the University of Texas and the world's largest CAD training center – The CAD Institute, insist on Tri-CAD quality.

We designed the Tri-CAD family with one goal – to build the best CAD workstations available anywhere, at any price.

Now, for a limited time, every Tri-CAD Workstation includes FastCAD – the fastest CAD in the microcomputer world.

Whether you're looking for your first CAD package or adding a new workstation, FastCAD® will change your mind about CAD once and for all. Written in assembly language, FastCAD is the undisputed speed champion. It zooms the fastest. Pans the fastest. And draws the fastest. Period.

TRI-CAD WORKSTATIONS

TC 425I
$5195

TC 433I
$5695

UPGRADES:

12" x 17" DIGITIZER $250
2MB HD CACHE CARD $395
RENDITION II/256V $695
20" COLOR DISPLAY $995

ADVANCED FEATURES INCLUDE:

- Intel 80486 Processor
- Integrated Intel Math Coprocessor
- 8MB of 32-bit DRAM
- 64K High Speed Static RAM Cache
- 210MB Fast Access Hard Drive
- 1.2MB 5.25-inch Floppy Drive
- 1.44MB 3.5-inch Floppy Drive
- 16-Bit SVGA Card with 1MB DRAM
- 16" Non-Interlaced 1024 x 768 Color Monitor
- Microsoft DOS 3.3 or 4.01
- Panacea CAD Display List Driver
- Quality 101-Key Tactile Keyboard
- Two Serial Ports & One Parallel Port
- 12" x 12" Digitizer with Cursor
- FastCAD Design and Drafting Software

Circle 281 on Inquiry Card.

ALL TRI-CAD COMPUTER SYSTEMS INCLUDE:

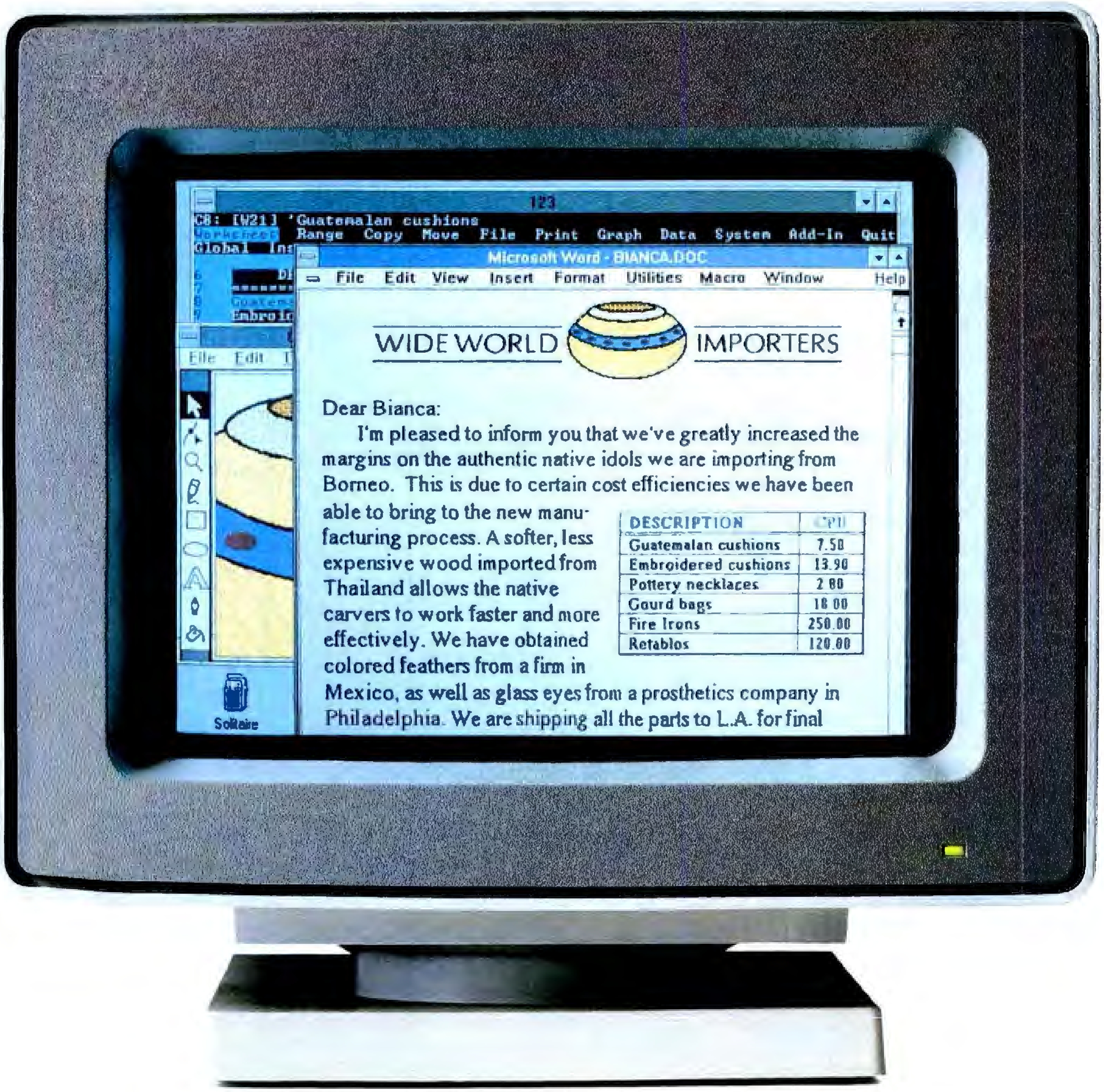
• 2 Year Parts & Labor Warranty • 60 Day Money Back Guarantee • 12 Month On-Site Service • Overnight Parts Replacement • Lifetime Toll-Free Technical Support

All prices and specifications subject to change without notice. We accept MasterCard & Visa (No Surcharge), AMEX (3% Surcharge), or COD. University & Corporate PO's are welcome (1%10, Net 25). Money Back guarantee does not include shipping charges. On-Site service available in most U.S. locations. 2 Year Warranty includes system and keyboard, non Tri-Star assembled peripheral items such as printers and monitors are covered for 1 Year. All systems have been verified or certified to comply with part 15 of the FCC rules for a Class A or Class B computing device. FCC Class A systems not intended for home use. FastCAD is a registered trademark of Evolution Computing. 386 & 486 are trademarks of The Intel Corporation. Product names mentioned herein may be trademarks and/or registered trademarks of their respective companies

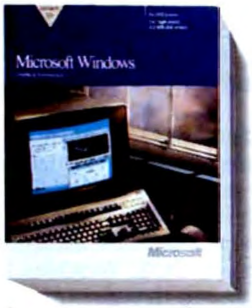
TRI-STAR
COMPUTER CORPORATION

1.800.678-2799
707 West Geneva, Tempe, Arizona 85282
Tech Support 1.800.688-TECH
Telephone 602.829-0584
Fax 602.345-0110
Monday - Friday 7:00am-7:00pm MST
Saturday 9:00am-4:00pm MST

The perfect en
the lazy and p



vironment for ower-hungry.



The Microsoft® Windows™ graphical environment version 3.0 makes it easy for you to do a lot more with your PC. That's because the Windows environment has friendly icons, menus and dialog boxes that make its powerful features very accessible.

Windows lets you work with a variety of applications on-screen at the same time. Including your character-based programs.

But it's when you start using Windows applications that you get the most out of your PC. Windows applications are easy. In addition they all work essentially the same way. So once you learn how to use one, you generally know how to use them all.

And they're so intuitive that experimenting with them is fun.

Windows applications let you cut and paste text and graphics. And let you combine them right on your screen. They also let you print out exactly what you see.

You can even establish links between Windows applications. Which means, if you change any numbers in Microsoft Excel for Windows, the chart you cut and pasted into your Microsoft Word for Windows document will be automatically updated.

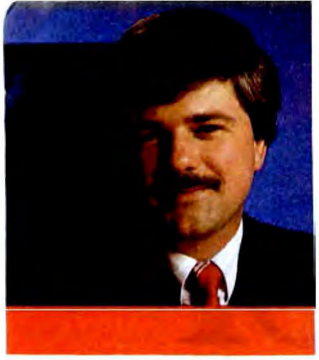
So call us at (800) 541-1261, Department P31, to find out more about Windows, Windows applications or the big Windows World Convention and Exposition coming up May 20th and 23rd in Atlanta.

Because with Windows, you can start taking the work you do every day a little easier.

And have more to show for it.

Microsoft®

Making it all make sense™



EDITORIAL

FRED LANGA

LOWER-COST DOWNLOADS

A new BYTE service can save you money when downloading material

One of the horrors of the early days of personal computing was the—argh!—type-and-run program. I can recall spending too many evenings with a magazine open on my lap, laboriously keying in page after page of code. I'd initially use rulers and pencil marks to try to keep my place on the page; then, with one finger on the screen and another on the page, I'd painstakingly cross-check my typed code against the original. Then, finally, I'd try to run the newly keyed program. It almost never worked the first time. With listings of any length at all, some subtle typo would inevitably creep in, fouling up the listing in whole or in part. What a pain.

With the advent of BBSes and on-line services, the type-and-run program largely died a well-deserved death. Full-blown print listings linger today only in a few publications: those that cater to novices (who may lack modems or the knowledge of how to download software) or, more sadly, publications looking to pad out their editorial ratio with space-filling code.

When BYTEnet and then BIX started in the 1980s, BYTE shifted the bulk of its routine program listings on-line, reserving printed listings only for special cases, and when there was some compelling reason. This worked pretty well: If you signed up for BIX or called the free BYTEnet number, you could download in minutes and with total accuracy code that might otherwise have taken hours to key in. This saved you time, and it gave us more space in the magazine to bring you additional articles.

The only catch was cost. Even the "free" BYTEnet number required that you call Lexington, Massachusetts, to access the BYTEnet host. The long-distance charges could be daunting.

Happily, that catch has been largely eliminated. Starting this month, instead of having to call Massachusetts for BYTEnet, most readers will be able to phone a much closer access point to obtain current BYTE listings for free. This will reduce your phone charges while still giving you error-free, timesaving downloads of program code.

We're able to do this by piggybacking the BYTE listings onto our Demolink service and using Demolink's international communications network.

Now, when you call Demolink, you'll have the option of downloading either the current BYTE listings or Demolink's normal fare, which is free "try before you buy" software offered by a group of major software vendors.

For example, on a recent weekend when I last logged on, Demolink offered free versions of Lotus Magellan 2.0; some Borland software; C-scape (an object-oriented C programming tool) and the Look & Feel screen designer from the Oakland Group; Zortech's multiplatform C++, which is portable to DOS, Windows 3.0, OS/2, extended DOS, Unix, and the Mac; and more.

The list of available software is constantly growing and changing, and it will probably be different when you call. But in all cases, instead of having to write or call to request a demonstration disk (and suffer the usual four- to six-week wait), Demolink lets you instantly download the demonstration software of your choice.

And now, Demolink also gives you access to the BYTE listings.

Demolink is currently available through local calls in the following cities: Chicago (312) 616-1071; Los Angeles (213) 383-9856; New York (212) 797-5620; San Francisco (415) 434-4510; Washington, DC (202) 463-4920; Denver (303) 220-0328; Hightstown, NJ (609) 426-7110; and Toronto, Ontario, Canada (416) 960-3187. Other cities, including European access points, are in the works.

Connecting with Demolink is standard: Using conventional modem settings (8 data bits, 1 stop bit, no parity; 2400 or 1200 bps), you call one of the numbers listed above and enter DEMOLINK at the first prompt. You'll then be walked through a brief sign-on process. After that, you're given a menu of available software and listings.

After you've selected what you want, Demolink downloads it to you error-free via XMODEM/CRC. Because it uses conventional settings and XMODEM, Demolink is compatible with virtually all telecommunications software.

We're glad to be able to offer you free electronic listings from more access points at lower telephone costs than ever before. Check out Demolink; we think you'll like it!

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

dFacts Are In.

DATABASE COMPARISON TABLE	dBASE IV version 1.1	Paradox version 3.5	FoxPro version 1.02
EASE OF USE			
Control Center organizes data, queries, forms, reports, labels, applications on one screen	Yes	No	No
Create applications *without programming*	Yes	Yes	No
Modern pulldown menus for all Design Tools	Yes	No	Limited
Query by Example (QBE) for easy access to information	Yes	Yes	No
Context specific help by menu item	Yes	No	No
PRODUCTIVITY			
Quick Layout for automatic forms, reports and labels	Yes	No	Yes
Application Generator for quick application development	Yes	Yes	No
Automatic code generation for all Design Tools	Yes	No	No
Automatic maintenance of multiple indexes for ordering data	Yes	No	No
Memo fields for notes, letters, descriptions	Yes	No	Yes
POWER & FLEXIBILITY			
Bold, underline, italic, subscript, superscript text for high impact reports and labels	Yes	No	No
User Defined Functions for extending programming language	Yes	No	Yes
Data input validity checking in forms	Yes	Yes	Yes
Multi-user transaction processing ensures data integrity	Yes	No	No
Number of file formats imported/exported	7	6	3
INDUSTRY STANDARDS			
#1 Selling, #1 Rated multiuser database; over 3 million users (1)(2)	Yes	No	No
Compatible with dBASE III PLUS data and applications	Yes	No	Yes
Compatible versions for DOS, VAX VMS, Macintosh, SunOS and other UNIX platforms (3)	Yes	No	Limited
Structured Query Language (SQL) integrated with programming language	Yes	No	No

(1) dBASE III PLUS and dBASE IV comprise approximately 55% of PC database systems sold (3 times nearest competitor) according to the most recent report by the market research firm Audits & Surveys (Oct. 1990) (2) Software Digest rated dBASE IV #1 among multiuser databases, October 1990 (3) Versions of dBASE IV are shipping for DOS, VAX, and SunOS. Macintosh and other UNIX Platforms are announced.

Based on what our customers tell us, we made a list of some of the most important features to look for in data management software.

Then we compared the new dBASE IV® version 1.1 with two other database products.

As you can see, dBASE IV offers exclusive advantages in many categories.

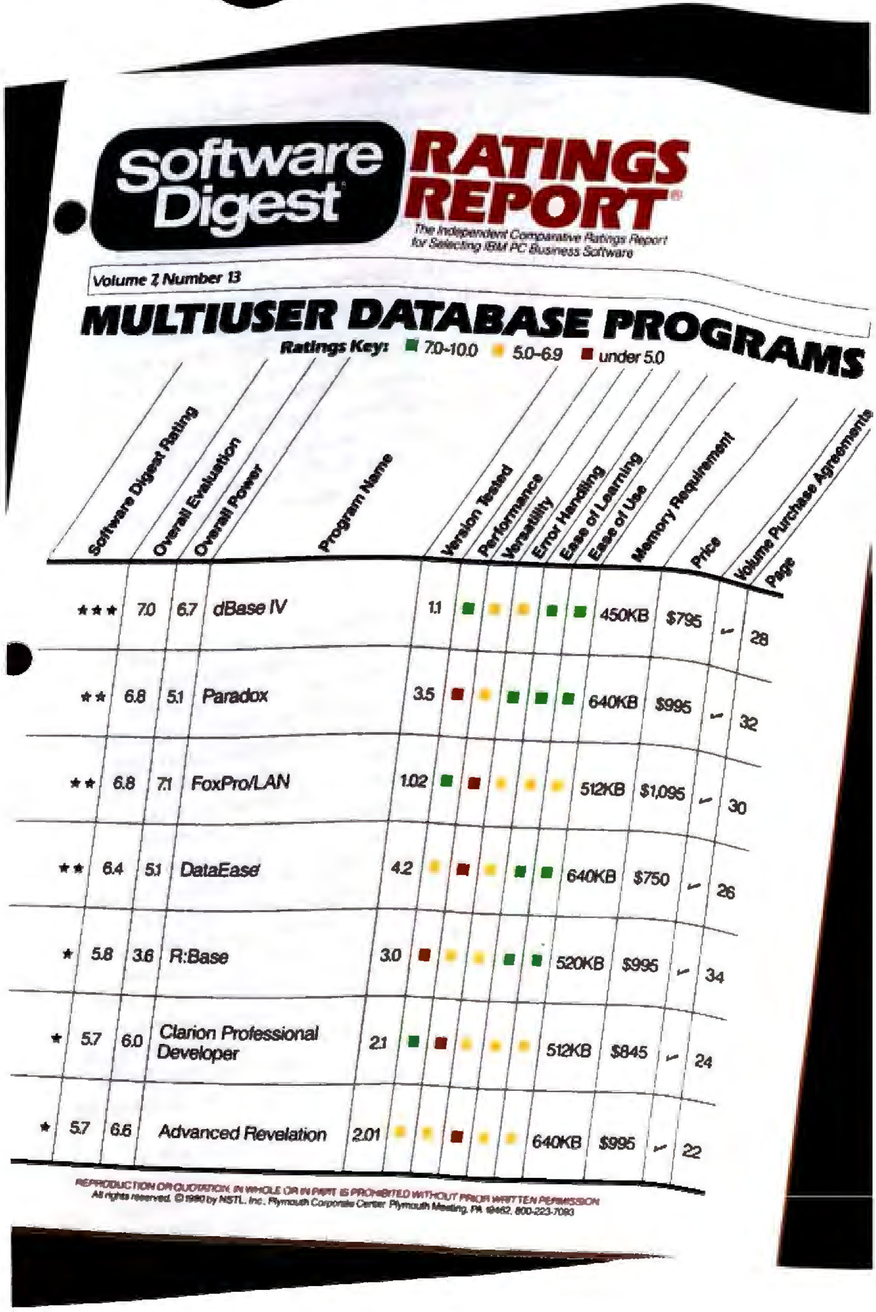
For instance, only dBASE IV lets you access all its functions from a single screen. Called the Control Center, this screen lets you manage existing data, and create new tables, queries, reports, forms and labels totally without programming.

When all the facts are on the table, it's easy to see which database software is best.

Of course we aren't the only ones who have come to this particular conclusion.

Software Digest rates dBASE IV version 1.1 the #1 Multiuser Database (Vol. 7, No. 13, Oct. '90).

dTruth Comes Out.



Software Digest RATINGS REPORT®

The Independent Comparative Ratings Report for Selecting IBM PC Business Software

Volume 7 Number 13

MULTIUSER DATABASE PROGRAMS

Ratings Key: 🟩 7.0-10.0 🟨 5.0-6.9 🟥 under 5.0

Software Digest Rating	Overall Evaluation	Overall Power	Program Name	Version Tested	Performance	Versatility	Error Handling	Ease of Learning	Ease of Use	Memory Requirement	Price	Volume Purchase Agreements	Page
★★★	7.0	6.7	dBase IV	1.1	🟩	🟨	🟨	🟩	🟩	450KB	$795	✓	28
★★	6.8	5.1	Paradox	3.5	🟥	🟨	🟩	🟩	🟩	640KB	$995	✓	32
★★	6.8	7.1	FoxPro/LAN	1.02	🟩	🟥	🟨	🟨	🟨	512KB	$1,095	✓	30
★★	6.4	5.1	DataEase	4.2	🟨	🟥	🟨	🟩	🟩	640KB	$750	✓	26
★	5.8	3.6	R:Base	3.0	🟥	🟨	🟨	🟩	🟩	520KB	$995	✓	34
★	5.7	6.0	Clarion Professional Developer	2.1	🟩	🟥	🟨	🟨	🟨	512KB	$845	✓	24
★	5.7	6.6	Advanced Revelation	2.01	🟨	🟨	🟥	🟨	🟨	640KB	$995	✓	22

REPRODUCTION OR QUOTATION IN WHOLE OR IN PART IS PROHIBITED WITHOUT PRIOR WRITTEN PERMISSION
All rights reserved. © 1990 by NSTL, Inc., Plymouth Corporate Center, Plymouth Meeting, PA 19462, 800-223-7093

Perhaps the most independent publication in the industry, *Software Digest* accepts no advertising whatsoever. Corporations pay hundreds of dollars a year to receive their monthly reviews—which are considered highly unbiased and objective. Their exhaustive, 75-page report concludes:

"Among the top ranking programs, dBASE IV (version 1.1) is the most well-rounded, with solid performance, versatility, and usability." Commenting on speed, *Software Digest* points out that "dBASE IV produces all three test reports as fast as or faster than FoxPro/LAN." As for Ease of Use and Ease of Learning, dBASE IV scored in the Excellent Range as many times as any other multiuser database product tested.

For a free evaluation kit, including competitive details and a free demo disk, call toll-free: 1-800-437-4329 ext. 1416. Better yet, call 1-800-2ASHTON to upgrade to the new dBASE IV now.

The truth is, no other database can do so much to improve productivity.

Ashton-Tate®

Circle 28 on Inquiry Card (RESELLERS: 29).

LETTERS

X.400: Theory vs. Practice

Imagine my surprise upon returning from the recently completed CCITT SGVII/Q18 meeting in Geneva to find Steven J. Vaughan-Nichols's "X.400: Standardizing E-Mail" (December 1990) dealing with the precise topic we were discussing (i.e., understanding X.400). As I read the article, I became concerned about the numerous inaccuracies and misconceptions it contains.

For example, the current version of the X.400 series is the 1988 version (i.e., the "blue book"), which has superseded the 1984 version (the "red book"). There is no X.401 or X.410 in the blue book. Furthermore, any speculation that X.410 was ever the "most important member of the X.400 family" is subject to some debate. You can be a perfectly happy user of an E-mail service without caring about the underlying transport protocol mechanism.

The simplistic explanation of the X.500 series of recommendations is hard to reconcile with the rest of the article, because X.500 was introduced in 1988 and certainly provides more than simple name-to-address resolution. The statement that X.500 is a database service is confusing at best.

Finally, X.400 does not define any format for presenting an originator/recipient address visually. Thus, the notion that an O/R address can be presented as "keyword:value" will come as a shock to those representatives at the Geneva meeting who are attempting to define appropriate visual representations. The fact that Vaughan-Nichols's service uses one particular visual representation does not imply that that representation is standardized in the X.400 series. Indeed, there are many parts of the global message-handling environment that are not standardized by X.400. To understand what is standardized in X.400, one must first understand the Open Systems Interconnection stack, and where in that stack X.400 sits.

Bruce Greenblatt
IBM Corp.
Roanoke, TX

What you describe as inaccuracies and misconceptions are really the differences between two views of X.400. Your view is representative of the ivory tower vision of the standard. My article, however, was about X.400's real-world implementations. Behind these positions is a long-standing debate in E-mail circles on what X.400 is and what it should be.

To go into more specific detail, you are quite correct that the "blue book" version of the protocols does not include X.401 or X.410. The subject matter these two standards address has now been incorporated into X.400 and a combination of X.218, X.219, X.228, and X.229, respectively. That's the theory, anyway. In practice, all commercial programs I am aware of are based on the 1984 model. In these implementations, how X.410 is handled is vital to the success of the mail-handling process. That this is transparent to the E-mail user does not in any way undermine the importance of the issues that X.410 addresses.

I am puzzled by your trouble with my explanation of X.500. From both E-mail users' and administrators' points of view, X.500 will be an easy-to-access distributed database of E-mail user information. Since yours has been the only criticism of the explanation, I can only assume that the fault lies with your understanding of X.500 directory services.

You seem surprisingly ignorant of real-world implementations of X.400. Whether you use X.400 addressing on MCI Mail, Sprint Telemail, AT&T Mail, or the Internet, O/R addresses are presented in one of several versions of a "keyword:value" format. While there are theoretical discussions on how addresses should be represented, the "keyword:value" style is the de facto standard for human-readable addresses in X.400 systems.

—Steven J. Vaughan-Nichols

WE WANT TO HEAR FROM YOU. *Please double-space your letter on one side of the page and include your name and address. Letters two pages in length or under have a better chance of being published in their entirety. Address correspondence to Letters Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. You can also send letters via BIXmail c/o "editors."*

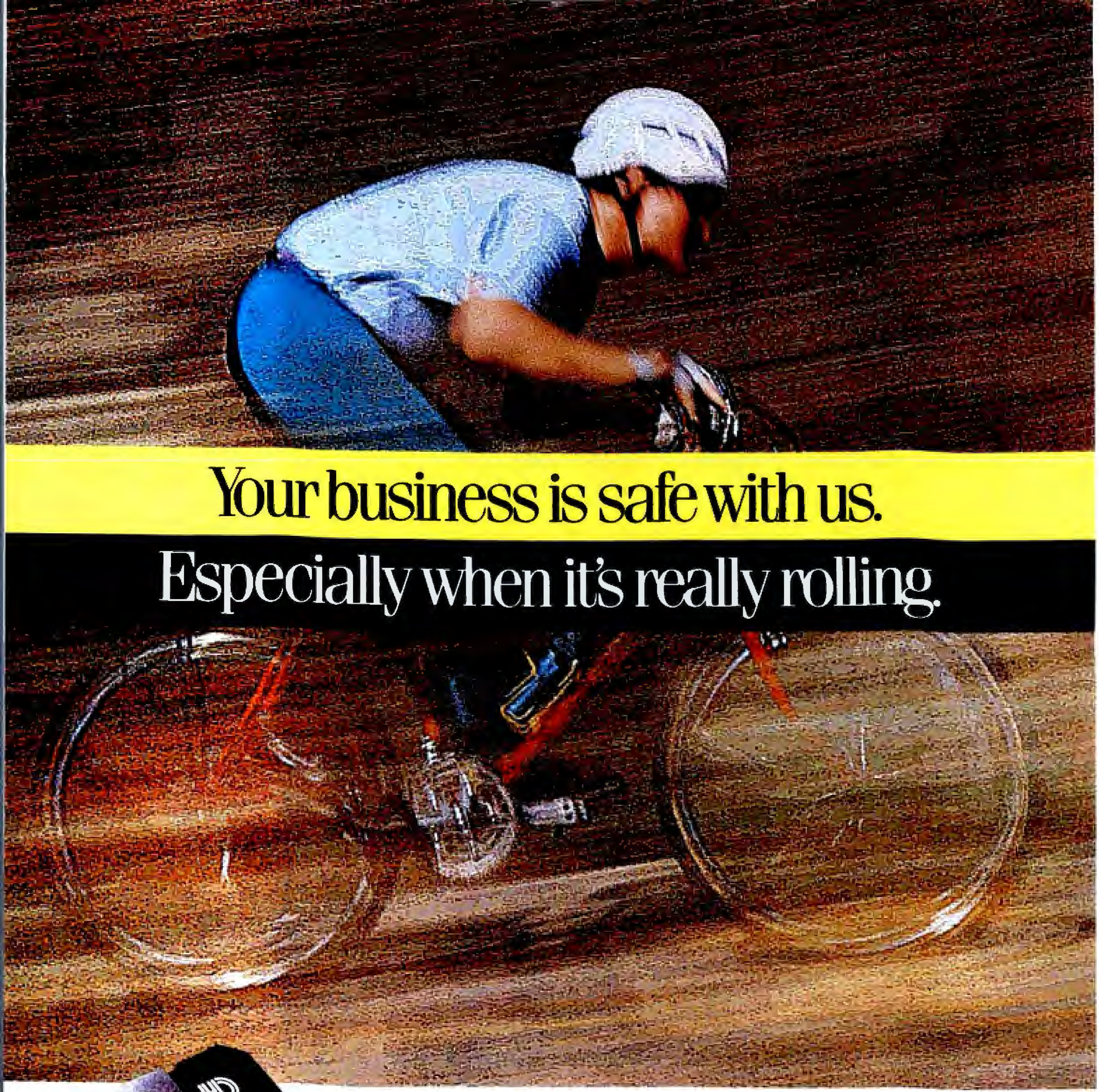
Your letter will be read, but because of the large volume of mail we receive, we cannot guarantee publication. We also reserve the right to edit letters. It takes about four months from the time we receive a letter until we publish it.

Multiplatform Fans

I just finished reading your January issue, and I had to turn on my Amiga, dial up BIX, and thank you for making this the most enjoyable issue in a long while. BYTE's most endearing quality for me has always been its willingness to explore more than just the latest application on the business platform of choice (whatever that might currently be). In January, I found articles on the history of Ethernet, the battle over who invented the microprocessor, a look at Intel's i860 chip, eight articles on AI, and a wonderful article on the Amiga's Exec. I am aware that both BYTE and Jerry Pournelle get a very unfair share of verbal and written abuse from Amiga users [who don't think their platform receives enough converage]. As an Amiga user and developer since 1985, I'm astounded by this. I would invite those people to count the articles about the Amiga published by all other computer magazines that are not Amiga specific. I'd be very surprised if taken all together they equaled the number BYTE has done.

After seeing the article on the Amiga Exec and a BYTE Award for NewTek's Video Toaster in the same issue, I think you deserve a round of applause. Instead of taking the easy way out and ignoring the Amiga, you report on those aspects you think might interest a significant portion of your readers, in spite of the flak you will most certainly receive.

Dave Quick
Edina, MN



Whatever business you're in, we're ready to roll in just about any size, capacity or factory formatted disk you need. And if business is really moving, look into our 4 megabyte diskette— it's ready for your new system whenever you are.

That's why more business protects important information on 3M brand diskettes and data cartridges than any other brand in the world.

Call 1-800-888-1889 ext.3 to find out more.

Innovation working for you™

Diskettes require a compatible drive. ©3M 1991.

3M

Worldwide Sponsor 1992 Olympic Games

36USC380

Circle 8 on Inquiry Card.

Why you need a 16″

Because the MultiSync® 4D color monitor, with 46% more active display area than a 14″ screen, lets you see more of your applications on-screen at one time. The digitally controlled MultiSync 4D also supports high resolution graphics, from VGA up to 1024 x 768 at 70 Hz non-interlaced. And with Dynamic Beam Focusing, your Windows™ will be clearer from

C&C
Computers and Communications

For technical information call 1-800-FONE-NEC. In Canada, 1-800-NEC-INFO.

Circle 191 on Inquiry Card.

MultiSy[redacted]

edge to edg[redacted]

Optimized fo[redacted]

have techno[redacted]

the graphics[redacted]

So, if you'd [redacted]

For 46% more information call 1-800 826-2255.

NEC

As usual, I enjoyed Jerry Pournelle's November column. I really wish he had brought his Amiga out of the spare bedroom and tried to use it to work on Mrs. Pournelle's promotional videotape. I think he'd find it has all the tools needed to do the job. Let me suggest an excellent reference on computer desktop video: *Amiga Desktop Video Guide* by Guy Wright (Abacus, 1990). While aimed at Amiga owners, it really explains the various hardware and software products that can be used in producing desktop video. Keep up the good work, Jerry, but don't relegate that Amiga to the closet just yet.

Gordon R. Zeese
Albany, GA

I agree: The Amiga would have done the job, and I should have used it. If Commodore would stop taking marketing lessons from AT&T, they would get some market share; the Amiga is falling a bit behind the very latest PCs, but not far, and is still about the easiest "desktop video" system I know of. They're particularly popular here in Hollywood. Alas, Mrs. Pournelle's program hasn't been ported to the Amiga; I'm working on that, but I have little time. David Joiner has offered to help, though, and he's an Amiga whiz.—Jerry Pournelle

QuickBASIC Fix

I wanted to share with Jerry Pournelle and his readers a "solution" to the problem of QuickBASIC 4.5 locking up during the binding process on large programs. As Garry Owens pointed out in his letter (Chaos Manor Mail, September 1990), running large programs from within the QuickBASIC environment will hang your machine during the binding process without issuing any error message.

Pournelle's reply suggested that Owens compile and link from DOS. That will alleviate the binding problem, but QuickBASIC users will not be able to make use of the integrated debugging and testing environment provided with QuickBASIC. I found that you can get around the binding problem by pretending you are going to compile into an executable module. QuickBASIC will bind normally in this mode and then let you select your compile options. At this time, you can cancel the compile process and run from within the QuickBASIC environment without any further binding problems.

I have used this method to develop and test some fairly large applications without any further incidents of the binding problem. As my programs have grown larger and more complex, the next barrier I have found for running large programs from within the QuickBASIC environment is a familiar one—640K bytes.

Carl F. Neer
Lakewood, CO

I tried it, and it works. Thanks for the tip!
—Jerry Pournelle

Hardworking Mac

What did Bill Calabrese mean by 1 gigabyte of ROM on the last page of his MacRenderMan review entitled "Photo-Realism for Those with Time (and RAM) to Spare" (January)? Seems like a lot, although the context implies that he is referring to disk space. I'm impressed—any Mac that needs a gig of disk storage is a hardworking Mac indeed!

R. Broome
Slidell, LA

I was referring to my disk storage space, which is 1000 megabytes. This size is needed for the animations I create with Dynaperspective, some of which reach 200 megabytes in size. I temporarily store them on my hard disk before I transfer them to videotape. I also have about 100 MB of applications and utilities, plus 200 MB of stored files. CADD files require large hard disk drives, and those seriously considering doing CADD need to purchase the largest storage medium they can afford.
—Bill Calabrese

Up to BAT for DOS

In "Alternative Operating Systems, Part 6: FlexOS's Muscle" (January), Ben Smith writes that the FlexOS "script language has the same flow control as DOS .BAT files, with one notable extension: BATCH. The BATCH command allows nested scripts." This "extension" has been part of DOS for at least two versions (3.3 and 4.01), with the CALL command.

Mike Firth
Dallas, TX

Good eye! The truth be told, my expertise is in Unix, and I was unfamiliar with the DOS CALL command for .BAT files. Thank you for your correction.—Ben Smith

Engineering Trade-Offs

As a software developer, I have to commend Brett Glass on his views about the problems of the software industry and its apparent lack of (or at least insufficient) concern ("A Plea for Software That Works," Stop Bit, December 1990). As Glass pointed out, far too many programs lack the error detection and correction necessary for reliable operation.

Being a devout Turbo Pascal programmer, I agree completely with his comments regarding C—it is not an ideal language for developing large, reliable, maintainable programs by any stretch of the imagination. Yet, many people swear by C, and many more are jumping on the bandwagon.

But for all my agreement with Glass, I have to question a remark of his regarding OS/2. He points out that OS/2 2.0 uses the 32-bit flat memory model and, due to hardware limitations of the 386, cannot check memory references to the exact byte. In fact, a reference can be as much as 4K bytes off without detection. How horrible! Does that mean one program can accidentally overwrite another program running in a different window? Not necessarily. Glass's statement and condemnation are valid only if you assume that the operating system will grant requests for more memory exactly as requested by the application program. Although I'm not certain, I would hope that OS/2 will allocate memory to an application in 4K-byte chunks. Thus, an application can never

THE FOLLOWING PRICES MAY BE SO SURPRISING, YOU'LL PROBABLY WANT TO SIT DOWN.

NEAR A PHONE.

Tandon Computers cost a lot less than other computers. Here's the surprising part. Tandon Computers also come fully loaded with a number of standard features you won't find on most other machines.

And we didn't stop there. With any Tandon Computer, you also get the support you'd expect from a $400 million company with fifteen years of manufacturing and design experience. Like prompt delivery, a one year limited warranty, on site service, and helpful toll-free tech support. We even offer a special leasing program. And if for any reason you're not pleased, you get a full refund within the first 30 days.

So if you want a great computer at a great price, why not give Tandon a call right now. After all, you're already sitting next to the phone.

Tandon

TO ORDER DIRECT, CALL NOW:

800-800-8850

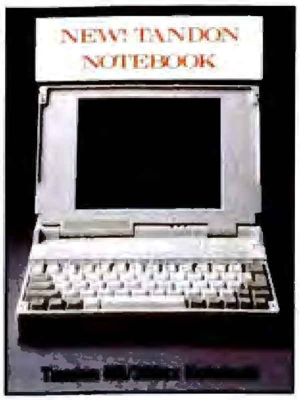
FAX 805-529-8408


Tandon LT/386sx Laptop

$2,499

LEASE: AS LOW AS $143/MONTH.

STANDARD CONFIGURATION
Microprocessor and Main Board: Intel® 80386SX running at 16 MHz. Supports optional 80387SX math coprocessor.
Memory: 1MB standard.
Storage: 1.44MB diskette drive. 40MB IDE hard drive. (Upgradeable to 100MB).
Video: Dual panel EL backlit VGA LCD. Supports external monitor.
Order now and receive a WorldPort Pocket Modem ($359 Value) at no charge.



$3,495

LEASE: AS LOW AS $123/MONTH.

STANDARD CONFIGURATION
Microprocessor and Main Board: Intel 80386SX running at 20 MHz. Supports optional 80387SX math coprocessor.
Memory: 2MB standard.
Storage: 1.44MB diskette drive. 30MB IDE hard drive.
Video: Paper white VGA, non-glare CCFT backlit LCD, 32 grey shades. Supports external monitor.

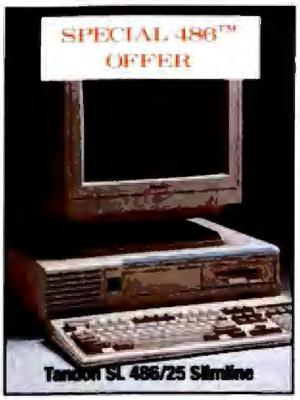
Call for information on our 60MB hard drive model.


Tandon SL 386sx/20 Slimline

$1,999

LEASE: AS LOW AS $114/MONTH.

STANDARD CONFIGURATION
Microprocessor and Main Board: Intel 80386SX running at 20 MHz. Supports 80387SX math coprocessor.
Memory: 1MB standard.
Storage: 1.2MB OR 1.44MB diskette drive. 40MB IDE hard drive.
Video: VGA monochrome display.



Tandon SL 486/25 Slimline

$2,999

LEASE: AS LOW AS $105/MONTH.

STANDARD CONFIGURATION
Microprocessor and Main Board: Intel 80486 running at 25 MHz.
Memory: 2MB standard.
Storage: 1.2MB OR 1.44MB diskette drive.
Video: VGA monochrome display.
Call for information on our SL 486 Upgrade Package and additional options.


Tandon 386sx/N Network Station

$1,199

LEASE: AS LOW AS $69/MONTH.

STANDARD CONFIGURATION
Microprocessor and Main Board: Intel 80386SX running at 16 MHz. Supports 80387SX math coprocessor.
Memory: 1MB standard.
Video: VGA monochrome display.
Options: 1.44MB diskette drive. 40MB IDE hard drive. Additional options available. Please call for details.

Call for information on our 286/N Low Profile, Network Station, starting at $949.


Tandon 386/33 Desktop

$3,199

LEASE: AS LOW AS $112/MONTH.

STANDARD CONFIGURATION
Microprocessor and Main Board: Intel 80386 running at 33 MHz. Supports 80387 or Weitek™ 3167 math coprocessors.
Memory: 4MB standard.
Storage: 1.2MB OR 1.44MB diskette drive. 110MB IDE hard drive.
Video: VGA monochrome display.

Call for information on our 386/25 Desktop.


Tandon 486/33 EISA Desktop

$7,299

LEASE: AS LOW AS $183/MONTH.

STANDARD CONFIGURATION
Microprocessor and Main Board: Intel 80486 running at 33 MHz. Supports Weitek 4167 math coprocessor.
Memory: 4MB standard.
Storage: 1.2MB OR 1.44MB diskette drive. 200MB IDE hard drive. EISA caching SCSI controller available.
Video: VGA monochrome display.


Tandon Tower 486/33 EISA

$7,699

LEASE: AS LOW AS $190/MONTH.

STANDARD CONFIGURATION
Microprocessor and Main Board: Intel 80486 running at 33 MHz. Supports Weitek 4167 math coprocessor.
Memory: 4MB standard.
Storage: 1.2MB AND 1.44MB diskette drives, 200MB IDE hard drive. EISA caching SCSI controller available.
Video: VGA monochrome display.

Tandon Tower 386/33

$4,199

LEASE: AS LOW AS $121/MONTH.
Call for additional specifications.

ATTENTION:
We have a special offer so big it won't fit on this page.
To find out what it is, just pick up the phone.

- 30-Day Money Back Guarantee
- 1-Year Limited Warranty
- 24 Hour Toll-Free, On Call Technical Support
- On-Site Service

OPTIONS AND CUSTOM CONFIGURATIONS
- Hard Drives, Diskette and Optical Drives
- Modems
- Memory Expansion
- Coprocessors
- VGA and Super VGA Monitors
- Additional Options Available On All Systems. Please Call.

Circle 262 on Inquiry Card.

step outside what the operating system considers its own.

Now, whether 4K bytes is too coarse is another argument entirely. But this coarseness, even if it were reduced to 2 bytes instead of 4096, does not prevent the operating system from ensuring that no application makes reference to a byte of memory that is not its own.

Finally, an important comment of Glass's deserves to be restated. The love affair people have with powerful machines and fast software is hurting the industry. To some extent it is the fault of the press, including the BYTE Lab, for publishing such exacting benchmark tests. Too often the buying public is swayed by as little as a 1 percent or 2 percent performance increase over someone else's box.

The PC market wants unbelievable speed, power, flexibility, support, and reliability, but it does not want to succumb to real-world trade-offs. People must begin to realize that computers are not wonder boxes that are above normal engineering trade-offs. If you want extra reliability, then it will cost you, either in dollars for hardware or in a performance hit in software.

Bill Jurasz Jr.
Applications Engineer
Texas Instruments
Dallas, TX

Laptop Etiquette

Fred Langa discussed how office decorum and business etiquette should be considered before buying a laptop ("Laptop Troubles and Triumphs," November 1990 Editorial). He specifically mentioned that taking meeting notes on a laptop can cause a commotion. I can confirm that from personal experience.

Last year our office was assigned to attend a series of 14 legislative hearings. The hearings were held throughout the state, and our job was to take notes and keep the executive staff informed. I lent my Toshiba laptop to the effort. The plan was to enter the notes from the testimony into Nota Bene and then use the text-based features of the program to compile the testimony by topic, speaker, and so on.

We were really quite pleased with ourselves until the tenth hearing, when we were told by the legislative staff that the witnesses found my laptop intimidating. Now, I admit that this thing weighs almost 20 pounds, requires a power cord, makes fan noises, and has a screen that creates an orange beacon—but intimidating? I never would have imagined it.

Langa was right—laptop hardware should be selected with more than just price and user-friendliness in mind. When I bought my laptop, my selection criteria were logical and technically correct, but I ignored what turned out to be a major variable—the environment in which the machine was to be used. I'm not talking heat and humidity here; this environment is composed of people who are suspicious of government. When I as a government employee entered this environment with my whizbang efficiency equipment, I was perceived as intentionally intimidating rather than efficient. It's a point to ponder.

Paul A. Smith
Citrus Heights, CA

DAT Spat

I read Karina Lion's article "DAT's a Solution" (November 1990) with great interest. While all of us in the industry try to present our products and technologies in the best light, her article contains serious misstatements of fact, as well as numerous conclusions that are open to debate. In the interest of accuracy, and in case you are misinformed, I would like to point these out.

1. She makes the statement that digital audiotape and 8-mm tape "store comparable quantities of data." Nowhere in the article, other than the table on page 324, which I will comment on below, does she specify the capacities of DAT drives. Eight-mm tape capacities of 2.5 gigabytes and 5 gigabytes, both in native, or uncompressed, mode, are available today. I know of no DAT products offering more than 1.3 gigabytes today. Sometime this year, DAT vendors promise 2 gigabytes, which will be achieved by using thinner 90-meter tape.

2. Lion's statement that "per megabyte, DAT is cheaper than 8-mm tape storage" is also up for discussion. The end-user price for a data-certified 8-mm cartridge with 2.5 gigabytes of capacity is about $25, or 1 cent per megabyte. A data-certified DAT cartridge with a capacity of 1.3 gigabytes costs about $19, or 1⅔ cents per megabyte. The same 8-mm cartridge can also contain 5 gigabytes if used on the latest 8-mm drives, cutting the cost per megabyte in half.

3. The table on page 324, comparing DAT and quarter-inch tape systems, is misleading at best. It states that the capacity in production of DAT is 2.5 gigabytes. This capacity can be achieved only by assuming a compression ratio of about 2 to 1. The next capacity level of 5 gigabytes also assumes compression and the use of 90-meter tape. By omitting the fact that these capacities require the use of compression, the table is deceiving. The DAT transfer rate of 207K bytes per second is also questionable. Every other DAT vendor specifies a transfer rate of 183K bytes per second for digital data storage format, and transfer rates of from 100 to 140K bytes per second in DataDAT format. I can only conclude that the higher transfer rate that Lion cites is also based on some expected compression ratio.

4. The statement that the 90-degree wrap angle of DAT provides an advantage over the 221-degree wrap angle used by 8-mm tape is certainly questionable. Conventional wisdom among tape designers maintains that a longer tape path provides better tape guidance. The 221-degree wrap provides less tension on the tape, both during normal read/write operations and during high-speed search, while the longer tape path sustains the high level of head-to-tape contact necessary to achieve helical scan's high areal densities reliably. In short, the longer wrap angle provides for gentler, more stable tape handling and reduces the likelihood of tape damage. If the author has any data that proves otherwise, we at Exabyte would like to see it.

5. The discussion on servo and data heads with the accompanying figure 2 is highly misleading. The 8-mm servo implementation allowing for track offset was specifically designed for data storage applications. The DAT servo system was lifted intact from the consumer product, retaining the integral servo/read/write head design but adding a pair of read-after-write heads. The distorted tracks shown in figure 2 are something we have yet to

Objects At Your Fingertips.

Now, if you want to develop applications for Windows 3.0, there's a fast and easier way to do it with the premiere object-oriented programming language. Smalltalk/V.®

With Smalltalk/V Windows, you can explore, prototype, build finished applications and ship them runtime free.

You can tap into applications using DDE so effortlessly you don't have to be a Windows expert to do it.

And with one of the world's most comprehensive class libraries, you can choose our objects or easily build your own.

But whatever you develop, it will be portable between the Windows, OS/2 and Mac versions of Smalltalk/V.

With so much at their fingertips, more people are solving more problems with Smalltalk/V than any other object-oriented programming system.

At only $499.95 and no runtime charges, you can solve them, too.

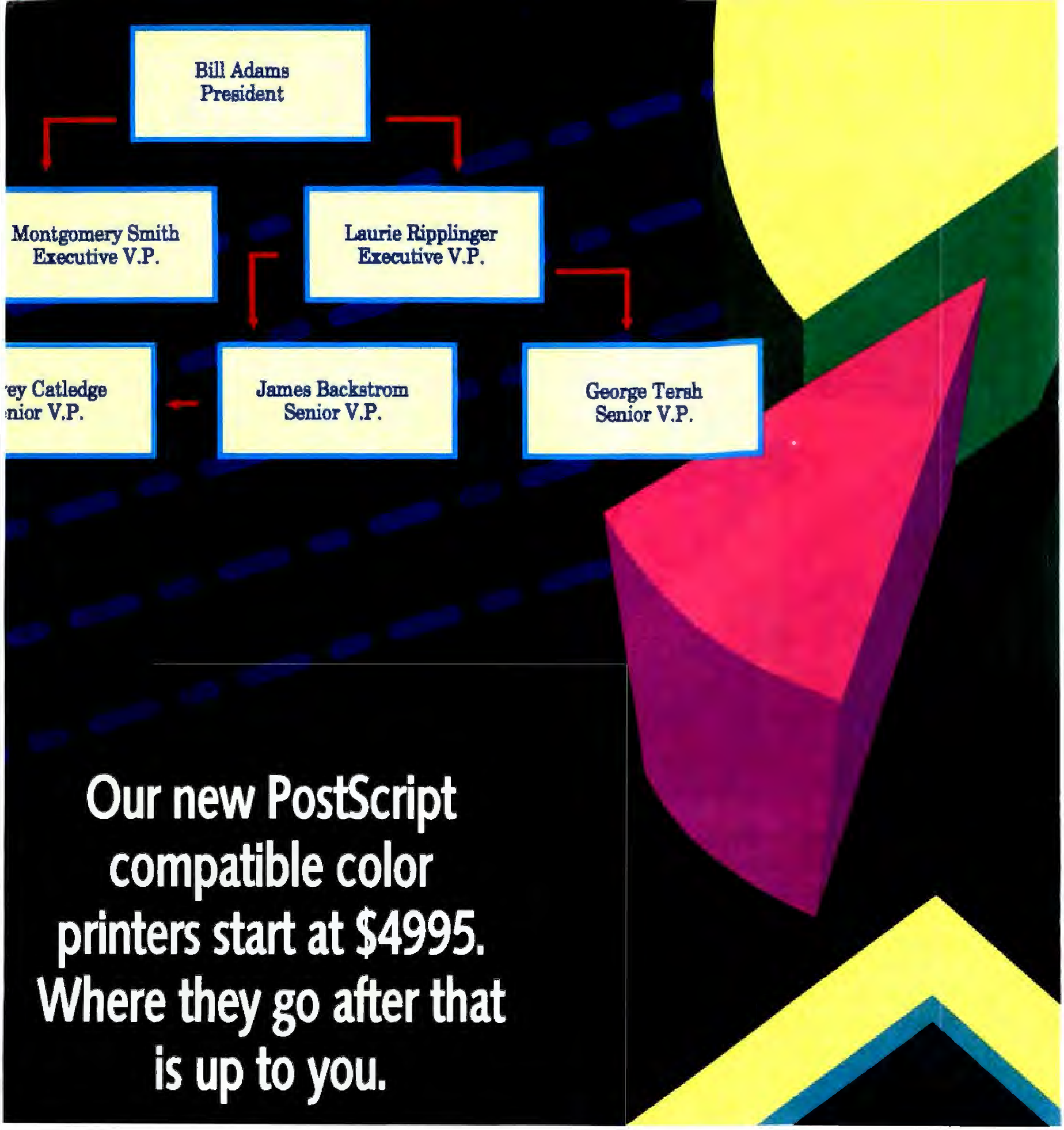
Just call us at (800) 922-8255. And see why programming Windows has never been easier.

Smalltalk/V Windows

DIGITALK

9841 Airport Blvd., Los Angeles, CA 90045 (800) 922-8255 (213) 645-1082 FAX (213) 645-1306

Circle 94 on Inquiry Card.



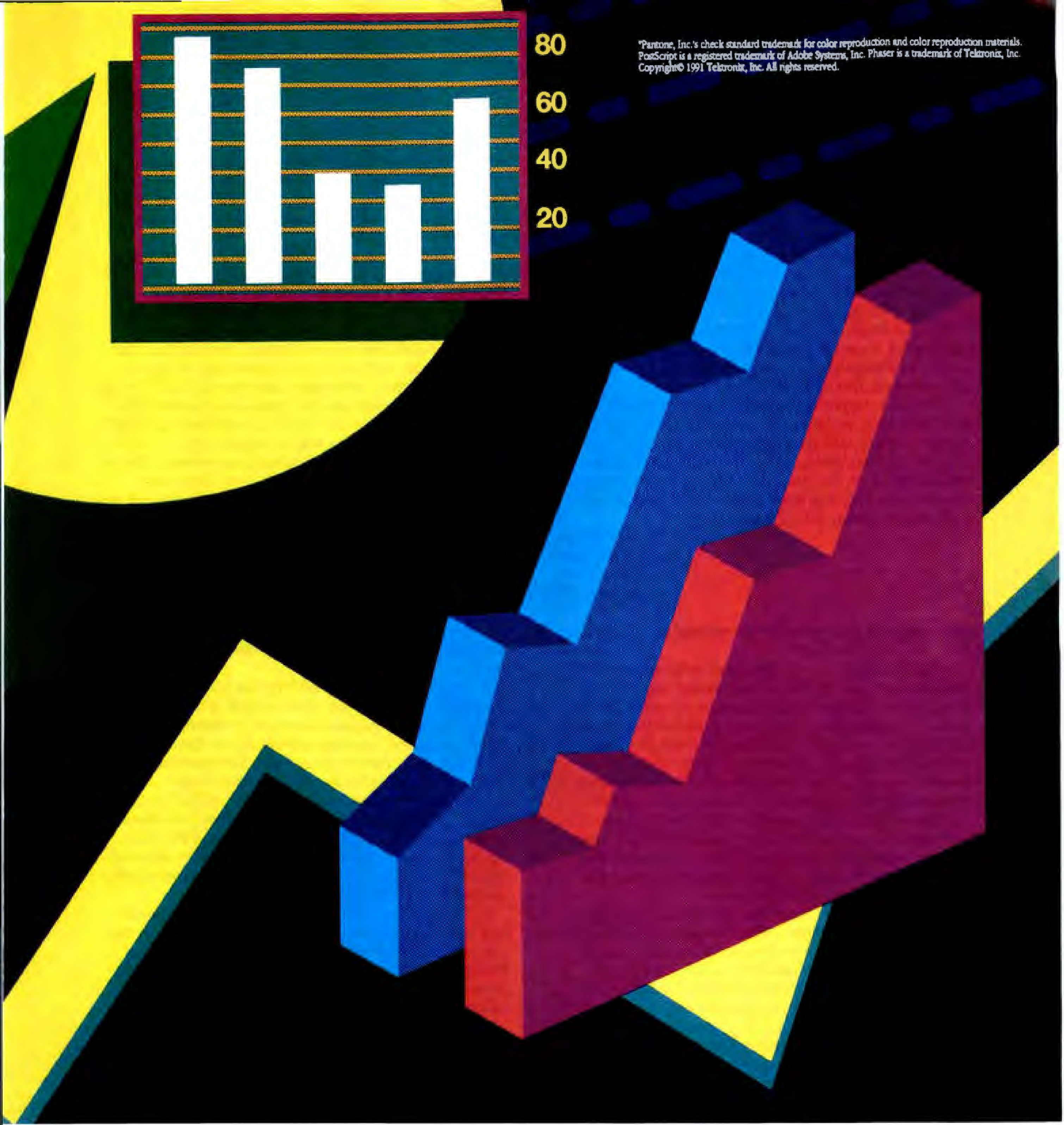
Our new PostScript compatible color printers start at $4995. Where they go after that is up to you.

Now you can let your imagination run wild. At a very conservative price. Because Tektronix introduces the first color printer that is PostScript-compatible for less than $5000.

The Phaser II SX is great for individuals or small groups. It works with Windows 3.0 or Macintosh QuickDraw and is software-based PostScript-compatible. It also delivers brilliant 300 dpi thermal-wax color as only Tektronix printers can.

For bigger businesses, we offer the new Phaser II PX. This printer is hardware-based PostScript-compatible with HP-GL and is licensed by Pantone, Inc*. It also works with Macs, PCs, and UNIX workstations. All at once.

Now, say you buy an SX, your business grows, and you end up wishing you'd gotten the PX. No


80
60
40
20

see in over three years of product shipments, yet the 8-mm servo system, using track offset, would allow all the data on those tracks to be read, while it is highly unlikely that any DAT system could successfully recover the data. This is as much a function of the data format as it is of the servo system. Eight-mm tracks are composed of individual blocks of data, and if an individual block, or blocks, cannot be read, the error-recovery procedures will offset the heads and reread the track to recover the missing block(s). DAT, on the other hand, must read the entire track in one pass, whether on the first attempt or during a subsequent retry, to be successful. In the example Lion used, that appears to be impossible.

6. Finally, regarding the statements that quarter-inch, half-inch, and 8-mm tape employ analog recording methods, while DAT uses digital recording techniques: *None* of these technologies uses analog recording; they are *all* digital. In fact, the NRZI data encoding method employed by DAT was developed for, and used by, half-inch tape more than 20 years ago.

Grant Wilcox
Product Manager
Exabyte Corp.
Boulder, CO

The numbered sections below correspond to the numbered items in your letter.

1. Since the article was published in November, DAT manufacturers have achieved even higher capacities of storage per cassette than was stated in my article. More than five companies have announced DAT drives with 2.5-gigabyte storage capacity per cassette using data compression. In January, my company, GigaTrend, announced the use of a new 90-meter tape that will enable storage of up to 4 gigabytes of data on a standard DAT cassette; without data compression, a 90-meter tape stores up to 2 gigabytes in native mode. As for the issues of data compression and extended tape, as long as data is backed up efficiently, reliably, and accurately, what difference does it make to the end user?

2. It is deceptive to claim that the Exabyte cartridge is "about $25 per cartridge." When we at GigaTrend called Exabyte to verify this, we were told by the direct sales department that a minimum order of 2.5-gigabyte cartridges put the individual cartridge price at $40. Additionally, in checking with two Exabyte OEMs, we learned they are charging $60 for a 2.5-gigabyte cartridge, not $25. Since GigaTrend and other DAT makers are charging $36 for a 2.5-gigabyte cartridge (using data compression), DAT is still cheaper by far.

3. The capacity of DAT drives in production is currently 2.5 gigabytes. In the first quarter of this year, the capacity of DAT drives in production using extended tape will be over 4 gigabytes per cassette. DAT at capacities of 2.5 gigabytes using compression was formally announced by GigaTrend in July 1990. Likewise, the use of extended tape in DAT has been known since November 1990. Industry analysts have been publishing announcements about extended DAT tape from five vendors since September 1990. Therefore, the 2.5-gigabyte DAT cassette capacity listed in the table was an established fact.

On August 9, 1990, I demonstrated GigaTrend's 2.5-gigabyte TurboDAT and a 207K-byte-per-second transfer rate at a press conference. This transfer rate was achieved during an actual demonstration of the product, not an "expected" compression ratio, as you claim.

4. The following excerpt from an article entitled "The Case for DAT" published in the July 1990 issue of Digital Desktop *explains why the Exabyte theory of a longer tape path is incorrect:*

"The 8mm format uses a tape wrap of 221° around a drum as opposed to DAT's shorter wrap of 90°. The DAT wrap angle has less contact with the recording tape and therefore creates less friction and requires fewer complicated mechanical parts to insure proper alignment. Given a similar drum size and speed, more surface contact with a tape will create more potentially damaging heat on the surface of the tape. Additionally, a 221° wrap leaves 8mm tape unguided for approximately three inches, which is just under the entire circumference of a DAT drum. Because of the mechanical requirements, a nominal 221° needs about 360° of actual wraparound. This is not possible on the same horizontal level. 8mm tape must descend one level below the horizontal tape path and return, in order to achieve this actual wraparound.

"There is stress and strain both in a vertical and horizontal direction on the tape using 8mm. Typically, worn edges are indicative of this type of wrap. Conversely, 4mm puts less strain on the tape by deviating only slightly from a straight vertical tape path with a 90° wrap. Also, a pure horizontal alignment level is maintained through electronic tracking, preventing any stretched edges on the tape."

5. Although the servo/read/write head of DAT for computers is based on the audio version of the drive, Japanese electronics manufacturers, not to mention Hewlett-Packard and GigaTape outside Japan, have modified the design for computer storage to achieve performance levels that are as yet unparalleled by 8-mm tape.

When the servo/read/write functions of DAT are performed by the same heads, there is absolutely no chance of alignment deviations. The combination of the tracking mechanism plus DAT's three levels of error checking and correction enables error recovery that is statistically even higher than 8-mm tape.

6. The analog recording method referred to in my article references the recording of tape filemarking. In this case, Exabyte uses an analog method called "physical" filemarks. Conversely, GigaTrend and other DAT manufacturers use logical filemarks, which is a digital method of tape filemarking.—Karina Lion

FIXES

- The current telephone number for Micron Technology (December 1990 State of the Art section) is (208) 368-4000.
- The correct telephone number for Monolithic Systems Corp. (December 1990 State of the Art section) is (800) 525-7661.
- Leading Edge (January Ask BYTE) is a subsidiary of Daewoo Telecomm.
- The correct address for Microsoft Press (January Ask BYTE) is Microsoft Corp., 1 Microsoft Way, Redmond, WA 98052.

NEWS

MICROBYTES

Intel Winds Up the i486 Clock to 100 MHz

Intel engineers have an experimental i486 running at 100 MHz, the company disclosed at the recent International Solid State Circuits Conference. The chip is a long way from a commercial product—Intel still hasn't banged the kinks out of the 50-MHz i486—but it does point toward Intel chips of the future. It's also a step toward the chip maker's goal of a 100-million-transistor microprocessor running at 250 MHz and delivering 2 billion instructions per second.

Intel says that it has achieved this increase to 100 MHz by using a combination of new techniques. First, the chip is implemented in 0.8-micron CMOS, instead of the current 1-micron CMOS. This alone makes the chip smaller and faster. More important, Intel has moved to a three-level metal design instead of a two-level design; this reduces gate interconnect distances and further speeds up the chip. Intel developed new CAD tools for laying out the chip on a three-level process to fully utilize the third layer.

One unusual feature of the new chip is that the clock has been implemented using a phase-locked loop. This allows the clock to operate more tightly and thus faster than previously. Clock skew has been reduced, and the setup time is now 1.5 ns, down from 3.0 ns; the hold time is 1 ns, down from 2.5 ns; and the overall output valid time is 7.5 ns, down from 9 ns. However, this design has its drawbacks. It relies heavily on the power signal coming in. Intel says that the PLL can lock on and operate fully in the time it takes the processor to power up. If the PLL couldn't do this, then serious system errors would occur. The major side effect is that the chip can't use a standby mode. Since the chip also uses 8 W of power at 100 MHz, it will not be very useful in laptop or notebook systems, as power consumption will be high and no power-saving standby mode can be implemented.

Intel engineers say that they have fabricated the chip and tested it. It operated at frequencies of up to 100 MHz at 5 V and at room temperature. Intel expects that any processors it manufactures using such high speeds would be part of a multichip or multipackage module rather than used in a traditional circuit board design.

Intel admits that many problems remain before this technology can be used in a commercial design. RFI noise could be a severe problem. Intel's John Crawford said that by isolating the high-speed elements of the design on a module, this could be minimized, but he confessed that it is a problem Intel has not fully addressed. A standard heat sink with good airflow will be adequate to cool the processor, he said.

A computer system based on this design would be heavily dependent on the performance of the cache, Crawford said. Intel designed the part with the use of a secondary cache in mind. Crawford acknowledged that the chip won't be quite three times as fast as the 33-MHz i486 but didn't think that the degradation would be significant.

—Owen Linderholm

OS Shuffle Has Developers Dizzy

The spin doctors have been working overtime at Microsoft. The software giant and its sometimes-partner IBM reshuffled their operating-system responsibilities last year, with Microsoft keeping OS/2 3.0; there has since been widespread talk that Microsoft was neglecting OS/2 to design industrial-strength Windows. Then the *Wall Street Journal* reported that Microsoft is "dropping

NANOBYTES

IBM made its fortunes in proprietary systems, but a senior executive says Big Blue will "be the most open company in the business." Senior vice president C. Michael Armstrong acknowledged in his UniForum keynote speech

that such a statement would be met with skepticism, but he claimed that IBM is committed to being the leader in open systems. "There are no illusions at IBM," Armstrong said. **"Open systems are the future,** and IBM's future is in open systems." That means support for POSIX, XPG3, ISO, and ANSI compliance, he said, but most of all, it means Unix.

Unix makes for **good business**, IBM officials are finding. The company recently issued sales figures for its **RISC System/6000** workstation, saying sales have tallied $1 billion.

All signs point to **Apple** finally releasing **System 7.0** next month. At the recent MacApp Developers Association conference, Apple announced four tools for use with System 7.0, the major new operating software for the Mac, including release 3.0 of MacApp, the object-oriented development system. MacApp 3.0 will let software designers incorporate System 7.0 features into their applications. Letting the tools out the door indicates that the operating software is pretty stable. Plus, Apple likes to give its faithful developers a little something at the annual developers' conference, which is slated for May. This year, it's likely that they'll get a shiny compact disc containing System 7.0.

OS/2," an incorrect assumption that further confused developers and users.

Contrary to the "inaccurate speculations," Microsoft says that it will not abandon OS/2 to focus on 32-bit Windows. The company maintains that it is still working on a portable version of OS/2 called OS/2 3.0 (or OS/2 NT, for new technology) and that it is still working on OS/2 applications.

"We will have a high-end and a low-end operating system offering, while having a single mainstream programming interface for developers," a Microsoft staff member said. That interface is now the Windows 3.0 API (for application programming interface) but will eventually be the Win32 API, he said.

This "new-technology" operating system, targeted for client/server situations and multiprocessor systems, will incorporate what is being called Win32, an API in which 32-bit Windows programs can run directly under OS/2 3.0. Microsoft officials insist that OS/2 3.0 is not taking a back seat to Windows, but that it is rather a product for users who need something stronger than DOS. Although some industry insiders say that Microsoft is adding the Presentation Manager API only to appease IBM, a Microsoft representative said that "the PM subsystem has always been part of the product plans for OS/2 3.0."

An IBM official said that the Windows-or-PM scenario just confuses the issue. "It's not a question of user interface. It is a question of which operating environment will give you what you need. The choice is Windows on DOS, which is fine for personal applications, or the advanced capabilities of OS/2." So

OPERATING-SYSTEM SCORECARD

With all the rumors and reshuffling, it's hard to keep track of what's what in the world of DOS-descendant operating environments. As it stands right now, here's what Microsoft and IBM have in the works.

MICROSOFT

OS/2 3.0
- Portable to other processors
- Runs Windows programs, courtesy of Win32
- Small-kernel architecture
- Supports at least four APIs: DOS, 16-bit Windows, 32-bit Windows, and POSIX
- Currently a prealpha project

Win32
- Lets 32-bit Windows programs run under OS/2 3.0
- Part of the OS/2 2.0 system kernel
- API set will be hosted on DOS and OS/2 3.0
- To be the "single mainstream programming interface"

Binary Compatibility Layer (BCL)
- A feature of OS/2 2.0
- Allows well-behaved Windows applications to run directly, without having to be recompiled for 16-bit segmented Windows programs

Windows Libraries for OS/2
- Allows developers to relink Windows 3.0 programs to run under OS/2 1.2, 1.3, and 2.0
- Combines functions of the BCL and the System Migration Kit
- Includes libraries that map Windows APIs to Presentation Manager APIs
- Version 0.9 was released in February

DOS 5.0
- Tiny, leaving more memory for applications
- DR-DOS-like memory management
- Due any month now

DOS 6.0
- Will have Installable File System, which can track and maintain links between documents

IBM

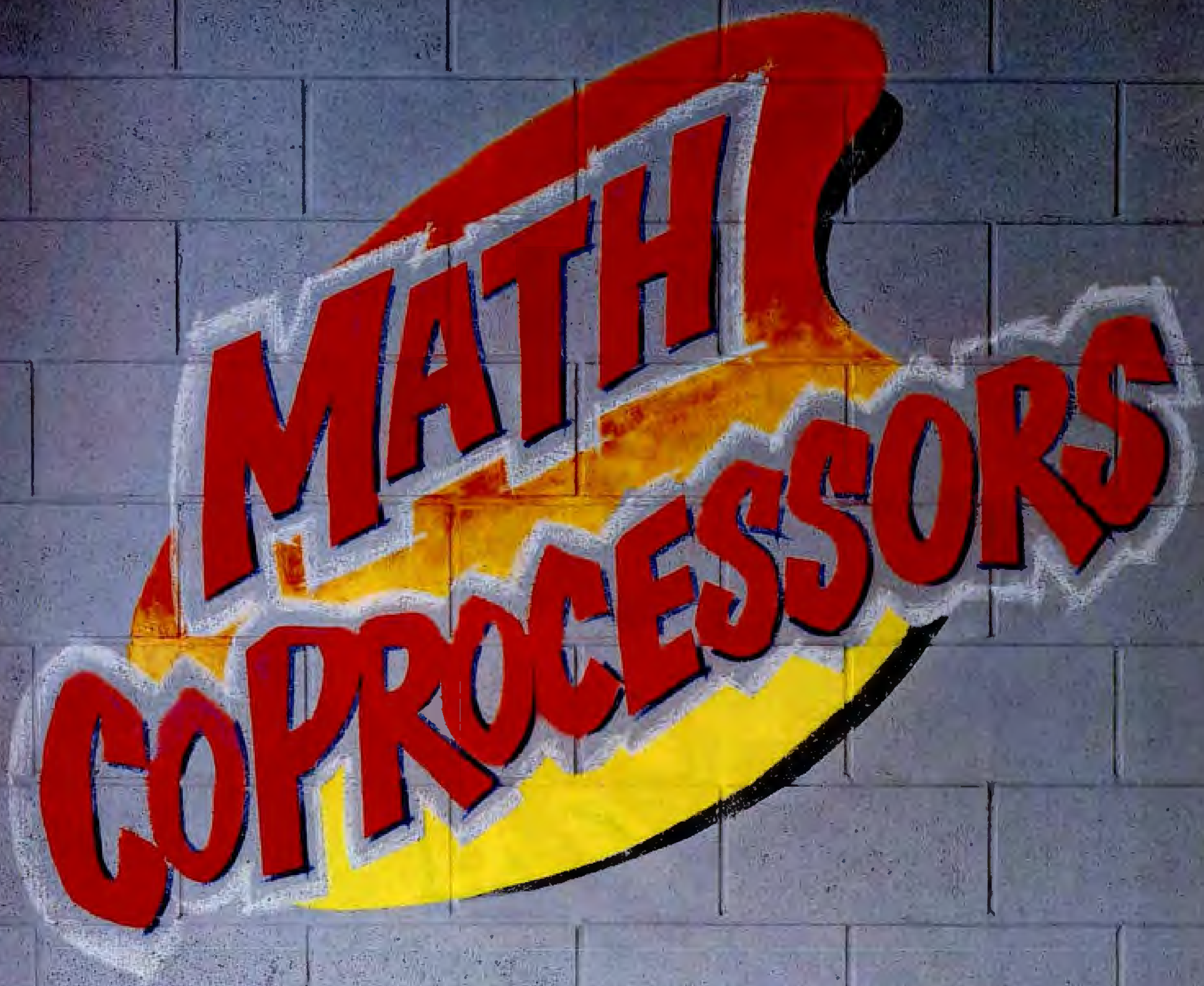
OS/2 2.0
- The 32-bit version will support future 32-bit Presentation Manager programs
- Also supports 16-bit PM programs
- Multiple DOS compatibility boxes
- Will be able to run Windows applications (without DOS box), possibly with a BCL
- Slated to be ready sometime this year

NANOBYTES

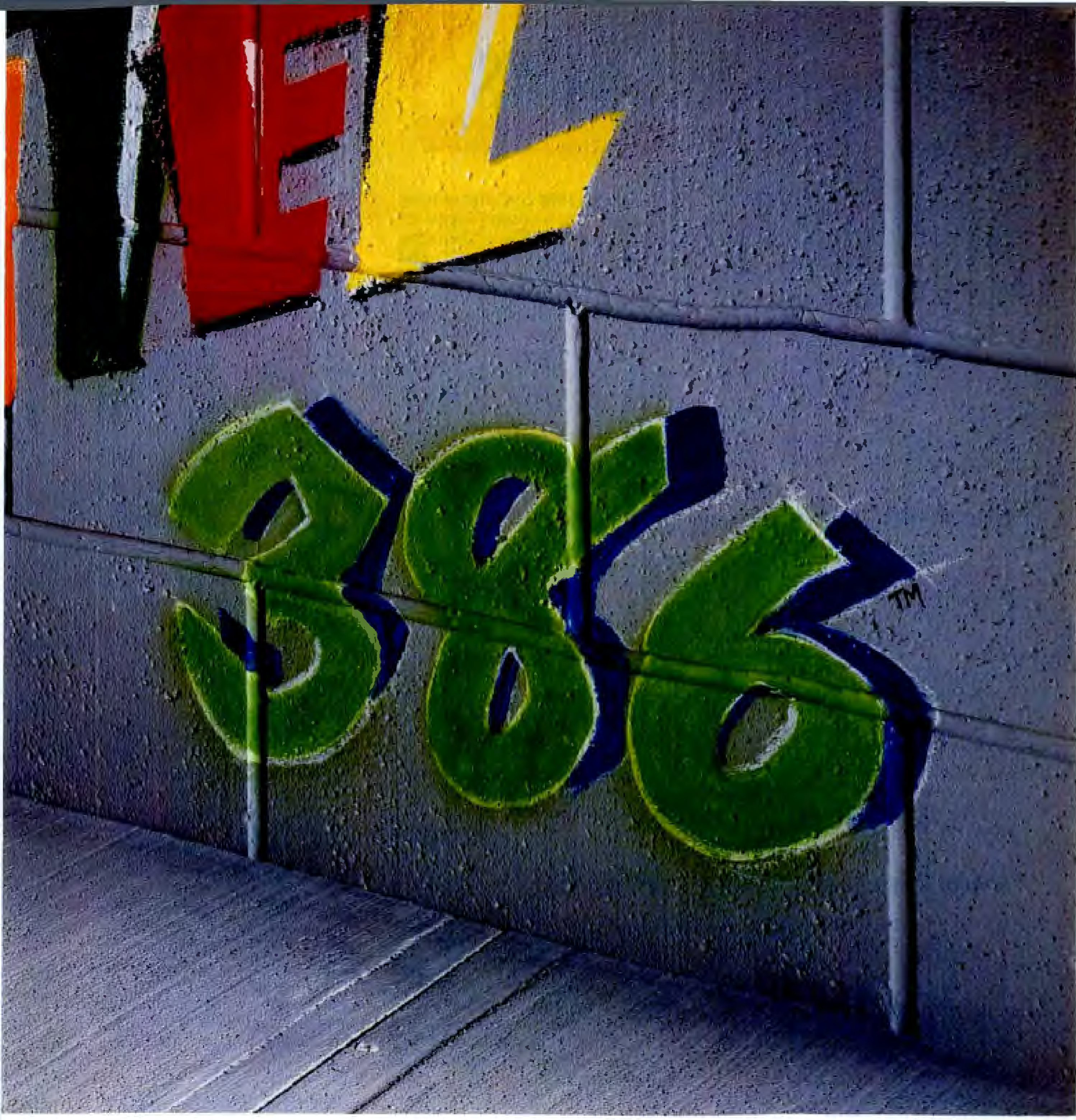
Novell says that it is nearly ready with the NetWare Loadable Modules that will allow DOS, Windows, Mac, OS/2, and Unix computers to share information and resources transparently. The new NetWare 3.11 will let users install the software that they need to run Mac and Unix clients with NetWare servers. The Mac NLM will support AppleTalk Phase 1 and 2 and will let Mac users access NetWare resources through the Mac network-client interface. NetWare NFS, Novell's implementation of Sun's Network File System, will let NetWare 3.11 give native file and print services to Unix clients. Novell also disclosed recently that it has incorporated in the core operating system a TCP/IP implementation to allow multivendor internetworking with environments that support TCP/IP. The company also has a GOSIP-compliant file transfer implementation that links NetWare with the OSI environment.

Responding to "an emotional firestorm," **Lotus** withdrew its MarketPlace CD-ROM databases from the market. Marketplace: Households, a Mac-based database of individuals (i.e., potential consumers), contained information (name, address, age, gender, marital status, income, dwelling type, purchasing propensity, and "lifestyle") of about 120 million Americans. It did not include home telephone numbers, nor was it possible to search for individual names. However, critics charged that a mass-marketed CD-ROM database could facilitate **abuses of privacy** by making consumer data easier to access and harder to control.

MarketPlace was a topic of discussion on BBSes around the country, and about 30,000 people called in to have their names removed. "While we believe that the actual data content and controls built into the product preserved consumer privacy, we couldn't ignore the high level of consumer concern," Lotus president Jim Manzi said.



You know what you need to speed up your power applications. There's just one more thing you should know.



facility, and then tested and retested against an exacting set of criteria.

And we can guarantee that every Intel Math CoProcessor lives up to the industry hardware standards we helped develop, delivering the same results regardless of what type of computer you're doing calculations on.

So call Intel at (800) 538-3373. Ask for Literature Packet #F6 on Intel's new and improved Math CoProcessors. And put an Intel Math CoProcessor inside your computer. It's the only one with the Intel name to live up to.

intel®

The Computer Inside.™

Circle 140 on Inquiry Card (RESELLERS: 141).

will IBM do Windows? In a recent internal memo on how to deal with questions about operating-system strategy, IBM said that it "is evaluating where Windows fits in the range of solutions available to our customers."

OS/2 3.0 is currently in the prealpha stage; sources say that it won't ship before 1992. Microsoft officials confirm that they've ported it to certain unnamed RISC machines; sources say that those machines are the IBM RISC System/6000 and computers based on the MIPS R3000 and the Intel i486 with the i860.

Many developers say that they think Microsoft and IBM are still sending mixed signals. The perceived dispute between Microsoft and IBM is "damaging our ability to market products," said one. "We are facing a nightmare."

So what should developers do? That "depends on the technical and marketing requirements of their product," says Cam Myhrvold, manager of developer relations at Microsoft. "If people want to target the largest graphical desktop market, it is clear that Windows is the volume leader," he says. For the server marketplace, it's OS/2.

—Martin Heller and D. Barker

Hitachi Claims Superconducting BIPS

Although the media hubbub over superconductivity has faded, research continues to bring the technology closer to the world of useful computing. Scientists at Hitachi recently revealed details of a superconducting microprocessor that is capable of running at 1 billion instructions per second (BIPS).

The prototype chip has a 4-bit architecture with 1K bit of on-board memory and 500 bits of ROM. At 7 mm square and with only thousands of devices rather than the usual millions, this microprocessor is obviously only the first step along this development track. The designers employ low-inductance chip-to-chip connections. They say that these connections reduce the effects of AC-power cross talk on the I/O signals and let the device operate at clock frequencies of around 1 gigahertz. The Hitachi team claims that power dissipation is only 50 mW, but the need for cryogenic cooling (the current device works only when kept in liquid helium) negates the overall advantage. The fact that the prototype works at all indicates that superconducting processors will have a role to play in the future of computer technology.

—Andy Redfern

Apple Breaks the Printer Cost Barrier

That headline might sound like one of those "headlines you'll never read," but Apple has in fact come out with two very price-conscious printers. One is a $1299 QuickDraw-based device called the Personal LaserWriter LS. The more novel model is an ink-jet printer, called the StyleWriter, that prints at 360 dpi. This machine retails for $599.

Canon's new StyleWriter, based on its bubblejet engine, is made in Japan for Apple; however, Apple has redesigned almost every aspect of the machine. Because this QuickDraw-based unit has a resolution of 360 dpi, it can generate gray-scale images that look better than those from a LaserWriter. A model that was shown to BYTE took about 2 minutes to put out a page, however.

The StyleWriter accepts compressed information from the Macintosh via high-speed serial communication, but it decompresses each band of information as it comes over and prints it. This means that the Mac is held up from further work until the page is finished. Still, to many users, that is an acceptable compromise for a printer of this price.

The new LaserWriter LS was designed to print a full page of text and graphics using only 512K bytes of memory. The printer driver software compresses the page image information and passes it to the printer, which decompresses it while printing in bands. This printer also uses a serial connection and clocks the serial port of the Macintosh at a much higher rate than it normally operates at. Apple representatives said that it effectively operates at 900,000 bps. Unlike the StyleWriter, the LaserWriter LS receives the whole page from the Mac before decompressing and printing. Both printers are being shipped with TrueType and TrueType fonts.

Mac Classic buyers have been hesitant to buy a laser printer when it costs twice as much as their computers. But now, the StyleWriter means that you can have a fully functional Mac and a laser-quality printer for a street price of about $1700.

—Owen Linderholm

NANOBYTES

Even **Microsoft** chairman **Bill Gates** agrees that people are confused about his company's intentions regarding operating systems. "We're confusing the market, that's for sure," he told a group of press and financial analysts. But there was nothing confusing about his attitude toward a competing operating environment. After being asked whether Microsoft's Object Linking and Embedding technology will do what Hewlett-Packard's **NewWave** already does, Gates said, "No, no, no, that's wrong. NewWave doesn't do anything."

While some people doubt that PCs can gain an edge over traditional workstations, **Interactive** president Dennis Peck thinks otherwise. In a couple of years, he said in a recent interview, the huge **Unix market** will be split between RISC (mostly, he thinks, SPARC) and Intel-based Unix. Intel's i586 chip, expected later this year, and the i686 will give Intel a lock on a vast number of desktops. Enhancements from Interactive, such as the high-priority effort to improve ease of use and administration through graphical applications, will keep Interactive the leading choice for Intel V.4, Peck said.

In an effort to help deal with **environmental disasters**, the **National Oceanographic and Atmospheric Administration** has launched a Macintosh program that provides quick access to **information on chemical compounds**, identifies areas that might be affected by toxins, plots the course of emissions into the air, and even analyzes possible accident scenarios. In addition, the Cameo II program can help communities and businesses prepare detailed contingency plans for emergencies.

NEWS

MICROBYTES

Has IBM Finally Gotten Its Portable Right?

IBM may finally have shaken the curse of its ill-fated Portable PC. The company was expected to have brought out by now its new laptop that is based on the 20-MHz 386SX processor.

According to people who have seen it, the new system is very similar to the Compaq LTE 386s/20. It features a 60-MB hard disk drive, a 3½-inch floppy disk drive, 2 MB to 18 MB of memory, and a VGA LCD screen. According to sources familiar with the new machine, the L40 SX weighs 7½ pounds.

One user at the Harvard Business School said that the new system's best feature is the keyboard. The keys do not travel as far as they do on a Toshiba notebook, but the key placement is better than that on Toshiba or Compaq laptops, he said. In addition, an external numeric keypad is available for those who like the feel of a full keyboard.

The new notebook incorporates a "fuel gauge" that indicates the power remaining in the system's battery. The system that was used at Harvard also includes a 2400-bps modem and 9600-bps fax modem, but it was not clear whether this fax modem will be included as standard when the machine is released.

As we were going to press, the price of the L40 SX was still a matter of speculation, but sources and published reports estimate the cost will be near $6000. With mail-order SX notebooks dipping down below $2500 and a new wave of Far East notebooks on the way, sales of the L40 SX could depend on its price. It is a fairly safe bet, however, that IBM will choose a list price close to that of the Compaq LTE ($6499).

—Rich Malloy

Photonics Transceiver Lets Hand-Held Systems Beam Data

Pen-based computers and wireless networking are a natural fit. One of the companies putting the two together is Photonics (Campbell, CA), which has prototyped a diffuse infrared transceiver that allows a mobile unit to be part of a network without a physical connection.

The transceiver has a range of approximately 30 feet. Photonics plans to provide repeater stations to carry the signal even farther than that. Photonics and GO Corp. recently demonstrated the equipment. They attached two GO systems to the Photonics transceivers and used the systems to hook into a stationary transceiver attached to its network with Ethernet and token-ring connections. They then demonstrated a remote Structured Query Language access to a Mac over a wireless link using software from TechGnosis. The transfer took a couple of seconds, but it was successful.

GO's PenPoint hardware can recognize network connections on its own. Users will be able to walk into a room and establish a network connection almost immediately. This could foreseeably allow instant networks of pen-based systems in meetings, or automatic data transfer from a mobile unit to stationary, central corporate units. These connections and transfers can happen automatically without user input, the moment a user returns to the base office.

Photonics president Dick Allen said that the new technology in its infrared transceiver will be capable of supporting Ethernet networking in the future at speeds of up to 10 Mbps. The current version can transmit at 1 Mbps. The Photonics scheme uses its own error-correcting method and does not require the retransmission of data, Allen said.

—Owen Linderholm

New AppleTalk Code Will Let Macs Tap Unix Services

Macintosh and Unix system users should soon be able to share services. Apple Computer and AT&T said that they will jointly develop a specification to standardize internetworking between Macintoshes running AppleTalk and Unix systems that are running System V release 4.

At the heart of the deal is agreement on an application programming interface that will allow Unix developers to write software that takes advantage of file-sharing, client/server, and other AppleTalk network services. Source code that

NANOBYTES

IBM recently demonstrated a working prototype of a **4-pound portable terminal** designed to work with the Motorola/IBM **Ardis** packet-radio network. The unnamed machine will be announced later in the year, IBM said. It's based on a 286 CPU and runs DOS in ROM but is mostly intended for connection to host systems via 3270 emulation.

The ruggedized device has a full keyboard and a backlit LCD screen but no hard disk drive or floppy disk drive; instead, it has a slot for credit-card-size IC cards. Both an RF modem and a standard modem for connecting to land lines are built in. The portable terminal will enter field testing this summer, and IBM said it will be "competitively" priced with Motorola hand-held RF terminals.

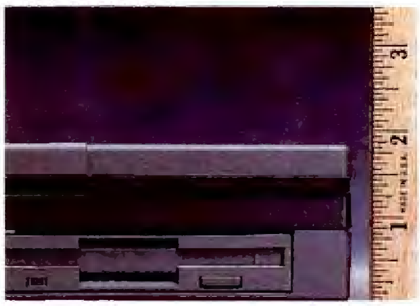
Developers who want to create new applications for **pen-based computers** will have to start thinking in a brand new mode. Robert Carr, vice president of GO Corp. and one of the designers of PenPoint, advises developers to forget about cursors, mice, and other aspects of the traditional user interface. **Dan Bricklin**, veteran programmer and vice president of **Slate**, says you don't have to be a "superprogrammer" to design pen-based applications, "but you do need to know C." Slate says that its PenApps development environment will let people write complete applications in a few weeks, while the Data Access Architecture will let them easily integrate the PenApps application with even proprietary databases. At a recent Boston Computer Society meeting, Bricklin used the PenApps tools on GO's 286-based machine to build a forms application from scratch. His demonstration was aimed at developers who want to quickly design forms applications.

The new TravelMate™ 3000 notebook computer packs 386™SX power into 1.8″ and 5.7 lbs.

Finally. A truly portable 386SX notebook computer attractively packaged in a sleek, breakthrough design that complements your workstyle – TI TravelMate 3000. This latest addition to TI's powerful new look of notebook computers packs 20 MHz, 386SX processing power into a convenient 1.8″ thin, 5.7-lb. package.

Portable power for power users.

Now you can easily carry desktop performance in an exceptionally lightweight package. Run power-hungry applications with 2MB of RAM (expandable to 6MB) and a 20MB, 40MB or 60MB hard disk drive. Get the full effect of Windows® and graphics-intensive software on the TravelMate 3000's big, bright 10″ diagonal VGA display with 32 shades of gray.



The new 20 MHz 386SX TM 3000 is just 8.5″ x 11″, a mere 1.8″ thin and weighs an easy-to-carry 5.7 lbs. (including battery)!

Loading application software and file back-up are easy with the built-in 3.5″ floppy diskette drive. The internal battery lets you work up to three hours nonstop. Plus, the TravelMate 3000's full-function AT®-enhanced keyboard lets you do it in comfort.

Call today for power without compromise.

To see the new look of 386SX power, call TI for the name of a TM 3000 dealer near you.
1-800-527-3500

TEXAS INSTRUMENTS

follows the API should be portable across hardware lines, as long as the target system provides services compatible with the API.

Apple has agreed to implement the new AppleTalk API in the next release of its Portable AppleTalk source code, available under an Apple licensing program. This API will let Mac users run Unix applications, such as E-mail, from within the AppleTalk environment. (To do that now, they must run a TCP/IP protocol stack.) Pacer Software has ported the protocol to a variety of Unix systems, including System V release 4 for the NCR System 3000. The AppleTalk specification will be distributed by both Apple and AT&T sometime this quarter, the companies said.

—Tom Yager

C&T Develops Multiprocessing Design; Alternative to C-Bus

Attempting to provide an alternative to Corollary's C-Bus Intel-based multiprocessing architecture, Chips & Technologies (San Jose, CA) has developed its own multiprocessing platform called M/PAX.

M/PAX and its Corollary counterpart both support multiple processors in a single chassis, communicating with each other over a proprietary bus. But M/PAX's main advantage is the bandwidth of its interprocessor data channel, or Multi-Processor Interface; the MPI is a 128-bit-wide bus that passes messages between processors. M/PAX calls for an additional level of cache, beyond the i486 internal cache, to reduce the total traffic between the processors and to the shared memory pool. Up to four memory controllers can be present in an M/PAX implementation, permitting multiple simultaneous transfers.

Chips & Technologies provides the interface circuits needed for the system, processor, and memory modules. A company representative claimed that M/PAX has a significant performance edge over Corollary's C-Bus and said that the SCO MPX extensions to Unix work with both C-Bus and M/PAX. The same representative said that one drawback is that M/PAX may not support as many total processors as C-Bus.

—Tom Yager

Compaq Now Offers a Little Help for Its Friends

Compaq has changed its ways and started offering product support directly to end users. The computer maker is also classifying its dealers according to its ability to sell and service complex networked systems.

The moves are an effort to satisfy customer demands for better support than has traditionally been available through the dealer channel—especially for complicated multivendor systems—while sparing Compaq the expense and political fallout of establishing a direct sales force to serve corporate buyers.

For the benefit of customers seeking "advanced connectivity solutions," Compaq will identify a subset of its authorized dealers who have the training and facilities necessary to sell and service products such as the Compaq SystemPro running Novell NetWare.

The end-user support will include a toll-free hotline that will be available to any Compaq customer seeking information about accessories, upgrades, or basic system configuration; and a paid service, called the Compaq Telephone Support Agreement, that will provide high-level system support and problem solving.

Compaq's new free customer support center is open Monday through Friday, 7 a.m. to 7 p.m. Central time, and you can contact it at (800) 345-1518. The center will offer answers to simple questions about hardware configuration and setup, operating systems, and BASIC language programming, as well as problem diagnosis, the company says. Sales information about upgrades, options, and dealer locations will also be provided.

For more sophisticated information, especially concerning networked systems, Compaq will sell a telephone support contract through its dealers for $3000 per year. The fee covers 10 "support incidents" during the year; each request for support (assuming it merits high-level attention and cannot be solved via the free hot line) will be assigned a case number and a supervising engineer. Compaq specialists, in conjunction with engineers from network vendors, will work on the problem until they solve it.

—Andy Reinhardt

NANOBYTES

NCR expects to introduce its **notepad computer** based on GO Corp.'s new PenPoint system in the third quarter of this year. The portable system will likely be based on a 386-class CPU. The NCR notebook will support handwriting recognition and mouse functions even when running standard DOS programs. NCR's pen can be a pointer, or, with a click of a button, it will emulate a keyboard; DOS programs won't know or care how the text was entered because characters written on the pad will be forwarded to the keyboard buffer.

Apple Computer has made a few adjustments to its **Macintosh Portable** and knocked $1000 off the price, but it couldn't keep the weight down. The biggest change is backlighting for the active matrix LCD, which makes it easier to read in a variety of lighting conditions. You can turn the backlight on or off, which is good because when it's on, the power consumption goes way up.

So that users will be able to run System 7.0 when it arrives, Apple has raised the standard amount of RAM it puts in the Portable, now offering 2-MB and 4-MB models. The Portable with 2 MB of RAM and a 40-MB hard disk drive is now $4199; with 4 MB of RAM and a 40-MB hard disk drive, it's $4699. Mac users we interviewed said they think the price is still too high, but at least Apple is moving it in the right direction. Others said that they're waiting to see the notebook-size computers expected from Apple later this year.

AT&T's new Unix System V Graphics Platform (developed by Quest Systems) gives a nod to a rival user interface. The software bundle comes with either the **Open Look** or **OSF/Motif** graphical user interface layers. This is the first sign that AT&T's competitive stance in the GUI arena is softening, or perhaps it's just a realistic response to market acceptance of Motif.

NEWS

MICROBYTES

Apple Asks for Airspace for Data Communications Service

Paving the way for wireless networking, Apple Computer has petitioned the FCC for permission to establish a "Data Personal Communications Service." Using 40 MHz in the 1850- to 1990-MHz bandwidth, the service would transmit data at 10 Mbps over short distances (less than 150 feet). Such a service could replace wired LANs within a workgroup. Users would send data between desktop systems or use "portable computers equipped with miniature, nonoptimum antennas." Apple officials say that they can't develop this new technology until the FCC "allocates sufficient bandwidth."

Apple has filed the petition to "put a stake in the ground," said Bill Stevens, manager of the Advanced Technology Group team working on wireless LAN technology. "What we are proposing is an unlicensed service with each transmitter containing a call that is specific to that transmitter for identification," Stevens said. "Also, we proposed that the service operate in a 'listen-before-talk' manner. This means a battery-powered device would not have to use continual power to maintain connectivity."

Apple notes in the petition that it has done tests in different buildings, using frequency ranges of 900, 1900, 2400, and 5800 MHz and several modulation schemes.

The proposed service would be open to other manufacturers who want to "connect services to the nonstationary user," Stevens said. One of those other manufacturers is likely to be General Magic, the Apple-funded company developing what it calls "personal communicators."

—Larry Loeb

Interactive Takes New Direction as Publisher of Unix System V Release 4

Shedding its role in distribution, AT&T's Unix System Labs (USL) has signed Interactive Systems (Santa Monica, CA) as "a principal publisher of System V release 4 for Intel platforms." Intel, which is currently marketing its own port of Unix V.4, said it will turn its V.4 business over to Interactive.

Under this new arrangement, USL will do the Unix development, aided by Intel, and turn a finished product over to Interactive. Interactive will then package it and offer optional added value (like OSF/Motif and Ported NetWare), as well as handle distribution and support.

The ramifications could be far-reaching. In gaining endorsements from both AT&T and Intel, Interactive will position its packaged version of V.4 as the obvious choice—instead of the one from rival The Santa Cruz Operation—for Intel-based systems. At least until AT&T selects its next "principal publisher."

Interactive appears to be moving away from developing operating systems. Instead, the company will use its software development talent to produce add-ons to System V.4, as well as new applications software. Interactive's parent company, Kodak, mandates one such application. Kodak has been investing heavily in its Photo CD technology, which basically converts photo prints into high-resolution digitized images on a compact disc. Kodak will market players and printers to accompany this technology, but Interactive is already well along in developing Unix imaging software that can expand the capabilities of the Photo CD.

The company has just started shipping its Ported NetWare package, an implementation of Novell's Portable NetWare for Unix. Ported NetWare operates on any 386 or 486 system running Interactive Unix 2.02 or higher. The company has also added a menu-driven utility for Unix-oriented administration.

—Tom Yager

TECHNOLOGY NEWS WANTED. *The news staff at BYTE is interested in hearing about new technological and scientific developments that might have an impact on microcomputers and the people who use them. If you know of advances or projects relevant to microcomputing, please contact the Microbytes staff at (603) 924-9281, send mail on BIX to Microbytes, or write to us at One Phoenix Mill Lane, Peterborough, NH 03458. An electronic version of Microbytes, which offers a wider variety of computer-related news on a daily basis, is available on BIX.*

NANOBYTES

3Com (Santa Clara, CA) has demonstrated the "first commercially available implementation of the Intermediate System-to-Intermediate System **(IS-IS)** routing protocol for OSI networks." IS-IS is a draft standard for intradomain routing on OSI networks. Support for this capability is included in a new version (2.0) of 3Com's NetBuilder Brouter software, which also has routing capabilities for Novell IPX and DECnet Phase IV. 3Com's brouters now support all the major routing protocols, which also include TCP/IP, XNS, and OSI.

DVI meets the Mario Brothers: Although aimed at computer graphics and imaging systems, Intel's Digital Video Interactive technology will show up in a new generation of **video games** slated to hit arcades next fall. **Data East USA** (San Jose, CA) will bring out four games that use Intel's i750 digital video processors. "Over the past few years, arcade video games have lost some of the technological edge over home entertainment systems," says Joseph Keenan, president of Data East USA. "DVI technology returns that advantage tenfold and makes immediately available a highly advanced multimedia computer technology that will be found in arcade systems long before its entry into the home marketplace." Data East will supply Intel with the video for the games.

A new program introduced at UniForum will let Unix users include **any type of text or binary data** in E-mail messages. The first product from **Alfalfa Software** (Cambridge, MA), called Poste, provides for multipart messages consisting not only of text but user-defined *enclosures* as well. These enclosures can contain text, images, fax transmissions, and digitized sound. Users or third-party developers can add new types as technology advances, Alfalfa says. Poste is a graphical application with an OSF/Motif interface. It's likely to cost $395.

Some days you have all the time in the world.

When the pressure is on, pour on the speed. With Hewlett-Packard's new LaserJet IIISi printer. A powerhouse that delivers at a throughput speed of 17 pages per minute.

With the LaserJet IIISi, you're up to speed the moment you give the "print" command. HP's RISC-based formatter and the PCL5 printer language, with vector graphics and on-the-fly typeface scaling, yield fast results. This printer also represents a new standard for I/O performance with optional Network Printer Interface cards for either Ethernet or Token Ring.

The LaserJet IIISi is specifically designed for shared-use environments. Its high-volume paper handling features include two 500-sheet input trays and a monthly duty cycle of 50,000 pages. HP offers software-selectable language switching between PCL5 and optional Adobe® PostScript®. For added versatility, your options include

Adobe and PostScript are registered trademarks of Adobe Systems Inc. in the U.S. and other countries.

And some days you need the new 17ppm LaserJet IIISi.

an envelope feeder and two-sided printing.

Beyond speed and efficiency, the LaserJet IIISi delivers the sharpest 300 dpi print quality yet. In fact, HP's revolutionary combination of Resolution Enhancement technology and new microfine toner challenges the print quality of many 600 dpi printers.

The price of the new LaserJet IIISi, just $5,495,* is as impressive as the work load it handles. If you're ready to pick up the pace, call **1-800-752-0900, Ext. 2067** for more information on the fastest LaserJet printer and the name of your nearest authorized HP dealer.

HEWLETT PACKARD

*Suggested U.S. list price. PE12101

FoxPro 2.0 Engages the Warp Engines

JON UDELL

A technology called Rushmore boosts FoxPro's performance by orders of magnitude

Sufficiently advanced technology, it's been said, cannot be distinguished from magic. So it is with Rushmore, the code-named patent-pending data-retrieval magic at the core of FoxPro 2.0. Rushmore enables the new version of FoxPro to wield huge sets of records at speeds that are utterly shocking. Certain basic operations run two orders of magnitude faster than under FoxPro 1.0, itself the performance leader among dBASE-compatible programs. For good measure, Fox has tossed in interactive menu and screen generators, a Structured Query Language (SQL) query facility, a project manager, a 32-bit extended-DOS version, application programming interface (API) libraries for C and assembly programmers, a collection of handy new user-interface objects, and a host of useful language enhancements. If you hear an unusual noise this spring, it may be the sound of the earth shaking. Even in an industry accustomed to upheaval, FoxPro 2.0's debut should score high on the Richter scale.

I maintain a small suite of applications under FoxPro/LAN 1.0, so my first order of business was to test these under version 2.0. The beta copy I used had no multiuser support, so I ran it on a LAN in single-user mode. (Fox says both single-user and LAN versions will ship in the second quarter of this year.) Other than that, everything checked out beautifully.

The Rushmore technology made its presence known in cases where my programs use SET FILTER TO to deliver subsets of records in response to the BROWSE command. Under version 1.0, subset BROWSEs tend to crawl. Only users with fast machines can really benefit from this otherwise marvelously useful access idiom. With 2.0, my programs could BROWSE filtered subsets with no perceptible strain. Almost unbelievably, that held true when I moved from my 4-megabyte 20-MHz 386 to a lowly 640K-byte 10-MHz 286. The world's full of such machines—I've got to support a number of them myself—and FoxPro's newfound ability to wring performance out of modest hardware is a godsend. Thanks to Rushmore, a new fine-grained segment loader (which replaces 1.0's overlay system), and a smaller root segment, low-end machines get a new lease on life.

THE FACTS

FoxPro 2.0
(price not set at press time)

Fox Software
134 West South Boundary
Perrysburg, OH 43551
(419) 874-0162
fax: (419) 874-8678
Circle 1060 on Inquiry Card.

Let FoxPro Write the Code

Although version 1.0's FoxView/FoxCode tool set gave savvy programmers a big head start on building rich user interfaces, you had to learn a rather obscure meta-language to use the tools. I've heard it's a good system for interactively designing and automatically generating programs, but I've never had time to master it. For me, database programming is a quick-and-dirty affair to which I devote a few odd hours stolen from official duties. Under 1.0, the quick-and-dirty solution was to lean heavily on the BROWSE command and avoid custom user interfaces.

What will my next generation of FoxPro applications look like? Take a look at photo 1. After I got the hang of the new screen builder, I was able to whip up a simplified working version of that program in under 2 minutes. How? FoxPro wrote most of it—including code to open database files, set relations, and place and activate interface objects. All I did was interactively build the interface and supply a few lines of code. "Scary," said one colleague who watched the demonstration.

Like FoxPro 1.0's report builder, the new screen builder supports mouse-driven positioning of text and database fields. It also handles new interface objects: text buttons, radio buttons, check boxes, scrollable lists, and multiline text fields. With these objects, programs written with FoxPro can now sport the exemplary character-mode graphical user interface (GUI) of FoxPro itself.

As with the report builder, there's a "quick" option that dumps fields and their names onto the screen to give you a head start on the design. You can select sets of objects, and group and ungroup them. (These conveniences also carry over to 2.0's report builder; 1.0's report builder didn't support multiple selection or grouping.) Double-clicking on an object brings forward a dialog box that you use to specify the object's behavior. In some cases, you won't even need to do that. The default behavior may be just what you want, as was true for most of the fields shown in photo 1. Note in particular the checkboxes, which map directly to logical (true/false) fields in the database.

The Automatic GUI

In other cases, though, you will need programmatic control. All the interface objects become statements (variants of the @ . . . GET command) in the program that FoxPro writes. These statements can have clauses that execute when the corresponding object receives or loses the input focus, and they can transmit the data that they solicit to variables or database fields. The screen builder prompts you for these clauses and variables, and it then stores the code that you supply in a FoxPro database.

In the case of the "next/prev/first/last/quit" text-button object shown in photo 1, I told FoxPro to store the user's choice in a variable called `choice`. Then, to the object's VALID clause (which FoxPro calls when the user pushes a button), I attached a DO CASE statement mapping button choices to appropriate FoxPro commands such as SKIP, GO TOP, and QUIT.

FoxPro turns these code snippets into procedures that have machine-generated names such as _PX201XDY7. Not too handy a string to search for in your text editor, but then the .PRG file FoxPro writes only looks like source code. It's actually intermediate object code not meant for human consumption. The idea is that you'll access _PX201XDY7 only through the screen builder, and you'll only need to think of it as "that thing right there on the screen." It's a matter of preference, I guess, but that bothers me a bit. I believe that naming is a key programming discipline.

Of course, there is a simple workaround. Just have _PX201XDY7 call a routine in a procedure file, which you can name according to your own conventions. That way you can also retain the use of your own text editor—another matter of strong personal preference.

Quibbles aside, the key point here is that you're only responsible for what happens when the user makes selections. FoxPro automatically generates code to manage the event-driven framework in which selections can occur.

Although it's character-based, FoxPro presents a full-blown GUI with much of the attendant complexity. As many Mac, Windows, and now Unix programmers are discovering, there's no advantage in managing the event loop yourself when the machine can do it for you. Life's too short, and there are so many interesting things that you can be using the GUI to accomplish. Version 2.0 buys you the time to make those things happen.

Menu Builder and Project Manager

Although I had learned how to program cascading pull-down menus under FoxPro 1.0, it's a technique I'll be happy to forget. Version 2.0's menu builder does it for you. You interactively build and test a menu tree and then link its leaves to commands or, more typically, programs generated by the screen builder.

Photo 1: *With FoxPro 2.0's interactive screen builder and code generator, even part-time programmers can get professional results.*

There is a "quick" option here, too. It duplicates the FoxPro system menu, which you can then restrict or modify as necessary. Menu items can now have checkmarks that convey binary status: A subsequent choice is available or it isn't; a switch is on or off. Like the screen builder, the menu builder provides for global initialization and cleanup. When you select one of these options, FoxPro presents an editing window in which you can write code to create or destroy global variables, arrays, and database configurations. The cleanup section is also a place where you can write functions and procedures. These you do name yourself, although you can't edit them except by way of the menu or screen builder.

Both the screen and menu builders use FoxPro databases (.SCX and .MNX files, respectively) to store the information that drives their respective code generators, which in turn produce .PRG files (which in turn compile to .FXP files). The new SQL facility produces .QRY files (which also compile to .FXP files). And, as before, the report and label generators crank out .FRX and .LBX files. An application may easily require many files of each of these types.

Thankfully, FoxBase 2.0 can help you sort out this alphabet soup. If you can swallow one more three-letter convention—.PJX, the project file—you can forget all the rest. You create a new project file, add the pieces of your application, and voilà: instant organization. Double-clicking on a file listed in the project manager opens the file and launches the appropriate tool: text editor, or screen, menu, report, or query builder.

The project manager keeps track of dependencies and, when you ask for a rebuild, refreshes only outdated files and their dependents. The Info dialog box remembers the date of the last build. It also lists variables, procedures, and functions by module and notes whether each identifier was defined or referenced in that module—a very handy feature.

I found the project manager helpful not only for developing programs, but also for casual interactive use. While exploring the SQL facility, for example, I used it to group a set of queries into a manageable collection.

And Then the SQL

FoxPro 1.0 sorely lacked an interactive query tool. Version 2.0's query tool (see photo 2) plugs that gap. Like many SQL front ends, it walks you through the selection of databases and fields and the specification of join conditions, functions, and qualifying expressions. You can look at the generated SQL code at any time. For interactive purposes, you typically save queries—each one an instance of 2.0's new SQL-oriented SELECT command—in .QRY files that the project manager associates with the query tool. Alternatively, you might save them in .PRG files for use by programs. Of course, you can also write SELECT statements yourself and run them from the COMMAND window or from within programs.

SELECT, unlike other FoxPro commands, opens databases on demand. The query optimizer may use available indexes or create temporary ones on the fly. SELECT relies on Rushmore and, in fact, is the only way you can bring Rushmore to bear on multitable retrievals.

Although still in rough form when I saw it (no HAVING or UNION clauses, no descending ORDER BY, query optimizer still unfinished), FoxPro's SELECT appears to be both fast and flexible. Queries that I have used with other SQL products ran snappily on small databases and came up with the right answers. You can dump results right into a .DBF file, which you can then further manipulate using all of FoxPro's interactive and programmatic tools.

SELECT is still evolving. One tantalizing feature on the to-do list is support for FoxPro functions in the SELECT statement. I don't know what SQL purists will say, but FoxPro developers certainly will be drooling over the possibilities inherent in that hybrid.

Rush Me More Records

The development tools and SQL facility so engaged me that it was several days before I got around to stress-testing Rushmore in earnest. As I've said, my programs' filtered BROWSEs flew where before they had crawled. But these programs used puny 1000- to 2000-record (1- to 2-MB) databases.

Nothing prepared me for what happened next. I doubled the size of a database again and again and again. At 8000 records, I brought FoxPro 1.0 down to its knees. BROWSE, with a filter, ground to a halt while the file server's disk took a beating. But 2.0 didn't even break a sweat at 8000 records, and it was the same story at 16,000 records and at 32,000 records—what was by now a 12-MB database.

I stopped there because I would have had to clear more space on the server to double the database again—and because I was stunned. BROWSE was still rapidly scrolling through filtered sets of records, the disk was chittering quietly, and I was walking around my office looking for mirrors, wires, trapdoors—anything that might explain this prodigious trick.

Where does it end? I didn't have a million-record database at hand (or space to create one), but I'm no longer inclined to doubt claims that 2.0 will handle such a thing with ease. Fox has simply built a better mousetrap. How, exactly, remains a mystery. The official story is that, by some means, Rushmore optimizes index expressions in the FOR clause of a number of FoxPro commands, including—another 2.0 first—BROWSE FOR. Commands like

```
BROWSE FOR state = "MA"
and city = "Cambridge"
```

or

```
SORT FOR fee > 300
and dept = "Reviews"
```

are fully optimizable if indexes exist for `city`, `state`, `fee`, and `dept`. However, the command

```
LOCATE FOR fee > 300
and "stein" $ author
```

is at best partially optimizable, since no index can exist for the second part of the FOR expression (which tests for the occurrence of "stein" in `author`). By the same token,

```
REPORT FOR "stein" $ author
```

is not optimizable at all.

Indexes, Indexes

Some of Rushmore's prowess, but by no means all of it, flows from FoxPro 2.0's compact index files. Version 2.0 can read and write standard FoxPro .IDX files but prefers a new compact format. These new .IDX files are much smaller. In the case of one 2.5-MB 2000-record database, an index that took 440K bytes under version 1.0 shrank to 50K bytes under 2.0. Smaller indexes confer obvious benefits—less disk traffic, more index data in memory. However, although Rushmore greatly appreciates compact indexes, it does not depend on them.

Building on the new compact index technology, FoxPro 2.0 introduces another great convenience: .CDX files that hold multiple compact indexes. When one of these index files shares the name of the database, it's a *structural index*; FoxPro silently opens it whenever you open the database. Because compact indexes are so small, you can index most or all of the fields of a database in less space than it used to take to index just one field—and still use up just one DOS file handle.

Structural indexes take almost all the hassle out of keeping lots of indexes. Seize the opportunity; Rushmore will put them to good use. When you need to refer explicitly to individual indexes within a .CDX file, you use a *tag name*. The SET ORDER TO and INDEX commands now have TAG clauses that accept tag names. Note, however, that you may need to rethink how you use the SET ORDER TO command. Although Rushmore likes having indexes available, it prefers that none of them controls the order of the database.

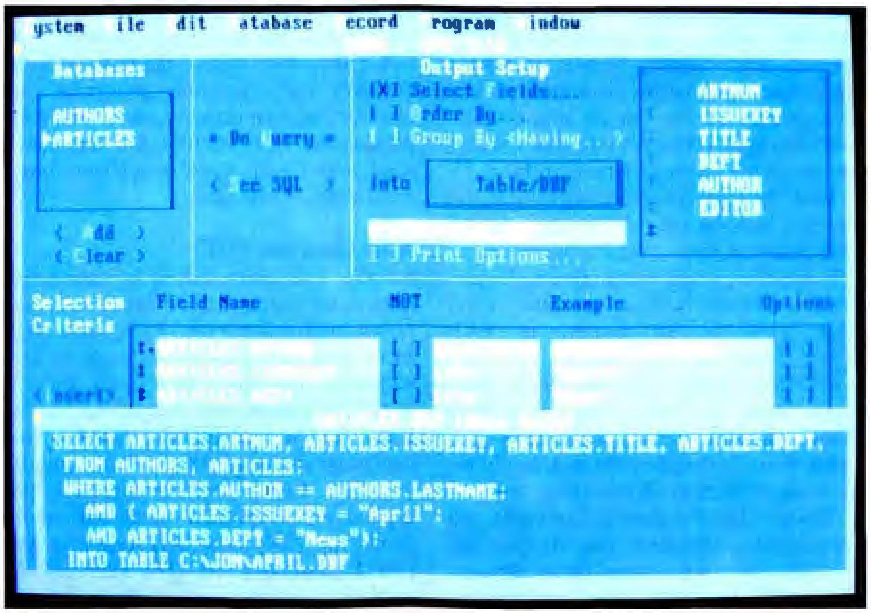
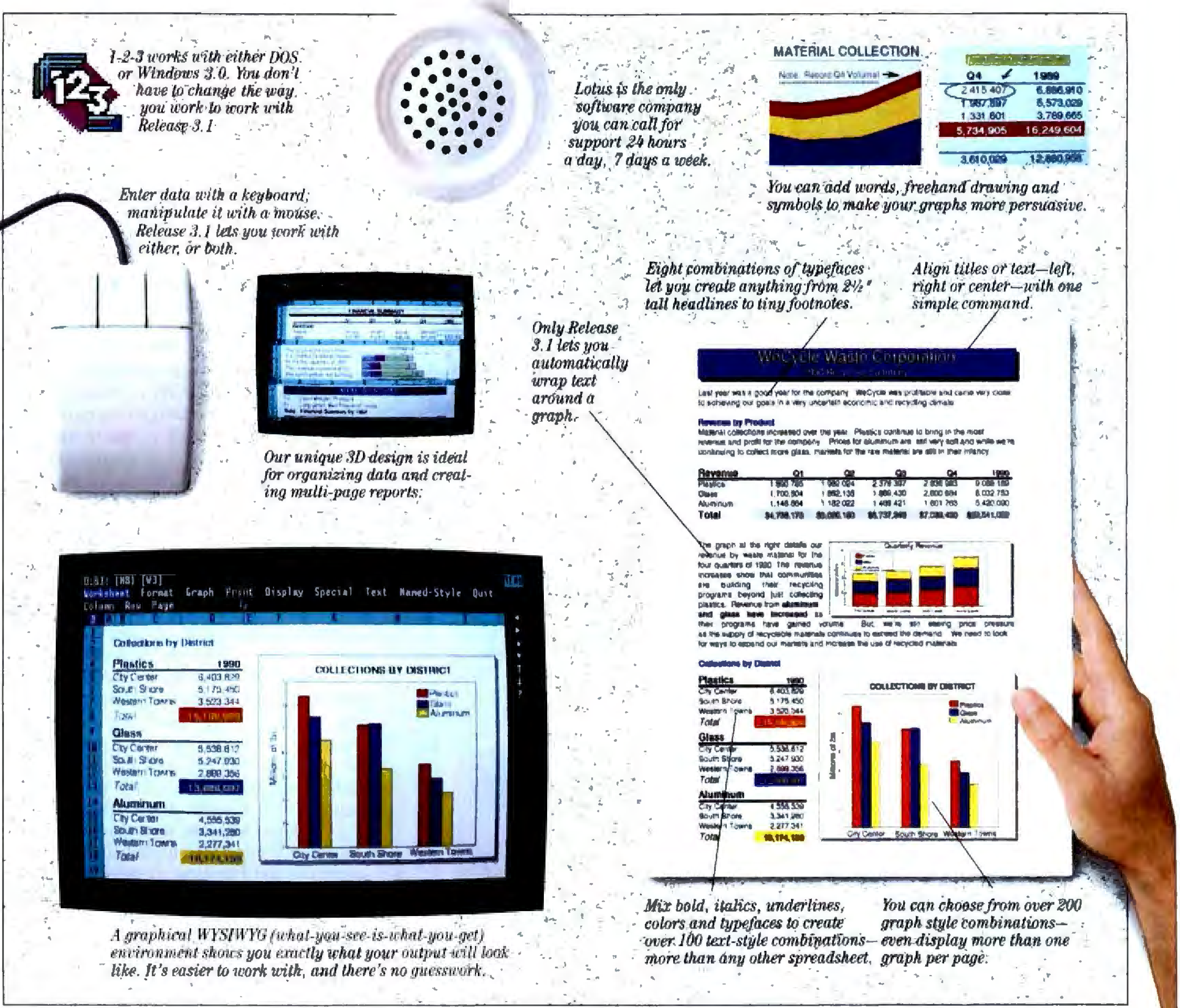


Photo 2: *The RQBE (relational query-by-example) window makes FoxPro 2.0's new SQL-style SELECT command accessible to beginners.*

continued



Since 1983, 7 out of 10 spreadsheet buyers have chosen 1-2-3.* Now we're going after the other 3.

Over 10 *million* business people are more productive and more insightful because of Lotus 1-2-3. Now Lotus introduces 1-2-3 Release 3.1.

And if you're currently using 1-2-3, you'll find it offers the features you've been wishing for.

Like the ability to see, on screen, exactly what your printed output will look like. Our unique 3D approach to organizing and consolidating spreadsheet data. And the most professional and persuasive printed reports you've ever created on your computer.

Or if you're one of the holdouts not using 1-2-3, you'll find it offers an interactive, graphical environment. Plus it works with Windows 3.0. And supports both a keyboard and a mouse.

And now, when you buy Release 3.1 between January 8, 1991 and April 30, 1991, we'll send you **a free† copy of Ami Pro,** the best word processor in the industry. See your participating Lotus Authorized Reseller or **call 1-800-TRADEUP ext. 1076.** today for details.

And see why 7 out of 10 spreadsheet buyers chose 1-2-3. And the other 3 may not be far behind.

Lotus 1-2-3 3.1

*As reported by Audits & Surveys, Inc., measuring IBM-Compatible spreadsheet sales among computer and software dealers nationwide. †Subject to a shipping and handling fee of $19.95

Circle 165 on Inquiry Card.

.DBF to the Max

There's tons more to say about FoxPro 2.0. The extended (32-bit) version, which Fox will bundle with all versions of the product, ices the performance cake. The Watcom-compatible API libraries should yield powerful FoxPro extensions; one third-party developer has used them to create a command that displays images stored in memo fields.

The new SET SKIP TO command enables BROWSE to navigate a pair of tables while preserving a one-to-many relationship. You can now redimension arrays on the fly, sort and search them, and insert and delete elements. The TEXT...ENDTEXT command can evaluate functions and expressions. New IMPORT and EXPORT commands support a variety of database and spreadsheet file formats. Reports can create and use variables. Pop-up programs can have scroll bars. And the list goes on.

Is it perfection? Not quite. FoxPro still tends to deliver unhelpful error messages like "Invalid expression" and "Type mismatch." The debug and trace tools are excellent, but you shouldn't need to deploy them to unravel simple problems such as these. Smarter diagnostics would be a big help. Also, the documentation is still mainly organized alphabetically by command and function. A more topical, technique-oriented approach would help new or occasional users to exploit FoxPro's power effectively. Fox says the shipping version of 2.0 should show improvements on both these fronts.

Delivering common applications to Mac and PC clients on a LAN is a problem that I face, and FoxPro 2.0 doesn't help yet. But I'll be watching for the Mac version that's now on the drawing board. (It should ship, along with a Windows version, later this year; there's no word yet on a Unix version.)

An early experiment with FoxBase+ and FoxBase+/Mac failed because AppleTalk was unable to handle the traffic. Rushmore's startling efficiency just might change that. Alternatively, Fox confirms that there's a server version even farther out on the horizon, which would also provide a venue for tackling unresolved issues such as transaction integrity and data dictionary support. Either way, FoxPro 2.0's highly developed character GUI should ensure that FoxPro applications will port readily to other platforms. I can hardly wait. ■

Jon Udell is a BYTE senior editor at large. You can reach him on BIX as "judell."

A Lean, Mean SCSI-2 Machine

STAN MIASTKOWSKI

Hewlett-Packard's Vectra 486/33T file server tames the temperamental SCSI

I've always liked Hewlett-Packard and its products. While too many companies in the PC industry hide behind torrents of marketing hype as they roll out more yawn-provoking products, HP quietly works on developing well-engineered, cutting-edge products. It's a company where engineering excellence and overall quality is highly prized, and the Vectra 486/33T is a prominent case in point.

As its name implies, the 486/33T is based on an i486 microprocessor running at 33 MHz. No real surprises there—HP's had a 25-MHz system for a while now. In the step up to the top-of-the-line 33-MHz 486, the company decided to eschew the ISA bus for the higher speed and bandwidth of the EISA bus. In this, HP has joined numerous other top-shelf PC makers. But unlike many others, HP uses the EISA bus to full advantage to deliver a fast machine with disk capacities and speeds matched to the needs of heavy multitasking and multiuser applications. Both the specifications and the size of the 486/33T testify to this use. The system is similar to a small refrigerator, measuring 8⅓ inches wide by 20 inches deep by 24 inches high, and it tips the scales at 60 pounds.

Delving into Disks

With a machine designed for heavy use (HP claims that it'll easily handle 200 LAN users or 100 Unix users), the company ran smack-dab into the problems associated with today's standard Intelligent Drive Electronics (IDE) and ESDI hard disk drive systems. An HP engineer told me that with the two-to-four-drive limit on hard disk drives and the limited bandwidth of the ISA bus, the "disk system was the key bottleneck."

HP decided that SCSI was the way to go. It was a decision that was not taken lightly. The existing SCSI standard has been far from standard. SCSI devices have always offered the promise of easily connected multiple drives and fast throughput, but they have seldom delivered on that promise. There's a confusing (and often incompatible) tower of SCSI Babel, with proprietary device drivers from different manufacturers. Getting a single SCSI device to work can be an interesting exercise—never mind the nightmare scenario of getting several SCSI devices to work together.

Enter SCSI-2

SCSI-2, the next-generation SCSI specification now in its final phases of approval from ANSI, offers much more in the way of compatibility and throughput. The details of SCSI-2 (whose specification runs to some 600 pages) are too involved to get into here, but suffice it to say that HP engineers felt confident that SCSI-2 finally delivered on the promise of SCSI, and that it was a logical solution for the applications that the 486/33T is designed for.

Developed by Adaptec, the hard disk drive controller in the 486/33T uses Intel's proprietary BMIC (for Bus Master Intel Corp.) chip to achieve high data transfer rates. On the bus side, it can deliver data in bursts of up to the maximum

33-megabyte-per-second bandwidth of the EISA bus. On the disk side, it's capable of handling the 10-MBps transfer rate of the "fast SCSI" specification that's integral to the SCSI-2 specification. That's largely academic right now, since the fastest existing SCSI drives can handle only 5 MBps. Later this year, 10-MBps drives are expected to become available, and an HP spokesperson told me that the company will eventually offer them as an option.

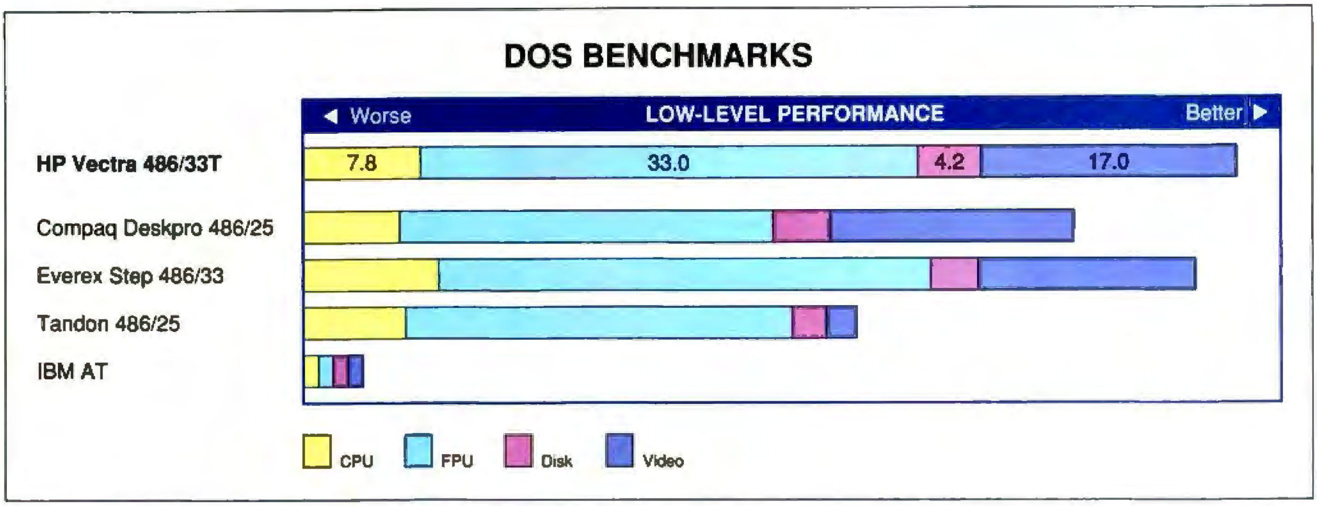
The proof is in the performance, so I ran preliminary benchmark tests on the 486/33T (which was equipped with a 670-MB SCSI-2 drive). The tests showed that the system/controller combination is no slouch, to put it mildly. With a preliminary BYTE Lab disk I/O benchmark index of 4.2, the 486/33T is the fastest system tested to date. The only system that comes close is the much more expensive Compaq Deskpro, with a disk I/O index of 3.8.

Traveling in Packs

Although I was only able to test the 486/33T with plain-vanilla DOS 4.01 and a single hard disk drive, the real promise of the bus-mastering controller and SCSI-2 drives lies in multitasking operating systems (e.g., Novell NetWare and OS/2) and multiple drives. In situations like these, the more drives the better. That's because intelligent SCSI-2 devices can dynamically disconnect and reconnect themselves to the bus. In a multitasking environment, the controller and drives in the 486/33T can handle streams of multiple data transfers, with one drive disconnecting itself from the bus and getting data while other drives

The HP Vectra 486/33T is solidly designed for full-time heavy-duty use and EISA expandability. The processor is located on its own daughterboard.

Now available on CD-ROM!
CORELDRAW!
PC Graphics for Everyone!
Break-Even Analysis
it's PARTYTIME
SUPERSALE
Amazing special effects
• envelope (warp) text and graphics
• simulate 3D with perspective function
• extrude to give depth to text/graphics
• blend between shapes and/or colors
Incredible type control
• over 150 fully scalable outline fonts
• see exact fonts on-screen
• paragraph and multi-column text
• import ASCII text files
• fit text to a curve
• create your own fonts or symbols
Superb value
• over 4000 symbols and clipart images
• dotted and dashed line styles
• over 80 arrowheads
• dozens of vector and bitmap patterns
• free Pantone* license
• 24 bit color supported
• 31 import/export filters
• CorelTRACE - batch autotrace utility
• MOSAIC - visual file manager
• WFNBOSS - typeface converter
CORELDRAW!
LAYOUTS WITH CORELDRAW!
Easy to Learn · Easy to Use
It's FAST
It's FUN
It's POWERFUL
COREL
Tel: (613) 728-8200
Fax: (613) 761-9176
Call customer service: (613) 728-8200 for information and a free demo disk.
*Pantone, Inc.'s check-standard trademark for color reproduction and reproduction materials.
Requires MS-WINDOWS 3.0
Circle 75 on Inquiry Card (RESELLERS: 76).



Preliminary BYTE Lab benchmark results show that the HP Vectra 486/33T's integrated design pays off in impressive numbers. While the CPU and FPU benchmarks are comparable to competing systems, the disk I/O and video benchmarks are the fastest the BYTE Lab has measured to date. Results are indexed and show relative performance; for each index, an 8-MHz IBM AT=1.

handle other data requests. At Boston's NetWorld show in February, HP demonstrated the 486/33T hooked to a large network and handling 26 gigabytes of mass storage. We've come a long way from the single, slow MFM drives of early PCs.

Getting It Together

Although the SCSI-2 controller/drive combination is the shining star of the 486/33T, it's not the only outstanding feature. In fact, it's obvious that all the individual components of the system are fine-tuned to maximize performance. It's a far cry from the "assorted parts and pieces" approach that too many PC manufacturers opt for these days.

The 486/33T's video system is far from being an also-ran; the standard HP Super VGA graphics board delivered a benchmark index of 17.0; once again, it is the fastest that the BYTE Lab has measured to date. The system supports 800-by 600-pixel noninterlaced resolution and interlaced resolution of 1024 by 768 pixels. Although this machine is designed as a file server, it's clearly also a perfect choice for graphics-intensive CAD applications.

As far as the rest of the 486/33T's vital statistics are concerned, it has eight 32-bit EISA slots (with five free in the standard system). To keep the data moving, the unit uses a custom HP memory controller with a 128K-byte external memory cache. Also, 4 MB of zero-wait-state RAM is standard, and you can expand the memory to a maximum of 64 MB. The processor and its associated circuitry are on a daughterboard that plugs into a proprietary slot on the motherboard, offering the intriguing possibility of future upgrades. HP has spared nothing in the design; the i486 is shielded in its own metal cage, and if the i486's built-in math processing isn't good enough for you, there is a slot for a Weitek WTL4167 coprocessor.

Every individual component of the 486/33T shows that it has been designed for full-time, 24-hour-a-day, heavy-duty use. Even the keyboard and mouse cables are heavy duty. The overall "fit and finish" of the system is superbly solid. And for the security conscious, there is a pair of keyed locks that can lock up the entire system.

Pricing Performance

You would expect the 486/33T to be expensive, and it is, especially when compared with today's crop of garden-variety clones from companies large and small. Nevertheless, I was surprised. HP has always priced its systems at a premium, and for good reason. But the 486/33T's pricing heralds a new era for HP. It is aggressive, especially when compared to comparable high-end systems such as the Compaq Deskpro.

The 486/33T starts at a relatively paltry $9499 for a system without a hard disk drive and controller. If you don't want (or need) the speed and capacity of the SCSI-2 system, there's a system with a 170-MB IDE drive for $11,249. Add SCSI-2, and complete system prices start at $14,449 with the Adaptec bus-mastering controller and a 440-MB hard disk drive. In addition, a system with a 670-MB hard disk drive is available (the system I tested); pricing wasn't available at press time. But why not go for the top? With a 1-gigabyte SCSI-2 drive, the system retails for $17,799. For a system with this type of speed and capacity, that's an unbeatable price/performance deal. The Vectra is also available in a 25-MHz EISA incarnation, at about $2000 less. With the introduction of the Vectra 486/33T, HP has retained its engineering edge while signaling that it is fast becoming a marketing force to be reckoned with. ■

Stan Miastkowski is BYTE's senior editor for new products. He can be reached on BIX as "stanm."

THE FACTS

HP Vectra 486/33T
Model 1 (no hard disk drive), $9499; Model 170 (170-MB IDE hard disk drive), $11,249; Model 440 (440-MB SCSI-2 hard disk drive), $14,449; Model 1000 (1-gigabyte SCSI-2 hard disk drive), $17,799.

Hewlett-Packard
P.O. Box 10301
Palo Alto, CA 94303
(415) 857-1501
Circle 981 on Inquiry Card.

"My Dolch 486™ is awesome. . ."

"Hey, I now own the ***perfect portable*** that lets me get my work done anywhere. Not just a few files . . .everything I had on my desktop!"

"Powerful? You bet! After I downloaded all my desktop stuff, on it's ***200 MB HD***, I still had plenty of room left and it screamed through everything at ***11 MIPS!***"

"My Dolch P.A.C. is setting new 'rules'. It's portable, fast and I still can add ***4 full-size internal expansion cards.*** Wow!"

"You have to see the brilliant display — I mean really see it. ***TFT*** is the ***latest color technology***, that's fully VGA compatible."

"Hey! Don't take my word for it. Experts like PC Magazine judged my Dolch P.A.C. to'. . . ***outclass all other portables'*** and picked Dolch three years in a row as Editors' Choice!"

PC MAGAZINE EDITORS' CHOICE 1988 | PC MAGAZINE EDITORS' CHOICE 1989 | PC MAGAZINE EDITORS' CHOICE 1990

"Get a Dolch today, choose a 286™, 386SX™, 386DX™ or a 486™ like mine. . . ***clearly the best PC you can buy today, and it happens to have a handle.*** Get a lot more work done —where and when you want."

Why Wait?. . .Call today.
(800)538-7506 US; (800) 233-2077 CA
In Canada call Laptech 1-800-561-4527

Dolch.

ROAD-POWER FOR THE BEST OF US

Dolch Computer Systems 372 Turquoise Street • Milpitas, CA 95035 • Tel: 408-957-6575 • Fax: 408-263-6305

™ 286, 386SX,386DX, and 486 are registered trademarks of Intel Corporation

Circle 100 on Inquiry Card.

The LaserJet IIISi: Hewlett-Packard's Flagship Printer

At 106 pounds and built like a small washing machine, Hewlett-Packard's new top-of-the-line **LaserJet IIISi** hunkers down like a printer that means business. It does. Fast, accurate, capacious, network-aware, and smoothly bilingual, the IIISi will surely become a mainstay of the corporate LAN.

At the heart of HP's behemoth rumbles a new Canon engine that pounds out 17 pages per minute. The brain is an Advanced Micro Devices (AMD) 29000 controller that executes HP's Printer Command Language 5 and (optionally) Adobe PostScript—both at a brisk clip. The PostScript option doesn't come in a cartridge; it installs as an integral component. Switching between the two languages is a snap. You can shift gears at the control panel, from an application, or by means of network queues (the best technique).

Like the LaserJet III and IIID, the IIISi employs HP's resolution-enhancement technology. Scanning an image in bands, at full speed, the resolution-enhancement subsystem adjusts dot sizes and locations to clarify features and create an apparent resolution better than the nominal 300 dots per inch. It's magic, in other words, but magic that really works.

I printed a Corel Draw sample illustration (the grasshopper) on a LaserWriter IINT and on the IIISi. The HP printer finished first by a long shot, and it also produced noticeably cleaner curves and subtly smoother gradations of texture. (Note, in fairness, that the IIISi had 5 megabytes of RAM versus the LaserWriter's 2 MB, so the performance gap isn't solely attributable to the AMD processor.)

In the IIISi, resolution enhancement works hand in hand with a new "microfine" toner featuring extremely small (and therefore more precisely controllable) particles. The "all-in-one" cartridges cost $169, but they last for 8000 pages; that works out to a very attractive 2 cents per page.

Printer performance on a LAN, as HP likes to point out, depends on a series of pipelined activities: preparing the job, shooting it across the network to a spooler queue, despooling it across the network again to the printer, forming the image, and committing it to paper. Why yoke a hot-rod controller and print engine to a parallel interface that can't keep them adequately stoked with data?

To eliminate the spooler-to-printer bottleneck, HP offers optional network interface cards for 3+Open and NetWare. Available in Ethernet and Token Ring flavors, these adapters come with despooling firmware that sucks data from queues at network speed. Advantages are threefold: The data moves faster, the server does less work, and the printer, freed from its 10-foot leash to the server, can be located wherever convenient.

I tested the Ethernet adapter on a NetWare 2.15 LAN. Installation is dead simple: You pop out the parallel/serial interface board, pop in the network adapter, tell NetWare there's a new queue server, and tell the IIISi that it is that new queue server. The difference is noticeable. When I printed a PageMaker document using the parallel interface, text-only pages printed instantly, while pages heavy with illustrations lingered for a few seconds. With the Ethernet connection, the graphics pages came out nearly as fast as the text pages.

Despite Ethernet's performance advantage, however, the parallel interface turned out to be best for our environment. Although BYTE's NetWare and Unix LANs share the same Ethernet cable, there was no way for Unix workstations to access the IIISi when it was directly connected to Ethernet. The firmware in the printer's network adapter communicates only with NetWare queues to which Unix has no access. Threatened with a riot in the Unix lab, whose staff had quickly grown fond of the new printer, I reverted to our standard solution: parallel cables feeding into an electronic switch.

Although the IIISi is plainly a more capable PostScript printer than the LaserWriters on BYTE's Mac LAN, I was not able to bring the Mac users into the fold. HP won't have an AppleTalk interface option until sometime this fall. It's not clear, as yet, how the IIISi would play in mixed Mac/PC LAN environments. NetWare for Mac users could presumably access an AppleTalk-configured IIISi from PCs, but it would have to settle for AppleTalk speed—and Unix users would again be left out in the cold. Ideally, the printer would accept multiple network connections and switch among them. Let's hope some entrepreneur will rise to the challenge posed by the IIISi's lone I/O slot.

A departmental printer had better be able to handle a lot of paper intelligently. The IIISi shines here, too. For starters,

THE FACTS

LaserJet IIISi
$5495

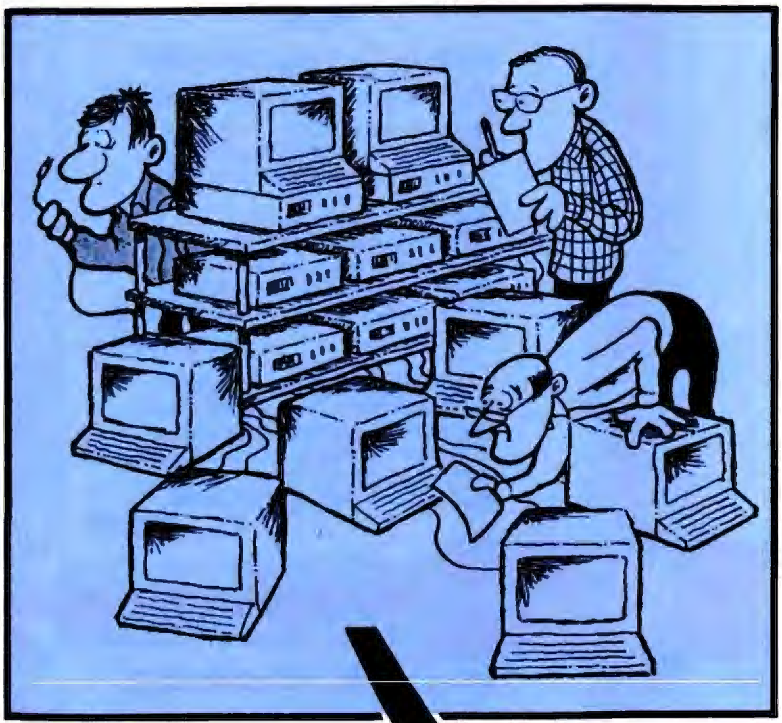
Options:
PostScript upgrade, $895; toner cartridge, $169; duplex option, $695; 4-MB single in-line memory module, $449; letter-size tray, $169; Ethernet interface, $695.

Hewlett-Packard Co.
Inquiries
19310 Pruneridge Ave.
Cupertino, CA 95014
(800) 752-0900
Circle 1178 on Inquiry Card.

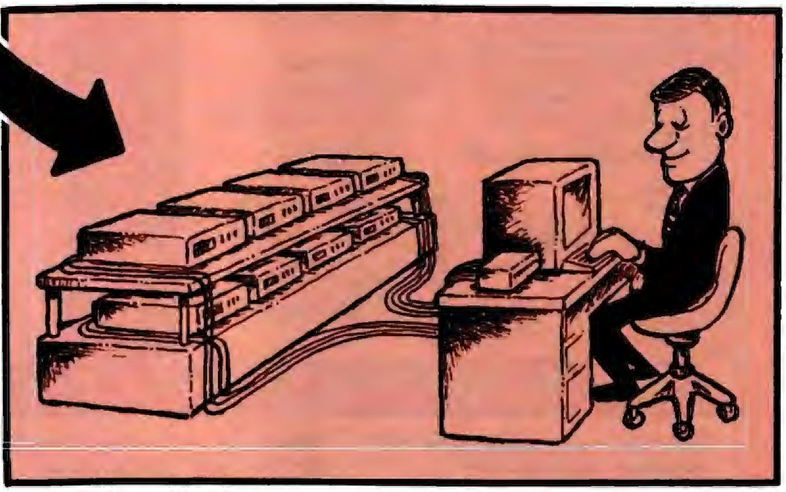
CONTROL UP TO 96 PC FILE SERVERS WITH 1 KEYBOARD AND MONITOR USING...

COMMANDER

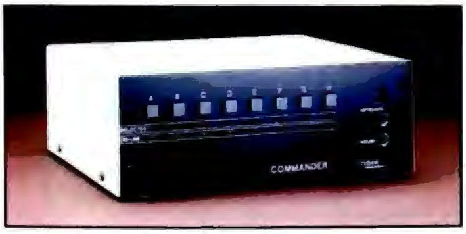
by cybex



- No external power
- "One-Touch" selection
- Mix PC, PC/XT, PC/AT and PS/2
- "AutoBoot" Feature boots attached computers without operator intervention after power failure
- Shows PC power status
- Mouse support available



- TTL (MDA, CGA, EGA) up to 600 feet away
- VGA up to 400 feet
- Each unit accommodates from 2 to 8 PCs
- Up to 12 units can be cascaded
- Mounting kit available for 19" rack installation

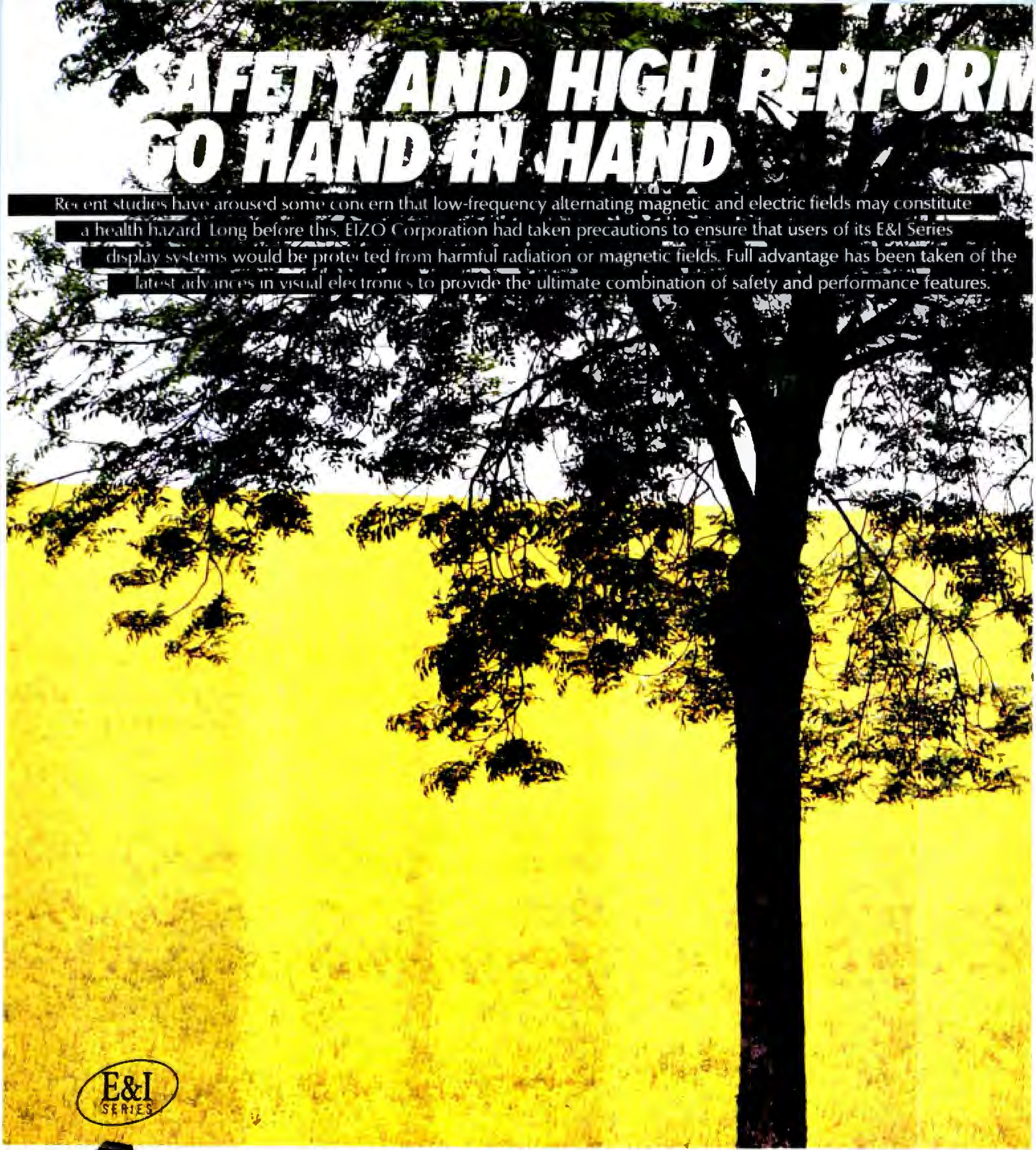


PC, PC/XT, PC/AT and PS/2 are trademarks of International Business Machines Corp.

Dealer Program Available

Cybex Corporation
2800 H Bob Wallace Ave.
Huntsville, Alabama 35805
(205) 534-0011
Fax (205) 534-0010

Circle 326 on Inquiry Card.



Recommended EIZO Controllers for EIZO Displays

T660	▶ MD-B12-70
9400i	▶ MD-B12-60
T560i	▶ MD-B12-70
9070S	▶ MD-B10, GC40
9060S	▶ MD-B07, B10
9052S	▶ MD-B07, B10

EIZO Distributors: ***Australia*** **MegaVision Pty Ltd.** Tel (02) 975 1877/***Austria*** **HAYWARD COMPUTER + PERIPHERIE** Tel (0662) 8529290/***Belgium*** **Manudax Belgium** Tel (02) 477 92 11/***Cyprus*** **IMC COMPUTER CENTER LTD.** Tel (51) 5 376447/***Denmark*** **SC Metric A/S** Tel (42) 804200/***Finland*** **TEHOKIVI OY** Tel (0) 754 1022/***France*** **INCOMA** Tel (01) 47 91 47 02/***Germany*** **Rein Elektronik GmbH** Tel (02153) 733-0/***Greece*** **MICROTEC Computers** Tel. (01) 8835115/***Hong Kong*** **LASER COMPUTER LTD.** Tel 735 5884/***Iceland*** **HANS PETERSEN LTD.** Tel (01) 680955/***Italy*** **EPSON ITALIA s.p.a.** Tel (02) 262331/

it accepts two 500-sheet trays. After years of refilling piddling quantities of paper, I found it enormously satisfying to load a thousand pages at a crack. I reserved the lower tray for letterhead—another luxury if your users have had to share a single tray and perform gymnastics to use letterhead. Then there's the duplex (two-sided-printing) option, and a job offset feature that staggers jobs in the output bin for easy separation. The tray full arm on top of the output bin helps stack paper neatly. Everything works to minimize shared-printer chaos.

I tip my hat to Hewlett-Packard. The IIISi is a marvelous—and surprisingly affordable—piece of work.

—Jon Udell

BeckerTools 2.0 Makes Doing Windows a Breeze

The Windows 3.0 version of BeckerTools reminds me of the old college trick of squeezing as many people as you can into a phone booth. The panel that runs down the left side of the screen is chock full of minute icons. You can't tell what the individual graphics are, but you can find out what they do by scrolling the mouse over them and *reading* what they are at the bottom of the screen. I thought this was an overuse and abuse of the concept of icons.

But those funny little icons are the only thing I didn't like about **BeckerTools 2.0.** The program is designed to do for Windows 3.0 what Central Point Software's PC Tools Deluxe and the Norton Commander do for DOS. Once you get hooked on such a package, it's hard to switch.

I've never gotten hooked on Windows 3.0. I've found myself working in it awhile and then popping out to do DOS-level stuff like copying to disk, formatting floppy disks, and editing with my word processor. There have been many complaints about File Manager in Windows 3.0, and I guess my experience shows that it's not all that useful.

BeckerTools seems more developed than File Manager, although they both have the standard file and disk management functions (e.g., Copy, Delete, Rename, Select Files, Find File, Edit Text, and Format). BeckerTools makes it easier to perform these functions, not because of the tiny icons, but because you can point and click on almost anything you want to do. Launching an application is as simple as clicking on the application, pulling down the applications menu, and selecting Launch.

The interface is similar to Norton Commander's split screen, which is my personal favorite. It took me no time at all to get accustomed to the source and target window concept. You can also activate the pull-down menus for the Windows 3.0 look and feel

BeckerTools 2.0 provides over 200 functions for disk and file management. In the tradition of DOS utilities, it also offers functions like undelete, file editing, disk verifying, file archiving, and a screen dimmer. BeckerTools has three levels of features: beginning, intermediate, and advanced. The only differences are in the number and sophistication of the features you can access.

Installation of BeckerTools 2.0 was a breeze. Basically, you just install it and move the little icon into position in the Windows Toolbox.

—Anne Fischer Lent

THE FACTS

BeckerTools 2.0
$129.95

Requirements:
A DOS system running Windows 3.0.

Abacus
5370 52nd St. SE
Grand Rapids, MI 49512
(616) 698-0330
fax: (616) 698-0325
Circle 1179 on Inquiry Card.

The First "What You See Is All You Get" Notebook

If the **Supernote 386SX** had a color LCD and a modem, I would be tempted to push my desktop machine into the trash can. This 6½-pound notebook from Twinhead has a 16-MHz 386SX processor, and it comes with a 40-megabyte hard disk drive, a sidelit electroluminescent 32-shade VGA LCD, 2 MB of RAM, and a 3½-inch 1.2-MB floppy disk drive. Times have changed since the trusty old Model 100 was born.

Of course, the prices have changed, too. But look at what you get for a list price of $3495. With the exception of no color and no room for add-in gizmos, you get good desktop performance in a truly notebook-size case (11 by 8⅝ by 2 inches). If you simply must communicate and network, you can use an external "portable" modem or Ethernet box offered as extra-cost options.

The Supernote 386SX has a socket for an 80C387SX coprocessor, a parallel printer port that can double as an external floppy disk drive connector (the Supernote automatically figures out what's connected to that port), two serial ports, and a 15-pin connector to drive an external VGA monitor (the LCD and the external VGA monitor cannot operate simultaneously because of BIOS limitations). Software provided includes MS-DOS 4.01 and two floppy disks full of utilities and drivers. The keyboard is full-size and has a nice feel, although the cursor arrangement took some getting used to.

Twinhead's own chip set, a single chip and one support chip, disguises itself as a 386SX. The TH4100 chip has about 85,000 transistor equivalents and is the size of a postage stamp. The TH4009 support chip is about "the size of a dime, only square," according to John Bryan of Twinhead's marketing department. The motherboard is about 4 inches square (as is the VGA board), and surface-mount technology is used. If you want the maximum of 4 MB of RAM, you have to specify it when you order your system because it also is surface-mounted.

The main glitch I had with this supposedly ready-to-ship unit was that the power management system had a hiccup and started to beep annoyingly after about 45 minutes to announce that the batteries were low. With a claimed running time of 2½ to 3 hours, the warning was a bit premature. Twinhead assured me that it would fix the problem before shipping. To meet this publication deadline, however, the company simply disabled the battery-monitoring circuitry on my unit.

Battery capacity is always a concern, so I set out to test it. The power management system enables you to adjust independently the length of time before the LCD blanks and the hard disk stops spinning. Defaults are 5 minutes for the screen and 1 minute for the hard disk. I wrote a batch file that changed directories, displayed the contents of each, and kept repeating itself. This way, the Supernote 386SX screen and hard disk would have no rest.

After recharging for the 1 hour and 45 minutes specified, I started the machine and ran it until it died, which took 2 hours and 20 minutes. Not bad for nonstop computing. A properly operating power management system would have alerted me earlier in stages, according to the manual, by sounding a beep and by changing the power LED's color from green to amber and then to red.

The only other problems were inconsistencies in the user's manual that state, for example, that you can have up to 8 MB of RAM, that the Chips & Technologies NEAT chip set was used, and that the keyboard Ctrl/Alt/− sequence would toggle the microprocessor between 8 and 16 MHz. (You can toggle via a setup screen, however.)

While the price is in line with similarly configured SX notebooks (see "The Tandon NB 386sx Notebook," March BYTE), the inability to add anything to this system is a serious drawback. It's a nice system, however, and is well made. So if you don't plan on expansion, the Supernote 386SX could be just the ticket.

—Gene Smarte

THE FACTS

Supernote 386SX
$3495

Options:
4 MB of RAM (installed by manufacturer), $199; 5¼-inch 1.2-MB floppy disk drive, $249; spare nickel-cadmium battery pack, $99.

Twinhead Corp.
1537 Centre Pointe Dr.
Milpitas, CA 95035
(408) 945-0808
fax: (408) 945-1080
Circle 1180 on Inquiry Card.

Pointing to a Portable Future

Mice are nice, and they are more and more of a necessity in the graphical-user-interface-crazy world of today's PCs. There are, however, problems mating mice with laptop or notebook computers. Have you ever tried to use a mouse with a laptop on an airplane tray? There just isn't any room.

Great technological minds think alike, and three major mouse makers have concurrently come out with add-on mouse products designed to eliminate the adventure of using a mouse with a laptop. Actually, *pointing device* is a more accurate moniker than *mouse*, since Microsoft's **BallPoint**, Appoint's **Thumbelina**, and Logitech's **TrackMan Portable** are all variations on a theme: a miniature trackball. Although all have similarities, each also has a quirky individual personality.

BallPoint is intriguing. It's evident that Microsoft spent a huge amount of time studying the ergonomics of pointing devices. The company supplied us with a photo of the scores of designs it rejected, some of them unusual indeed. The final design looks deceptively simple at first glance. Microsoft decided that actually attaching BallPoint to the computer is essential to its usability.

BallPoint comes with several sets of adapters that let you easily hook it to virtually any laptop or notebook computer. We tried it with a half-dozen different computers, with no problems at all, attaching it to the left, right, and front of the keyboard.

Clever thumbscrews ensure that you cannot overtighten them and damage your computer, yet you can easily remove BallPoint. (It comes with a small padded case for portability.)

BallPoint has four click stops that let you use it at angles of 0, 30, 60, or 90 degrees. We liked the 30-degree setting best, but that's purely subjective. The trackball in BallPoint is relatively large for the size of the unit and is easy to control. It comes with a software utility that lets you control the sensitivity and the orientation direction of where the ball tracks.

The interestingly named Thumbelina is—as its name implies—tiny. Measuring 1½ inches square and only ¾ inch high, Thumbelina also uses a tiny (⅝ inch) trackball. In general, the larger the trackball, the better the control, but Thumbelina is an exception to this.

The finely tuned friction mechanism that holds the ball allows a surprising amount of control with minimal thumb movement. Where are the buttons? The entire top of the case clicks down. Clever.

The early Thumbelina prototype we used didn't have a way of attaching to a keyboard. An Appoint spokesperson said a rudimentary attachment kit (probably Velcro) will be shipped with the final version. Most users, however, will probably use Thumbelina as is. It's small enough to stuff into the smallest space.

The Logitech TrackMan Portable is essentially a tiny trackball device that you hold in one hand and operate using the thumb on the ball and the index finger to press the main button. You can remove the button and switch it to the other end of the curve, as you also can switch the connector cable, which comes out of the end of the curve that is opposite the button. Switching these around lets TrackMan Portable operate as either left- or right-handed.

The trackball takes up the center of the face of the semicircle, and on either side of it are the second and third buttons. These are almost impossible to reach while operating the device when it is held in one hand. We found it more comfortable to rest the straight side of the semicircle on a flat surface with the hand curved over the top, thumb resting on the trackball, and index finger on the main button. In this position, your wrist is supported, and TrackMan Portable is extremely easy to use. While it is possible to use the device when it is held up in the air in one hand, this is tiring and also makes it harder to reach the second and third buttons.

These three products are only the beginning of what's likely to be an avalanche of laptop-specific pseudorodents. From looking at the first three, it's not hard to see that the choice will be difficult—and highly personal. Of the three, we liked Thumbelina best for its daring innovation and low price. It's also the only one of the three that has a Mac-specific model. But at the same time, BallPoint is elegant, and TrackMan Portable is most attractive. Some advice: Try before you buy.

—Stan Miastkowski and Owen Linderholm

THE FACTS

BallPoint (center)
$175

Requirements:
Serial port or PS/2 mouse port.

Microsoft Corp.
One Microsoft Way
Redmond, WA 98052
(800) 426-9400
(206) 882-8080
fax: (206) 883-8101
Circle 1181 on Inquiry Card.

Thumbelina (bottom)
$99

Requirements:
PC version: Serial port or PS/2 mouse port.
Mac version: Apple Desktop Bus port.

Appoint
1332 Vendels Cir.
Paso Robles, CA 93446
(800) 448-1184
(805) 239-8976
fax: (805) 239-8978
Circle 1182 on Inquiry Card.

TrackMan Portable (top)
$149

Requirements:
Serial port or PS/2 mouse port.

Logitech, Inc.
6505 Kaiser Dr.
Fremont, CA 94555
(800) 231-7717
(415) 795-8500
fax: (415) 792-8901
Circle 1183 on Inquiry Card.

A High-Resolution Duo for Eye Relief

A few years ago, the 640- by 400-pixel resolution of a VGA setup seemed incredibly sharp. But in the interim, the waters of choice have been muddied by a flood of (often conflicting) graphics standards. There are several different varieties of so-called Super VGA, Texas Instruments Graphics Architecture (TIGA) for that company's powerful 34010 and 34020 graphics processors, and IBM's recently announced Extended Graphics Array (XGA).

Nearly lost in the confusion is the 8514/A, which IBM introduced along with VGA back in 1987. There were, however, a few problems. Its 1024- by 768-pixel resolution was sharp but interlaced, which often resulted in a discernible and bothersome flicker. Also, not only were 8514/A cards expensive, but unlike with VGA,

Free i860™ Processor and i860/APX Software!
By now, you've probably heard about our industry-first 4860™ MotherBoard that packs the power of the Intel 80486 CPU with the Intel 80860 RISC processor (i486™+ i860=4860).

What you haven't heard is that, for a limited time, when you buy a 4860 MotherBoard with 8MB of RAM, Hauppauge will give you an i860 RISC processor and the i860/APX operating system at no additional cost.

Why *give* you this capability? Because you'll enjoy a level of processor performance never before seen in a PC. Our bet is that you'll be so impressed, you'll come back for more!

A PC Revolution: In the PC environment, the 4860 is a 486-based MotherBoard with the new EISA I/O bus. It runs over 2 times faster than 386 computers and delivers mainframe power for applications including CAD, LAN and desktop publishing. This board is fully compatible with DOS, IBM's OS/2, Novell Netware and SCO UNIX. What's more, Hauppauge's 4860 supports up to 64 MBytes of memory *without* a RAM expansion board.

RISC-Y Business: The i860 processor is ideal in complex applications, performing up to 25 million floating-point operations per second. It adds to the power of the 486, so you can run rings around ordinary PCs.

By adapting Intel's APX (Attached Processor Executive) software to our 4860 MotherBoard, we've created a way to exploit the power of the i860 to give you *practical* multiprocessing. In fact, i860/APX provides a base for entirely new applications made possible by the advent of the i860 RISC processor.

Technical Features: 25 or 33MHZ 486/860 • 4 Mbytes of high speed RAM expandable to 64 Mbytes shared between i486 and i860 processors • Socket for optional Intel Turbo Cache 485™ and Weitek 4167 • 7 EISA I/O slots • 64-bit expansion slot for optional high-speed graphic frame buffer • 1 parallel, 2 serial ports and a built-in PS/2-style mouse port.

Enjoy a RISC-free investment. Our 4860 MotherBoard is designed with the world's highest performing microprocessors. So you can have the world's highest performing PCs and workstations.

For more information, call **1-800-443-6284**.

Hauppauge Computer Works, Inc.
91 Cabot Court
Hauppauge, New York 11788
Telephone: 516-434-1600
Fax: 516-434-3198
In Europe (49) 2161-17063
In Australia: (7) 262-3122

Hauppauge!

Available at your local computer dealer.

Trademarks: OS/2: IBM • Intel 386, i486, i860 and Turbo Cache 485™: Intel Corp. • DOS and Xenix: Microsoft Corp. • 4860, 4860 MotherBoard: Hauppauge

Circle 123 on Inquiry Card.

IBM refused to release its technical details, insisting that companies write 8514/A drivers to an adapter interface, which limited its applications.

Several companies have gone through the not-inconsequential process of developing register-level 8514/A clones. The latest is ATI Technologies' **8514/Ultra**, a reasonably priced board with a few tricks up its sleeve. The first is that it gives a *noninterlaced* resolution of 1024 by 768 pixels. In addition, it adds a 70-Hz refresh rate for a truly rock-steady, flickerless, and sharp image.

Getting the 8514/Ultra up and running is a bit more complicated than just plugging in the board and turning it on. The board does feature a very clever design that lets you use it with either a standard ISA bus or the PS/2 Micro Channel bus. Just move the connector and flip it over. Although the 8514/Ultra is available with an integrated VGA board, the one I tested was designed to be used with an existing VGA board. A jumper cable connects between the 8514/Ultra and the "feature connector" that's on the top of all VGA boards. There's also a terminator plug that plugs into the VGA card.

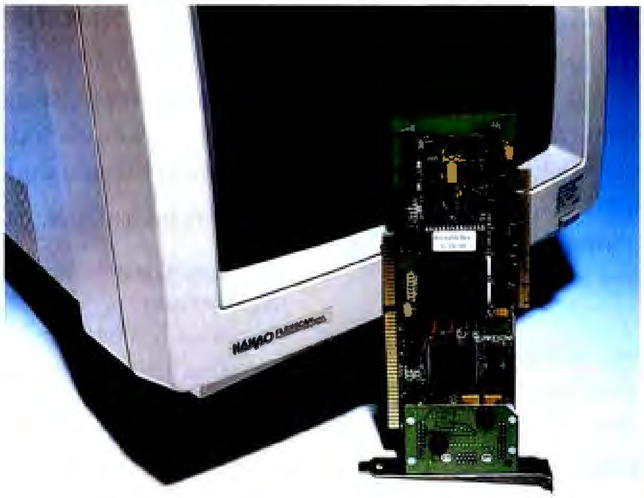
The 8514/Ultra has a set of software utilities that largely automate the process of the board's installation. The utilities search for a free memory location for the board and set the on-board EPROM to that address. They also fine-tune the board's output for your particular monitor.

When it's started in a text-only mode, there's definitely a different "look and feel" to the screen. Characters are denser, sharper, and easier to read. However, to get to the power of the board, you need to use graphics. I changed my Windows 3.0 setup from VGA to 8514/A. The difference was striking. The 1024- by 768-pixel desktop brings a whole new dimension to Windows. Sure, individual icons and characters are smaller, but they're easier to see and give you lots of capability to customize the desktop to your own particular preferences.

1024 by 768 pixels shows a new graphics perspective.

Unfortunately, I wasn't able to test what ATI is touting as one of the biggest features of the 8514/Ultra, the Crystal Font technology that gives real-time font-scaling capabilities to Windows 3.0. ATI claims it gives an effective on-screen resolution of nearly 300 dots per inch. But no matter what I did, I couldn't get it to work on my computer. Windows 3.0 just kept locking up. ATI promised to send me an updated version of the prerelease software that I was using, but I didn't get it.

The 8514/Ultra is slick and fast, using ATI's proprietary graphics processor, which the company claims is up to 10 times faster than the IBM 8514/A board. Of course, you need a monitor that handles what the board is putting out. I hooked it up to the Nanao **FlexScan 9080i**, a 16-inch monitor from a company whose name isn't exactly a household word, although it's been making monitors for other companies for many years. The 9080i is a state-of-the-art microprocessor-controlled monitor that handles everything the 8514/Ultra can put out. It also conforms to the Swedish VLF (very low frequency) emission standards for some peace of mind on the health front.



The monitor also has a few neat and unique features. I could hook up video from two computers to the 9080i and switch between them. And it also has a switch that let me toggle between color, amber, and white-on-black displays.

The combination of a high-resolution card and a high-resolution monitor brings new usability (and comfort) to many applications. But it also isn't cheap. The combination that I tested added a hefty $2728 to the price of my PC. But for those who spend hours in front of their computers day in, day out, a combination like this one is more than just an eye-saver—it's virtually a necessity. ■

—Stan Miastkowski

THE FACTS

8514/Ultra
with 512K bytes of RAM, $599; with 1 MB of RAM, $799

Requirements:
IBM AT, PS/2, or compatible with a VGA board.

ATI Technologies, Inc.
3761 Victoria Park Ave.
Scarborough, Ontario,
Canada M1W 3S2
(416) 756-0718
fax: (416) 756-0720
Circle 1184 on Inquiry Card.

FlexScan 9080i
$1929

Nanao USA Corp.
23535 Telo Ave.
Torrance, CA 90505
(800) 235-2202
(213) 325-5202
fax: (213) 530-1679
Circle 1185 on Inquiry Card.

Get the industry standard Windows™ Development Tools in one professional package —*at one great Programmer's Paradise price!*

Microsoft C and the Windows Software Development Kit have been used to create virtually every leading Windows application. This special package for serious developers contains everything found in Microsoft C Professional Development System 6.0 and Windows Software Development Kit 3.0.

Microsoft® C:
The industry-standard C development system

- ✓ State-of-the-art optimization for the fastest code.
- ✓ Powerful, flexible tools for all phases of development.
- ✓ Three generations of Windows support. C 6.0 is the compiler the world's leading developers have trusted to create their Windows applications.
- ✓ Improved Microsoft CodeView® windows-oriented debugger.
- ✓ In-line assembler supports the 8086 and 80286 instruction sets.

Microsoft® Windows™ Software Development Kit:
Powerful Windows development tools

—complete set of tools for creating Windows applications.

- ✓ CodeView for Windows—Windows specific version of the leading CodeView debugger.
- ✓ Dialog, icon, bitmap and cursor editing tools.
- ✓ Font editor.
- ✓ Performance analysis tools—including Swap tuning, data/code movement, message monitoring, and profiling.

Together they equal everything you need to create the highest quality applications for Windows.

A combined value of $749

Yours for the Programmer's Paradise special bundle offer of $519

Programmer's Paradise is your source for the entire line of **Microsoft®** products!

	list	ours		list	ours
MS BASIC Prof. Dev. System	$ 495	349	MS OS/2 Pres. Mgr. Softset	$150	105
Microsoft C	495	339	MS OS/2 Pres. Mgr. Toolset	500	349
Microsoft COBOL	900	629	Microsoft Pascal	300	209
Microsoft FORTRAN	450	299	Microsoft QuickBASIC	99	69
Microsoft Learning DOS	50	35	MS QuickC w/ QuickASM	199	139
Microsoft Macro Assembler	150	105	Microsoft QuickPASCAL	99	69
Microsoft Mice	CALL	CALL	MS Windows Software Dev. Kit	500	349

To order, call *Programmer's Paradise* Today! (800) 445-7899

Programmer's

DROVER'S TOOLBOX FOR WINDOWS™

Comprehensive toolkit for Microsoft® Windows™ development. Dynamic link library (DLL) with 200 functions plus 7 new Windows classes for use with Microsoft SDK™, ToolBook™, Actor™, SQL-Windows™ and WindowsMAKER™. Formatted, validated input of dates, money, time, floating point and integers plus DOS file, disk & directory management, date and listbox functions. No royalties.

List: $295 Ours: $239
w/ source List: $885 Ours: $719
FAXcetera #2608-0001

WindowsMAKER™ PROFESSIONAL

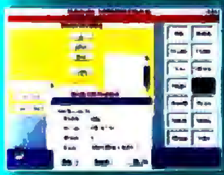
The fastest way to create Windows applications. Generates the Windows .EXE w/ complete source & production files (no royalties). Point & Click to define the user interface. Animate your design to instantly test its look & feel. Make changes on the fly without compiling. Custom code is preserved during code regeneration. A state-of-the-art programming tool. Supports C++.
List: $995 Ours: $795
FAXcetera #2602-0003

HIJAAK RELEASE 2.0

HiJaak 2.0 is a graphics conversion and capture utility that translates more than 36 graphics file formats. HiJaak provides batch conversion capability from the DOS command line or from the user interface. Supported formats: GEM, PICT I&II, GCM, HPGL, PIC, DXF, PCX, MAC, TIF, and support for more than 16 group 3 fax devices. A 5K pop-up provides capture function of text screens, graphics screens, and laser printer output.
List: $199 Ours: $139
FAXcetera #1976-0002

DIALOGCODER

DialogCoder is a powerful Windows CASE tool and source code generator for dialog boxes, the user-interface components of an application. Provides a unique animation feature for testing. Supports conditional states, multiple triggers, custom code, automatic code regeneration, owner-drawn controls, edit field validation, color, optional generation of DLLs, and much more. Saves hours of costly coding and debugging time.
List: $499 Ours: $479
FAXcetera #2939-0001



DEVELOPMENT SOFTWARE

	LIST	OURS
386 Development Tools		
386 ASM/LinkLoc	1295	1159
386/DOS Extender	495	439
Lahey F77L-EM/32 (w/ OS/386)	1290	1035
MetaWare High C 386	995	919
WATCOM C 8.0/386 Prof.	1295	1099
w/ 386/DOS Extender	1790	1399
WATCOM C 8.0/386 Standard	895	719
WATCOM FORTRAN 77/386	1095	929
Zortech C++ Devel. Ed. 386	995	849
Assembly Language		
MS MacroASM	150	105
Sourcer w/ Pre-Processor	170	139
SpontaneousAssembly	199	169
Turbo Debugger & Tools	150	105
C-Compilers		
Instant C	795	719
Microsoft C 6.0	495	339
w/ Objective-C	699	539
MS QuickC w/ QuickAssembler	199	139
WATCOM C 8.0 Professional	495	419
WATCOM C 8.0 Standard	395	335
C++		
Borland C++	495	325
C++/Views	495	419
Turbo C++	100	169
Zinc Library	200	179
Zortech C++	200	165
Zortech C++ Database	300	255
Zortech C++ Developer's Ed.	450	399
C++ Bundles		
Borland C++ and Tier 1	975	499
Zortech C++ and C++/Views	945	595
Zortech C++ (DOS & OS/2) w/ CommonView (DOS & OS/2)	1400	749
C-Communications		
Essential Communications	329	259
Greenleaf CommLib	359	279
C-File Management		
Codebase IV	295	219
c-tree Plus	595	475
Essential B-Tree w/ source	198	149
The Toolbox - Prof. Edition	1095	799
The Toolbox - Special	695	509
C-General Libraries		
C Function Library	99	79
C TOOLS PLUS/6.0	149	109
C Utility Library	249	199
Greenleaf Functions	229	179
Greenleaf SuperFunctions	299	239
Turbo C TOOLS/2.0	149	109
C-Screens		
C-Worthy	399	CALL
Greenleaf DataWindows	395	315
Vermont Views	495	415
Vitamin C	395	289
VC Screen	149	125
C-Utilities/Other		
Bar Code Library	389	319
C-DOC	189	169
Clear for C	200	169
INTERWORK	189	165
MKS LEX & YACC	249	197

	LIST	OURS
Database Development		
Clarion Personal Developer	79	72
Clarion Prof. Developer 2.1	845	585
dBASE IV	795	495
Dr. Switch-ASE	180	149
R&R Code Generator	150	129
R&R Report Writer	249	219
Say What?!	50	39
SilverComm "C" Interface	99	89
SilverComm Library 2.0	249	209
Debuggers (DOS)		
Periscope Debuggers	CALL	CALL
Trapper	200	179
Editors		
BRIEF 3.0	249	CALL
MKS Vi	149	129
Sage Professional Editor	295	249
VEDIT PLUS	185	115
Embedded Systems		
C6toPROM	149	119
Link & Locate ++	395	329
Link & Locate ++ Extended	479	389
FORTRAN Language		
FORWARN	329	295
FORTRAN Dev. Tools	129	116
Lahey F77L	595	535
Lahey Personal FORTRAN 77	99	89
MS FORTRAN	450	299
SALFORD FTN 77	CALL	CALL
Graphics Libraries		
Baby Driver	250	199
Essential Graphics	399	339
Font-Tools	150	119
Graf/Drive Plus Developer's	299	269
GrafPrint Developer's	300	265
GrafPrint for Graphoria	95	85
GrafPrint Personal	75	69
GrafPrint Plus	150	129
graphics-MENU	179	159
w/ source	379	329
graphics-MENU Data Entry	99	89
w/ source	224	199
GX Graphics	149	135
HALO	395	279
HALO Professional	595	395
HALO Window Toolkit	595	419
Icon-Tools/Plus	150	119
Menuet	325	279
PCX Effects	99	89
PCX Programmer's Toolkit	195	175
PCX Text	149	135
Super Pro-Pak	899	809
Turbo Geometry Library	200	179
Z-PHIGS Lite	199	179
Z-PHIGS Professional	799	699
Linkers/Librarians		
Blinker	189	175
Plink86+	395	335
.RTLink/Plus	495	359
OS/2 Tools		
CASE:PM for C or C++	1995	1799
MS OS/2 Pres. Manager Tlkt.	500	349
Smalltalk/V PM	495	369

Call FAXcetera (908) 389-8173 from your FAX phone for more product information!

Reason Enough for a Desktop System

Reason Technology's new 486 desktop system incorporates 4 MB of RAM, 8K bytes of cache RAM, an 80-MB hard disk drive, and an 80387 coprocessor. It also has 1.2-MB and 1.44-MB floppy disk drives.

The small-footprint system uses a 1024- by 768-pixel Super VGA controller in concert with a 14-inch Super VGA color monitor. Additionally, it has one parallel and two serial ports, eight expansion slots, and five disk drive bays.

Price: $3995.

Contact: Reason Technology, 290 Coon Rapids Blvd., Minneapolis, MN 55433, (612) 780-4792; fax (612) 780-4797.

Circle 1287 on Inquiry Card.

Reason Technology's 486 desktop computer is power packed into a small footprint.

Power to Go

Bitwise has packed a desktop of power into its 23-pound, 486 EISA portable computer. The company says its 33-MHz Model 433E/VP is fully compatible with 286 and 386 operating systems.

The 433E/VP features 8K bytes of cache RAM, an integrated math coprocessor and a socket for a Weitek WTL4167, a Conner Peripherals 212-MB hard disk drive with 64K bytes of cache, two 5¼-inch drive bays, and a third drive bay for a 3½-inch drive. The system includes three free full-length slots.

The unit's video consists of a VGA gas-plasma flat-screen display with 16 levels of gray. It uses an Ahead VGA Wizard video adapter and has an external monitor port that lets it display on two screens simultaneously.

Price: Basic model, $12,995.

Contact: Bitwise Designs, Inc., 701 River St., Troy, NY 12180, (800) 367-5906 or (518) 274-0755; fax (518) 274-0764.

Circle 1288 on Inquiry Card.

A True 386 Laptop

The LP-386C laptop from Fora uses Intel's 386 chip and incorporates an optional expansion chassis. According to the company, this gives the system the expansion capacity of a desktop in addition to its portability.

With 2 MB of RAM, which is expandable to 8 MB when the unit is slipped into its expansion chassis, the LP-386C includes a parallel and a serial port, a proprietary slot for an internal modem, and ports for an external VGA monitor and a floppy disk drive. The unit's backlit LCD double-supertwist VGA screen supports up to 32 levels of gray. Its 14-pound weight includes a detachable, rechargeable nickel-cadmium battery and an AC adapter.

Price: $4995; expansion chassis, $9500.

Contact: Fora, Inc., 3081 North First St., San Jose, CA 95134, (800) 367-3672 or (408) 944-0393; fax (408) 944-0392.

Circle 1289 on Inquiry Card.

With an optional expansion chassis, Fora's LP-386C becomes more than a portable.

Traveling Companions

Random's Companion and Companion Plus portable computers, with a proprietary operating system and firmware, feature a built-in 2400-bps V.22bis modem. The units also have an RS-232 port, serial and parallel ports, and built-in MNP level 5 software. The Companion Plus also offers word processing and communications capabilities, the ability to capture sessions and take a snapshot of the screen, and 65K bytes of nonvolatile RAM. Each model weighs under 4 pounds.

Price: Companion, $1295; Companion Plus, $1595; optional memory for Companion Plus, $400.

Contact: Random Corp., Northland Blvd., Cincinnati, OH 45240, (800) 553-6773 or (513) 825-0880.

Circle 1290 on Inquiry Card.

486 Memory and Performance

A 33-MHz 486 computer designed for CAD/CAM, database, and server use, Cheetah's Model 433D features 8 MB of 35-ns DRAM, expandable to 16 MB. The unit includes an intelligent caching hard disk drive controller with 512K bytes of RAM, expandable to 20 MB. The proprietary Bus Cycle Machine provides concurrent I/O processing, full 32-bit write operations to I/O devices, and elimination of wait states while writing to I/O devices.

Price: $15,223.

Contact: Cheetah Computer Systems, Inc., 7075 Flying Cloud Dr., Eden Prairie, MN 55344, (612) 943-8690; fax (612) 943-8331.

Circle 1291 on Inquiry Card.

Traveling in the Express Lane

The Data Express comprises a receiving frame that fits into a 5¼-inch half-height disk drive slot or into a stand-alone expansion chassis of a PC, workstation, or VMEbus system. Within this frame is a drive carrier that acts as a removable drawer and contains a 3½-inch hard disk drive with a storage capacity of 450 MB. The device supports peripheral interfaces such as Intelligent Drive Electronics, ST506, SCSI, and ESDI.

The transportable design of the unit gives system users the flexibility of sharing a single workstation. Additionally, removing and locking up the drawer is an easy way to ensure that your sensitive data remains secure. The Data Express has the advantage of letting you collect data at several remote sites and process it at your convenience at a central location. The product line includes the ruggedized, shock-mounted Data Commuter and the Data Silo, a SCSI peripheral expansion cabinet that accepts 3½- or 5¼-inch half-height tape drives, hard disk drives, removable drives, and optical drives.

Price: Data Express, $315; Data Silo, $440; Data Commuter, $1395.
Contact: Kingston Technology Corp., 3023 South Harbor Blvd., Santa Ana, CA 92704, (714) 435-2600; fax (714) 545-2176.
Circle 1292 on Inquiry Card.

The Data Express from Kingston provides flexibility as well as transportability.

In Touch with McKey Mouse

In Touch Systems has added a mouse option to its Magic Wand Keyboard. Called the McKey Mouse, the Microsoft-compatible mouse requires no strength or dexterity on the part of the user, enabling quadriplegics to use software such as Windows and PageMaker.

You use McKey Mouse by touching keys on the 12-ounce Magic Wand Keyboard. Features include left and right click, double-click, drag, chord click, and 11 speed settings.
Price: Magic Wand Keyboard with McKey Mouse, $1590; McKey Mouse as an upgrade, $349.
Contact: In Touch Systems, 11 Westview Rd., Spring Valley, NY 10977, (914) 354-7431.
Circle 1293 on Inquiry Card.

Output Continuous Forms

A continuous-form laser printer with a speed of 16 ppm is available from Output Technology. The LaserMatrix 1000, Model 3, is Hewlett-Packard compatible and features a 3½- to 9½-inch adjustable tractor feed. Its emulations and interfaces include HP LaserJet Series II, IBM Proprinter II, and Centronics parallel and RS-232 serial interfaces. When used with standard bar coding software, the printer can produce bar code symbologies.
Price: $5995.
Contact: Output Technology Corp., East 9922 Montgomery Dr., Spokane, WA 99206, (800) 468-8788 or (509) 926-3855; fax (509) 922-4742.
Circle 1294 on Inquiry Card.

Nonglare Color Monitor

A 14-inch Ultra VGA analog color monitor with a 250-mm by 190-mm nonglare, dark-tinted display is available from Aamazing Technologies. With a palette of unlimited colors, the Model CM8484EX has a built-in text switch that gives you the flexibility to adjust the text color to amber or green from the normal white on black.

The monitor's 0.28-mm dot pitch display has an interlaced display resolution of 1024 by 768 pixels. In support of VGA, Super VGA, and 8514/A video standards, the monitor has a dual horizontal scan frequency of 31.5 and 35.5 kHz and a vertical scan frequency of from 50 to 70 Hz.
Price: $579.
Contact: Aamazing Technologies Corp., 5980 Lakeshore Dr., Cypress, CA 90630, (714) 826-9680; fax (714) 826-9681.
Circle 1295 on Inquiry Card.

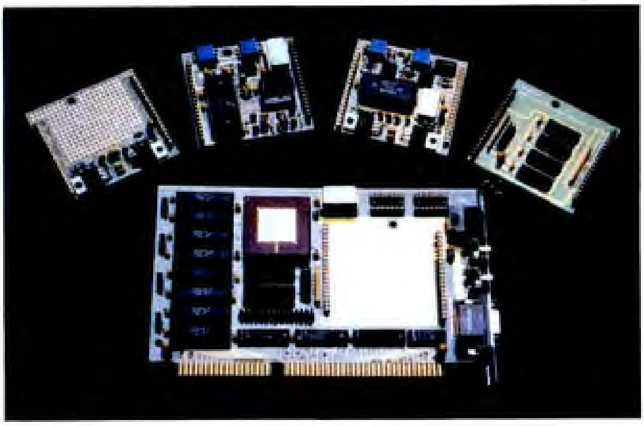
Computer-Controlled VCR

The Selectra/Panasonic AG-1960/RS computer-controlled VCR is controllable from any personal computer through an RS-232 port. Among other capabilities, the unit automatically records computer graphics and animation sequences on videotape, brings motion video to the computer to combine with other multimedia elements, and turns your computer into a controller to create finished multimedia presentations or image databases on videotape.
Price: $2195.
Contact: Selectra Corp., P.O. Box 5497, Walnut Creek, CA 94596, (800) 874-9889 or (415) 283-1670; fax (415) 284-2117.
Circle 1296 on Inquiry Card.

DSP Board with Options

The AC5-AO floating-point digital signal processor board, based on AT&T's DSP32C floating-point DSP, is available from Communication Automation & Control. The 50-MHz board comes with daughterboards and software development tools.

With a peak performance of 25 MFLOPS, the AC5-AO uses an I/O-mapped ISA bus host interface. It includes 64K bytes of zero-wait-state static RAM, expandable to 256K bytes. Daughterboards available for the AC5-AO are the DBCS5339, a dual-channel audio-band data acquisition card; the DBT7525, a single-channel voice-band I/O card; and the DBSERIAL, a buffered serial interface card. Software support includes a C compiler, assembler, linker, and simulator; a window-based debugger; and a library of trigonometric functions.
Price: AC5-AO board, $1195; daughterboards, $95 to $295; C compiler package, $1495; assembler package, $495; debugger, $395.
Contact: Communication Automation & Control, Inc., 1642 Union Blvd., Suite 200, Allentown, PA 18103, (215) 776-6669; fax (215) 770-1232.
Circle 1297 on Inquiry Card.



The AC5-AO floating-point DSP board has a 2.5-MBps ISA bus data transfer rate.

Universal Frequency Counter

The Model PC-10 Universal Frequency Counter drop-in board for the PC uses Windows 3.0 as its control panel for displaying the frequencies. The board's operating range is from 10 Hz to 2.4 GHz.

The PC-10 has on-board RF amplifiers and switchable prescalers to operate as a stand-alone high-frequency RF counter. The board can also send frequency data to a communications receiver for instant tuning and listening to radio signals it has detected.
Price: $335.
Contact: Optoelectronics, 5821 Northeast 14th Ave., Fort Lauderdale, FL 33334, (800) 327-5912 or (305) 771-2050; fax (305) 771-2052.
Circle 1298 on Inquiry Card.

Optoelectronics' PC-10 Universal Frequency Counter uses Windows 3.0 for instrument control.

Cache in Static RAM

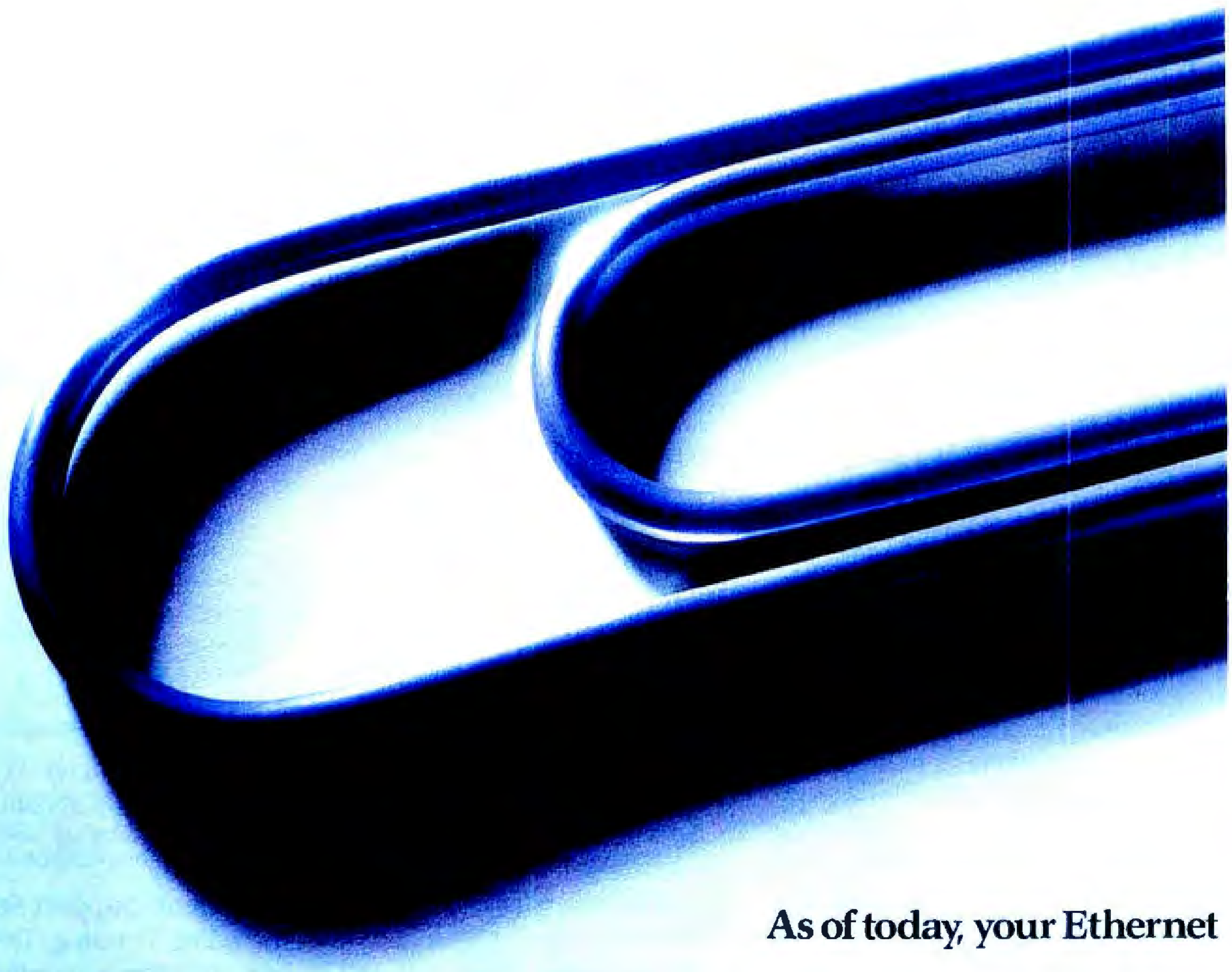
The Atto Cache ci, a 64K-byte static RAM cache, increases Mac IIci performance by 40 percent to 70 percent, according to Atto Technology. The Atto Cache ci stores frequently used data in 25-ns SRAM, holding it until the 68030 processor requests it. The unit plugs into the 120-pin cache connector on the Mac IIci.
Price: $279.
Contact: Atto Technology, Inc., Baird Research Park, 1576 Sweet Home Rd., Amherst, NY 14228, (716) 688-4259; fax (716) 636-3630.
Circle 1299 on Inquiry Card.

Monitor and Control the Temperature

Keithley MetraByte's DAS-Temp 32-channel, 12-bit temperature-measurement board measures up to 200 samples per second. For use with the IBM PC XT, AT, and compatibles, the board has a minimum temperature resolution of 0.1°C and is accurate to within 0.1°C.

Working within a temperature range of from −25°C to 105°C, the DAS-Temp includes three levels of software: a pop-up package that lets you use the board without programming, a high-level device driver, and a callable driver. You can manually or automatically calibrate the board. According to MetraByte, DAS-Temp is extremely noise immune.
Price: $399.
Contact: Keithley MetraByte Corp., 440 Myles Standish Blvd., Taunton, MA 02780, (508) 880-3000; fax (508) 880-0179.
Circle 1300 on Inquiry Card.

There are still some t



As of today, your Ethernet

Motorola introduces the Altair™ wireless network—connectivity for your Ethernet LAN that gives you all the advantages of wire, without the wire.

Oh, the disadvantages of hard wiring your Ethernet LAN. It starts with installation: the endless waiting for workmen to tear up your walls, ceilings or carpeting only to discover that there isn't room for one more wire. But it doesn't stop there. When you need to reconfigure your LAN, you may find yourself starting the process all over again.

That's the beauty of Altair wireless Ethernet. Its revolutionary wireless technology lets you

Stargazing with Your PC

The StarScape IIA, IIB, and IIC charge-coupled device (CCD) cameras constitute First Magnitude's new line of ultralow-light-level digital imaging devices. The PC-compatible cameras, for use in astronomy, medicine, and remote sensing, include a camera head, a controller board, cabling, and software.

The StarScape IIC, for amateur astronomers, has a thermoelectrically cooled CCD with a 14-bit A/D converter and offers a choice of a 590- by 490-pixel monochrome or a 250- by 250-pixel color CCD. The StarScape IIB, also thermoelectrically cooled, and the StarScape IIA (liquid nitrogen cooled) use a 16-bit A/D converter. They are available with 590- by 490-pixel CCDs or optional 1024- by 1024-pixel CCDs.
Price: IIC, $9500; IIB, $12,900; IIA, $13,900.
Contact: First Magnitude Corp., 519 South Fifth St., Laramie, WY 82070, (307) 745-3744.
Circle 1301 on Inquiry Card.

First Magnitude's PC-compatible StarScape CCD cameras.

Wall Outlet Surge Suppressor

A single-outlet, wall-mounted surge suppressor, the Electra Guard EG3C plugs directly into any standard grounded electrical outlet. The EG3C responds within 1 ns of an overvoltage, surge, spike, or transient. Rated for use at 120 V AC and 15 amps, its hybrid circuitry enables it to clamp voltages as low as 345 V and protect from surges of up to 6000 V.
Price: $9.95.
Contact: Intermatic, Inc., Intermatic Plaza, Spring Grove, IL 60081, (815) 675-2321.
Circle 1302 on Inquiry Card.

The Electra Guard EG3C.

Communication with a UPS

American Power Conversion has added three uninterruptible power supplies to its Smart-UPS line. The 900-, 1250-, and 2000-VA units protect multiple servers or CPUs, intelligent hubs, multiple workstations, telecommunications equipment, and minicomputers.

The new Smart-UPS units are designed to let network managers communicate with the UPS to diagnose problems that may be a result of faulty power. Features include an internal control language, a replace-battery indicator, and site wiring fault indicators.
Price: Smart-UPS 900, $999; Smart-UPS 1250, $1299; Smart-UPS 2000, $1999.
Contact: American Power Conversion, P.O. Box 278, 132 Fairgrounds Rd., West Kingston, RI 02892, (401) 789-5735; fax (401) 789-3710.
Circle 1303 on Inquiry Card.

Windows 3.0 Quick Reference

The Quick Reference Card for Windows 3.0 provides the most frequently needed programming reference information. Sized to be easily accessed, the card includes the correct spelling of all Windows procedures, which parameters to use, the order in which to use them, and the spelling of manifest constants.
Price: $14.99.
Contact: Cooper Software, Inc., 3523A Haven Ave., Menlo Park, CA 94025, (415) 364-9150.
Circle 1304 on Inquiry Card.

Put the Emphasis on Pointing

The Emphasis laser pointers are available in two models: the Professional and the Executive. Constructed from brass and aluminum, the pointers are visible in all normal office lighting at ranges of up to 150 feet and are clearly visible against a light projector screen, according to the manufacturer. Both models are 8½ inches long and weigh 5½ ounces with two AA batteries installed.

Price: Professional, $219; Executive, $249.
Contact: The Layman's Laser Co., P.O. Box 58770, Seattle, WA 98138, (800) 258-2202 or (206) 439-7894.
Circle 1305 on Inquiry Card.

INSTANT WORKSTATION. JUST ADD OPEN DESKTOP.

Take a look at the vast majority of graphical workstations developed over the past decade and you'll see something they all have in common:

An integrated UNIX® System environment.

Now take a look at the vast majority of businesses that have put computing power directly onto their office desktops over the past decade, and you'll see something they all have in common:

Industry-standard personal computers.

It doesn't take a computer to forecast the platform that's going to put graphical workstations on the vast majority of business and engineering desktops in the next decade:

An integrated UNIX System environment for industry-standard personal computers.

And that's what Open Desktop® is all about.

Open Desktop is the complete graphical operating system that's built on the most popular UNIX System platform of all time—SCO®. And it lets you create your own networked, icon-driven workstation environment using the industry-standard 386 or 486 computers and peripherals of your choice.

In a single, easy-to-use, fully supported—and completely integrated—package, Open Desktop delivers:

- the full 32-bit, multitasking computing power of SCO UNIX System V/386, designed to meet C2-level security
- compliance with POSIX™ and X/Open® standards
- an OSF/Motif™-based, Presentation Manager-compatible, graphical user interface
- distributed SQL database management services
- compatibility with existing DOS, XENIX®, and UNIX System applications and data files
- NFS™, TCP/IP, and LAN Manager networking facilities

And all at an unbelievably affordable price.

Discover the complete graphical operating system that leading companies worldwide are choosing as their development platform for the '90s—and using to turn their 386 and 486 PCs into instant workstations today.

Open Desktop from SCO.

OPEN DESKTOP®
The Complete Graphical Operating System

Call SCO today and ask for ext. 8400

SCO
THE SANTA CRUZ OPERATION

(800) SCO-UNIX (726-8649) (408) 425-7222 FAX (408) 458-4227 E-MAIL: ...!uunet!sco!info info@sco.COM

Circle 232 on Inquiry Card.

A Pocket Modem for Your Laptop

Accton's 2400MNP-P pocket-size modem incorporates MNP level 1 to 5 error correction and data compression. Designed for use with laptop computers, the 2400MNP-P runs for up to 4 hours on a 9-V battery; it has transmission speeds as high as 4800 bps over a standard phone line.

The roughly 4¾- by 2½- by 1¼-inch modem connects to your computer's RS-232 serial port and to the telephone line via a standard RJ-11 jack. The modem features automatic dialing, redialing, and answering, as well as full call-progress monitoring. It also supports serial, binary, and asynchronous connections.

Price: $459.

Contact: Accton Technology Corp., 46750 Fremont Blvd., Suite 104, Fremont, CA 94538, (415) 226-9800.

Circle 1306 on Inquiry Card.

Versatile Ethernet Adapters

Two Ethernet adapters designed for the Mac IIsi and Mac SE/30 have been introduced by Compatible Systems. EtherDS is a direct-slot Ethernet adapter for client applications; EtherVHP is optimized for server applications.

The EtherDS has 16K bytes of memory, a 16-bit on-board data path, and a 16-bit direct slot interface. The EtherVHP includes 32K bytes of memory, a 32-bit on-board data path, and a 32-bit direct slot interface. Both adapters are available in standard coaxial or 10Base-T twisted-pair versions.

Price: EtherDS, $395; EtherVHP, $595.

Contact: Compatible Systems Corp., P.O. Drawer 17220, Boulder, CO 80308, (800) 356-0283 or (303) 444-9532; fax (303) 444-9595.

Circle 1307 on Inquiry Card.

The 2400MNP-P pocket modem from Accton.

Three Share a Line Automatically

SmartMax II, a fax/phone autoswitch from MaxTrek, makes it possible for a fax, a phone, and a computer modem to share a single telephone line. The unit automatically routes the calls.

The Model 6000 and the Model 6500 do fax/phone switching; the 6500 also has an auxiliary port for such uses as a computer modem or a credit card terminal. Features of the SmartMax II include a sentry mode for nighttime operation, a programmable ring count for additional switching options, and the power to handle multiple extension phones.

Price: Model 6000, $199; Model 6500, $249.

Contact: MaxTrek, Inc., 23210 Bernhardt St., Hayward, CA 94545, (415) 785-6282; fax (415) 785-6657.

Circle 1308 on Inquiry Card.

One-Board Ethernet Graphics

United NetWorks has begun marketing GrandSlam Ethernet/VGA, an adapter that combines the capabilities of Ethernet hardware and Super VGA graphics on a single board. The 16-bit adapter uses Fujitsu's EtherStar chip.

The GrandSlam Ethernet/VGA has 512K bytes of memory and includes a 64K-byte RAM buffer. It supports up to 256 colors at resolutions of 800 by 600, 640 by 480, or 640 by 400 pixels and a 70-Hz refresh rate. The adapter also supports thin and thick Ethernet cabling and is available with jumper-selectable remote boot PROM for diskless workstations. The company is planning a Micro Channel architecture version of the adapter.

Price: $695.

Contact: United NetWorks, Inc., 2178 Paragon Dr., San Jose, CA 95131, (408) 436-2800; fax (408) 436-2807.

Circle 1309 on Inquiry Card.

Network Multimanager

The CMS 910 Dial Management System monitors and manages high-speed dial-up communication networks. The multiuser, multitasking network management system uses a Unix-based PC with a window- and menu-based graphical interface as a central site-control platform. The CMS 910 lets you do such tasks as monitoring your network's performance, conducting tests and diagnosing problems, and compiling operational statistics and reports while the system continues to work in the background.

Price: CMS 910 system software with SCO Xenix 2.23/286, $3500; six-port controller card with cabling, $1700; VA1690 chassis, $2195.

Contact: Racal-Vadic, 1708 McCarthy Blvd., Milpitas, CA 95035, (800) 482-3427.

Circle 1310 on Inquiry Card.

Phone from Your Computer

The TE 158 Telephone Control Card provides complete computer control of a telephone call. Its capabilities include automatic dialing, line connect and disconnect, call-progress detection, and Touch-Tone encoding and decoding. You can use the TE 158 to dial out and send messages with tones and as an answering machine.

Price: $190.

Contact: Alpha Products, 242 West Ave., Darien, CT 06820, (800) 221-0916 or (203) 656-1806; fax (203) 656-0756.

Circle 1311 on Inquiry Card.

Take Our Course In C And The First Lesson You'll Learn Is In Economics.

NTSC or PAL Formats

"I heartily recommend. . . . . .an excellent bargain."
GARY RAY
PC WEEK

C's power, and portability make it the language of choice for software developers.

Unfortunately, learning C can be a very costly proposition. Classroom instruction is, in a word, expensive. And many C video courses carry hefty price tags.

```
#include <stdio.h>
#define NAMLEN 15
#define NUMMARK 4
struct person
{
  char name[NAMLEN];
  int mark[NUMMARK];
};
```

The top C video course at the lowest possible price

But now, there's The Complete C Video Course from Zortech. It's the ultimate C training tool for home or work. And all it costs is $295.

You get ten videos with 36 lessons covering all levels of programming skill. A comprehensive, easy-to-follow 365 page workbook. And even a free C compiler.

Free C compiler included

Yes, that's right. The Complete C Video Course includes our famous C compiler (it runs on any MS-DOS machine) with linker, library manager, full graphics library and on-line help. It's the choice of professional programmers everywhere for fast code, fast development and fast debugging.

Learn C in as little as two weeks

Speaking of speedy, with The Complete C Video Course you can learn C in only two weeks. Compare that with the up to four months it can take to learn C in class.

Each lesson averages 17 minutes of clear, concise instructions. Used in conjunction with our workbook you'll find they provide everything you need to know to become proficient in programming in C.

Save your company thousands

If you think The Complete C Video Course is a great way for you to save money learning C, think about how much it could save your company. Use it instead of sending programmers to school and you'll save thousands. What's more, The Complete C Video Course is even tax deductible.

C is unquestionably the most valuable programming language you can master. And now you can get everything you need to become productive in it from course to compiler to tools for an economical $295. Mail the coupon or call our hotline to receive it ASAP.

ZORTECH

Look at all these C video pluses

- Only $295 complete.
- Ten videos with 36 lessons
- Comprehensive 365-page workbook
- Free C compiler with linker, library manager, full graphics library and on-line help
- Compiler and hardware independent
- Designed to help you learn C in as little as two weeks
- Tax deductible.

Zortech Inc.
4-C Gill Street
Woburn, MA 01801
Voice: 617-937-0696
Fax: 617-937-0793

★ Yes, rush me The Complete C Video Course including free C compiler for $295.00 (VHS only)
★ Please include (No.   ) extra workbooks at $29.95 each.
★ I'd like to order (No.   ) extra C compilers with this course at the special price of $49.95.

Name/Company ....

Address ....

....

Phone ....

City ....

State .... Zip ....

Here's my check for ....

VISA/MC # ....

Exp. Date ....

Prices do not include shipping

The Complete C Video Course $295

Order Hotline (800)848-8408

Circle 308 on Inquiry Card.

The New ZEOS®

Now '386 SX Only $2295!

Notebook.
'286 Only $1995!

"A NEW KING OF THE HILL"—PC MAGAZINE

PC MAGAZINE SAID IT BEST.

"In the unending battle to become the most functional notebook for the most attractive price, there's a new king of the hill—the Zeos Notebook…" *PC Magazine.* What did they like most?

Everything. As they said, the Zeos Notebook "offers a top notch combination of power, weight, features and price…" In short, everything you're going to appreciate in your new ZEOS notebook.

INCREDIBLE DESKTOP FEATURES IN A NOTEBOOK.

Pick your power. Choose our '286 version or go for the incredible new ZEOS '386SX version. Combine that with our high speed hard disk, built in 1.44MB floppy drive, VGA and more—you've got the greatest notebook going at any price!

Look closely at the details. Like our crisp 10" VGA display. The ultimate in sparkling clarity featuring advanced fluorescent backlighting for vivid VGA graphics. And then the drives.

Two drives are better than one! First, you're getting our whisper quiet high speed, high capacity hard disk. Then we've built in an industry standard 1.44 Megabyte, 3.5 inch floppy as well. And we don't stop there.

DETAILS MAKE THE DIFFERENCE!

For instance, the battery system of your new notebook is the most advanced on the market. You can quick charge, or trickle charge, any time your system is plugged in. Or, you can use the optional charging stand if you wish.

Either way, you're sure to appreciate our light weight snap-in, snap-out battery packs. They're so light and easy to use, you can easily take an extra one with you on those really long trips. Plus, you can get even more life out of a single charge by using our programmable power management system. Hour upon hour of Notebook computing power!

CONNECTIVITY TOO!

Your new ZEOS notebook is a great connectivity tool! Using our optional built-in 2400 baud MNP Class 5 modem, connectivity buffs will find themselves logging on at every turn.

And speaking of connectivity, we've kept the I/O easy to use too. Because unlike many of the others, your new ZEOS notebook has the same industry standard port connectors you'll find on your larger desktop system. Serial and Parallel ports; even an external VGA connector. Completely compatible!

ZEOS 24 HOUR A DAY SUPPORT.

Don't forget your new ZEOS notebook is backed by the best Technical and Sales support in the industry, 24 Hours a Day. We're always here to help, *any time* of the day or night. And we don't stop there either.

Your new notebook is also backed by our 30 Day Absolute Satisfaction Money Back Guarantee and One Full Year Limited Warranty. You're going to be very satisfied. We don't just say it. *We guarantee it.*

ORDER YOUR OWN ZEOS NOTEBOOK NOW!

You can order your new ZEOS notebook *right now.* Simply pick up the phone and give us a call now at 800-423-5891. At last, a full featured notebook that lets you compute anywhere. You're going to love it. *That's a guarantee!*

ORDER NOW TOLL FREE:

800-423-5891

Circle 306 on Inquiry Card.

NOW. YOUR COMPLETE '286 NOTEBOOK! VGA, 20MB HARD DRIVE, 1.44MB FLOPPY AND MORE. LIGHT AND LOADED! INCREDIBLE.

ONLY $1995!

386SX ONLY $2295!

- Genuine Intel® 80286-12 or '386SX-16.
- 1MB DRAM, expandable to 3 or 5MB.
- 20MB High Speed HDD.
- Built in High Density 3.5" 1.44MB floppy drive.
- High resolution VGA display. Fluorescent backlit 640x480, 32 grey scales. Bright and clear!
- Removable quick charge NiCad battery. Two hour plus battery life typical, more using Programmable Power Management!
- Quick charge or trickle charge using included AC power adapter.
- Extra battery packs and external charging stand available.
- 82 key keyboard. True 101 key emulation.
- Industry standard Serial and Parallel Ports.
- VGA port for external VGA color display. Great for demos!
- Total system weight under 7 lbs. with battery.
- 30 Day Absolute Satisfaction Money Back Guarantee and ZEOS Customer Satisfaction Package.
- One Full Year Limited Warranty.
- 24 Hour a Day Toll Free Technical Support, 365 Days a Year.

ORDER NOW TOLL FREE

800-423-5891

FAX Orders: 612-633-1325
Minnesota: 612-633-4591
Hearing Impaired (TDD) Orders: 800-228-5389
Outside US and Canada: 612-633-6131
MasterCard, VISA, Am Exp, Z-Card and COD.
Open 24 Hours a Day, 365 Days a Year!

ZEOS® INTERNATIONAL, LTD.

The Next Microphone

MicroPhone II for Next computers takes advantage of the Next graphical interface and uses scripting for you to automate your communications activities. For example, you click once on an E-mail icon to instruct the program to access a remote mail service and automatically transfer mail.

MicroPhone II uses file transfer protocols to communicate with BBSes, on-line services, and mainframes. It can transmit text, files, pictures, and sound to another Next, a Macintosh, or a PC.

Price: $395.

Contact: Software Ventures Corp., 2907 Claremont Ave., Suite 220, Berkeley, CA 94705, (415) 644-3232; fax (415) 848-0885.

Circle 1312 on Inquiry Card.

MainLaning Ethernet

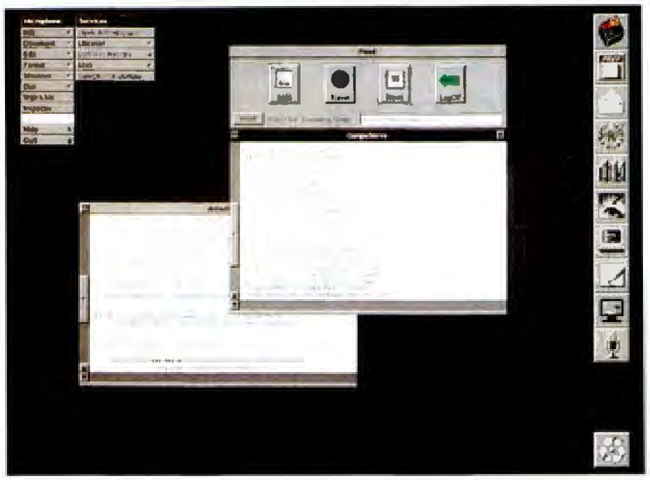
MainLan Ethernet, an Ethernet peer-to-peer network system, transmits program-sharing, file-sharing, printer-sharing, and E-mail data at 10 Mbps on PCs. The system requires 30K bytes of RAM in conventional PC workstations and 15K bytes of RAM in workstations using expanded memory. With additional software such as MacLan by Miramar Systems, MainLan Ethernet can connect Macintosh computers into the network.

Compatible with NetWare and NetBIOS, MainLan Ethernet also runs network versions of Microsoft Windows, WordPerfect, Lotus 1-2-3, dBASE III, and Paradox. MainLan Ethernet is available as a starter pack, supporting connection of two PCs. The pack includes software, two Ethernet cards, 16½ feet of coaxial cable, Novell NetWare drivers, and a user's manual. Packs supporting an additional PC apiece are available.

Price: Starter pack, $499; additional pack for one PC, $199.

Contact: US Sage, Inc., 2005 Tree Fork Lane, Suite 113, Longwood, FL 32750, (800) 999-6770 or (407) 331-4400; fax (407) 331-4406.

Circle 1313 on Inquiry Card.



MicroPhone II for Next computers uses scripting to let you automate your communications.

Miniature Interface Converter

Rad's MIC-232/485 miniature interface converter connects terminals and computers that have different interfaces. The unit, which operates asynchronously over two or four wires, connects the RS-232 interface with the RS-485 multipoint interface. It operates at data rates of up to 38,400 bps.

The MIC-232/485 operates on low power from the RS-232 data and control signals. Used as a short-range modem, the device lets you connect a single computer or terminal with an RS-232 interface to one or several terminals with an RS-485 interface. It has a transmission range of from 3¾ to 6⅕ miles, depending on signal speed.

Price: $200.

Contact: Rad Data Communications, 151 West Passaic St., Rochelle Park, NJ 07662, (201) 587-8822; fax (201) 587-8847.

Circle 1314 on Inquiry Card.

Joining Apple and Ethernet

Two cards and three adapters make up Apple's new line of plug-and-play Ethernet products. You can use all of them in any existing Ethernet environment, according to Apple.

The Ethernet LC Card brings Ethernet capability to the Mac LC computer. The Ethernet NB Card is an intelligent NuBus card for Mac II computers.

The Ethernet Cabling System includes the Ethernet Thin Coax Transceiver, the Ethernet Twisted Pair Transceiver, and the Ethernet AUI Adapter. These adapters connect the cards to any industry-standard Ethernet medium.

Price: Ethernet LC Card, $199; Ethernet NB Card, $424; adapters, $175 each.

Contact: Apple Computer, Inc., 20525 Mariani Ave., Cupertino, CA 95014, (408) 996-1010.

Circle 1316 on Inquiry Card.

A Sun-Touched Apple

SunTops 3.0, for Sun workstations, provides a seamless link for file transfer and printer sharing between the workstations and Macs and PCs. Version 3.0 supports AppleTalk Filing Protocol's shared environment extensions, as well as AppleTalk Phase II. Additionally, it provides transparent routing between AppleTalk Phase I and Phase II, and it lets you print to any serially attached laser printer without using third-party products.

Price: For Sparcstations, $1295; for other Sun workstations, $1395.

Contact: Sitka Corp., 950 Marina Village Pkwy., Alameda, CA 94501, (415) 769-9669.

Circle 1315 on Inquiry Card.

AT 9ms, THIS SHOULD BE ON THE COVER.

Stop the presses, call the editor. Now you can get more speed, more room, more power, more of everything. Except price.

Presenting the Hardcard II *XL*.™ A 9ms hard drive designed for 286/386 systems.

Now here's the news. *The New York Times* says Hardcard II XL offers "more speed than regular drives for a comparable price."

And the numbers confirm this. 9ms effective access time[1] and 1.4 MB per second transfer rate[2] mean your system runs 8 to 9 times faster than standard hard drives. With 50 or 105 MB capacity, you have enough room to run Windows™ 3.0.

There's also a two year warranty and a level of service and reliability our customers (and *PC Magazine**) tend to brag about.

All this for about the same price as the standard old 28ms drive.

Nice cover.

For your nearest dealer, call 1-800-624-5545.

Plus
A Quantum Company

THE 9ms ERA
XL
HARDCARD II XL

*PC *Magazine* service and reliability survey ranked Plus Development #1. September 25, 1990.

Circle 217 on Inquiry Card.

Recycle

Everyone wants more productivity out of their computers.

But not everybody is willing to spend a fortune to get it. That's why Quarterdeck productivity software is outselling everyone elses—including Microsoft's.

DESQview Multitasks and Windows on Your PC

As early as 1982, computer enthusiasts found our products helped them set up their ideal working environment. Since then, step-by-step, we've improved DESQview into what some very knowledgeable people call "the best alternative to OS/2".

Today's DESQview allows you to multitask multiple programs in windows side by side—text programs; graphic programs. But best of all, you don't have to buy a lot of new hardware and software to use it. DESQview works with the PC and the programs you now own.

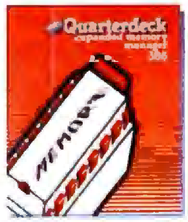
Over 1,000,000 users multitask their programs with DESQview.

QEMM Breaks the 640K Barrier

Break the 640K barrier in DOS—or in Windows 3.0—and give your DOS programs up to 130K more room within the first megabyte of memory, plus another 96K of video memory, in some instances.

QEMM takes buffers, network drivers, TSRs and other memory-using utilities and moves them into idle areas between 640K and one megabyte.

It's not complicated. It's easy. You can just type *Optimize* and QEMM will do the rest.



Number one.

QEMM 386 is incorporated into DESQview 386 to provide the optimum operating environment for productivity oriented users of 386, 386SX and i486 PCs.

QEMM 50/60 is designed to work in IBM® PS/2™ Model 50 and 60 PCs with specific IBM adapter boards.

QEMM is the #1 selling utility according to distribution sources. In fact, it was the number one selling sofware package in the PC industry in April, May and June 1990.

Before *After*

These are some of DESQview's most recent awards

These are some of QEMM's most recent awards

Microsoft is a trademark of Microsoft Corporation. IBM and PS/2 are trademarks of IBM Corporation. PC Tools Deluxe is a trademark of Central Point Software. 80286, 386, 386SX and i486 are trademarks of Intel Corporation.

your PC

Manifest Gives You in-Depth Knowlege of Your PC

Our newest utility is Quarterdeck Manifest, the best way to discover everything you ever wanted to know about your PC. Manifest shows you around 'under the hood', pointing out how memory is used, comparing memory speeds, and indicating how you can gain more room for your programs to work.

It can point you to as much as 130K of additional RAM your programs can use. It shows you which memory areas are faster. It even helps you compare add-in memory board performance.

QEMM 386 PC WEEK PRODUCT EVALUATION SCORE 8.6 — INFO WORLD BEST IN ITS CLASS

Manifest does for memory what PC Tools Deluxe does for disks. And it's easier to use.

Manifest has been quick to win recognition

QRAM Optimizes the Memory of 8088 and 80286 PCs

Once you know where you can move those memory-hogging utilities, QRAM lets you do it. It even works on 8088, 8086 and 80286 PCs with EMS 4.0 or EEMS memory boards.

QRAM and Manifest help you get every last 'K' out of the hardware you own.

In fact, all our products are designed to give you more productivity out of the system you already have, whether it's an 8088, 8086, 286, 386SX, 386, or i486.

Quarterdeck. Products for Everyday Heroes

Our mission is to protect your investment. Whether your PC is 8 years old or fresh out of the box, our products make it more versatile, more flexible; and help deliver performance dividends from your computer investment. Our products help fine-tune your PC which helps you do your work better, which makes you look good.

A Glimpse of the Future: DESQview/X

We're also looking ahead to the next wave of computer development: enterprise computing. Our new

DESQview/X allows different computers with different operating systems to work together. Using the advanced X-windows environment, it lets users run programs on remote computers and watch them run in their PC's windows. DESQview/X will be avalable later this year.

Quarterdeck products. The best way to get the most out of your PC today. And tomorrow.

Quarterdeck

Quarterdeck International Ltd., B.I.M. House, Crofton Terrace, Dun Laoghaire County Dublin, Ireland Tel.(353) (1) 841-444 Fax: (353) (1) 844-380

Circle 223 on Inquiry Card.

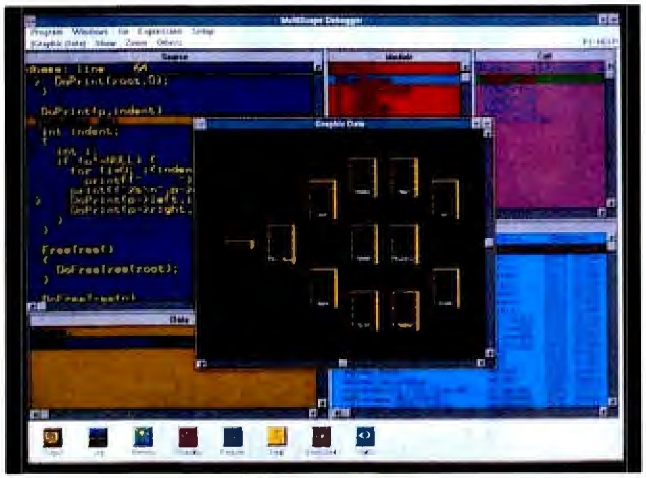
Rational Adds Support for Microsoft C 6.0

Instant-C 4.1 integrates an incremental compiler with an editor and debugger and adds compatibility with the Microsoft C 6.0 compiler. Version 4.1 lets you develop applications with more than 100,000 lines of source code and use the Microsoft compiler to produce the final program.

The program includes source-level debugging; interactive C expression evaluation including macros, cross-referencing, and browsing; and single or partial program execution. It supports programs of up to 16 MB using Rational's DOS extender technology.
Price: $795.
Contact: Rational Systems, Inc., 220 North Main St., Natick, MA 01760, (508) 653-6006; fax (508) 655-2753.
Circle 1271 on Inquiry Card.

Put a Mac Face on FORTRAN Code

Users of AppMaker's application generator can now generate code for use with the Language Systems FORTRAN compiler. AppMaker, which previously supported only C and Pascal, lets you develop user interfaces without having to learn all the details of the Macintosh Toolbox.
Price: FORTRAN Tools for current AppMaker owners, $100; bundled with AppMaker, $295.
Contact: Language Systems Corp., 441 Carlisle Dr., Herndon, VA 22070, (703) 478-0181; fax (703) 689-9593.
Circle 1272 on Inquiry Card.



MultiScope's Graphic Data Window lets you display a graph of simple or complex data structures. Arrows represent records, pointers, and values. You can zoom in on an item for details.

MultiScope Debuggers for DOS

The MultiScope Debuggers for DOS provide a Microsoft Windows and standard character-mode interface for debugging DOS applications. The package supplies DOS Virtual Machine capability, remote debuggers, and post-mortem debugging. When hosted under Windows or the character-mode interface, the CodeView-compatible debugger provides the extended memory and 386 and i486 services needed for debugging large DOS applications. With the Windows DOS VM capability, you can run the DOS application in a virtual DOS window side by side with the MultiScope debugger, eliminating switching between the application screen and the debugger. For character mode, a VCR remote control interface stays on top of the application.

Monitor Execution Dump-BC, a TSR program included with the debuggers, tells you what source line results in a hang or crash. MED-BC flushes out the offending source line, and the TSR's MED portion dumps the contents of computer memory into a file. You can then use the Post-Mortem Debugger to analyze the crash.
Price: $179 (includes Windows 3.0 and character-mode-interface run-time, post-mortem, and remote debuggers).
Contact: MultiScope, Inc., a Logitech company, 1235 Pear Ave., Mountain View, CA 94043, (415) 968-4892; fax (415) 968-4622.
Circle 1273 on Inquiry Card.

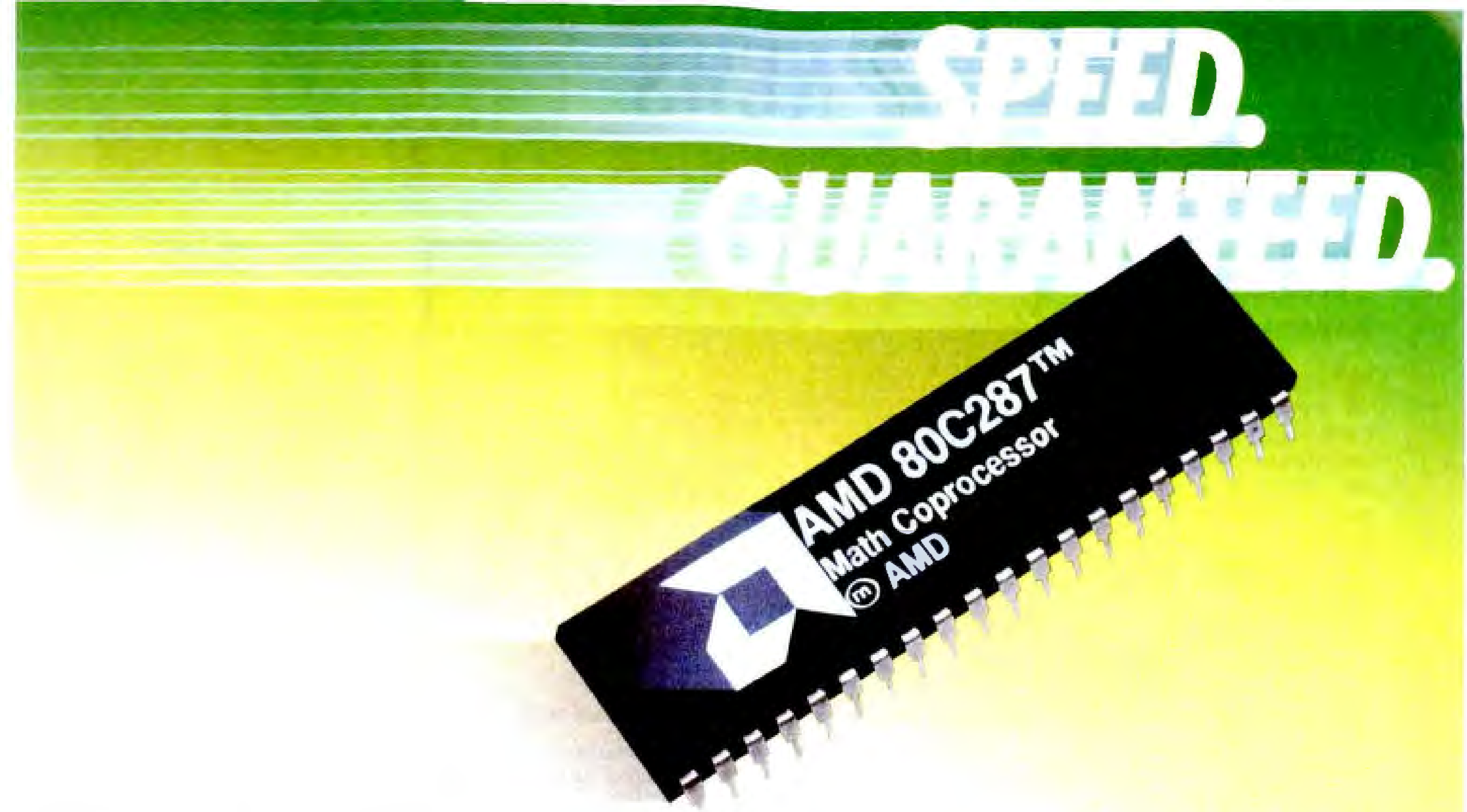
Jasik's Mighty Mac Debugger

Jasik Designs' new version of its debugger is the closest thing you'll find to an in-circuit emulator for the Mac. The Debugger 2.0 provides source-level debugging for MPW 3.x (Pascal or C), MacApp, and Think C programs. Jasik's debugger, however, provides this capability as a true low-level debugger: It's not an application running under MultiFinder in lockstep with the program, like the Standard Apple Debugging Environment or Think's source debugger.

For those Macs with memory management units (68030-based Macs or 68020-based Macs equipped with 68851 paged MMUs), the Debugger now provides the ultimate in debugging protection: It uses the MMU to write-protect your code resources and the rest of the system from the program you're debugging.

When a program makes an invalid address reference or attempts to write into a section of memory that it doesn't own, the Debugger halts program execution. Instantly, the Debugger has nailed down a hard-to-detect program error.

An Incremental Build System for MPW lets you compile and link only the modifed portions of a program, thus eliminating MPW's lengthy edit-compile-link cycles.
Price: Universal version (runs on all Macs, including the Mac IIsi and LC), $350.
Contact: Jasik Designs, 343 Trenton Way, Menlo Park, CA 94025, (415) 322-1386.
Circle 1274 on Inquiry Card.



Here's a chance to buy our $99 Math Coprocessor at no risk whatsoever! It's fully guaranteed to at least double the math performance of your software.

If you want to unlock the full power of your PC, pick up the phone and order an AMD 80C287 math coprocessor. Without it, your PC just isn't really complete. You see, our math coprocessor can *dramatically* increase the performance of 1-2-3,® dBASE,® Excel, and hundreds of your other favorite business applications! It actually runs calculations *two to ten times faster* than your PC can *without* a math coprocessor. Which means your graphs will draw incredibly fast and your spreadsheets will recalculate at truly blazing speeds. (And that's just for starters!)

High speed at a low price.

Don't think you have to pay over $200 for a math coprocessor. Now you can get ours for just $99 when you order direct from AMD! The AMD 80C287 is fully compatible with your 80286-based PC and the hundreds of commercially available software packages written for it. Our coprocessor is also compatible with the Intel NMOS 80287.

Installation is a snap.

The AMD 80C287 plugs easily into a socket that's already inside your 80286-based PC. In fact, you can be up and running in just five minutes. Simply plug the chip into the socket and watch the dazzling improvement in performance! The AMD 80C287 comes with easy-to-follow installation instructions, a free utilities disk (which includes diagnostics and test software), and free color computer games.

Our Triple Guarantee

Guarantee #1: If the AMD 80C287 doesn't do everything we promise, or if you are unsatisfied for any reason, return the product within 30 days of purchase and AMD will happily refund your money.
Guarantee #2: If your AMD 80C287 Math Coprocessor ever fails to perform for any reason, AMD will replace it free of charge, no questions asked. Limited to two lifetime replacements per person.
Guarantee #3: AMD guarantees that the AMD 80C287 is fully compatible with your 80286-based hardware and software. If you have any compatibility problems with the AMD 80C287 during the first year, return the product and we will gladly refund the purchase price.

To Order Call Now
1-800-888-5590 ext. 2600
Outside of USA call (512) 345-1728

☑ **Yes.** I want to double or triple the calculation speed of software running on my 286-based PC. Send me an AMD 80C287 Math Coprocessor, risk free, for only $99 plus tax, shipping and handling. I understand that I can return the AMD 80C287 for a full refund within the first 30 days if I am not completely satisfied.

NAME ______________________
ADDRESS ______________________
____
CITY STATE ZIP ______________________
Visa MC # ______________________
Type of PC ______________________

Advanced Micro Devices, Inc.
9020-II Capital of Texas Hwy N., Suite 400
Austin, TX 78759-9797

Volume or dealer inquiries welcome. 1-2-3 is a registered trademark of Lotus Development Corporation. dBASE is a trademark of Ashton-Tate Corporation. Intel is a registered trademark of Intel Corporation

Circle 18 on Inquiry Card.

Three Spreadsheet Forecasters

The new version of Crystal Ball, a Monte Carlo-based forecasting and risk analysis add-in for Mac spreadsheets, offers new forecasting tools, support for larger models than the previous version had, and compatibility with WingZ and Full Impact. The program also works with Excel. Crystal Ball 2.0 lets you pose what-if questions that contain several variables and view the results and the probability of each result.

A new Correlated Variables feature takes into consideration the relationship of two variables (e.g., the rate of inflation and discretionary income in a sales projection model) being analyzed. The CV feature generates a series of random numbers for your assumptions and tracks the results, determining when a model that appears risk-free is suspect, and vice versa.

Other improvements include support for iterative calculations, multiple linked spreadsheets, and up to 8192 forecasts generated from a single model.

Price: $395.

Contact: Market Engineering Corp., 1738 Wynkoop St., Suite 200, Denver, CO 80202, (303) 298-0020.

Circle 1275 on Inquiry Card.

Crystal Ball's trend charting tool compiles multiple forecasts from a single model, showing the probability of various results. The program generates up to 32,768 assumptions per model.

The new version of @Risk, a risk analysis and modeling spreadsheet add-in first introduced for Lotus 1-2-3, is compatible with Excel 3.0 for the Mac and Windows.

In addition to letting you launch a simulation from within Excel, it lets you launch a simulation in Excel and have any release 2.x of 1-2-3 perform the actual analysis when speed is critical. You can also run multiple simulations in the background in 1-2-3 while you continue to work in Excel. Likewise, you can choose to model in 1-2-3 but present the results using Excel.

Price: $395.

Contact: Palisade Corp., 31 Decker Rd., Newfield, NY 14867, (800) 432-7475 or (607) 277-8000; fax (607) 277-8001.

Circle 1276 on Inquiry Card.

Axcelis says the new version of its nonlinear optimization add-on for Informix's WingZ spreadsheet program for the Mac offers new reporting, analysis, and graphing features. Evolver takes over the task of trying different what-if scenarios to optimize a value in a given cell. Evolver also works with Microsoft Excel on the Mac and Windows and WingZ for Windows.

A new three-dimensional landscape feature lets you view how close the current generation of solutions is to the overall best solutions, the company says. Evolver can work in the background and requires about 50K bytes of RAM. It can optimize spreadsheets with linear, nonlinear, table-based, or random functions.

Price: $345.

Contact: Axcelis, Inc., 1406 Western Ave., Seattle, WA 98101, (800) 292-3547 or (206) 624-2446; fax (206) 622-5790.

Circle 1277 on Inquiry Card.

Timeslips Links to Mac Accounting

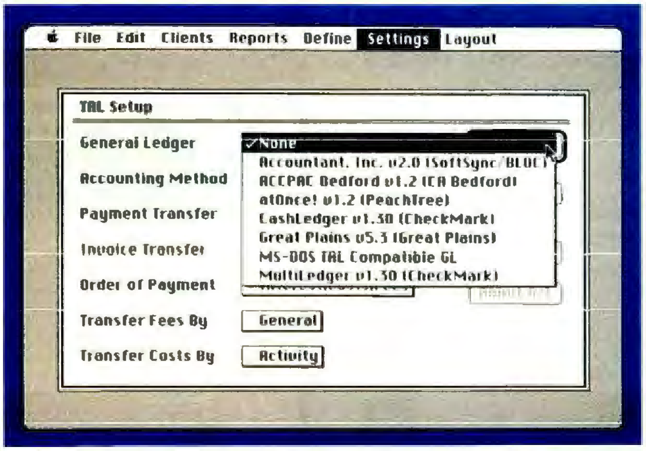
With the Timeslips III Accounting Link (TAL) for the Mac, you can link the Timeslips time and expense tracking and billing system to six general-ledger programs.

As with TAL and Timeslips III for DOS-based systems, once you install the TAL module, certain functions created in Timeslips III will be automatically posted to the linked accounting module. Timeslips III provides receivables, invoice, and payment acceptance capabilities. General-ledger programs supported include Computer Associates' ACCPAC Bedford; SoftSync/BLOC's Accountant, Inc.; Peachtree's atOnce!; Great Plains' Accounting Series; and CheckMark's MultiLedger and CashLedger. TAL for the Mac also extends the reporting capability of Timeslips III by adding open item invoicing and customized income reports such as client statements and invoice analysis reports. TAL will require Timeslips III 2.00a or higher ($299.95).

Price: $79.95.

Contact: Timeslips Corp., 239 Western Ave., Essex, MA 01929, (800) 338-5314 or (508) 768-6100; fax (508) 768-7660.

Circle 1278 on Inquiry Card.

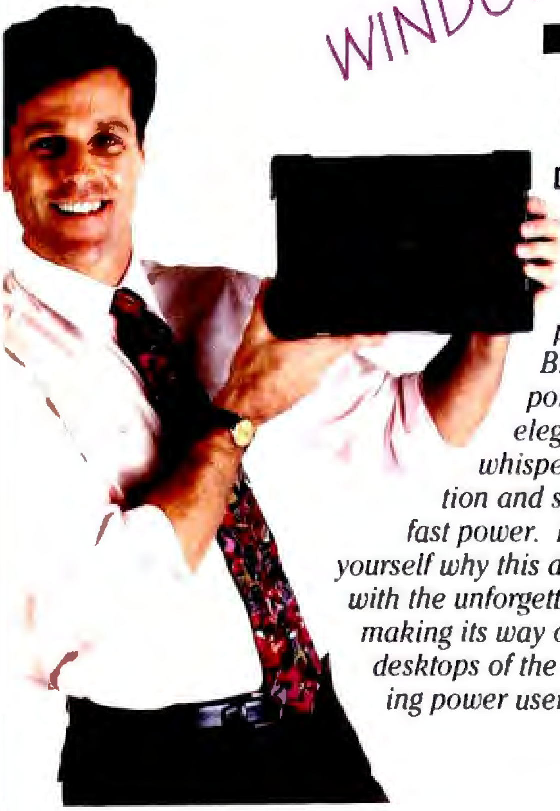


The Timeslips III Accounting Link interfaces expense tracking and billing to six general accounting programs on the Mac.

NOW WITH WINDOWS 3.0

THE BRICK™

Designed for the Way you Always Wanted to do Computing



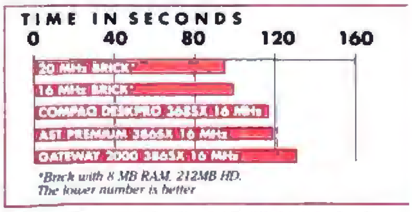
Customers and critics alike are praising the Brick for its portability, elegant design, whisper quiet operation and screamingly fast power. Find out for yourself why this diminutive PC with the unforgettable name is making its way onto the desktops of the most demanding power users.

More Practical Than a Portable

For multisite computing, the Brick offers an alternative to the usual trade-offs of laptops or multiple PC's. Just keep your preferred keyboard and full size monitor, plus power supply at your regular destination and carry only the 8 lb. Brick in between. You'll save half the cost, half the weight and all the hassle of coordinating files between multiple machines.

Blazingly Fast

Compared to published reports of **all** 386SX machines tested to date by *PC Magazine*, the Brick offers superior performance on the aggregate of



Time to complete PC Magazine's full benchmark test set.

"The Brick is... a great personal computer in every respect. It takes up minimal desk space, it's both rugged and stylish, and it's extremely fast."

Bill Machrone, **PC Magazine**, 1/91

Fits in half a briefcase, leaving room for full-sized folders, notebooks, etc.

system, video and hard disk benchmarks.

Massive Hard Disk

Bricks are available with 16 or 20 MHz 386SX, 1-8 MB of RAM, a fast 44, 104 or 212 MB Conner or Teac IDE hard disk, and a 387 coprocessor socket. A 2,400 bps Hayes compatible modem is standard.

"A whole new slant on portable computing... exceptionally ingenious."

Portable Office

12/90, Eric Grevstad

"Recommended."

Jerry Pourmelle **Byte**, 1/91,

The fast VGA graphics feature up to 1024 x 768 non interlaced resolution with a full 1 MB of video memory. In fact, the Brick's video performance is twice as fast as the average of 42 386SX systems tested to date by *PC Magazine!*

Surprisingly Expandable

The Brick is only about the size of a ream of copier paper, yet you can still add up to two ISA half cards internally, (one card with a floppy drive). A docking port allows easy, drop-in connection to our Docking Terminal, **$349**, which instantly hooks up all cables and provides another 16-bit 3/4 length slot. The "Stretch" version of the Brick accomodates full length cards.

"A Tote-able That Outperforms the Desktops."

PC Magazine

9/90, Matt Ross

Brick & Windows Hot Special

It takes more than just software and a mouse to make a satisfying Windows machine. Our Brick & Windows Special comes with 4 MB of RAM (not 2 as others provide), Windows 3.0, DOS, and a Logitech mouse with our hot 16 MHz 386SX Brick. You also get two award winning programs that are essential to fulfilling the promise of Windows. Adobe's wonderful Type Manager (ATM) with 13 fonts for true WYSIWYG display and high quality printed documents and Quarterdeck's QEMM 5.1 memory manager for running Windows on a network.

No other 386SX matches the Brick's graphics processing power, storage capacity, quietness and versatility. And while others give you Windows, we give you what it takes to make Windows 3.0 really perform.

$2,495

Brick & Windows Special includes:

- 16 MHz Intel 386SX
- 4 MB RAM
- 44 MB 28ms hard disk
- 1024 x 768 VGA adapter
- 2,400 bps modem
- 3.5" floppy
- 16-bit half card exp. slot
- 1 parallel, 2 serial ports
- Windows 3.0 and DOS
- QEMM 5.1
- Adobe Type Manager
- Logitech Mouse
- All software completely set up. Ready to go.

Options:

104 MB	add **$395**
212 MB	add **$995**
20 MHz Brick	add **$250**
8 MB RAM	add **$396**
12" mono VGA monitor & 101 keyboard	add **$218**
14" color VGA 640 x 480 monitor & 101 keyboard	add **$464**

- Freight prepaid.

Save **$881** off 1990 catalogue prices

Offer expires 5/31/91

BY491

Ergo

COMPUTING

One Intercontinental Way, Peabody, MA 01960
Tel: (508) 535-7510 Fax: (508) 535-7512

Circle 104 on Inquiry Card.

CALL TOLL FREE 1-800-633-1925
OR FAX AUTOMATICALLY 24 HRS
1-800-THE-BRICK

PV-Wave Streamlines Data Importing

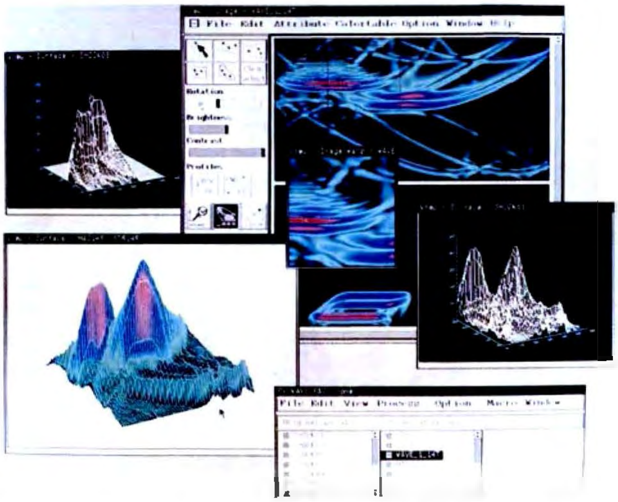
The Point & Click version of PV-Wave, an interactive visualization and data-analysis program for Unix workstations, includes an easy-to-use data import/export system, a data table editor, and graphics and imaging capabilities.

More than half of the R&D effort for the new program went into streamlining the data import/export process, Precision Visuals says. A menuing system can handle most of the data file formats used in the scientific community without requiring end-user programming. A set of tools for addressing other formats is also included.

A data previewer lets you read in and navigate through ASCII data files to identify file records and all or part of the data files with unknown formats. PV-Wave Point & Click lets you select from several missing data-handling and data value substitution alternatives, a helpful feature if you're working with time-series or test instrument data. The program supports standard CSV, TIF, PICT, and Structured Query Langauge data file formats and 8- and 24-bit image file formats.

You can use the program for data analysis and reduction, slicing and dicing, and what-if analysis. A data table window lets you scan and edit large data vectors and arrays and select data subsets. A macro language automates complex and repetitive tasks.

PV-Wave Point & Click is available for SunView and, soon, Motif-based platforms running on all Sun workstations, the Hewlett-Packard 9000/300 series, DECstations, and Silicon Graphics' Personal Iris line.
Price: $4500 for a single floating license.
Contact: Precision Visuals, Inc., 6260 Lookout Rd., Boulder, CO 80301, (800) 447-7147 or (303) 530-9000; fax (303) 530-9329.
Circle 1279 on Inquiry Card.



Precision Visuals' Point & Click version of PV-Wave lets you import, analyze, and visualize data in several windows under Motif and SunView.

Visualize and Manipulate Data on the Mac II

Transform 2.0, a program for scientific data visualization and analysis, adds new data manipulation functions to its interactive color raster-imaging techniques. Version 2.0 lets you overlay contour and vector plots onto other images for comparison while adding data smoothing, array resampling, missing data interpolation, and support for fast Fourier transforms.

For visualizing the meaning behind data sets, the program supports color contour, color surface, and vector plotting. Spyglass says version 2.0 lets you visualize two-dimensional data arrays as contour plots, where lines connect equal data values. The company also beefed up Transform's import capabilities to support data in generic files of byte, integer, or floating-point numbers, ASCII, and ASCII lists of (X, Y, data) triplets. Support for PICT, TIF, and FITS formats is also included.
Price: $395.
Contact: Spyglass, Inc., 701 Devonshire Dr., C-17, Champaign, IL 61820, (217) 355-1665; fax (217) 398-0413.
Circle 1280 on Inquiry Card.

DOS Utility Plots Data

For use with programs that can store data in the ASCII format, RPlot lets you quickly view and compare data sets from the DOS command line. It can overlay data sets on-screen or plot them on Epson-compatible dot-matrix or Hewlett-Packard LaserJet or DeskJet printers. In addition to letting you view the data, the program lets you create figures with error bars, logarithmic axes, labels, scientific symbols, and other options.
Price: $79.
Contact: RSoft, Inc., 345 Riverside Dr., Suite 2G, New York, NY 10025. (212) 666-0959.
Circle 1281 on Inquiry Card.

TK Solver Plus for the RISC System/6000

TK Solver Plus, a math equation solver and graphing program, is now available in a Motif version running on the IBM RISC System/6000. TK Solver Plus features include a virtually unlimited number of linear and nonlinear equations; tables and high-resolution plots for presenting results; over 70 built-in functions; a back solver; and provisions for creating customized functions.

A library of models with hundreds of functions for statistical analysis, advanced numeric methods, utilities, and sample applications is included with the program. The program also includes applications such as Roark & Young on TK (to accompany *Roark's Formulas for Stress & Strain*) and Heat Transfer on TK (to accompany *Fundamentals of Heat and Mass Transfer*). The program is also available for the IBM PC and Mac ($395 each) and Unix workstations.
Price: Unix versions, $995 per user (volume discounts are available); owners of Eureka: The Solver (which Borland no longer supports) can upgrade to TK Solver Plus for $195 until May 31.
Contact: Universal Technical Systems, Inc., 1220 Rock St., Rockford, IL 61101, (800) 435-7887 or (815) 963-2220; fax (815) 963-8884.
Circle 1282 on Inquiry Card.

Work with Color on Monochrome Screens

MacDraw Pro takes full advantage of 32-bit color QuickDraw and features a Pantone Matching System, file exchange through the XTND architecture, and named colors, for selecting colors on a monochrome monitor. If you use the program with a monochrome screen and select part of a drawing, the named color palette identifies the selected portion by color name or Pantone identifier, Claris says.

As you create the drawing, you can use either the polygon or bezigon tool. With polygonal modeling, you create the image by linking lines to points that you've established as you sketch the image. The bezigon tool gives you access to full Bézier curvature. An eyedropper tool lets you match colors in documents and extract colors from imported images. Other features include automatic color approximation (dithering) for displaying up to 2000 colors on a 256-color (8-bit) card, enhanced drawing tools, and rulers for precise placing and positioning of text.

The program supports Claris's XTND architecture for opening and working with images in formats such as PICT, Color PICT2, MacDraw II, Encapsulated PostScript, and others The program runs on any Mac but requires 32-Bit QuickDraw for color.

Price: $399.

Contact: Claris Corp., 5201 Patrick Henry Dr., Box 58168, Santa Clara, CA 95052, (800) 544-8554 or (408) 987-7000.

Circle 1283 on Inquiry Card.

MacDraw Pro now supports the industry-standard Pantone Matching System.

A Smoother, More Powerful Streamline

With Streamline's lower price and the ability to realistically convert and portray artwork on the computer, Adobe is going after artists and CAD users who need to convert scanned and other images into PostScript line art. The program converts bit-mapped images such as scanned drawings, illustrations, forms, or schematics into Adobe Illustrator or Encapsulated PostScript (EPS) language files.

In addition to the $200 price reduction, Streamline 2.0 adds new import and export formats for supporting other software programs. The program can now import files in Sun raster, TIF, PICT, PICT1, and MacPaint formats. As a benefit to AutoCAD and MacDraw users, the program now exports in PICT and DXF formats. The program exports to applications that support Adobe Illustrator 1.1 format, EPS files for the Mac and IBM PC compatibles, and Adobe Illustrator 3.0 for Microsoft Windows users.

A new select tool lets you convert just a portion of an image. You can use this tool in freehand mode; the program automatically invokes the select tool if a file is too large for available memory.

Streamline now converts scanned continuous-tone photographs and gray-scale illustrations into PostScript line art at 2 to 16 levels of gray. As you scan in an image, the new Separate Shapes feature can identify individual shapes (e.g., counties within a map of a state) so that you can separate them from the whole image for later editing. It does this by duplicating coincident borders and transparently attaching a border to each shape.

This duplication, which you can't see on the image, lets you treat each state individually, separating it from the rest of the image for further editing or color manipulation. The program also can be set to assign colors to the output based on types of line or area from the input file.

When the program imports scanned forms, it can strip out text from the document during line recognition and compensate for imperfectly squared images, converting lines skewed up to 5 degrees into perfect lines.

The program provides effects such as pen and ink, pastel, or charcoal and brush. Streamline 2.0 runs on any Mac. Adobe is also developing a Windows 3.0 version.

Price: $195.

Contact: Adobe Systems, Inc., 1585 Charleston Rd., P.O. Box 7900, Mountain View, CA 94039, (415) 961-4400; fax (415) 961-3769.

Circle 1284 on Inquiry Card.

SPREAD THE WORD

Your new product is important to us. Please address information to New Products Editors, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Better yet, use your modem and mail new product information to the microbytes.hw or microbytes.sw conferences on BIX. Please send the product description, price, ship date, and an address and telephone number where readers can get more information.

Clip Art for Artists

Slide Link, a 35mm-slide service bureau, has released Backgrounds1, a selection of corporate and high-tech designs in more than 250 styles and color variations. You can use the images with programs that support CGM files with more than 16 colors and IMA files for Mirage and Pixie users. A PICT version for the Mac is also available.

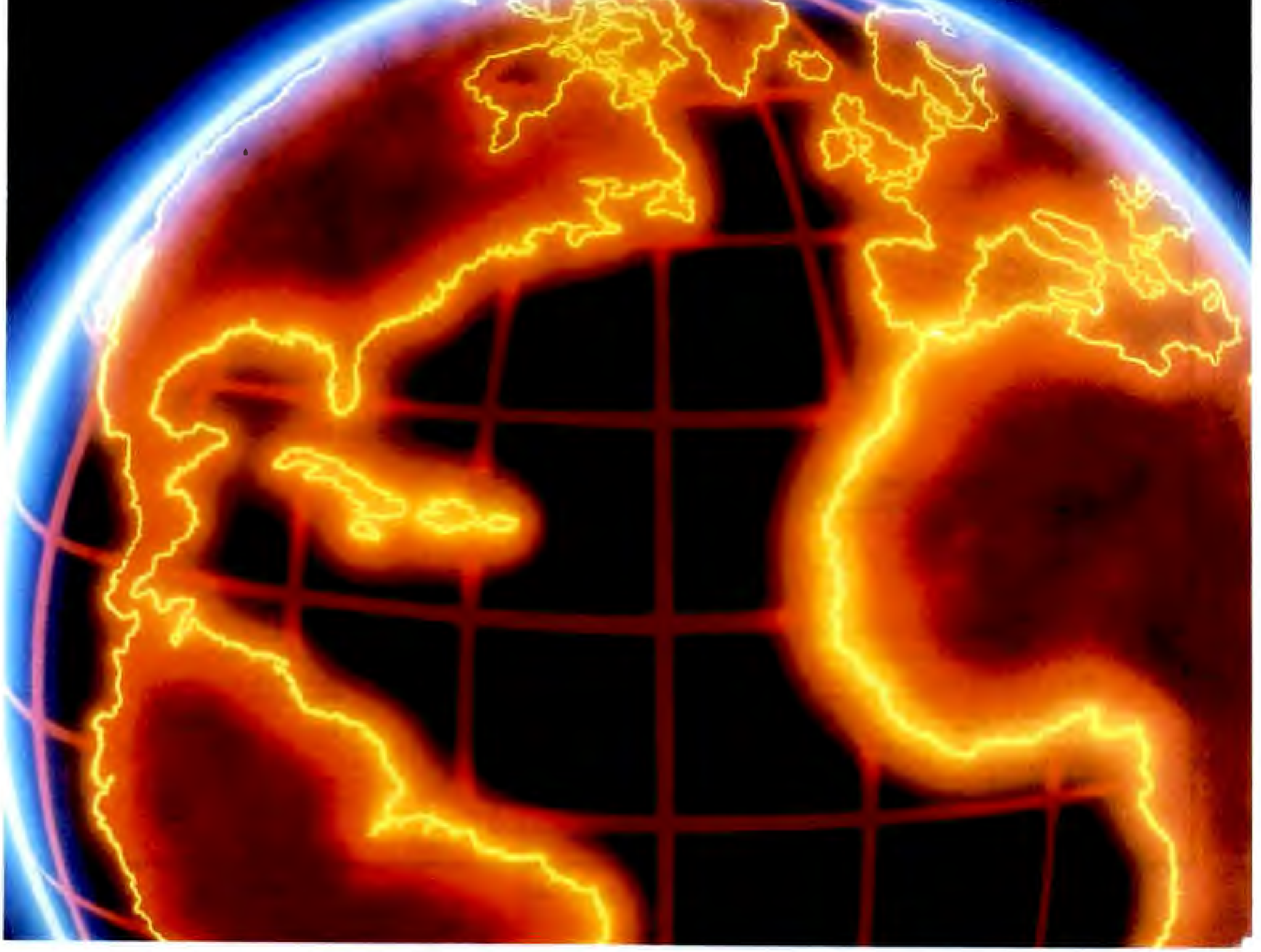
Price: $250.

Contact: Slide Link, Inc., 17951 Sky Park Cir., Suite E, Irvine, CA 92714, (714) 250-3131; fax (714) 250-0518.

Circle 1286 on Inquiry Card.

BYTE

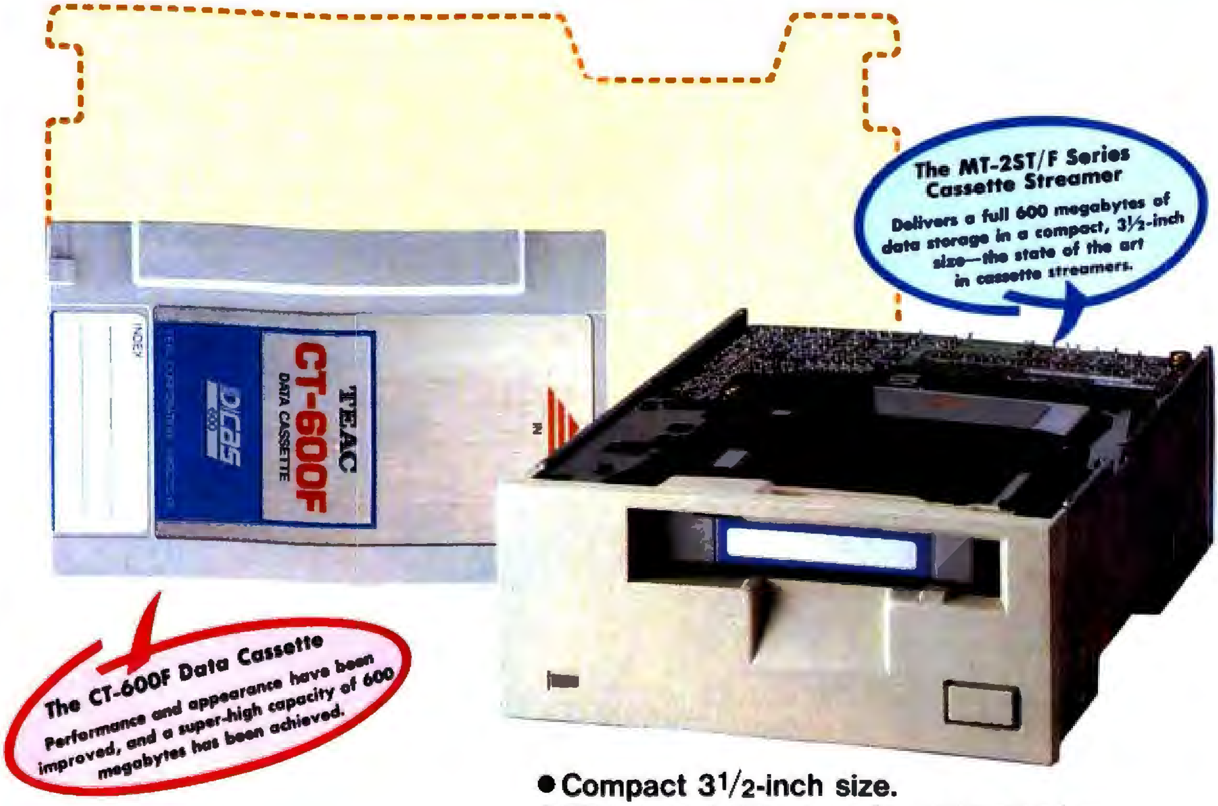
INTERNATIONAL



STREAMERS FOR SCREAMERS!

TEAC®

SMALL IN SIZE (3½ INCH FORM FACTOR). HUGE IN CAPACITY (A FULL 600MB).



- Compact 3½-inch size.
- High-speed data transfer: 242.3KB/sec.
- A choice of interfaces: SCSI or D/CAS-5.
- Autoeject function.
- 5¼-inch form factor models also available.

3½-inch Form Factor Cassette Streamer

MT-2ST/F SERIES

For Memories You'll Be Glad To Have

TEAC CORPORATION Musashino Center Bldg., 1-19-18 Naka-cho, Musashino, Tokyo 180, Japan Tel:0422-52-5041 Telex:34435 Fax:0422-55-2554

■**Hong Kong,** Nissei Sangyo Co., Ltd. Hong Kong Branch Tel: 3-343441-6; KARIN ELECTRONIC SUPPLIES CO., LTD. Tel: 3-898252 ■**Singapore,** NISSEI ELECTRONICS, LTD. SINGAPORE BRANCH OFFICE Tel: 2357900; UAC SINGAPORE REP. OFFICE Tel: 2922608 ■**New Zealand,** DATAMATIC NETWORKS LIMITED Tel: 09-444-0760 ■**Australia,** AWA DISTRIBUTION Tel: 02-888-9000 ■**Indonesia,** CHUGAI BOYEKI CO., LTD. Tel: 370824 ■**Philippines,** COMPEX INTERNATIONAL INC. Tel: 213020 ■**India,** Priya Electronics & Chemicals Limited Tel: 2863611 ■**Kuwait,** Bader Al Mulla & Brothers Co. W.L.L. Tel: 2423250 ■**United Kingdom,** TEKDATA LIMITED Tel: 0782 577677; Data Peripherals (UK) Limited Tel: 0785 57050 ■**F.R. Germany,** nbn Elektronik GmbH Tel: 08152/390 ■**Austria,** nbn Elektronik GmbH Tel: 0316/40 28 05 ■**Netherlands,** SIMAC DATA B.V. Tel: 040-582933 ■**Belgium & Luxemburg,** SIMAC ELECTRONICS SPRL/BVBA Tel: 02/252.36.90 ■**France,** TEKELEC AIRTRONIC S.A. Tel: (1)4534-75-35 ■**Italy,** A.E.S.S.E. S.p.A. Tel: 02/54.64.741 ■**Spain,** ATAIO INSTRUMENTOS S.A. Tel: 735-0252 ■**Portugal,** BASF PORTUGUESA LDA. Tel: (351) 1-562511 ■**Switzerland,** WENGER PERIPHERALS AG Tel: 01/830 75 55 ■**Denmark,** Dansk Binaer Teknik A/S Tel: 03/66-20 20 ■**Sweden,** MACROTEK AB Tel: 08-733 02 20 ■**Norway,** SCANTELE A/S Tel: (02)65 69 20 ■**Finland,** INSTRUMENTARIUM CORPORATION Tel: 90-528 4338

** If no distributor listed above is in your area, please contact us directly for further details about our products.*

Circle 468 on Inquiry Card.

NEWS

INTERNATIONAL MICROBYTES

Industry news and technological developments in the international microcomputer market
Written by Andy Redfern

Peace Message Holds Promise of Storage Breakthrough

In a development that hints of future storage possibilities, scientists at the Hitachi Central Research Labs have managed to write this year's smallest peace message—in letters that are less than 2 nanometers high. By removing individual sulfur atoms from the surface of a molybdenum disulfide crystal, the researchers at the Hitachi facility in Kokubunji, Japan, were able to "write" the words "PEACE '91 HCRL." As a message of peace to the world's leaders, it will probably go unnoticed. But as an indication of future computer-storage technology, it could mark a major breakthrough.

By using a scanning tunneling electron microscope, the researchers destroyed atoms on the surface of the crystal. They applied a 5½-V signal for 70 ms, just 3 angstroms above the crystal surface, causing the nearest atom to become displaced from the lattice.

The potential is phenomenal. Hitachi claims that a storage device operating at an atomic level could store 1 terabyte (1000 gigabytes) of data in an area less than half a millimeter square—a volume of data that would currently need a huge array of magnetic disk drives to store.

Of course, the gulf between minuscule graffiti and producing a reliable storage medium is immense. Surface faults, problems with reading and writing the medium, and the current cost of the equipment prove that it will be many years before this type of data repository reaches the open market. IBM scientists performed a similar feat last year, writing "IBM" in letters constructed out of xenon atoms. But not only are the Hitachi letters smaller, IBM's technique could only be performed at temperatures approaching absolute zero.

Citizen Shrinks One Floppy, Has Trouble with 20-MB One

Citizen Europe has designed a new floppy disk drive that could lighten the load of laptop and notebook users. The new V Series floppy disk drive is only 15 mm tall, which is less than two-thirds the height of its predecessor. And at 168 grams, it weighs less than 50 percent of the weight of a comparable device.

The new drive currently supports the industry-standard duo of 720K-byte and 1.44-MB floppy disks, but a new version, slated for the fourth quarter of this year, will also support 4-MB floppy disks. Although Citizen says that the drive is in full-scale production, OEMs are not expecting major deliveries until May or June.

Citizen says that notebook manufacturers have welcomed the arrival of the drive, but the company would not say exactly who had done the welcoming. Compaq, Toshiba, and Zenith have all shipped products with Citizen floppy disk drives before, and they are all investigating the new drive's potential; however, none would comment on whether future products would use the drive. Industry insiders said that at least one machine using the 15-mm-high drive would be launched in March at the CeBIT show in Germany.

A much less promising development is Citizen's admission that its 20-MB floppy disk drive has been further delayed. Samples of the drive should have been delivered to OEMs already, but Citizen officials are not expecting even limited production quantities of the drive until the end of this year. The product was initially announced at the end of 1989 by Citizen Europe's parent company in Japan.

The problem with the 20-MB drive appears to be in the process used to make the disk drive head. Even though the

NANOBYTES

The **Siemens-Nixdorf-Informationssystem** conglomerate holds a strong second place in the lucrative German computer market, according to recently published statistics from Diebold. The overall winner is IBM (so what's new?), with 33 percent of the DM-22-billion (about US$15 billion) market, while SNI took 22 percent of the total information systems sales during 1989 (17 percent went to Siemens, and 5 percent to Nixdorf). DEC is third, with 6 percent. Much of SNI's business comes in the mainframe sector, but according to Diebold, it also holds (under the Siemens name) second place in the personal computer sector: 8 percent, compared to IBM's 20 percent. These 1989 figures refer only to West Germany (as was). Now, Germany (East and West) represents a single market that the German-based SNI group is well positioned to exploit.

The vast **majority of German PCs** are 286-based machines running DOS, according to research figures from Diebold. Systems based on the 386 and i486 are gradually gaining momentum, the analysts say. Unlike the rest of the world, **the Germans aren't rushing to buy laptops**. Diebold researchers predict that laptops will represent only 16 percent of the German PC market in 1995, compared with 1989's 12 percent.

Speaking of small computers, observers of the Far East predict that a **wave of notebook-size machines** from that area will be coming on the market soon. This proliferation of mostly Taiwanese notebooks will mean a fall in prices, to end-user costs of less than $2000 for an SX system, some analysts say.

product worked well in the lab and in the few preproduction drives that were made, yields have been low. Sources within Citizen claim that a new, more reliable head design has been developed, and they are confident that once production begins, the price will be low enough to compete with those of 20-MB hard disk drives. The Citizen 20-MB floppy disk drive is expected to sell for around $200 each (OEM quantities), with the disks costing around $20 each. Citizen also says that the new head will be backwardly compatible with current 3½-inch floppy disks, as well as prospective 4-MB floppy disks.

The Bat: New Device Like a Mouse with Wings

Getting around a graphical user interface without a mouse has become almost unthinkable. And researchers at London University say that in the future, using a 3-D visualization or virtual-reality application without a "bat" will be equally unheard of.

The bat, designed by Allan Davison and Mel Slater, aims to be a simple way of communicating the mouse's missing dimension: depth positioning. The bat's design includes a spherical ball that sits on top of the device. By placing the ball in your palm, you can move it around the surface of a table. You can also tilt and twist the ball to move the pointer from front to back or left to right.

The developers claim that the bat is simple to control; the real operating difficulties only come from a confused screen metaphor. Move a mouse left, and the cursor moves left. But if you twist the bat to the right, does the whole screen image swivel, or does the cursor simply point in another direction? Well, it can do either, depending on which software you use. Unlike a window/icon mouse pointer interface, there is no standard metaphor for what each of the bat's physical movements should reproduce electronically on the screen. Davison says that they continue to experiment with different metaphors to find one suitable for every possible 3-D application.

The bat is intended to compete with a current virtual-reality interface device called the *dataglove* that translates the physical movement of the user's hand into electronic movement on the screen. But the bat is expensive, and you must wear it, making it impractical.

The two inventors patented the bat themselves and presented their work at a conference in London earlier this year. Since then, they've met parties, including the British Technologies Group venture capital firm, who are interested in the bat's commercial possibilities. There are no plans for the bat to go into commercial production yet, but the high speed of development in the virtual-reality industry means that once a standard metaphor is adopted, the bat could become as well-loved as the mouse.

Quarterdeck Software Now Made and Supported in Europe

Quarterdeck's European strategy is coming together. All the firm's products are now in production at its Irish facility (in Dun Laoghaire, Eire), and distributors were expecting to receive stock that was made in Europe in March. A multilingual team, based in Ireland, will provide European technical support. Many users outside of Dublin have complained about the expense of calling technical support. Quarterdeck has finally set up local numbers in each country to solve this problem.

Although some pundits said that Microsoft Windows 3.0 would be the end of Quarterdeck, the company claims the reverse. Sources close to Quarterdeck say that European sales of the Windows-compatible version of QEMM (version 5.11) were up 400 percent last quarter. The more likely casualty of Windows 3.0 would be Desqview, but we could not verify any information on Desqview's sales since the debut of Windows 3.0.

WANTED: TECHNOLOGY NEWS

Are you involved in the development of new technology or products that could affect the international microcomputer market? If so, we'd like to hear from you. Contact BYTE in the U.S. by phone at (603) 924-2638; fax: (603) 924-2552; or mail: Martha Hicks, BYTE Magazine, One Phoenix Mill Lane, Peterborough, NH 03458, U.S.A.

NANOBYTES

The **government of Spain** spent more than 68 billion pesetas (about US$700 million) on computers and other information technology, according to a new study by the Spanish Ministry of Public Administration. The total represents a 60 percent increase in expenditures on computers (mostly mainframes, and mostly IBM).

WordStar International has opened offices in Singapore, Hong Kong, and Malaysia, which should bring better support for its customers in those areas, as well as South Korea, Taiwan, and the Philippines (the latter three to be supported by the Hong Kong branch). In the past, WordStar users have had to contact the product's distributor for help.

In the surprise legal move so far this year, **Compaq Computer** served a writ against **Dell UK** and applied for an injunction to stop Dell advertisements that carry comparative price and performance information. The supposedly offending advertisements, which suggest that Compaq and Dell are comparable in everything but price, often run under headlines like the "Lap of Lunacy" and "Does not compute." The ads have run worldwide, but this suit relates only to the U.K. Some observers speculate that Compaq objects to the recommended retail prices quoted in the advertisements, since Compaq's dealers can give a discount (Dell always sells at the advertised price).

Apologies to Asterix: In our coverage of the Robotic Olympics (see the December 1990 and January BYTE), we incorrectly identified the winner of the obstacle avoidance competition. The real winner was **Asterix**, built by **Anthony Green** and **Pavel Rozalski** while studying AI at the University of Toronto. "Although not nearly as good-looking as its competitors, Asterix was the only competitor that didn't hit anything," Mr. Green said in a letter. We apologize for the error.

OUR BRILLIANT DISPLAYS CARRY A CLEAR MESSAGE.

Our range of data monitors is a brilliant collection of highly versatile units - each one ready to give you a precise and vivid display.

InterQuad provide exactly what you are looking for; sharp images, crisp text, and vivid colours, all presenting the information you need with faultless clarity.

Here is the reliability and the performance you require to meet present and future information display needs to perfection.

'Quality' is the ultimate message which shines out clearly from every screen.
These display monitors are designed and manufactured to the highest standards, with every unit passing a series of stringent test procedures.

They also have 'the right attitude' to everyday working - all feature an integral tilt and swivel base permitting choice of the best viewing position for comfort and convenience. The result: monitors which will be an asset to any office.

A BRAND NEW 14"! Look closely at our new autoscanning 14" intelligent high resolution monitor! (Main illustration). It automatically synchronises 31.5 and 35.5 kHz and 50 to 90 Hz.

The AC1440 supports VGA, Super VGA (800 x 600) and IBM 8514A (1024 x 768 interlaced) and has a dot pitch of 0.28mm. The AC1448 supports 1024 x 768 non interlaced.

InterQuad can give you a completely fresh angle on brilliant graphics, data, and whatever you want to see.

Contact us at the address below.

AC1440/AC1448.
14" super VGA up to 1024 x 768 interlaced and non-interlaced.

MS 1480 New.
14" Multiscan colour monitor for XT/AT and PS/2 families of Personal Computers.

AM 1412.
14" Analog Mono high resolution 720 x 480 ideal for DTP and WP type applications

AC 1432.
14" Analog Colour VGA monitor compatible with all VGA systems including the IBM PS/2 range

INTERQUAD
LIMITED

*INTERQUAD have international distributors: **AUSTRIA**, Micropoint Warenvertriebs GmbH. Tel: 02236 82575. **BELGIUM**, Cloetens Distribution. Tel: 03 828 2823. **CYPRUS**, Mechatronic Ltd. Tel: 024 44192 **DENMARK**, Techware A/S. Tel: 42 94 80 33 **HOLLAND**, Akam Electronics bv. Tel: (0) 79 443200 **ICELAND**, Ortolvutaekni-Tolvukamp hf. Tel. 354 1 687220. **ISRAEL**, Hal Computers Ltd. Tel: 03 575 0625. **ITALY**, Bit Computers Gruppo S r 1. Tel: 06 429 5236. **NORWAY**, Dataimport AS. Tel. 05 314085. **PORTUGAL**, Decada Equipamentos de Electronica e Cientificos. Tel. 01 574984. **SPAIN**, SDI SA. Tel: 01 413 7246 **SWEDEN**, Dataimport AB. Tel: 08 716 94 55 **SWITZERLAND**, Mini-Peripherals AG. Tel. 042 36 58 77. **YUGOSLAVIA**, Boman Establishment (Liechtenstein). Tel: 75 23945 **KENYA**, Computech Consulting Services Ltd. Tel: 02 721314. **GREECE**, Plural SA. Tel: 6550827*

InterQuad Limited 653/654 Ajax Avenue, Slough, Berkshire SL1 4BG. England. Tel: (44) 753 36464/(44) 753 34421 ext 139 Telex: 847542 INTQAD G. Fax: (44) 753 77256
Germany: InterQuad Computer GmbH Tel: (49) 6102 20 080. France. InterQuad S.A.R.L. Tel: (33) 1 46840515.

Circle 444 on Inquiry Card.

Compuclassics

Your Source For Software

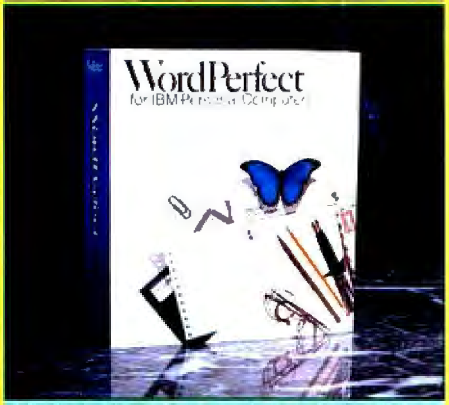
TO ORDER, OR INQUIRE CALL
800-733-3888
OR FAX YOUR ORDER
818-347-9977

ACCOUNTING	
DAC Easy Accounting	85.00
Pacioli 2000	35.00
Peachtree Double Bonus Pack	235.00
Quicken 4.0	39.00
Timeslips III	195.00
Turbo Tax 1040 Personal	42.00
Turbo Tax 1040 Professional	229.00
CAD	
Autosketch 3.0	149.00
Design Cad 3D 3.1	205.00
Design Cad 2D 4.2	155.00
Generic Cadd 5.0	235.00
COMMUNICATIONS	
Carbon Copy Plus 5.2.2	109.00
Close Up Customer 3.0	129.00
Compuserve Membership Kit	22.00
Mirror III 2.0	89.00
PC Anywhere IV	99.00
Procomm Plus V2.0	65.00
Reflection 2+ 4.0	225.00
Reflection 4+ 4.0	299.00
Smarterm 340	199.00
Smarterm 320 V1.2	135.00
Smartcom Exec 2.0	75.00
DATABASE	
Clarion Personal Devel 2.0	52.00
Clarion Professional Devel 2.1	475.00
Clipper 5.0	529.00
Data Ease 4.2	459.00
DBase IV 1.1	489.00
Foxbase Plus S/U 2.1	195.00
Foxpro S/U 1.02	455.00
Monarch 1.0	315.00
Paradox 3.5	525.00
Paradox 3.5 Upgrade	145.00
PC File 5.0	89.00
R & R Rel Rept Writer 4.0	155.00
UI Programmer	342.00
DESKTOP PUBLISHING	
Bitstream Fonts (each)	85.00
Freedom of Press Light	59.00
Freedom of Press 2.2	249.00
Goscript Plus	179.00
PFS First Publisher 3.0	95.00
Professional Clip Art Gallery	159.00
Readright	319.00
The New Print Shop	39.00
Ultrascript Plus	279.00
Ventura Publisher Gold	549.00
EDUCATION/ ENTERTAINMENT	
Flight Simulator 4.0	39.00
Kings Quest V	45.00
Language Assistant French	45.00
Language Assistant German	45.00
Language Assistant Italian	45.00
Language Assistant Spanish	45.00
PC Globe 4.0	39.00
Simcity	33.00
Simearth	45.00
Test Drive III: The Passion	37.00
Where In The World...Deluxe	52.00
FORMS/FLOWCHARTING	
Flowcharting III	145.00
Formtool Gold	59.00
Formtype Complete	169.00
Interactive Easyflow 6.1	105.00
Org Plus Advanced 5.0	65.00
Perform 2.1	85.00
GRAPHICS	
Dan Bricklin Demo II 3.0	189.00
Deluxe Paint II Enhanced	85.00
Drawperfect 1.1	279.00
Freelance Plus 3.01	329.00
Harvard Graphics 2.3	299.00
Hijaak 2.0	99.00
Hot Shot Graphics	149.00
Inset Plus (w/HiJaak)	135.00
PC Paintbrush IV	65.00
PC Paintbrush IV Plus	112.00
Pizazz Plus 2.0	65.00
Presentation Task Force Drw	175.00
HARDWARE & PERIPHERALS	
Adobe Postscript Cartridge	299.00
ATI VGA Wonder+ 256 W/Mse	209.00
Best Data Traveller	169.00
Best Data9624Fax/Modem Brd	185.00
Canon BJ-10E Bubblejet	349.00
Copy II PC Option Board Deluxe	115.00
Hardcard IIXL 50MB	409.00
Intel 80387-SX	305.00
Intel Satisfaxion Board	395.00
Logitech Bus Mouse	85.00
Logitech Serial Mouse	75.00
Logitech Scan Man Plus	159.00
Logitech Scanman 256	319.00
Logitech Trackman Serial/Bus	89.00
MS Mouse w/Win 3.0 Ser/Bus	159.00
MS Mouse w/Paint Serial/Bus	105.00
Pacific Data 1-2-4 Plus w/0MB	115.00
Pacific Data 1-2-4 Plus w/2MB	245.00
Pacific Page /2MB Memory Brd	365.00
Pacific Page Personal Edition	365.00
Pacific 4 Memory Board w/0MB	75.00
Pacific 4 Memory Board w/2MB	199.00
Pacific 4 Memory Board w/4MB	335.00
25-In-One Font Cartridge	269.00
Plotter In A Cartridge	249.00
Plotter In A Cartridge P.E.	239.00
Proc. Periph 2400 Ext V.42 Bis	215.00
Proc. Periph 2400 Int V.42 Bis	179.00
Super Cartridge 1 by IQ Enging	275.00
Super Cartridge 2 by IQ Enging	479.00
Worldport 2400	229.00
Worldport 2400 w/MNP	339.00
Worldport 2496	469.00
Worldport 9600	635.00
Zoom Int 24/96	95.00
Zoom Ext 24/96	105.00
INFORMATION MANAGEMENT	
askSam 5.0	175.00
Calendar Creator Plus 3.0	45.00
Infoselect 1.1	55.00
Instant Recall	69.00
Lotus Agenda 2.0	299.00
Quick Schedule Plus	62.00
INTEGRATED	
Eight In One 2.0	39.00
Lotus Works	95.00
MS Works 2.0	95.00
PFS First Choice w/Prodigy	92.00
Symphony 2.2	509.00
LANGUAGE/ PROGRAMMING	
Brief 3.0	179.00
BTree Filer Multiuser	119.00
BTrieve 5.1	439.00
C Tools Plus	92.00
Xedit	105.00
MS Macro Assembler	99.00
MS Basic 7.1 Devel System	329.00
MS C 6.0	329.00
MS Fortran 5.0	299.00
MS Quick Basic 4.5	67.00
MS Quick C 2.5	67.00
Norton Editor 2.0	68.00
Object Professional 1.1	129.00
Powerbasic	79.00
Power Tools Plus	92.00
Smalltalk V 286	129.00
Turbo C ++ Professional	199.00
Turbo C ++ Prof Upgrade	149.00
Turbo C Tools	92.00
Turbo Pascal 6.0	99.00
Turbo Pascal Professional 6.0	199.00
Turbo Professional	85.00
Zortech C ++ 2.1	149.00
NETWORKING	
Lantastic 2MBPS Adapter	165.00
Lantastic 2MBPS Starter Kit	359.00
Lantastic Ethernet Adapter	225.00
Lantastic Ethernet Starter Kit	509.00
Novell NE1000	169.00
Novell NE2000	199.00
Western Digital Ethercard Plus	155.00
Western Digital Ethercard + 16	189.00
Word Perfect Office 5-Pack	329.00
Xircom Pocket Ethernet Adapter	399.00
OPERATING ENVIRONMENTS	
Desqview 2.3	82.00
Desqview 386 2.3	135.00
DR DOS 5.0	139.00
Geoworks Ensemble	125.00
HP New Wave	115.00
MS DOS 3.3 or 4.01	72.00
OS/2	
MS Word for OS/2	335.00
Multiscope OS/2 Debugger 1.1	309.00
Smalltalk/V PM	299.00
PROJECT MANAGEMENT	
Harvard Project Manager 3.01	455.00
Scitor Project Scheduler V	429.00
Timeline 4.0	469.00
STATISTICS/SCIENCE	
Brainmaker	149.00
Chi Writer Deluxe	249.00
Derive	139.00
Grapher	145.00
Mathcad 2.5	319.00
Mathematica 386 w/387 Supp	845.00
Print A Plot 2.0	189.00
Sigma Plot	435.00
Sourcer w/Bios	135.00
SPSS/PC Plus Base	185.00
Statgraphics	569.00
Surfer	359.00
Systat 5.0	649.00
SPREADSHEET	
Allways (Lotus 1-2-3 or Sympy)	119.00
Baler XE	579.00
Impress	79.00
Lotus 1-2-3 Ver. 2.2	339.00
Lotus 1-2-3 Ver. 3.1	419.00
Quattro Pro 2.0	319.00
Quattro Pro Upgrade	95.00
Sideways 3.3	59.00
Baler 5.1	359.00
UTILITIES	
1 Dir + 3.5	49.00
386 To The Max 5.1	
Above Disk 4.0	65.00
Amidiag	59.00
Automenu 4.7	39.00
Blue Max for PS/2	85.00
Brooklyn Bridge 3.0	89.00
Central Point Back-up	63.00
Check It	85.00
Copy II PC 6.0	27.00
Copywrite	65.00
Direct Access 5.0	65.00
Disk Manager	39.00
Disk Technician Gold	95.00
Fastback Plus 2.1	115.00
Headroom 2.0	65.00
Lap Link Release III	92.00
Lotus Magellan 2.0	109.00
Mace Utilities 1990	92.00
Move Em (286 to the Max)	55.00
Netroom (10 User)	159.00
Netroom Single User	49.00
Norton Antivirus	89.00
Norton Commander 3.0	99.00
Norton Utilities Advanced 5.0	115.00
PC Kwik Powerpak 2.0	75.00
PC Tools Deluxe 6.0	87.00
Power Menu	59.00
Print Cache	99.00
Print Q 5.0	89.00
Q-Dos II	39.00
Qemm 386 5.1	62.00
Qram	52.00
Software Bridge 4.1	79.00
Software Carousel V5.0	55.00
Spinrite II	67.00
Virex PC	75.00
XTree Gold 2.0	95.00
WINDOWS	
ABC Flowcharter	185.00
Actor 3.0	829.00
Adobe Type Manager	59.00
AMI Professional	305.00
Arts & Letters Graphics Editor	465.00
Asymetrix Toolbook	299.00
Bitstream Facelift	59.00
Corel Draw 2.0	389.00
Crosstalk For Windows	125.00
Dynacomm Asynch for Windows	189.00
Faxit for Windows	169.00
Folio Views	369.00
Grammatik IV for Windows	52.00
hDC Windows Express 3.0	52.00
hDC First Apps	52.00
IBM Current 1.1	235.00
Language Master for Windows	59.00
Micrografx Designer 3.01	485.00
Micrografx Charisma	345.00
MS Excel V3.0	319.00
MS Powerpoint for Windows	319.00
MS Project for Windows	469.00
MS Windows 3.0	99.00
MS Windows Entertainment Pak	29.00
MS Windows Productivity Pack	45.00
MS Windows Software Dev. Kit	335.00
MS Word 1.1 for Windows	325.00
Omnipage 386 V3.0	469.00
Omnipage Professional	655.00
Owl Guide	395.00
Packrat 3.0	255.00
Pagemaker V4.0	499.00
Perform Pro	279.00
Professor Windows	30.00
Soft Type	115.00
Spinnaker Plus	285.00
Superbase 4 for Windows	425.00
Thinx	209.00
WIN Connect	82.00
Winfax	49.00
Wingz	339.00
Wordscan Plus 2MB	699.00
Xerox Formbase 1.1	319.00
WORD PROCESSING	
IBM Displaywrite V 2.1	245.00
Facelift for Wordperfect	59.00
Grammatik IV	52.00
MS Word 5.5	229.00
Professional Write w/Pro File	165.00
Rightwriter 4.0	55.00
WordPerfect 5.1	249.00
WordPerfect 5.1 Station	159.00
WordStar 6.0	249.00
XENIX/UNIX	
Interactive Unix Op Sys 1-2 User	329.00
Interactive Dev. System	509.00
SCO Foxbase + 386	715.00
SCO Unix Develop Sys 386	715.00
SCO Unix Operating Sys 386	675.00
SCO VP/IX (Unlimited)	645.00
SCO VP/IX (2 User)	355.00
Wordperfect for SCO Xenix 5 User	509.00

PRE-SPRING SPECIALS

- **BUY KNOWLEDGE PRO WINDOWS FOR $625 and GET Math Toolkit FREE!**
  BUY FREELANCE PLUS RECEIVE CALCULATOR/PEN SET *FREE!*
- BUY PC TOOLS RECEIVE A PC TOOLS KEY RING *FREE!*
- BUY LOTUS 1-2-3 v3.1 AND GET *FREE* AMI PRO (19.95 MANUFACTURER'S SHIPPING CHARGE) AND RECEIVE NEXT 1-2-3 UPGRADE FOR $49 *(OFFER VALID UP TO 6 MONTHS FROM PURCHASE DATE)*
- BUY ANY SPC SOFTWARE GET HARVARD GRAPHICS MOUSE PAD *FREE*

All promotions good while supplies last.



***WORDPERFECT® 5.1** Includes the Tables feature which automatically encloses data you create. The Equation Editor includes an extensive collection of symbols, characters, and mathematical functions. You can define mailing label formats, hyphenation is now dictionary-based, mouse support is offered, and spreadsheets can be imported into WordPerfect 5.1 documents.*

Special Value $249.00

***RUN YOUR 386 TO THE MAX!** 386MAX and BlueMAX for PS/2s let you get MAXimum performance out of your 386. Unique FlexFrame technology allows 386MAX to load more programs into high DOS than any other memory manager. Both are Windows 3.0 compatible, and our exclusive instancing capabilities allow many resident programs to run reliably in the Windows environment.*

386MAX $72. BlueMAX $85.

A GREAT DEAL IN ANY LANGUAGE!
... TRANSLATE ENGLISH into Spanish, French, German or Italian
LANGUAGE ASSISTANT
ONLY $45 each

800-733-3888/818-347-7500/FAX 818-347-9977

PLEASE CALL US FOR PRODUCTS NOT LISTED.
WE WELCOME CORPORATE AND INTERNATIONAL ORDERS. WE SHIP TO APO & FPO ADDRESSES
Please Specify Disk Size When Ordering

Immediate shipment on purchase orders from government and state agencies, cities, counties, school and universities. • Prices subject to change without notice • We ship the latest versions. • We accept Visa, Master Card, and American Express. • 2% surcharge on American Express. • 15% restocking fee for all non-defective items returned. • Please call (818) 347-9400 for an authorization number on 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. • (Domestic Sales) $5.50 minimum shipping per item, less on bulk orders. • $10 Blue Label shipping • $4.50 C.O.D. charge. • International sales call for freight pricing. • 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. Monday to Friday (PST), Saturday 10 A.M. to 2 P.M.

Circle 421 on Inquiry Card.

P.O. Box 10598, Canoga Park, CA 91309 • Showroom: 7959 Deering Ave., Canoga Park, California 91304.

Kyocera's Multilight IIIsx

COLIN BARKER

Kyocera has entered the European personal computer market with a 386SX system

Kyocera Electronics is best known for its laser printers, but the company recently decided to expand its activities into personal computers. The company's European management persuaded the head office to design and manufacture personal computers that would only be available in Europe. The Multilight family consists of a 386SX, a 25-MHz 386, a 33-MHz 386, and EISA-based 486 tower systems. If the 386SX is any clue, these systems will be stylishly designed and well made.

Why launch a system just for Europe? Kyocera thinks the European personal computer market is much more fragmented than the U.S. or Japanese markets. While Compaq and IBM are at the top of the quality spectrum, they account for less than half of high-end sales, and no company dominates the other half of the market. Although the market looks crowded with suppliers, many have a sizable market share in only one or two European countries. In Kyocera's view, the market is wide open, and there is still a chance to become a serious contender.

A High-End Machine

The Multilights are high-end machines, and they look the part. I tested the Multilight IIIsx, which is at the bottom of the range but is still a sleek and powerful system. It is compact, measuring 67 by 317 by 320 millimeters, designed to pack the maximum features into the smallest possible space, with little room or need for expansion, apart from a modem. It is powered by a 20-MHz 386 microprocessor and has a generous 2 megabytes of RAM, with the option to expand this to 4 MB on-board. The hardware supports EMS 4.0.

The system uses an Intelligent Drive Electronics hard disk drive controller, which is located on the motherboard and controls the standard 50-MB hard disk drive. There is a connector on the back of the machine to attach an external 100-MB hard disk drive. The standard connections are generous, with two serial ports, a parallel port, and an LCD monitor connection along with the VGA monitor attachment (the motherboard supports VGA). The keyboard plugs into the front of the unit, and the system has a Microsoft-compatible mouse. The only floppy disk drive available is a 3½-inch internal unit. Kyocera sees no need to support monochrome monitors, so it offers a 14-inch multiscan Sony Trinitron monitor.

The unit is small enough to fit into a briefcase, although at 20 pounds with keyboard and cables it is not light. The LCD screen makes the system semiportable. It would be OK to take it home at night, but it is not the sort of system you are going to carry around the world.

Graceful Design

While it is not small enough to carry around easily, the unit looks great on the desktop. It is one of the new generation of systems that is trying to distinguish itself with style. The designer approach to the personal computer has been attempted by many suppliers, with distinctly mixed results. But Kyocera, like other companies (Victor is a good example), thinks executives no longer equate computer size with power. This is a system whose compactness and eye-catching two-tone design aim to distinguish it from the rest of the pack.

The software offered includes DOS 4.01 and Phoenix Technologies' DOS Help! utility. Unlike with most systems, the documentation is crammed with information, with all you need to know about the system and a complete DOS manual. The documentation is well presented and indexed—a nice touch.

This is not a bargain-basement system; pricing on all the Multilight systems is between 5 percent and 10 percent below Compaq's pricing. The price is in the same range as those of Tulip of Holland, Apricot of the U.K., Olivetti's high-end personal computers, and Schneider of Germany. Against this group, the Multilight compares well.

One of the nice things about this system is its details. The packaging of the system is excellent, and the unit is well designed, with two feet to hold it upright on the desk. Also, the system fan is very quiet.

In terms of performance, the Multilight checks out at the speed of the Amstrad 386SX—in other words, slightly higher than the average for a 386SX.

The Bigger Multilights

Many of the qualities of the Multilight IIIsx apply to its more powerful sibling, the Multilight III25. This 25-MHz 386 system uses the same system unit and motherboard as the 386SX-based system and has the same specifications. The other three systems in the Kyocera family will be available later in the year.

Unlike a number of European manufacturers, Kyocera is adopting the EISA bus. There will be eight expansion slots for the 33-MHz 386 and the 486 systems. The units are floor-standing and offer 2 MB of memory, which is expandable to 60 MB. Standard equipment includes 5¼- and 3½-inch floppy disk drives, along with a 100-MB hard disk drive. Kyocera says that cache memory will be available, but does not specify the size at this writing.

If the larger systems are anything like the smaller ones, Kyocera will opt for off-the-shelf components. Indeed, there is nothing fancy about the internal features of these systems. The difference is in the design and packaging of the systems. They are up-market, look the part, suggest that no corners have been cut in design or manufacturing, and compete favorably with companies like Compaq and IBM.

Europe Offers Variety

The question remaining is, Why bother? Who needs another standard personal computer on the market? Most of the marketing information on Europe seems to back up what Kyocera's executives think. At one level, the European market is mature. Personal computers have been around for a long time, and the customers are getting more and more sophisticated—many of them are on their third or fourth purchase. But on a second level, the market has not stabilized. The mix and match of leading suppliers, with the possible exception of IBM, Apple, and Compaq, changes every year. There are a lot of computers being manufactured and a lot of people to buy them. Japanese suppliers have not gained the market share you would have expected, considering their dominance of other electronics fields.

Kyocera is known in Japan as a maverick company, founded by an executive from one of the big corporations who went out and formed his own company when his employer would not use one of his business ideas—a very un-Japanese thing to do. Now the company thinks that the European market is ready for a new series of personal computers, and with its considerable marketing skills, Kyocera should succeed in capturing a significant market share.

But there may be another motive behind the decision to concentrate on Europe. For all the talk of the single European market, it still consists of a series of nation-states, some of which are large enough to provide a comfortable market in their own right. In Europe, it is possible to enter the personal computer market on a modest budget and see significant returns quickly.

You can expect to see an influx of new companies into the personal computer market across the continent for some time to come. Although the plethora of choices will not make it any easier to select a computer system, European buyers should be able to get a good bargain in the deal. ■

Colin Barker is a former BYTE editor based in London. He can be reached on BIX c/o "editors."

THE FACTS

Multilight IIIsx
(price not yet available)

Kyocera Electronics GmbH
Emanuel-Luetze Strasse 1B
D-4000 Dusseldorf 11
Germany
49-211-529-824
fax: 49-211-596-709
Circle 1000 on Inquiry Card.

V.32 Smorgasbord

UDS offers more choices, more features than any other modem builder

UDS, acknowledged by leading trade magazines and independent research organizations as the world's premier supplier of V.32 modems, offers more variations on the V.32 theme than any other manufacturer.

Every modem in the UDS V.32 family has the dial-up, full-duplex 9600 bps and associated fallback capabilities mandated by the CCITT recommendation. Beyond basic V.32 conformity lies a myriad of features and options. Among the user options available are:

PACKAGING – UDS V.32s may be ordered as board-level IBM plug-ins, in standalone packages or as central site rack-mountable cards.

THROUGHPUT – Selected models offer MNP® levels 4 and 5 for error control and data compression; others, in compliance with CCITT V.42 *bis*, offer MNP or LAP-M compression throughput rates up to 38,400 bps.

CONNECTIVITY – Sync-Up™ board-level versions of V.32s are available for various combinations of BSC, SNA and OS/2 host-to-remote communication for EDI, X.25, BSC, SNA and LU6.2 applications.

PC APPLICATIONS – V.32s are available in the FasTalk® configuration, designed especially for PC use.

INTERNATIONAL ACCEPTABILITY – Several versions of the UDS V.32 have already been qualified to non-U.S. operating standards, assuring their acceptability in multi-national networks.

Features and value make UDS the favorite choice for V.32s. For a look at the whole menu, contact UDS, 5000 Bradford Drive, Huntsville, AL 35805-1993. Telephone 205/430-8000; FAX 205/430-8926.

UDS

MOTOROLA

Circle 474 on Inquiry Card (RESELLERS: 475).

Olivetti Tosses Its Hat into the 386SX Ring

In 1988, the 25-MHz 386 was king, and 386s in general were too dear for all except those who could justify Ultimate Power. Compaq introduced the first 386SX in June of that year, but prices were still high compared to those of the 286. Now, this is no longer the case. After a few iterations and some hot competition, 386SX-equipped PCs are beginning to come within range for most of us—and just in time, too.

PCs equipped with 386SX microprocessors may, in fact, be the minimum specification for business machines in the 1990s. The steep decline in pricing should make 386SX-based PCs affordable to almost anyone. And the amount of available software, led by Microsoft Windows 3.0, is increasing.

The triumphant appearance of Windows 3.0 on the world stage has finally driven home the advantage of 386 computing. For a little more money than the cost of a 286, you can get the same 32-bit compatibility, 386 memory management, and virtual 8086-mode capabilities as the full-house 386DX microprocessor. And to make Windows snap to action, you need the power of at least a 16-MHz 386 microprocessor.

Olivetti has designed a range of third-generation 386SX machines that incorporate the performance and features it believes business PC users require. The two machines in the range are the **M300-05**, a low-cost, entry-level computer, and the **M300-10**, which offers about 25 percent more horsepower, bigger hard disk drives, and similar housing.

The M300-05 sits on a 15-inch square of your desktop, providing a relatively small footprint but still leaving room for internal features.

Olivetti brings some style to the rather staid world of standard beige boxes with its use of a gray finish and a variety of slots, holes, and louvers. The system's front panel contains the power switch and an oversize hard disk-access LED that shows you when your disk is hard at work. However, there is no reset button, and security could be a problem because the system has no lock.

The M300-05 is an office workstation, so it comes with your choice of a 3½-inch 40- or 100-MB hard disk drive. The drives use an embedded interface, which doesn't require a bus-mounted controller. In addition, the M300-05 not only comes with a 3½-inch floppy disk drive, but also provides space for a 5¼-inch floppy disk drive for those users who have files on 5¼-inch floppy disks.

The company has made upgrading the M300-05 easy. It is a fast and simple job to remove the system's cover (it lifts off after you loosen only two finger screws). Once the cover is off, you can add memory, a floating-point coprocessor, or an expansion card in the machine's four full-length 16-bit IBM AT-style expansion slots.

The motherboard features a large proportion of surface-mount technology and, therefore, takes up hardly more than half of the floor area of the case. As with most modern PCs, the I/O services are integrated into the motherboard, which includes a standard 640- by 480-pixel VGA, 25-pin parallel and serial ports, and receptacles for PS/2-compatible mouse and keyboard connectors. Olivetti has kept the number of components and connections down to decrease cost and increase reliability—features greatly appreciated by end users.

The M300-05's microprocessor is a regulation Intel 16-MHz 386SX. While this was once a fantastic amount of processing power three years ago, it now merely represents the entry level for serious business computing.

The system comes with just 1 MB of RAM, but it is expandable to up to 5 MB on the motherboard via four single in-line memory module sockets. While 1 MB is enough for simple DOS users, most users will want at least 3 MB to use the multitasking capabilities of Microsoft Windows 3.0.

Olivetti is pitching its latest 386SX against fairly stiff competition—the IBM PS/2 Model 55SX was the most popular PC in 1990 (judging by the market research figures for the U.K. and Europe), followed closely by Compaq's 386s and 386N machines. There's also plenty of competition from the likes of Amstrad, Apricot, and Tandon, who put 20-MHz 386SX microprocessors in similarly priced systems.

Is the 386SX really what we all need for the dawning Windows era? The graphical user interface environment is so inviting that one tends to load it down with heavyweights like Corel Draw and Microsoft Excel, and performance suffers. This year promises a few microprocessor developments from AMD and elsewhere that will put more power in more users' hands for even less money.

Should you buy a 386SX now, or should you wait? Based on the current installed base (largely 8086 and 286 machines), I would have to say that upgrading to a 386SX as soon as possible is a step in the right direction.

—Paul Lavin

THE FACTS

M300-05 and M300-10
(prices not yet available)

Olivetti spa
Via Jervis 77
1-10015 Ivrea
Torino
Italy
39-125-52-12-09
fax: 39-125-52-15-46
Circle 979 on Inquiry Card.

Digital Research's Multiuser DOS

While DOS has become the standard single-user operating system for PCs, there is no shortage of choices in multiuser operating systems. Digital Research (DR) of Monterey, California, has been selling multiuser operating systems for PCs since the first PC was launched. One of these is Concurrent DOS 386, a fully featured, multiuser version of DOS.

In 1988, DR introduced a single-user, single-tasking version of DOS called DR-DOS. Over the years, the company has continued to enhance the product. DR-DOS 5.0, which it launched last year, has a memory management system that frees up 620K bytes of DOS's 640K bytes of application-usable memory. That, together with some other features, makes it a good alternative to Microsoft DOS.

DR has combined several features of Concurrent DOS 386 and DR-DOS 5.0, together with some enhancements, into a new operating system called **Multi-User DOS**. The operating system is a replacement for Concurrent DOS 386 and a partner for DR-DOS 5.0, which will continue as DR's single-user operating system of choice. Like all the DR-DOS operating systems, Multi-User DOS was developed in the U.K.

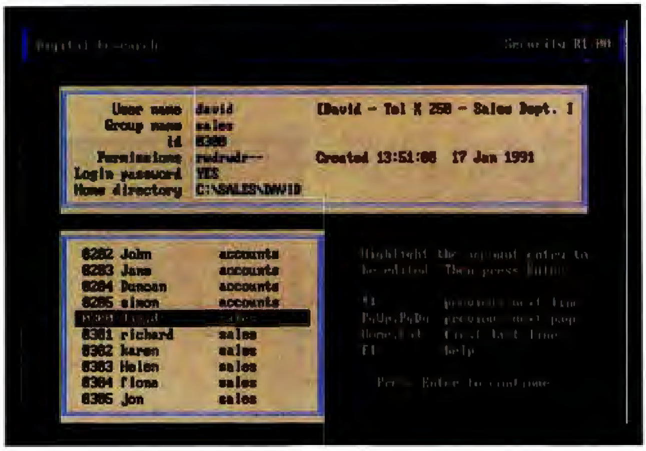
Multi-User DOS can support up to 64 users operating 386-based systems and up to 128 users operating i486-based systems; but these are only theoretical limits, and it is unlikely that many networks of that size will be implemented. Most networks will have between 2 and 5 users, with 10 to 12 users being a practical maximum for most applications. Each user can have up to eight "virtual PCs" running simultaneously and can move between them using hot keys.

Multi-User DOS has a memory allocation system that divides up the physical memory according to the amount of available memory, the number of users on the system, the number of screens each user opens, and the memory requirements for each application. Each time a user opens a virtual screen, the full 640K bytes of memory is, in theory, available along with space in high memory for TSR programs. But this space is not allocated in physical memory unless the user's application needs it. Multi-User DOS uses the same approach as Concurrent DOS 386: It works in the background to minimize the memory and processor resources that each application requires. The system can then maintain maximum performance.

DR has also incorporated into Multi-User DOS some improvements in performance balancing. The most important one is the introduction of an application-profiling system that can spot which applications are in use and which ones are asleep. This feature is based on DR's BatteryMax software for portable PCs, which tries to maximize battery life by turning off the portable when it is not in use.

Multi-User DOS offers two caching systems: A system-memory cache that is configurable to almost any size (dependent on physical memory), and a hard disk cache. The system-memory cache writes through to the hard disk cache as a safety precaution in the event of a power failure.

When you are using the system, it gives you the impression that you are working with a single-user DOS system. If the application you are working with runs into trouble and hangs up, you can use the soft reset (Ctrl-Alt-Del) without affecting other applications. Multiple users can open single-user applications, but only one user can open an individual data file at one time. It is the user's responsibility to ensure that the copyright on single-user software is observed properly.



THE FACTS

Multi-User DOS
About £495

Requirements:
IBM PC with at least 1 MB of RAM (more than 1 MB is recommended), one floppy disk drive, and a hard disk drive; PC-compatible terminals or PCs.

Digital Research (U.K.) Ltd.
Oxford House
Oxford St.
Newbury
Berkshire RG13 1JB
U.K.
44-635-35304
fax: 44-635-35834
Circle 978 on Inquiry Card.

Setting up Multi-User DOS is simple. There is a complete, menu-driven front end that guides you through what could otherwise be a very complex setup procedure. The software analyzes the system to see what memory, disks, and ports are available. To facilitate the setup procedure, you simply use the defaults. You install your applications software just as you would on any DOS system, and single-user applications work as if they're on a single-user system.

The comprehensive security system allows you to allocate identities, passwords, and privilege levels to users. It also includes the concept of file ownership, in which you own any files that you create and can give other users access to your files but still stop them from writing to your files. If you permit other users to amend any of your files, the system keeps a record of the users that have made changes.

In addition to common directories and subdirectories, each user can have personal directories. The system manager can control access to directories and allocate privileges on three levels: read only, read/write, and read/write/delete.

Interestingly, you can lock any hard disk drive on the system so that a potential intruder cannot boot up the host system from a floppy disk and try to bypass the security. This feature should also help stop viruses from being introduced to the system.

All in all, Multi-User DOS is an efficient and secure multiuser operating system. Users who want a small multiuser DOS system rather than a relatively expensive network should welcome it.

—*Colin Barker*

A Pocket Computer Connection for the Macintosh

The Pocket PC from Distributed Information Processing is a pocket-size computer that strongly resembles the Atari Portfolio. This is no coincidence, since DIP designed the Portfolio for Atari and retained the rights to market its own version of the system in Europe. DIP is designing added-value products based on the Pocket PC and targeting them to specific markets. The latest of these products is the **Mac Professional**, a complete package for Macintosh users.

The Mac Professional consists of a Pocket PC with 32K bytes of RAM, a program card with a set of utilities (a diary, spreadsheet, text editor, calculator, and address book), two sets of three nonrechargeable batteries, an AC power adapter/recharger, a serial-port expansion box, a serial cable for attaching the Pocket PC to a Mac, Pocket Mac software, and documentation.

I found the documentation particularly good. It includes a 200-page user's manual and five pocket-size books that let you learn about the package while you are on the move.

The Mac Professional has two main objectives. First, it lets you modify some of the Pocket PC applications on a Macintosh. For example, you can run your diary on both your Mac and the Pocket PC, and you can import Pocket PC spreadsheets to Microsoft Excel on the Mac. Second, it enables you to use your Mac's hard disk drive as a repository for Pocket PC files and as a backup for the Pocket PC. In effect, it lets you use the Pocket PC as a mobile extension of your Mac.

There are some problems, of course. The Pocket PC runs a DOS-like operating system that produces DOS-compatible files. So, because it is a DOS machine, there are more severe limitations on its usefulness than there would be if you linked it to a PC. In addition, it doesn't have the look and feel of the Mac, and the only files you can use on both systems are text files. However, it seems unlikely that you will see a fully Macintosh-compatible computer that you can carry around in your jacket for some time; therefore, it is a neat compromise for Macintosh users who want a hand-held computer rather than a heavy—and expensive—portable.

To set up the system, you fit the serial-connection expansion board onto the side of the Pocket PC and plug the serial cable into your Mac's printer or telephone port. Next, you load the Pocket Mac software onto your Mac's hard disk (you can also use it with a floppy disk drive–only system).

After you install the software, you download the linking software to the Pocket PC. Space on the Pocket PC's internal RAM disk is limited, so you may want to download this software every time you make a connection, but it's not absolutely necessary to do so. The data transfer rate is 1200 bps, which is pretty slow.

To start the linking process, you run the Link program on the Mac and then on the Pocket PC. The Mac beeps and then displays the directory of the internal disk drive (drive C) on the Pocket PC. It is important to remember that you can transfer files to and from this drive only, so if you want to transfer files from an external program card to the Pocket PC, you must transfer the files to drive C first.

THE FACTS

Mac Professional
£399.95

Requirements:
Mac Plus or higher with 512K bytes of memory and two floppy disk drives or a hard disk drive.

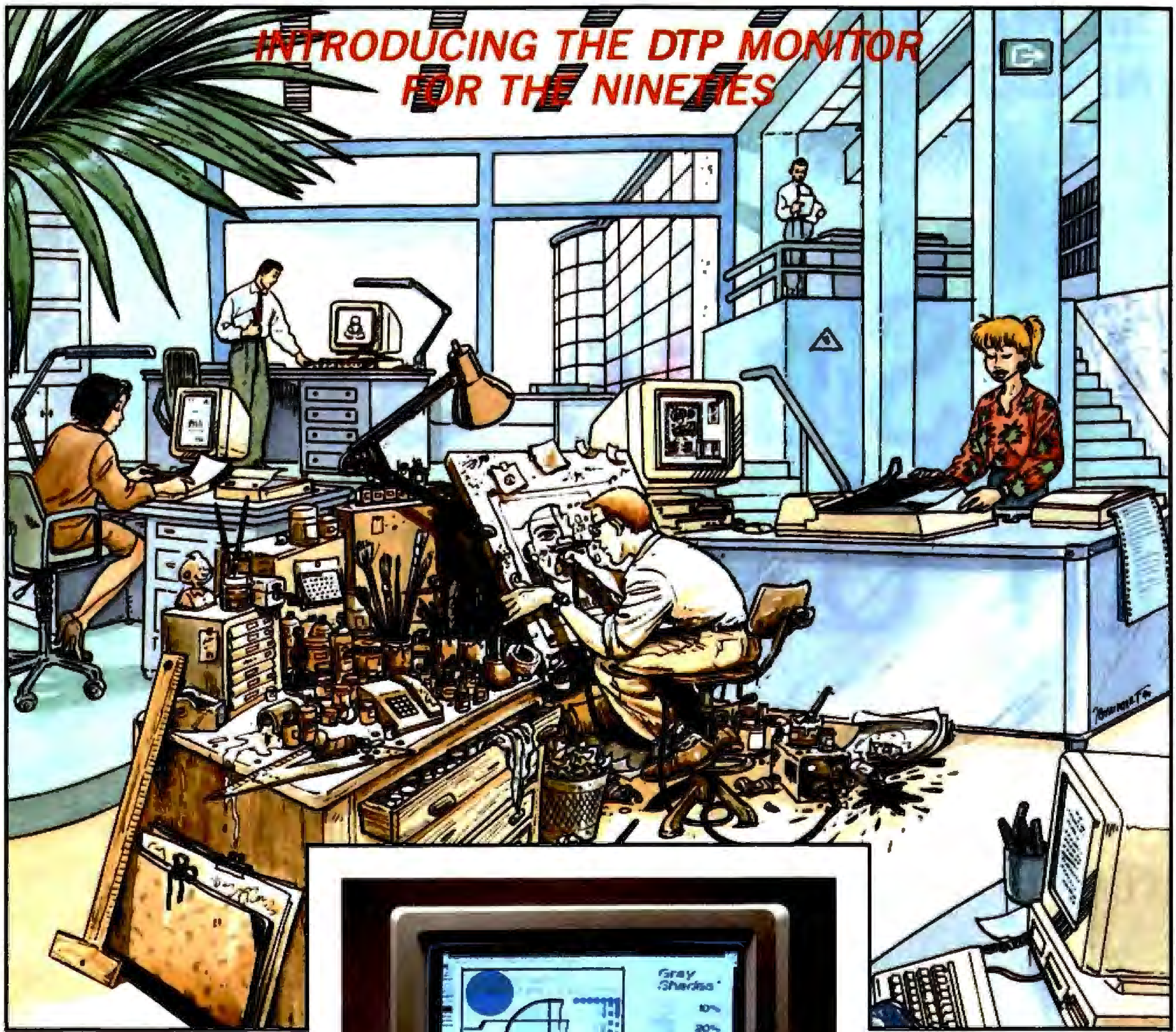
Distributed Information Processing Ltd.
2 Frederick Sanger Rd.
Surrey Research Park
Guildford GU2 5XN
U.K.
44-483-301555
fax: 44-483-301434
Circle 977 on Inquiry Card.

Despite the problems that the different file structures of the Pocket PC's DOS applications and the Mac's applications create, the Pocket Mac software offers an impressive level of interoperability. The software includes the Pocket PC's diary and address applications, which run on the Mac in the same way as they do on the Pocket PC, and you can freely exchange files between the two systems. The Pocket PC's text editor is a good one for short documents (considering the limitations of the memory and screen size), and it lets you export text files into whichever word processor or editor you use on the Mac.

The Pocket PC's spreadsheet system allows you to produce files that you can directly export to Microsoft Excel. Spreadsheet files that you copy from the Pocket PC are converted as .WKS or .WK1 files. If you want to copy Excel files to the Pocket PC, you must first save them in these formats. Although the link has been created specifically for Excel, any spreadsheet that can take .WKS or .WK1 files will accept worksheet files from the Pocket PC.

Will Mac owners like using the Mac Professional? Well, I found the Pocket PC a good system to use, although touch-typists will find the keyboard difficult to use. Even though it is a DOS system, it has a good, easy-to-use file manager that also provides a lot of help; in normal use, you will not have to tangle too much with DOS. And when it comes to pocket computers that you can use with a Mac, you are not exactly spoiled for choices. The Mac Professional offers a fairly high level of integration with the Mac, which people on the move will find useful. Its price won't exactly break the bank, either.

—Colin Barker



(to be continued ...)

ETAP's Sfinx Quattro: a new A3-size display offering 256 shades of grey, ultra-high resolutions (up to 1600x1200) and a 2000x2000 virtual screen.

Sfinx Quattro supports Windows 3 and GEM/Ventura Publisher on four high-end resolutions. Moreover ETAP's new display system provides superior VGA compatibility with a flicker-free 75 Hz refresh rate.

Incorporating 2 custom VLSI chips and a 64-bits internal videobus, ETAP's greyscale display offers high speed for Windows and Desktop Publishing. Thanks to several virtual screen resolutions with mouse-controlled hardware panning, you can move about very fast in documents larger-than-A3-size. That makes Sfinx Quattro the ideal display system for Desktop Publishing and Windows users.

ETAP SFINX QUATTRO	
1600 x 1200	very high resolution for scanning and DIP
1440 x 1080	ideal for DTP, Windows, Ventura, Presentation Manager
1280 x 960	2x VGA resolution: for DTP and windows environments
1440 x 728	extremely stable image (96Hz)

ALL BRANDS AND PRODUCTS ARE TRADEMARKS OF THEIR RESPECTIVE HOLDERS.

ETAP

THE IMAGE OF ERGONOMICS

THE WHICH COMPUTER SHOW
NATIONAL EXHIBITION CENTRE BIRMINGHAM

23 - 26 APRIL 1991 HALL 4 BOOTH DTP6

Just pick up the phone or return the coupon for more information!

BYTE 04/91

Please send me more information about:

256 shades of grey
multi-resolution: up to 1600x1200
virtual screen: 2000x2000
VGA Video Engine - 75 Hz

ETAP SFINX QUATTRO

Name ....

Job Title ....

Company ....

Address ....

....

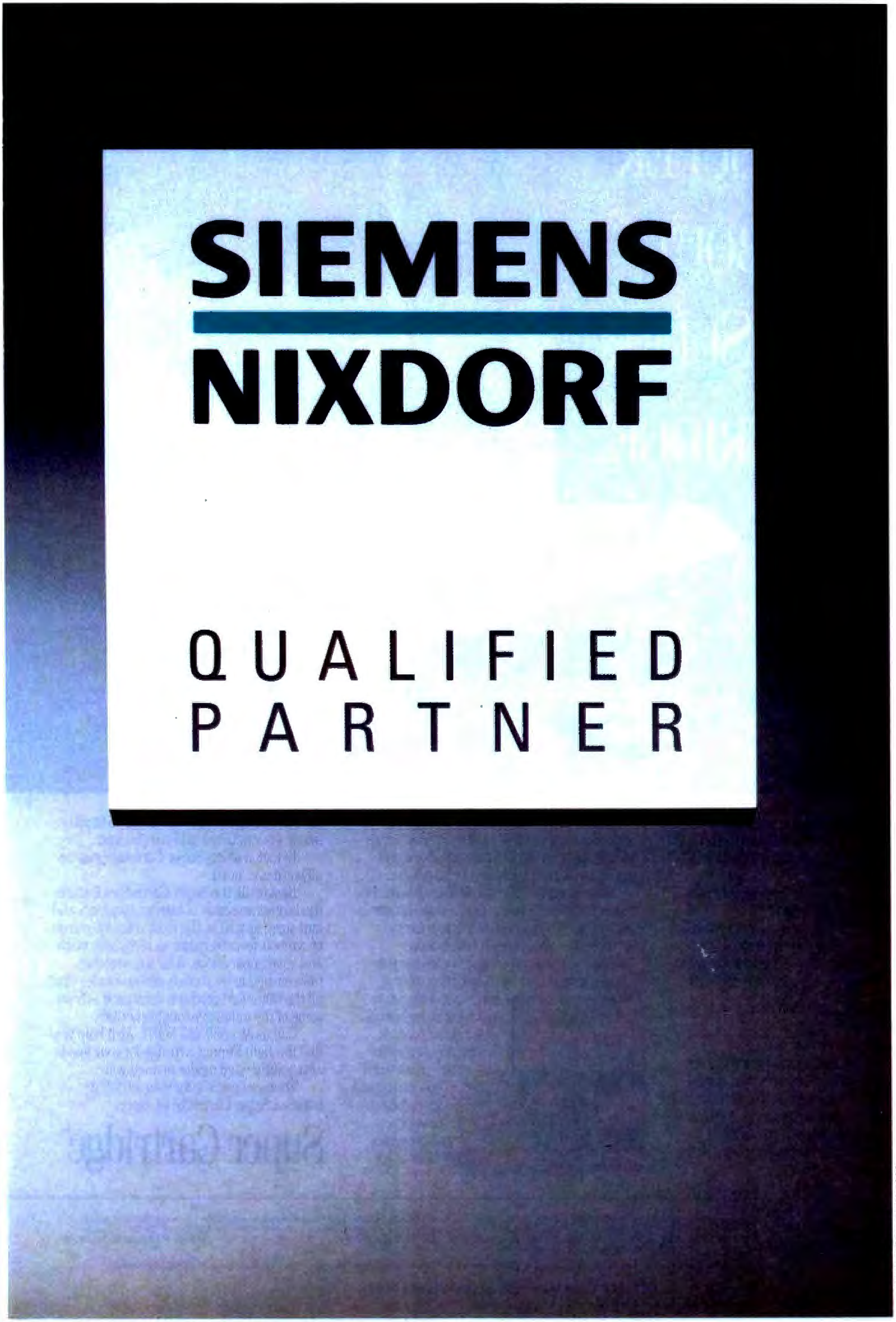
Phone ....

System: ☐ PC ISA ☐ Micro Channel

Return coupon to:

ETAP INFORMATION TECHNOLOGY
Steenovenstraat 1A, 2390 Malle • Belgium
Tel. +32 3 310 04 11 • Fax +32 3 311 76 38

Circle 432 on Inquiry Card.


SIEMENS
NIXDORF
QUALIFIED
PARTNER

Fresco Paints a Colorful Future

ETAP Information Technology offers three color monitors in its Fresco range. The Fresco 1 is a 16-inch Trinitron display providing 8-bit color with a standard resolution of 1024 by 768 pixels, switchable to 24-bit mode at a resolution of 512 by 384 pixels in zoom mode. Fresco 2 is a dual-frequency 19-inch Trinitron display providing 8-bit color in resolutions of 1280 by 960 pixels or 1024 by 768 pixels and 24-bit color at a resolution of 512 by 384 pixels. Fresco Quattro is a 19-inch multiscan 8-bit color display providing eight software-selectable resolutions of from 1024 by 768 pixels to 1600 by 1200 pixels and 24-bit color resolutions of from 512 by 384 pixels to 800 by 600 pixels in zoom mode.

All three Fresco monitors use ETAP's VGA Video Engine, which lets them run all standard VGA applications full-screen with an ergonomic 75-Hz refresh rate. The three monitors also offer several virtual screen resolutions and high-speed mode for Microsoft Windows, Ventura Publisher, and Presentation Manager. They are upgradable to high-resolution 24-bit color with ETAP's Sky 4-MB video RAM extension board. Fresco Quattro converts 386 and 486 PCs into high-end workstations for electronic publishing and other applications requiring high-resolution and photo-quality images.

The Sky 4-MB VRAM mezzanine board provides 24-bit pixel depth (true color) at high resolutions of up to 1600 by 1200 pixels.
Price: 200,000 Belgian francs for Fresco 1; 310,000 BF for Fresco 2; 335,000 BF for Fresco Quattro; 155,000 BF for Sky.
Contact: ETAP Information Technology N.V., Steenovenstraat 1A, B-2150 Malle, Belgium, 32-3-310-04-11; fax 32-3-311-76-38.
Circle 1317 on Inquiry Card.

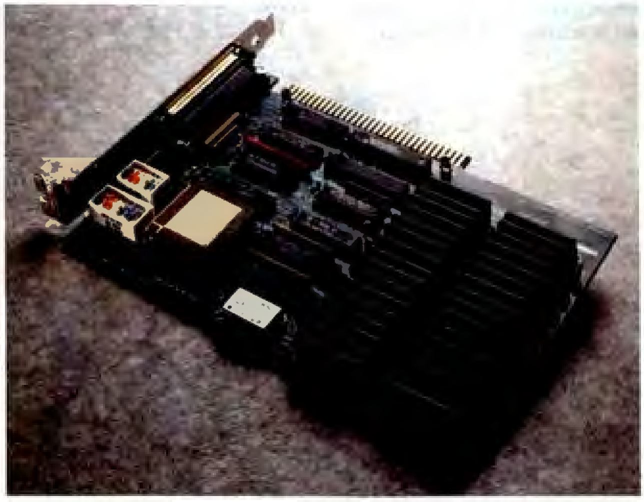
The Fresco 2 dual-frequency color monitor provides 8-bit color in resolutions of up to 1280 by 960 pixels and 24-bit color at a resolution of 512 by 384 pixels.

More Parallel Power

The new version of the Sprint transputer board gives you higher performance and higher-density memory in only a half-length IBM PC expansion slot. You can use Sprint 2 as the foundation of a parallel-processing environment, since linking a number of Sprint 2s together gives you a linear increase in speed.

Sprint 2 comes with a 20- or 30-MHz 32-bit T800 or T805 transputer; 4, 8, or 16 MB of DRAM; and an Inmos B004-compatible PC interface, which provides support for C, FORTRAN, Pascal, Ada, Occam, and Helios.

At peak performance of more than 5600 Whetstones, Sprint 2 exceeds a VAX 8600 and is more than twice the speed of a 33-MHz 386/80387 machine, according to Paratech Solutions.
Price: £995.
Contact: Paratech Solutions Ltd., Sentinel House, 163 Brighton Rd., Coulsdon, Surrey CR3 2NX, U.K., 44-81-763-1540; fax 44-81-763-1534.
Circle 1318 on Inquiry Card.


The Sprint 2 board comes with a 20- or 30-MHz T800 or T805 transputer; 4, 8, or 16 MB of DRAM; and an Inmos B004-compatible PC interface.

The OED on Tape

The magnetic-tape version of the *Oxford English Dictionary* gives you access to the meaning, history, and pronunciation of words. It contains more than half a million definitions and 2.4 million illustrative quotations. The new edition also offers an extra layer of information, called the markup language, or tagging system, that lets you automatically search entire categories of information. No matter where they are in the text, you can retrieve headwords, pronunciations, quotations, and etymologies in a matter of seconds, according to the company.

The *Oxford English Dictionary* on magnetic tape requires a minimum of 550 MB of disk storage. It comes on 2400-foot half-inch magnetic tape at 6250 or 1600 bpi in ASCII or EBCDIC format. It is also available on 8-mm digital videotape (e.g., Exabyte). A variety of other formats are available to suit individual requirements.
Price: £15,000 for a commercial license; £6500 for an educational license.
Contact: Oxford Electronic Publishing, Oxford University Press, Walton St., Oxford OX2 6DP, U.K., 44-865-56767; fax 44-865-56646.
Circle 1319 on Inquiry Card.

A VGA Laptop with Detachable Keyboard

The 80-key keyboard of Diode Export's DEX-CP286 laptop is detachable and has 12 function keys and a coil cable. You can also use the keyboard connector to connect other IBM PS/2-compatible keyboards.

The laptop is powered by a 12-MHz 80C286 microprocessor. It comes with 1 MB of DRAM (expandable to 4 MB), a 3½-inch 1.44-MB floppy disk drive, a 20- or 40-MB hard disk drive, one parallel port, two serial ports, an RGB connector for an external VGA monitor, and a bus connector for an expansion box. The DEX-CP286 also has an internal slot for a 2400-bps mini-modem card. The machine runs under DOS 3.3, which is available separately.

The double-supertwist display is backlit and has a resolution of 640 by 480 pixels. The laptop's built-in rechargeable battery pack lets you use it for 3 hours of continuous operation. An AC adapter is also included, which you can use as a battery charger.

Options available for the DEX-CP286 include a carrying bag, expansion box, modem card, and numeric keyboard.

Price: US$2995 for the 20-MB hard disk drive model; US$3255 for the 40-MB hard disk drive model.

Contact: Diode Export, Wilgenkade 10, 3992 LL Houten, The Netherlands, 31-3403-91390; fax 31-3403-91372.

Circle 1320 on Inquiry Card.

Diode Export's DEX-CP286 laptop has an 80-key detachable keyboard with 12 function keys and a coil cable.

Accessories for Atari Portfolio

A basic Atari Portfolio comes with 128K bytes of memory, expandable to 640K bytes by connecting extension units to the system bus. Instead of disks, the Portfolio is equipped with memory cards secured by battery with a capacity limit of 128K bytes. The system has no expansion capability for an external floppy disk drive.

Becker & Partner offers a new accessory line for the Atari Portfolio, including an internal extension of the working memory in steps of 128K bytes up to a limit of 640K bytes and an interface Trans-Drive Portfolio. The interface connects the Portfolio to a compatible PC and allows the pocket computer to use the floppy disk drive and RAM disk of the desktop machine as its own drive.

Price: 698 to 1348 deutsche marks for the Atari Portfolio, depending on the amount of memory; DM 198 for the Trans-Drive Portfolio; DM 158 to 998 for memory modules, depending on the amount of memory.

Contact: Becker & Partner Mobile Datensysteme, Postfach 190, Wilhelmstr. 91, Viktoriastr. 51, 5100 Aachen, Germany, 49-241-509018; fax 49-241-509577.

Circle 1321 on Inquiry Card.

Becker & Partner's internal memory extensions for the Atari Portfolio are available in steps of 128K bytes up to 640K bytes.

Debug Your OS/2 Programs

The OS/2 User Group offers RemDeb, a remote debugger for OS/2 that you can use to debug Presentation Manager (PM) programs as well as full-screen OS/2 programs. RemDeb lets you debug keystroke processing, window repainting, and VIO popups.

You can hot-key to the session manager without locking up the machine, see the debugger screen and program screen simultaneously, and add `printf` trace statements to programs during the debug phase. RemDeb also lets you use a PM debugger to debug PM programs, and you can run RemDeb in a PM window.

Price: £95.

Contact: OS/2 User Group, Cecily Hill Castle, Cirencester, Gloucestershire GL7 2EF, U.K., 44-285-655888; fax 44-285-640181.

Circle 1322 on Inquiry Card.

NEWS

INTERNATIONAL

Integrate Live Video into Superbase 4

You can create applications that require photographic storage with LiveLink, a set of routines that integrate a live video signal directly into a fully relational database—namely, Superbase 4. LiveLink lets you control a video camera through database commands or push-button options on the screen. You can open and close the video window, freeze it, and save and load it as a 16-bit TGA file. You can also display multiple pictures simultaneously, with one of the pictures being live.

To use the system, you first design a data-entry form in which you determine the size of the image-capture area. LiveLink scales the image to the area without cropping any part of the picture. You can see an image live on the screen or freeze it and repeat this process as many times as you need to achieve the desired view. However, the video input need not be live. You can record images using videotape or disk and then play them back through the database, saving the required frames to disk.

DaVinci Computers also offers a compression card that reduces the amount of storage space required at a ratio of 25 to 1, so, for example, an image that normally takes up 70K bytes of memory would take up only 3K bytes.

LiveLink requires an IBM PC with a 286, 386, 386SX, or i486 CPU, 2 MB of RAM, DOS 3.1, Microsoft Windows 3.0, VGA capability and a VGA color monitor, a high-capacity hard disk drive, and a Microsoft-compatible mouse.

Price: £595 each for LiveLink and Superbase 4.

Contact: DaVinci Computers Ltd., Unit 3, Grahame Park Way, Hendon, London NW9 5QY, U.K., 44-81-200-5757; fax 44-81-200-8444.

Circle 1323 on Inquiry Card.

A New Concept in Hard Disk Upgrades

Megastor's new range of external hard disk drives plugs into the parallel port of your IBM XT or AT, so you don't have to dismantle your computer or run complicated format routines. In addition, if your laptop has an internal hard disk drive, now you can easily upgrade it with the Megastor drives.

The units let you store confidential or sensitive data by locking the drives away when not in use. Megastor drives come in a rugged steel box, which is ideal for transporting data from office to home. When you back up other disks onto a Megastor drive, you can immediately verify that the backup was successful. You can add up to three Megastor drives of 200 MB each to a system with sufficient parallel ports.

Megastor hard disk drives are available in 44-, 84-, 124-, 177-, and 211-MB versions. The units are DOS compatible and come with cables, installation software, and power supply.

Price: £349 for the 44-MB version.

Contact: Megastor, Unit 10, Elder Way, Langley Business Park, Langley, Slough, Berkshire SL3 6EP, U.K., 44-753-581017; fax 44-753-655864.

Circle 1324 on Inquiry Card.

A Colorful Keyboard

The latest industrial keyboard from Blue Chip Technology helps you identify the keys even when the keyboard is covered with oil and dirt. The SKB-128 uses high-contrast primary colors to identify key groups such as the function, numeric, and letter keys, providing a greater chance of correct data entry when you use the keyboard in poor lighting or in dirty environments.

In addition to being housed in a heavy-duty steel case, the SKB-128's keyboard area is sealed with neoprene gaskets (as is the underside cover) and can be wiped clean. It is dustproof, splashproof, and able to withstand heavy-duty usage.

The SKB-128 keyboard uses primary colors to identify key groups to facilitate correct data entry.

The keyboard uses short-travel keys mounted underneath a tough but flexible polyester overlay, which is back-printed to avoid wear. You depress the overlay through a metal matrix that allows the key underneath to be pressed. This gives a good tactile response while totally encapsulating the keys and associated electronics.

The SKB-128 keyboard is plug-compatible with the IBM AT keyboard. Other versions are also available for RS-232C and RS-485 interfaces.

Price: £395.

Contact: Blue Chip Technology, Hawarden Industrial Park, Manor Lane, Deeside, Clwyd CH5 3PP, U.K., 44-244-520222; fax 44-244-531043.

Circle 1325 on Inquiry Card.

Circle 479 on Inquiry Card (RESELLERS: 480).

WE TRY HARDER

- ✓ 386 33MHz CACHE
- ✓ 4Mb MEMORY
- ✓ COLOUR SUPER VGA 14"
- ✓ 1024 x 768 PIXELS
- ✓ 512Kb SVGA GRAPHICS CARD
- ✓ 90Mb 19mSec HARD DISK
- ✓ 1.2Mb & 1.44Mb FLOPPY
- ✓ WINDOWS 3.0 & MOUSE

£1899

TI'KO Computer Corporation specialises in fast, high precision, IBM compatible computer systems. Our standard models as shown below are superior in almost every way to our competitors' top of the range offerings. All of our systems are supplied with Windows 3.0 and a mouse as standard. These run at 1024 x 768 Pixels and 16 colours or 256 colours (option). Only TI'KO looks good at these prices.

TI'KO products have proven themselves time and time again. After several years of meeting and surpassing the DP requirements of the world's most demanding markets you can now benefit from Japanese quality and American know how.

TI'KO supplies direct to its customers, thus reducing costs and providing a superior support plan second to none which includes a One Year On-Site nationwide maintenance agreement as standard.

Today's economic situation demands higher quality at realistic prices. TI'KO is committed to fulfilling those requirements for you. Make the call today and find out why TI'KO is fast becoming the UK's Number 1 choice. We do try harder.

FEATURE	PC216	PC316	PC325	PC333	PC425
Processor	i80286	i80386sx	i80386dx	i80386dx	i80486sl
Processor speed	16MHz	16MHz	25MHz	33MHz	25MHz
Landmark speed	21MHz	21MHz	31MHz	58MHz	120MHz
Cache memory				64Kb 25nS	Integral 8Kb
User memory	1Mb exp to 4Mb	2Mb exp to 8Mb	4Mb exp to 8Mb	4Mb exp to 16Mb	4Mb exp to 16Mb
Floppy disks	1.2Mb & 1.44Mb	1.2Mb & 1.44Mb	1.2Mb & 1.44Mb	1.2Mb & 1.44Mb	1.2Mb & 1.44Mb
Hard disk	15Mb 25mSec	15Mb 25mSec	90Mb 19mSec	90Mb 19mSec	180Mb 19mSec
Hard disk options	90, 180, 300Mb	90, 180, 300Mb	180, 300, 600Mb	180, 300, 600Mb	300, 600Mb
I/O Ports	2xSERIAL 1xPRINTER	2xSERIAL 1xPRINTER	2xSERIAL 1xPRINTER	2xSERIAL 1xPRINTER	2xSERIAL 1xPRINTER
Graphics card	SVGA 1024x768 512Kb	SVGA 1024x768 512Kb	SVGA 1024x768 512Kb	SVGA 1024x768 512Kb	SVGA 1024x768 512Kb
Monitor	COLOUR SUPER VGA 14"	COLOUR SUPER VGA 14"	COLOUR SUPER VGA 14"	COLOUR SUPER VGA 14"	COLOUR SUPER VGA 14"
MSDOS	MSDOS 4.01	MSDOS 4.01	MSDOS 4.01	MSDOS 4.01	MSDOS 4.01
Software	Windows 3.0 & mouse	Windows 3.0 & mouse	Windows 3.0 & mouse	Windows 3.0 & mouse	Windows 3.0 & mouse
Onsite maintenance	1 YEAR	1 YEAR	1 YEAR	1 YEAR	1 YEAR
PRICE	£999	£1199	£1599	£1899	£2498

SALES CALL (7 DAYS A WEEK)

TI'KO
PERSONAL COMPUTERS

44 71-734-5093 (SALES)
44 506-631-567 (SALES)
44 506-630-838 (FAX)

E. & O.E. Prices and specifications are subject to change without prior notification. Prices exclude VAT.

THE ONLY CORNER TO CUT
PLEASE RUSH ME FURTHER INFORMATION

NAME: __________
POSITION: __________
COMPANY: __________
ADDRESS: __________

POST CODE: __________ TEL NO: __________

BM4

COMMERCIAL FINANCE AVAILABLE

VISA

14 BLACKBURN ROAD, BATHGATE,
WEST LOTHIAN EH48 2EY. U.K.

Circle 471 on Inquiry Card.

Monitor Testing Software

If you've ever wished that you could analyze the performance of your monitor, then Black Star has a program for you. TestCard lets you test and align your monitor with the standard patterns and colors that service engineers use, including focus, dots, vertical and horizontal lines, grating, shading, checkerboard, high-intensity/low-intensity color bars, composite test-card, circle, raster, gray scale, and multiburst.

TestCard runs on the IBM PC, XT, AT, and PS/2s and can check most PC monitors capable of operating in text mode, including MDA, CGA, MCGA, EGA, Hercules, VGA, and IBM 8514.

Price: £29.

Contact: Black Star Ltd., 4 Harding Way, St. Ives, Huntingdon, Cambridgeshire PE17 4WR, U.K., 44-480-62440; fax 44-480-495172.

Circle 1326 on Inquiry Card.

TestCard software lets you analyze the performance of your monitor using the patterns and colors that professional service engineers use.

Process Data Visualization Using OS-9

Mikro Elektronik designed its OS-9 ProVi process data-visualization software in conjunction with the function extension of OS-9 Windows 3.0's graphical user interface. The package lets you create display images that you can use to display and control process data.

The package provides the following output forms: trend curve, bar graph, pointer instrument, and alphanumeric, which are available for analog process quantities. You can easily create a variety of icons for discrete process quantities using the uFont symbol editor, which is already integrated into the OS-9 Windows package.

ApMan, a graphics editor for interactive management of all objects in the applications library, provides the link between the user interface and OS-9 ProVi. It generates a C source code text from graphics data you have gathered and translates and links it with the functions of the user program. You can then create the display images you need to display process data, using the applications manager and the integrated OS-9 ProVi library.

OS-9 ProVi lets you change physical characteristic data (e.g., the maximum and minimum values of a process quantity) or load new display images. You assign physical measurement values to graphical objects via channels, which are referenced symbolically (e.g., charging voltage and flow temperature) within the applications manager. The individual meausurement values are referenced numerically in an external interface.

OS-9 ProVi requires an A301 VMEbus graphics card and VMEbus system (see April 1990 What's New International, page E&W 58).

Price: 4500 deutsche marks for a single license; DM 500 for a run-time license.

Contact: Mikro Elektronik GmbH, Wiesentalstrasse 40, D-8500 Nürnberg 90, Germany, 49-911-332755; fax 49-911-396686.

Circle 1327 on Inquiry Card.

Circle 456 on Inquiry Card (RESELLERS: 457).

DARE TO
LOWEST PRICES

- **NO SURCHARGE ON EXPORT SERVICES**
- **FASTEST COMPUTERIZED EXPORT LICENSING** — 72 Hours in Most Cases
- **IMMEDIATE PRODUCT AVAILABILITY**
- **ALL FREE PROFESSIONAL SERVICES** — Export Licensing, Documentation, Follow Through

IBM PS2

MOD 30(286)–E1/E21/E31	$1526/1725/1879
MOD 50Z–31/61	$2178/2375
MOD 55SX–30/60	$2684/3012
MOD 60–41/71	$3152/3553
MOD 70–E61/061/121	$3491/3888/4320
MOD 70–A61/A21	$5620/5990
MOD 80–41/71	$3988/4629
MOD 80–111/311	$5670/7475
PORTABLE 70–60/120	$5250/5740

COMPAQ

DS 286–1/20/40	$1543/1951/2157
DS 286E–1/20/40	$1797/1995/2099
DS 386S–1/20/40	$2260/2466/2772
DS 386S–84/100MB	$3295/3450
DS 386/20–1	$3564
DS 386/20–60/70/130MB	$4117/4250/4480
DS 386/20E–1/40/110MB	$3579/4114/4785
DS 386/25–60/84/110MB	$5835/5890/6999
DS 386/25–300MB	$8028
DS 386/25E–1/60/120MB	$5150/5473/6143
DS 386/33–84/320MB	$7223/10295
DS 386/33–650MB	$12102
DS 486/25–120/320MB	$9374/11250
DS 486/25–650MB	$13490
386 SYSTEM PRO–240MB	$10558
386 SYSTEM PRO–420MB	$12760
386 SYSTEM PRO–840MB	$17280
PORTABLE LTE–1/20	$1684/2060
POR. LTE 286–1/40MB	$2762/3199
POR. LTE 386S/20–30/80MB	$4999/5499
PORTABLE III–20/40MB	$3393/3870
PORTABLE SLT 286–20/40MB	$3656/3857
PROTABLE SLT 386S/20–60/120	$5022/5580
PORTABLE 386–40/100MB	$4777/5577

APPLE

Mac CLASSIC	$998
Mac PLUS/Mac SE(1FD)	$1247/1852
Mac SE–20/40MB	$2054/2363
Mac SE30–1/40/80MB	$2775/2920/3895
Mac IICI–(1FD)/40MB	$4320/5090
Mac IICI–80/100MB	$5453/5762
Mac IICx–1/40MB	$3347/3885
Mac IIx–1FD/40MB	$3777/4130
Mac IIfx–80/160MB	$7805/8536
Apple 21" Monitor Incl Card	$1873
Mac PORTABLE 1/40MB	$3599/3888

LAPTOP / PORTABLE

NEC

ULTRALITE–640KB/1MB	$1596/1630
PROSPEED 286/16–40/100MB	$2989/4186
PROSPEED 388SX–40/100MB	$3999/4695
PROSPEED 386/16–40/100MB	$4068/4732

TOSHIBA

T1000/T1000SE	$655/1099
T1000XE/T1000LE–20MB	$1495/1645
T1200XE/T2000SX–20MB	$1995/3249
T2000SX–40MB/T1200HB–20MB	$3585/1395
T1600–20/40MB	$2275/2485
T3100SX–40/80MB	$3900/4420
T3100e/T3200–40MB	$2795/2925
T3200SX–40/120MB	$3715/4250
T3200SXC–120MB/T5100–100MB	$5595/4395
T5200–40/100/200MB	$4195/4625/5265
T5200C–200MB/T8500–100MB	$6175/3695

AST RESEARCH

BASE SYSTEMS

AST BRAVO 286	$824
AST BRAVO 386SX/16	$1464
AST PREMIUM 286	$1047

AST RESEARCH *(Continued)*

AST PREMIUM 386SX/16	$1499
AST PREMIUM 386SX/20	$1749
AST PREMIUM 386-25	$3044
AST PREMIUM 386-33	$3718
AST PREMIUM 386-33T	$4065
AST PREMIUM 386-33TE	$4386
AST PREMIUM 486-25	$4729
AST PREMIUM 486-25E	$5070
AST PREMIUM 486-25TE	$5403

HARD DRIVE

NEC

D–3142 65MB 23MS RLL	$325
D–3661 110MB 18MS ESDI	$605
D–5655 150MB 18MS ESDI	$745

CONNOR

CP 3100–100MB,25MS	$499
CP3044–44MB,28MS KIT	$339
CP3084–80MB,19MS KIT	$479
CP3104–100MB,25MS KIT	$535
CP3204–209MB,19MS KIT	$1122

IBM

20MB–PS2 30/PS2 30(286)	$472/516
30/60MB–PS2 50Z,55SX,70's	$716/1015
120MB–PS2 70/70A	$1538
40/70MB–PS2 60's,80's	$827/1035
115/311MB–PS2 60's,80's	$1555/3323

IMPRIMIS

94181–385H,SCSI	$2028
94181–702,SCSI	$2314
94186–383H,ESDI	$1757
94191–766,SCSI	$2802
94196–766,ESDI	$2802
94601–1.2,SCSI	$4784

MAXTOR

1085–80MB,MFM	$577
4380–380MB,SCSI&ESDI	$1650
8780–760MB,SCSI&ESDI	$2802

TOSHIBA

MK134FA 44/66MB, MFM/RLL	$315
MK156FA 155MB 23MS ESDI	$735
MK358FA 760MB 16MS ESDI	$2250
MK358FB 760MB 16MS SCSI	$2395

NOVELL NETWORK

NETWARE ELS1/ELS2	$519/1180
NETWARE ADVANCE V2.15	$1990
NETWARE SFT V2.15	$2990
NETWARE 386 V3.0	$4499
NETWARE 386 V3.1	$4999

MATH COPROCESSOR

INTEL

8087–5/8087–1/8087–2	$86/155/126
80287–6/8/10/80C287	$117/186/206/269
80387–SX/16/20	$297/308/349
80387–25/33	$448/539

IIT

8C287–6/8/10	$125/190/209
8C287–12/20	$265/289
8C387–16/20/25/33	$298/330/420/536

WEITEK

3167–20/25/33	$309/385/529

CYRIX

80387–16/20/25/33	$278/325/410/509

ATICOM SYSTEMS

One Year Warranty — Tower Case Available — 110/220V

ATICOM 286-12MHz SYSTEM	$749

– 1MB RAM
– 40MB HDD/1.2MB OR 1.44MB FDD
– BASE CONFIGURATION WITH DOS 4.01

HIGH VOLUME BIDS INVITED!

For International Orders, FAX Us at (415) 680-1408

ATICOM SYSTEMS *(Continued)*

One Year Warranty — Tower Case Available — 110/220V

ATICOM 286N WORKSTATION	$699
– 100% NOVELL READY, w/14" Mono Monitor.	
ATICOM 386SX–16MHz	$1339
ATICOM 386SX–20MHz	$1479
ATICOM 386–20MHz	$1699
ATICOM 386–25MHz w/64K CACHE	$1789
ATICOM 386–33MHz w/64K CACHE	$1959
ATICOM 486–25MHz ISA	$2999
ATICOM 486–25MHz EISA	$4599

Above SUPER VGA SYSTEMS consist of:
– 2MB RAM
– 1.2MB & 1.44MB FDD
– 1024X768 SUPER VGA CARD w/512K
– 14" 1024X768 VGA COLOR MONITOR
– 1 PARALLEL & 2 SERIAL PORTS
– 101 ENHANCED KEYBOARD
– MS DOS 3.3 OR 4.01

MEMORY UPGRADE OPTIONS

2MB KIT	$120
4MB KIT	$239
8MB KIT	$419
16MB KIT	$1129

HARD DISK OPTIONS

44MB 28ms KIT	$298
80MB 19ms KIT	$595
100MB 19ms KIT	$645
200MB 19ms KIT	$1095
330MB 16ms ESDI/SCSI KIT	$1895
760MB 16ms ESDI/SCSI KIT	$2995
1.2GB SCSI KIT	$4695

OTHER OPTIONS

SERIAL MOUSE	$39
TRACK BALL	$69
9600 BAUD FAX/MODEM CARD	$299
120MB TAPE BACKUP	$269
MS WINDOWS 3.0 w/MOUSE	$119
UPS 600 WATTS	$475
UPS 1000 WATTS	$695

Prices are offered with system purchase only

VIDEO BOARD

ATI

VGA WONDER,1024x768,256K	$206
VGA WONDER,1024x768,256K,MOUSE	$240
VGA WONDER,1024x768,512K	$243
VGA WONDER,1024x768,512K,MOUSE	$264

GENOA

VGA 6300,1024x768–256K/512K	$175/196

MONITOR

IBM

8503/8512/8513 MONITOR	$203/437/530

NEC

MULTISYNC 2A/3D/PLUS	$473/609/858
MULTISYNC 5D/XL RGB	$2348/1869

SONY

14" FOR Mac/1304 SUPER VGA	$700/682

LASER PRINTER

APPLE

IMAGE WRITER/LASER WRITER	$442/1971
LASER WRITER–IINT/IINTX	$3394/4627

CANON

LBP–8 III/IIIR	$1799/2724
BJ–10e PORTABLE PRINTER	$399

HP

DESK JET+/DESK WRITER	$658/749
LASER JET–II/IID/IIP	$1488/2599/972
LASER JET–III/IIID	$1599/2649
PAINT JET–COLOR/XL	$974/1871

IBM

4019–001 LASER PRINTER	$1658

LASER PRINTERS Continued

NEC

LC290/LC890/LC890XL	$2547/3047/3492

PANASONIC

KX–P4420/4450i	$849/1250
KX–P4455 Post script	$2199

QMS

PS800–2/PS810/PS JET+	$2724/3372/2317

TOSHIBA

PAGE LASER 12	$2873

PRINTER

EPSON

FX850/FX100/FX1050	$328/363/450
LX810/LQ510/LQ850	$195/365/485
LQ950/LQ1010/LQ1050	$494/421/623
LQ2250/LQ2550	$935/935

IBM

PRO PRINTER–II/IIXL/III	$353/492/452
PRO PRINTER IIIXL/QUICK WRITER	$586/983
PRO PRINTER–X24E/XL24E	$578/785
QUIET WRITER III	$1080

NEC

P2200/P2200XE/P5200	$310/289/486
P5300/P9XL	$618/935

OKIDATA

172/182/182+/182TURBO	$196/232/236/236
320/321/390/391	$329/445/449/599
393/393 COLOR	$966/1038

PANASONIC

KX–P1092i/P1180/1191	$332/165/216
KX–P1124/P1592/P1595	$279/228/411
KX–P1524/P1624/P1695	$510/412/414

STAR MICRONICS

NX1500/NX2400/NX2410	$281/295/386
NX2415/XB24–10/XB24–15	$514/419/572
XR1000/XR1500	$342/446

PLOTTER / SCANNER

HP

7440A/7470A/7475A	$948/403/1360
7550A/7570A/7575A	$2847/2889/3774
7595A/SCANJET+ & INT. S/W	$6422/1495
SCANJET+/INT S/W	$1055/470

TAPE BACKUP

COLORADO MEMORY SYSTEMS

120MB XT,AT–EXT /INT	$364/260

IBM

6157 ST TAPE DR –60/150MB	$988/1582

TEAC

150MB TAPE BACKUP	$723

UNIX SPECIAL

SYSTEMS

AST PREMIUM 486/25	$4729
UNISYS PW 500/20A	$2255
UNISYS PW 800/33A	$4180
UNISYS S/480	$10495
WYSEsystem 386/3225	$3984

PERIPHERALS

COMPUTONE ALC-EISA	$1090
COMPUTONE ALC-ASYNC	$818
STORAGE DIMEN. X/STOR	$3590
MAYNARD/ARCHIVE VP	$1238
GIGATREND UNIDAT/SCO	$4253

SOFTWARE

CONN. ATLANTIX COCONET	$1980
UNIPLEX FOR SCO XENIX 386	$1390
SCO UNIX V/386 3.2	$629
SCO VP/IX	$690
XENIX 386 (8 USER)	$1123
XENIX 386 (16 USER)	$1790

- Prices are FOB USA shipping point and subject to change.
- Please add 4% (lowest in industry) handling charge (Minimum $20) on FOB price for international order.
- 14.5% (lowest in industry) restocking charge on non-defective or non-authorized return.
- No return on opened software.
- Shipping & insurance extra.
- *All trademarks acknowledged.*

- 3.95% surcharge for VISA/MC and minimum surcharge for L/C term.
- We do not charge your credit card until your order is shipped.
- All products are new and carry manufacturers' warranty.
- Not responsible for typographical errors.

Member of the World Trade Centers Association

SHIPPING BY
- Air Freight
- Federal Express
- UPS Air
- US Mail Express
- DHL

Circle 409 on Inquiry Card.

COMPARE IN THE WORLD!

Atico

SERVING WORLDWIDE SINCE 1965

MEMORY UPGRADES

New...100% Compatibility... Lifetime Warranty — Guaranteed —

APPLE

DESCRIPTION	FOR MODELS	REF. P/N	PRICE
1MB UPGRADE KIT	II, IICX, IIX, PLUS, SE, SE/30	MO218	$88
2MB UPGRADE KIT	PLUS, SE	MO219	$98
4MB UPGRADE KIT	II, IICX, IIX, PLUS, SE, SE/30	MO2707	$219
1MB UPGRADE KIT	IICI	MO291LL-A	$91
4MB UPGRADE KIT	IICI	MO292LL-A	$227
4MB UPGRADE KIT	LaserWriter II/NTX	M6006	$25
16MB UPGRADE KIT	IICI, IICX	N/A	$1100
4MB UPGRADE KIT	IIFX	MO376LL-A	$211
16MB UPGRADE KIT	IIFX	N/A	$1004
1MB UPGRADE BOARD	MAC PORTABLE	MO248	$254
2MB UPGRADE BOARD	MAC PORTABLE	N/A	$610
3MB UPGRADE BOARD	MAC PORTABLE	N/A	$904
4MB UPGRADE BOARD	MAC PORTABLE	N/A	$1235
2MB UPGRADE BOARD	MAC SL	N/A	$208
1-3MB EXP BRD	MAC CLASSIC	N/A	$104

AST

DESCRIPTION	FOR MODELS	REF. P/N	PRICE
1MB UPGRADE KIT	PREMIUM 386/33	500718-002	$64
4MB UPGRADE KIT	PREMIUM II,486/25,386/25	500780-004	$449
1MB UPGRADE KIT	PREMIUM 386C/16	500510-007	$72
4MB UPGRADE KIT	PREM 286, 386C/16	500510-008	$242
1MB UPGRADE KIT	PREMIUM 386	500510-003	$88
2MB UPGRADE KIT	PREMIUM 486	500718-004	$169

AT & T

DESCRIPTION	FOR MODELS	REF. P/N	PRICE
2MB MEM EXP KIT	AT&T 6286 WGS	37727	$117
4MB MEM EXP KIT	AT&T 6386, 6386E WGS	37716	$234
2MB MEM EXP KIT	6386/SX, 6386/25 & /33 WGS	37338	$123

COMPAQ

DESCRIPTION	FOR MODELS	REF. P/N	PRICE
512K KIT	DESK PRO 286	113012-001	$52
1MB ADD-ON MODULE	386S	113646-001	$96
4MB ADD-ON MODULE	386/20e, 20, 25&25e, 286e	113132-001	$280
4MB ADD-ON MODULE	386S	112534-001	$260
1MB MEMORY EXP. BRD	386S	113633-001	$156
1MB MEMORY EXP. BRD	PORTABLE 386	107651-001	$202
INTFC BRD	PORTABLE 386	107707-001	$98
4MB MEMORY MODULE	SLT/286	110237-001	$741
1MB MEMORY MODULE	SLT/386	118303-001	$209
2MB MEMORY MODULE	SLT/386	118304-001	$369
4MB MEMORY MODULE	SLT/386	118305-001	$741
2MB MEMORY EXP. BRD	386/16	108069/71-001	$397
1MB UPGRADE KIT	386/16	108069-001	$88
1MB UPGRADE KIT	386/16	108071-001	$71
8MB MEMORY EXP. BRD	386/16	108070/72-001	$1131
4MB UPGRADE KIT	386/16	108072-001	$319
INTFC BRD	PORTABLE III	107808-001	$86
2MB UPGRADE KIT	PORTABLE III	107332-001	$123
EXP BRD	PORTABLE III	107811-001	$254
1MB MEMORY BOARD	LTE 286	117081-001	$104
2MB MEMORY BOARD	LTE 286	117081-002	$163
4MB BRD	LTE 286	117081-003	$813
2MB MEMORY MODULE	386S/20, PP386N	118689-001	$138
4MB MEMORY MODULE	386S/20, PP286N, 386N	118690-001	$331
2MB MEMORY MODULE	386/33, 486/25, SYS PRO, 33L	115144-001	$140
8MB MEMORY MODULE	SYS PRO & 486/25	116561-001	$684
0-16MB EXP BRD	286N, 386N	118700-001	$88

DATA GENERAL

DESCRIPTION	FOR MODELS	REF. P/N	PRICE
4MB BOARD	AVIION SERIES	N/A	$1740

DEC

DESCRIPTION	FOR MODELS	REF. P/N	PRICE
4MB	DECSTATION 3100	MS01AA	$410
8MB	DECSTATION 5000	MS02AA	$804
32MB	DECSTATION 5000	N/A	$7267
4MB UPGRADE KIT	VAX 3100	MS01-AA	$410
8MB EXP BRD	VAX 3100	MS42-KA	$878
12MB	VAX 3100	N/A	$1333
16MB	VAX 3100	MS42-CA	$1765
24MB	VAX 3100	N/A	$2542
4MB	VAX 3100	N/A	$598
8MB	VAX 3100	N/A	$930
12MB	VAX 3100	N/A	$1333
16MB	VAX 3100	N/A	$1723
20MB	VAX 3100	N/A	$2087
8MB	VAX 3000 SER. (MICRO VAX III)	MS650AA, M7621	$1073
16MB	VAX 3000 SER. (MICRO VAX III)	MS650BA, M7622	$1976
32MB	VAX 3000 SER. (MICRO VAX III)	MS650BA, M7622	$3848
8MB	VAX 2000	MS400CA	$1106
12MB	VAX 2000	MS400CA	$1496
4MB	MICRO VAX II	MS630BB	$738
8MB	MICRO VAX II	MS630CA, M7609AX	$1073
16MB	MICRO VAX II	MS630CA, M7609AX	$1862
16MB	VAX 8600/8650	MS86CA, L00225	$3673
1MB	VAX-11/780, 11/785	MS780FX, M8373	$884
4MB	VAX-11/780, 11/785	MS780JX, M8374	$1287
1MB	VAX-11/750, 11/730	MS750CA, M8750	$774
8MB	VAX-11/750	MS750HB	$3800
12MB	VAX-11/750	MS750HB	$5385

EPSON

DESCRIPTION	FOR MODELS	REF. P/N	PRICE
1MB UPGRADE KIT	IIe, 386/20	A808091	$78
1MB UPGRADE KIT	IIe, 386/20, 386SX, 386/25	A808231	$78
4MB UPGRADE KIT	IIe, 386/20, 386SX, 386/25	N/A	$142
2MB UPGRADE KIT	IIe, 386SX	A808101	$128
2MB UPGRADE BOARD	EPL 6000	1BS401	$172
4MB UPGRADE BOARD	EPL 6000	N/A	$273
2MB UPGRADE KIT	EPL 6000	N/A	$102

EVEREX

DESCRIPTION	FOR MODELS	REF. P/N	PRICE
2MB BRD	386 STEP 33	N/A	$188
4MB BRD	486 STEP 25	N/A	$462
2MB UPGRADE KIT	286 STEP 12, 16, 20, 386 STEP IS	N/A	$117
4MB UPGRADE KIT	286 STEP 12, 16, 20, 386 STEP IS	N/A	$234
1MB UPGRADE KIT	386 STEP 16, 20, 25	N/A	$71
2MB UPGRADE KIT	386 STEP 16, 20, 25	N/A	$141
4MB UPGRADE KIT	386 STEP 16, 20, 25	N/A	$280
8MB UPGRADE KIT	386 STEP 16, 20, 25	N/A	$462

HP

DESCRIPTION	FOR MODELS	REF. P/N	PRICE
2MB UPGRADE BOARD	LASERJET II, IID	H33444B	$130
4MB UPGRADE BOARD	LASERJET II, IID	H33445B	$205
2MB UPGRADE BOARD	LASERJET III, IIP	H33475B	$145
3MB UPGRADE BOARD	LASERJET III, IIP	H33476B	$152
4MB UPGRADE BOARD	LASERJET III, IIP	H33477B	$238
2MB UPGRADE KIT	VECTRA QS/16S ES/12PC	D1354A	$117
4MB UPGRADE KIT	VECTRA QS/16S RS/20PC	D1542A	$234
4MB UPGRADE KIT	VECTRA QS/20S RS/25PC	D1642A	$244
1MB UPGRADE KIT	VECTRA 486 PC	D2150A	$78
2MB UPGRADE KIT	VECTRA 386/25	D2381A	$140
4MB UPGRADE KIT	VECTRA 486 PC	D2151A	$328
8MB UPGRADE KIT	VECTRA 486 PC, 386/25	D2125A	$653

HP/APOLLO

DESCRIPTION	FOR MODELS	REF. P/N	PRICE
2MB BOARD	DN3000	N/A	$886
4MB BOARD	DN3500, 4000, 4500	N/A	$1080
8MB BOARD	DN3500, 4000, 4500	N/A	$2886

HP/9000 WORKSTATION

DESCRIPTION	FOR MODELS	REF. P/N	PRICE
1MB UPGRADE	200, 310, 320	N/A	$571
2MB UPGRADE	200, 310, 320	N/A	$1079
4MB UPGRADE	200, 310, 320	N/A	$2177
8MB UPGRADE	200, 310, 320	N/A	$4386
4MB BOARD	318	N/A	$3462
8MB BOARD	318	N/A	$4833
4MB CONTROLLER BOARD	330	N/A	$3881
4MB ADD-ON BOARD	330	N/A	$3246
8MB BOARD	330	N/A	$4833
12MB ADD-ON BOARD	330	N/A	$7301
1MB UPGRADE	332	N/A	$571
4MB UPGRADE	332	N/A	$1386
4MB UPGRADE	340	N/A	$2008
4MB RAM BOARD	345	N/A	$1661
8MB RAM BOARD	345	N/A	$3289
16MB RAM BOARD	345	N/A	$4886
4-12MB BOARD	350	N/A	$4838
4MB BOARD	350	N/A	$3245
12MB BOARD	350	N/A	$7626
4MB UPGRADE	360	N/A	$1880
8MB UPGRADE	360	N/A	$3640
12MB UPGRADE	360	N/A	$5081

IBM

DESCRIPTION	FOR MODELS	REF. P/N	PRICE
512K KIT	PS/1	1057035	$91
2MB KIT	PS/1	N/A	$368
2MB MODULE	PS/2, 95XP	6450902	$158
4MB MODULE	PS/2, 95XP	6450128	$307
2MB UPGRADE KIT	30/286, ADT BRD 1497259	30F5360	$134
1MB MEMORY MODULE	70/121, 061, E61, 55SX, 65SX	6450603	$65
2MB MEMORY MODULE	70/A21, A61, 821, 881	6450608	$138
2MB MEMORY BOARD	80/111, 311, 121, 321	6450379	$146
4MB MEMORY BOARD	80/A21, 80/A31	6451060	$346
4MB MEMORY MODULE	55SX, 65SX	34F2933	$327
2-16MB EXP. CARD	30, 50, 50Z, 60, 55SX, 65SX	6450608	$646
4-16MB EXP. CARD	70, 80	34F3011	$889
1MB MEMORY CARD	LASER PRINTER 4019, 4019E	1039136	$117
2MB MEMORY CARD	LASER PRINTER 4019, 4019E	1039137	$168
2MB MEMORY CARD	ADAPTER 6450367	6450372	$308

IBM COMPATIBLE (XT & AT)

DESCRIPTION	FOR MODELS	REF. P/N	PRICE
128K	XT	N/A	$118
256K	XT	N/A	$184
512K	XT	N/A	$186
1MB	XT	N/A	$208
2MB	XT	N/A	$247
512K	AT	N/A	$163
1MB	AT	N/A	$234
2MB	AT	N/A	$338
3MB	AT	N/A	$418
4MB	AT	N/A	$607
8MB	AT	N/A	$793

NEC

DESCRIPTION	FOR MODELS	REF. P/N	PRICE
1MB MEMORY EXP. BRD	POWERMATE SX PLUS	APC-H850E	$283
2MB MEMORY EXP. BRD	POWERMATE SX PLUS	N/A	$601
4MB MEMORY EXP. BRD	POWERMATE SX PLUS	APC-H852E	$774
8MB MEMORY EXP. BRD	POWERMATE SX PLUS	N/A	$1408
2-8MB BOARD	POWERMATE SX PLUS	APC-H251E	$488
4-8MB BOARD	POWERMATE SX PLUS	APC-H250E	$831
1MB UPGRADE KIT	PROSPEED 286, SX (NOT THE PLUS)	PC-21-21	$260
2MB UPGRADE KIT	PROSPEED 286	N/A	$383
4MB UPGRADE KIT	PROSPEED 286, SX (NOT THE PLUS)	PC-21-22	$264
2MB UPGRADE KIT	PROSPEED 386	PC-31-21	$383
8MB UPGRADE KIT	PROSPEED 386	PC-31-22	$1404
4MB BOARD	POWERMATE 386/16, 20	N/A	$715
8MB BOARD	POWERMATE 386/16, 20	N/A	$1001
16MB BOARD	POWERMATE 386/16, 20	N/A	$1547
2MB UPGRADE KIT	POWERMATE 386/25	APC-H655X	$563
8MB REPLACEMENT BRD	POWERMATE 386/25	APA-H657X	$1424
8MB UPGRADE KIT	POWERMATE 386/25	APC-H655X	$1563
2MB UPGRADE KIT	POWERMATE 386/25S	OP-410-5201	$141
8MB UPGRADE KIT	POWERMATE 386/25S	OP-410-5202	$482
2MB CPU UPGRADE KIT	POWERMATE SX/20	OP-410-8101	$383
2-8MB EXP. BRD	POWERMATE SX/20	OP-410-8102	$383

SILICON GRAPHICS (IRIS SERIES)

DESCRIPTION	FOR MODELS	REF. P/N	PRICE
4MB KIT	PERSONAL 4D/20/25	H4C04A	$699
16MB KIT	PERSONAL 4D/20/25	HUBC16B	$2643
4MB KIT	PRO 4D/40/50/70/80	H4C04B	$699
16MB KIT	CS/12 TURBO 12/16	H49C16B	$2643
8MB KIT	POWER SER. 4D/120/220/240/280	H4C08X	$1806

SUN

DESCRIPTION	FOR MODELS	REF. P/N	PRICE
4MB OPTION	3/60	N/A	$754
8MB OPTION	3/50	N/A	$1125
4MB OPTION	3/60, 3/80, 4/60, SPRAC	X104C,G,H	$280
4MB OPTION	SPRAC SLC	X105Z	$345
16MB OPTION	SPRAC 4/60	X116H	$1326
16MB OPTION	4/110	X116D	$1028
16MB	4/330	N/A	$2487
32MB	4/330	N/A	$4825
64MB	4/330	N/A	$8791
8MB OPTION	4/330, 4/370	X108H	$807
4MB OPTION	3/75,110,140,150,160,180	N/A	$1138
8MB OPTION	3/75,110,140,150,160,180	N/A	$1684
12MB OPTION	3/75,110,140,150,160,180	N/A	$2208
16MB OPTION	3/75,110,140,150,160,180	N/A	$3244
20MB OPTION	3/75,110,140,150,160,180	N/A	$4453
24MB OPTION	3/75,110,140,150,160,180	N/A	$5526
8MB OPTION	3/260,280,470,480, 4/260,280	N/A	$4808
16MB OPTION	3/260,280,470,480, 4/260,280	N/A	$6886
32MB OPTION	3/260,280,470,480, 4/260,280	N/A	$11843

TOSHIBA

DESCRIPTION	FOR MODELS	REF. P/N	PRICE
512KB MEMORY KIT	T3100E	PC9-PA8340U	$78
2MB MEMORY KIT	T3100E	PC9-PA8341U	$129
3MB MEMORY KIT	T3200	PC6-PA7137U	$306
2MB MEMORY CARD	T5100	PC7-PA8301U	$172
2MB MEMORY KIT	T5200	PC10-PA8304U	$172
8MB MEMORY KIT	T5200	PC-PA8313U	$1196
2MB MEMORY KIT	T3200/SX	PC12-PA8307U	$29
4MB MEMORY KIT	T3200/SX	PC12-PA8909U	$338
2MB MEMORY CARD	T1600	PC8-PA8302U	$172
2MB MEMORY CARD	T3100/SX	PC15-PA8308U	$129
4MB MEMORY CARD	T3100/SX	PC15-PA8310U	$325
1MB MEMORY CARD	T1000/SE, XE	PC14-PA8311U	$227
2MB MEMORY CARD	T1000/SE, XE	PC14-PA8312U	$273
2MB MEMORY KIT	T8500	PC10-PA8304U	$180
8MB MEMORY KIT	T8500	PC-PA8313U	$1179
2MB MEMORY CARD	T1200XE	PC13-PA8306U	$180

ZENITH

DESCRIPTION	FOR MODELS	REF. P/N	PRICE
1MB UPGRADE KIT	Z386/20, 25, 33, 33E	ZA3800ME	$86
2MB UPGRADE KIT	Z386/20, 25, 33	ZA3800MG	$137
4MB UPGRADE KIT	Z386/20, 25, 33, 33E	ZA3800MK	$380
2MB UPGRADE KIT	Z386SX	Z-605-1	$124
1MB EXP. CARD	SUPERSPORT 286, 286E	ZA-180-66	$188
2MB EXP. CARD	SUPERSPORT SX, 286E	ZA-180-84	$306
2MB EXP. CARD	SUPERSPORT SX	ZA-180-86	$306
2MB EXP. CARD	SUPERSPORT SX	ZA-180-87	$306
1MB EXP. BRD	TURBOSPORT 386, 386E	ZA-3034-ME	$242
4MB EXP. BRD	TURBOSPORT 386E	N/A	$646

PAYMENT TERMS: (In US Funds Only)

- International Money Order
- Certified / Cashier's Check
- L/C
- Wire Transfer (T/T)

TEL: (415) 680-8271
FAX: (415) 680-1408
TELEX: 470166

ATICO
1130 Burnett Ave., Suite H
Concord, CA 94520 USA

VGA to Video

Digithurst has enhanced its MicroEye Video Output Card (VOC) to include a Siemens ASIC, which gives you full graphics-on-live-video functionality. The VGA-to-video converter and overlay card provide sharp text and graphics in resolutions of up to 640 by 480 pixels, and you can use it to mix and record combinations of computer graphics and video from other recordings or from live camera sources. Or you can use it to present computer graphics through large-screen-projection systems or one or more standard TV monitors.

When you want to add text to a video picture or overlay graphics of any kind, the MicroEye VOC lets you quickly and easily create windows of variable size to contain inset areas of video or blocks of computer-generated text and graphics. You can create masks of any pattern of pixels taken from video signals. If you change the mask in software, you can create effects such as fade, dissolve, and picture merge in any shape or pattern. If you need to shrink or compress a video picture into a particular window or perform other processing effects on the incoming video, you will need the companion MicroEye PB Card (see July 1990 What's New International, page 64IS-48).

You can use the MicroEye Video Output Card to mix and record combinations of computer graphics and video from other recordings or from live-camera sources.

The card has a genlock mode that lets you use it with video mixers and other audiovisual or TV studio equipment. You can combine high-quality computer graphics with CCTV and video signal sources.

The MicroEye VOC requires a half-length slot in an IBM PC.

Price: £495.

Contact: Digithurst Ltd., Newark Close, Royston, Hertfordshire SG8 5HL, U.K., 44-763-242955; fax 44-763-246313.

Circle 1328 on Inquiry Card.

An Innovative Outlook on the Future of Lisp

The new version of Delphi Common Lisp has a modular structure that lets you tailor the size of your system to meet your requirements. Delphi Common Lisp Plus (DCL+) also has two new features: D-Prolog, a full implementation of Prolog with Edinburgh syntax, and D-Motif, a Motif Graphic Toolkit Interface.

D-Prolog is designed for

language interoperability. You can develop a program modularly, adopting the most suitable programming paradigm for each module from among functional Common Lisp, procedural C, Prolog, and object-oriented (i.e., Common Lisp Object System [CLOS]) style. D-Motif is an object-oriented library for building user-interface applications under Motif. The library includes an environment for using DCL+ with panels, menus, and dialogues that allow you to invoke Lisp functionalities, such as trace, step, compile, and load, and to select and edit files.

Other DCL+ features include a full implementation of Common Lisp; a kernel implemented in C; multitasking; CLOS; a CLX interface between DCL and the X Window System; and the Common Lisp User Interface Environment (CLUE), the portable X Window–based system for user-interface programming in Common Lisp. DCL+ also offers efficiency improvements for general programming and object-oriented programming; a reduction in the size of compiled code; and a reduction of the Garbage Collector calls through the Immediate Data feature, which reduces memory usage.

Price: 1,150,000 lire for the kernel; 1,150,000 to 3,950,000 lire for the graphics module (D-CLX+, D-CLUE, and D-Motif); 1,950,000 lire for D-Prolog.

Contact: Delphi S.p.A., Via della Vetraia, 11, I-55049 Viareggio (LU), Italy, 39-584-395225; fax 39-584-395366.

Circle 1329 on Inquiry Card.

Keep Your Eye on the Stars

Now you can map the positions of the moon, stars, planets, and other celestial objects visible to the naked eye on your IBM PC with SkyWatch, an interactive planetarium program designed for educational and recreational use. The software lets you adjust the date, time, location, and direction of viewing within the program, as well as a large number of other parameters, including the size of the field of vision, the color and brightness of the stars, and the scale of the reference grid, which you can superimpose on the display.

You can view constellations in isolation to learn their outlines or flash them on a full display to identify them among their neighbors. You can also add or remove the names of the constellations and the brighter stars. A list of the constellations visible on the current screen is available at the press of a key, and a quiz mode lets you test your knowledge of star names.

SkyWatch lets you rotate the sky on the screen at intervals ranging from 1 minute to one year, a feature that is useful for observing the daily and hourly motion of the stars and planets, the changing phases of the moon, or the progression of a solar eclipse.

SkyWatch requires an IBM PC with 256K bytes of RAM, DOS 2.0, a graphics adapter, and a monochrome or color monitor.

Price: £30.

Contact: Biosoft, 22 Hills Rd., Cambridge CB2 1JP, U.K., 44-223-68622; fax 44-223-312873.

Circle 1330 on Inquiry Card.

SERVING ALL OF EUROPE FROM LONDON & ZURICH!

PRE-SALE CONSULTING

AT UNBEATABLE PRICES!

POST SALE SUPPORT

NEW AND NOTEWORTHY:

	£	$
Calera's Word Scan 286/386 — Probably the best implementation of optical character recognition today.	364	729
Expanz Disk Expander Card — Triple hard disk storage without performance loss, make your floppies run 4 times faster	119	239
GEOWorks Ensemble — Multitasking, virtual memory, Motif user interface available to ANY PC, including an XT	99	199
IntelSatisFAXtion — Easy to use modem, fax, scanner port, communications coprocessor & software. Sends, receives & prints faxes.	344	689

ARTIFICIAL INTELLIGENCE:

	£	$
Arity Combination Pack v5.1	659	1319
BrainMaker	148	297
BrainMaker Professional	638	1277
PDC Prolog DOS v3.21	189	379
PROLOG-2 Personal	89	179

ASSEMBLERS & LINKERS:

	£	$
Blinker v1.1	144	289
Microsoft Macro Assembler v5.1	87	176
Plink/LTO v2.3	299	599
RT-Link Plus v4.1	299	599
PolyLibrarian II	91	184
Spontaneous Assembly	151	304

BACKUP:

	£	$
Back-It	55	112
Copy II PC v6.0	24	50
Copy II PC Deluxe Option Board	104	209
Central Point Backup	54	110
Norton Backup	88	178

BASIC:

	£	$
HyperHelp	81	163
Microsoft BASIC PDS v7.1	286	574
Microsoft Quick Basic v4.5	59	120
PowerBASIC v2.1	68	137
ProBas	129	259

BUSINESS

	£	$
Ami v1.2	111	224
FormFiller v3.0	78	157
FormTool Gold v3.0	53	107
Grammatik IV	46	94
GrandView v2.0	176	353
LetterPerfect	118	237
Lotus 1-2-3 v3.1	381	764
Mace Vaccine	54	110
Microsoft Office for Windows	579	1159
Norton AntiVirus	77	156
ORG Plus Advanced v5.0	58	118
Quattro Pro v2.0	276	554
Sidekick v2.0	54	110
Sideways v3.3	52	105
SQZ! Plus	61	123
Super Project Expert v2.0	393	787
TimeLine v4.0	412	825
WordPerfect v5.1	239	480

C:

	£	$
C ASYNCH MANAGER v3.0	115	232
C-terp w/Source v3.3	181	363
C-Worthy w/Forms & Source	348	698
Clear + for C	114	229
Control Pak/Windows	359	719
Essential Communications v3.0	183	367
FairCom Toolbox Special Edition	419	839
Greenleaf CommLib v3.0	235	472
Lattice C Dev Sys for DOS & OS/2	152	305
Microsoft C Compiler v6.0	286	574
Microsoft Quick C/Quick Asm. v2.51	116	234
PC-Lint	72	145
Turbo C Tools	91	184
WATCOM C /386 Professional	843	1689

CADD:

	£	$
3-D Drafting v1.1	187	375
AutoCAD Release 11	2655	5311
Design CAD 3D v3.1	182	365
Generic CADD v5.0	211	424

CASE:

	£	$
CASE: Windows	838	1677
CASE: PM for C	1678	3357
CASE: PM for C++	1678	3357
Compeditor II	212	425
EasyCASE Plus	238	477
Teamwork/PCSA	897	1796

COBOL:

	£	$
Microsoft COBOL v4.0	519	1039
LPI COBOL	974	1949
RM/COBOL-85 v5.0	706	1413

COMMUNICATIONS:

	£	$
Carbon Copy Plus + Host	102	205
CO/Sessions Complete	151	304
Crosstalk Mk. 4 v2.0	124	250
LapLink III	77	155
Mirror III v2.0	76	154
PC Anywhere IV (Host & Remote)	91	184
Procomm Plus v1.1b	61	124
Remote2 (Host & Caller)	99	199
SmarTerm 240 v3.1	174	350
Takeover	149	300

DATABASE & FILE MANAGEMENT:

	£	$
4GL Rapid Dvlp System w/Debugger	670	1341
ALPHA Four v1.1	276	554
Btrieve for DOS	359	719
Clarion Professional Developer v2.1	424	849
Clipper v5.0	469	940
dB FILE & db Retrieve w/Object, Source	208	418
dBASE IV v1.1	447	895
dbFast/Plus v1.4	157	316
DBXL Diamond v1.3 R	126	254
FoxBASE+ v2.1	180	361
FoxPro	415	832
Novell XQL Relational Data Mgr	495	991
Paradox v3.5 Competitive Upgrade	128	257
Paradox v3.0	415	832
Paradox v3.5	468	937
Paradox SQL Link	324	649
Professional Oracle Developers Kit	608	1216
R&R Clipper/Foxbase+ Module	32	65
R&R Report Writer for XDB SQL	181	364
R:BASE v3.1	439	880

DEBUGGERS:

	£	$
Breakout II	77	155
Multiscope DOS Debugger	107	214
Multiscope Windows/DOS	225	452
Periscope I v4.1	356	714
Periscope IV 25Mhz	1689	3379

DESKTOP PUBLISHING:

	£	$
Aldus PageMaker v3.01	461	923
Aldus Persuasion v2.0	291	584
Freedom of the Press	225	451
GoScript Plus v3.0	169	340
Halo DPE	111	223
HiJaak v2.0	121	244
Micrografx Designer v3.01	426	853
Omnipage 386 v3.0	419	839
ProScan Grayscale Full-Page Scanner (incl. FREE Picture Publisher)	457	915
Publish It!	102	205
Ventura Publisher Gold Series v3.0	495	990

DISK/DOS UTILITIES:

	£	$
Lotus Magellan v2.0	93	187
MACE Utilities 1990	86	173
Norton Utilities v5.0	109	220
OPTune	43	85
PC Tools Deluxe v6.0	84	170
Q-DOS II	34	69
SpinRite II	58	118
System Sleuth v2.1	69	139
Windows DOS	38	78
Xtree Pro Gold v2.0	85	172

EDITORS:

	£	$
Brief v3.0	169	339
Sage Professional Editor	179	359
VEDIT PLUS v3.3	94	190

FORTRAN:

	£	$
FORTRAN F77L-EM/32 v3.0	628	1258
Fortran Toolkit 1 v5.2	66	134
Fortran Toolkit 2 v5.2	109	220
GRAFMATIC & PLOTMATIC	146	293
Microsoft FORTRAN v5.0	260	522
RM/FORTRAN v2.44	335	671
WATCOM Fortran 77 /386	713	1429

GRAPHICS:

	£	$
Corel Draw v2.0	299	600
Cricket Graph for Windows	111	223
Essential Graphics v3.0	229	460
GraphicsMenu v3.0	127	256
GRASP w/Art Tools	103	208
GSS Graphics Dvlpt Toolkit	519	1039
HALO	213	428
HALO Professional	320	642
Harvard Graphics v2.3	282	565
MetaWINDOW	208	418
STATGRAPHICS	503	1007

HARDWARE:

	£	$
ASCII 2400 Internal Modem	73	147
ASCII SuperVGA 1024X768 w/512K	126	253
Echo II Speech Synthesizer	111	223
Hercules Art Dept (Incl. Graphics Station card & Lumen	2279	4559
Intel 80387-33 Math Coprocessor	539	1079
Logical Connection Plus	526	1054

INTEGRATED:

	£	$
Framework III v1.1	397	795
Lotus Symphony v2.2	454	909
Lotus Works	85	172
Microsoft Works v2.0	88	178
Q&A 3.0	208	417

LAN & LAN-READY SOFTWARE:

	£	$
FoxPro Multiuser	571	1144
Framework III (5 Users)	567	1135
LANtastic Ethernet Adapter	226	454
LANtastic Ethernet Starter Kit	468	938
Microsoft Windows Add'l Station	74	149
Microsoft Word Add'l Station	171	344
Networker Plus	131	264
Novell ELS I Netware v2.12	495	991
Novell ELS II Netware v2.15c	1177	2355
Novell: Entire product line.	CALL!	
Paradox Network Pack v3.5	589	1179
Q-DOS II (8 User)	99	200
R:BASE v3.1 (5-User) LAN Pack	559	1119
Saber LAN Administration Pack v1.1	328	658
Saber Menu for Windows v3.0	233	468
Super Project Expert (3-User)	393	787
TimeLine v4.0.1 Add'l user	177	355
Ventura Publisher Gold Add'l Node	262	526
WordPerfect Add'l Station	149	300
Wordstar Pro v6.0 Add'l Station/Server v6.0	77	155
XtreeNet v2.0 for ELS Level 1 & 2	141	284

MACINTOSH:

	£	$
Adobe Photoshop	476	954
Adobe Type Manager v2.0	54	110
Carbon Copy Mac	103	208
Claris CAD v2.0	532	1066
Color Studio	559	1119
Copy II Mac	24	49
DiskLock v2.0	108	217
FastBack Mac v2.5	108	217
FoxBASE+ V2.01	259	520
Freedom of the Press v3.0	224	450
FullWrite Professional v1.5	130	262
Generic Cadd Level 1 v1.1	91	184
Gofer v2.0	42	85
LapLink MAC	81	164
MacPaint v2.0	76	155
Macromind Director v2.0	391	783
MacSleuth	69	139
MacTools Deluxe v1.0	73	147
Mathematica for Mac II v1.2	638	1277
Microsoft Write	75	151
MiniCAD+	433	867
Norton Utilities	78	157
OmniPage	420	839
PageMaker v4.0	471	943
Publish It Easy v2.0	127	255
Smalltalk/V v2.0	114	229
Statview II	240	480
SAM v2.0	61	123
SUM II	90	182
SuperCard v1.5	173	347
Think C v4.0	149	299
Think Pascal	149	299

MEMORY MANAGEMENT:

	£	$
386 Max v5.1	67	135
Above Disk v4.0	55	112
Blue MAX v5.1	80	160
DESQview 386 w/QEMM v5.1	118	239
QEMM/386 v5.1	55	111
QRAM with Manifest	44	90
Turbo EMS v6.0	47	95
VM/386 Multitasking	124	250

MODULA-2:

	£	$
EmsStorage with Full Source	46	94
Logitech Modula-2 Dvlpt Sys	149	299
Topspeed Modula-2 DOS Compiler Kit	141	284
Topspeed Modula-2 OS/2 Compiler Kit	348	698

OBJECT ORIENTED PROGRAMMING:

	£	$
Asymetrix Toolbook (Windows)	269	539
Object Professional v1.1	115	232
Smalltalk/V 286	114	229
Turbo C++ Pro Competitive Upgr	132	265
Turbo C++ Professional	176	353
Windows Maker	557	1115
Zinc Interface Library	151	303
Zortech C++ Compiler v2.1	122	245
Zortech C++ Devlpr's Ed. v2.1	272	545

OPERATING ENVIRONMENTS:

	£	$
DR DOS v5.0	123	248
IBM OS/2 Extended Edition v1.2	558	1117
Interactive UNIX 386/ix Op Sys	299	599
Microport Sys V Rel 4 Comp Limited	CALL	
Microport Sys V Rel 4 Comp Unlimited	CALL	
Microsoft Windows 3.0	88	177
SCO Open Desktop	748	1498
SCO UNIX 386 Dev GT v3.2	614	1229

OS/2 PRODUCTS:

	£	$
Asymetrix ToolBook	262	526
Brief Editor v3.0	169	339
Btrieve	359	719
Control Pak/PM	359	719
Describe Word Publisher v2.0	365	731
GSS Graphics Devel. Toolkit	519	1039
IBM DisplayWrite 5/2	220	441
Lotus 1-2-3/G	445	892
MS LAN Mgr Server 1-5 usrs	609	1219
Microsoft SQL Server 1-5 usrs	609	1219
Multiscope Debugger v1.2	267	535
OS/2 Presentation Mgr Toolkit	289	580
Paradox	432	865
PDC Prolog v3.2	451	904
Poly AWK	121	244
R:BASE	549	1099
SideKick PM	118	237
Smalltalk/V PM	282	565
WideAngle	60	121

OTHER LANGUAGES, TOOLS & MISC.:

	£	$
Adobe PostScript Cartridge	264	530
LaserGo 1Mb Board w/GoSelect	128	258
MS Mouse With Windows v3.0	138	278
Niscan Grey Scale Hand Scanner	190	381
PolyMake	91	184
RPG II Development System v3.1	1042	2085
ScanMan Scanner	161	324

PASCAL:

	£	$
B-Tree Filer	77	155
Pascal TOOLS & TOOLS 2	107	215
POWER SCREEN	91	184
Turbo Analyst w/Source	79	160
Turbo Pascal v6.0	89	179
Turbo Pascal Professional v6.0	178	358
Turbo Plus	131	264
Turbo Professional	79	160

SCIENCE & ENGINEERING:

	£	$
Advanced Math Applications Pack	59	119
Derive v2.0	172	345
MathCAD v2.5	284	569
Mathematica/386 v1.2	558	1117
Mathematica for Windows	798	1597
SSP/PC Scientific Subroutine Library	229	460

SCREEN DESIGN & WINDOWING:

	£	$
Flash-Up Developer's Toolbox	50	102
Greenleaf DataWindows w/Source	299	599
PANEL Plus II	252	505
Vermont Views v2.0	299	599

TRANSLATORS:

	£	$
dBx/dBport v4.7	752	1505
FOR_C w/Binary Runtime	407	815
FOR_C++	812	1625

UNIX/XENIX PRODUCTS:

	£	$
4GL Rapid Dvlpt Sys w/Debugger	2076	4153
Grammatik IV	173	347
Microsoft FORTRAN Compiler	433	867
Norton Utilities for System V	179	359
Pascal Compiler for XENIX/286	433	867
Professional Oracle Unix/Xenix	1377	2756
RM/COBOL-85 for UNIX/XENIX 386 (1 User)	1162	2325
SCO Portfolio Suite 386 v6.0/1.0	991	1983
VEDIT PLUS for Unix/Xenix	173	347

WINDOWS 3.0 APPLICATIONS:

	£	$
Actor for Windows w/Lang. Ext.	664	1330
Adobe Illustrator v1.1	254	510
Adobe Type Manager	52	106
Btrieve for Windows	359	719
Crosstalk for Windows v1.1	112	225
dbFast/Windows 2.0	180	361
DRAFIX/Windows CAD v1.1	391	783
Facelift for Windows	57	115
Form Publisher	126	254
FormBase	279	559
Grammatik Windows	46	94
Guide 3 for PC	334	670
Gupta SQLWindows v2.0	850	1700
JetForm Design	249	500
Micrografx Charisma v2.0	304	609
Microsoft Excel v2.1	279	559
MS Powerpoint for Windows	284	569
Microsoft Project for Windows	400	802
Microsoft Word for Windows v1.0	286	574
PER. Form Pro	249	499
Superbase 4 Windows	391	783
Tempo Macro Utility v1.2	58	117
Thinx for Window	279	559
Wide Angle	60	121
Windows Device Drvr. Dvlp. Kit	288	578
Windows Productivity Pack	36	74
Windows SDK 3.0	288	578
Wingz for Windows & OS/2PM	291	584
WinSleuth v2.1	69	139

USA ★ SOFTWARE

LIMMATQUAI 116
8001 ZURICH, SWITZERLAND
PHONE. (01) 252-6710 FAX. (01) 252-7795

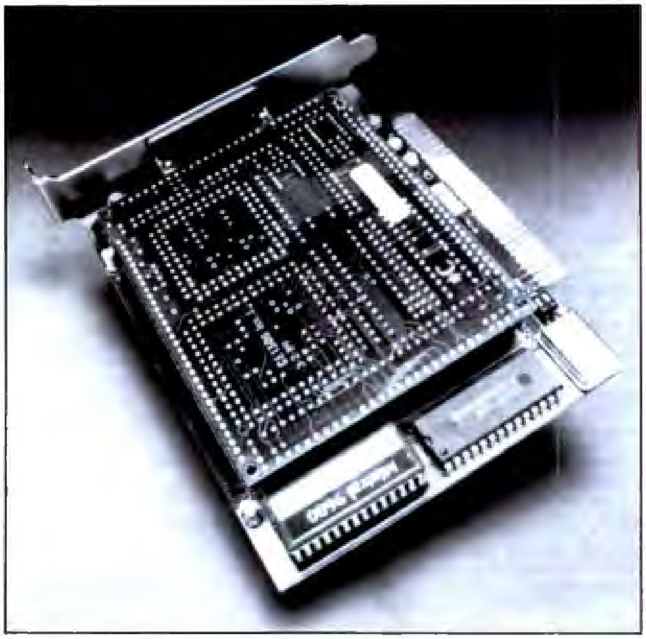
16 CONNAUGHT STREET
LONDON W2 2AG • UK
PHONE 071-402 0722 FAX. 071-724 9847

- All major credit cards accepted.
- (30) day billing for qualified organizations.
- Special discounts for large or corporate buyers.
- Prices do not include VAT or other local taxes
- Prices subject to change without notice

B04/91

Over 3,500 products carried. Call today for price list-disk.

Circle 477 on Inquiry Card.



The Mistral 9600PC modem card uses compression techniques to preprocess data before it is transmitted, allowing the modem to achieve throughputs in excess of 18,000 bps.

Innovative Modem Technology

Amber Logic says that its V.32 and V.32bis half-length modem cards enhance the performance of personal computers. The Mistral 9600PC and 14400PC V.32 and V.32bis modems and the Mistral 2400PC V.22bis modem offer enhanced high-speed communications and fit into most IBM PC and portable computers having a standard 8-bit bus slot.

Using compression techniques to preprocess data before it is transmitted, the Mistral PC modems operating at V.22bis can transfer data at speeds in excess of 5500 bps, while the V.32 and V.32bis modems can achieve throughputs in excess of 18,000 bps. You can upgrade the 2400 models to the 9600 and 14400 standards.

As with the desktop modems in the company's range, the PC half-length modems combine multistandard operation with MNP level 4 error control and MNP level 5 data compression to provide enhanced on-line performance and flexibility. Other features include pulse and tone auto-dialing, an audible call-progress monitor, automatic repeat dialing, security dial-back with password protection, and password-protected remote control via normal AT commands.

Price: £399 for the Mistral 2400PC; £799 for the Mistral 9600PC; £899 for the Mistral 14400PC.

Contact: Amber Logic Ltd., 33 Saltaire Rd., Shipley, West Yorkshire BD18 3HH, U.K., 44-274-585483; fax 44-274-589221.

Circle 1331 on Inquiry Card.

PURE MAGIC

Computer Aided Programming
Application Generator and Relational Database

Yes, 'PURE MAGIC' is what thousands of professionals all over the world experience working with MAGIC. MAGIC was designed for the professional developer concerned with providing solutions to real-life data processing applications. MAGIC is a powerful and innovative tool that outstrips all existing programming methods.

No. 1 in Programming Power

★ Awarded 1st Place by PC WEEK Poll - January 1989
★ Outright Winner of Australian PC WEEK Database Challenge - Sydney, March 1989.

MAGIC BENEFITS

★ Reduction of 60 to 90% in software development time
★ Huge savings in software maintenance costs
★ Integral IBM™ host communication
★ Enhanced human engineering
★ Standardization in development of end-user interface
★ Portability between various operating systems - PC-DOS™, Unisys-BTOS™, Convergent-CTOS™

STATE-OF-THE-ART FEATURES

★ Automatic non-procedural processing
★ Quick prototyping tool
★ Full multi-user RDBMS
★ Multi-file pop-up windows and zoom techniques

MORE MAGIC PRODUCTS

DOS versions - LAN versions - Unisys BTOS/XXX versions - AAC mainframe connectivity module - Personal MAGIC — STatGRaf statistics and graphics package.

SOME MAGIC REVIEWS

"There is no competitive product" (PC TECH JOURNAL)

"One of the most powerful DBMS packages available" (PC MAGAZINE)

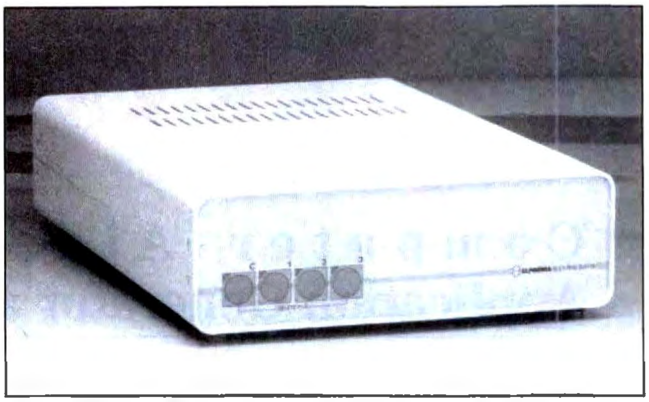
"Excellent overall value" (PC WORLD)

Distributor and Dealer Enquiries Welcome.

SHAPIRA—WAXMAN

MSE

Magic Headquarters: ■ **Israel:** MSE Ltd., 3 Bezalel St., Ramat Gan 52521, Tel: [972 3] 751 1914, Fax: 751 6218 ■ **U.K.:** MSE Ltd. (U.K.) Tel: [44 1] 902 8998, Fax: 903 1465 ■ **France:** Magic France S.A., Tel: [33 1] 4897 4820, Fax: 4897 8125 ■ **Germany:** Fink Software, Tel: [49 40] 527 0235, Fax: 524 4727 ■ **Austria:** M-Computer, Tel: [43 222] 535 9860, Fax: 53 59 861 ■ **Hungary:** Medicor Medorg Co., Tel: [36 1] 129 4281, Fax: 149 5957 ■ **Australia:** Sigma Data Co., Tel: [61 2] 957 3777, Fax: 957 2013 ■ **The Netherlands:** A.V.R., Tel: [31 10] 434 3262, Fax: 460 0805 ■ **Switzerland:** Aker S.A., Tel: [41 22] 477 177, Fax: 477 348 ■ **U.S.A.:** Aker Corp., Tel: [1 714] 250 1718, Fax: 250 7404 ■ **Japan:** Wacom Co. Ltd., Tel: [81 3] 985 0097, Fax: 985 8636.



Each port of the Multiport Spooler-Selector can be an input or an output port, and the unit is able to accept data on all inputs and send data to all outputs at the same time.

Multiport Spooler-Selectors

The Elproma Multiport Spooler-Selectors are microprocessor-controlled and have additional memory for efficient performance. Each port can be an I/O port, and the units support all ports simultaneously, meaning that the Multiport Spooler-Selectors can accept data on all inputs and send data to all outputs at the same time.

The unit tracks which file came first and works on a first-in/first-out basis. You can select the output ports by a code word or through a pop-up menu. There are 15 models available: 4-, 8-, and 16-port models for serial or parallel processing, output port–selectable or not, and bidirectional.

Price: 1000 to 6900 Dutch guilders.

Contact: Elproma B.V., Nijendal 42, 3972 KC Driebergen, Postbus 170, 3970 AD Driebergen, The Netherlands, 31-3438-18724; fax 31-3438-12286.

Circle 1332 on Inquiry Card.

MacProlog 3.5

Logic Programming Associates has added full-color support for graphics windows with access to the Macintosh Color Wheel, scrolling text fields for help dialogues, a structured hypertext-style file browser, and dynamic menu facilities to the new release of its MacProlog series of software development tools. MacProlog 3.5 also includes new releases of the MacProlog compiler system, the flex expert-system toolkit, the MacObject/Prolog++ system, the MacProlog Dialog Editor, and the new MacProlog/Oracle Interface.

The graphics-based MacProlog Dialog Editor helps you easily construct sophisticated user interfaces with a palette of dialog items such as buttons, check boxes, radios, edit fields, text fields, icons, pictures, and scrolling menus. By simply selecting and positioning items from the palette, you can create a mock-up of your dialog layout.

While you are designing the dialogue, you can freely create, drag, delete, resize, or reedit items with the mouse. Once you achieve your desired layout, the editor generates all the Prolog code needed to create the actual dialogue. You can immediately execute this code for testing purposes or paste it into a program window.

The MacProlog/Oracle Interface provides a transparent coupling between the two products so that you can access Oracle tables from within MacProlog as if they were Prolog assertions. The interface supports concurrent access and update, indexes, and data conversions, and it offers full access to the Oracle data dictionary. It also allows for the execution of general Structured Query Language commands from within Prolog.

Price: £650 for the MacProlog 3.5 Programmers Edition; £1250 for the MacProlog 3.5 Developers Edition; £1000 each for the flex 1.21 and the MacObject/Prolog++ 1.01 Programmers Editions; £2000 for the flex 1.21 and the MacObject/Prolog++ 1.01 Developers Editions; £250 for the MacProlog Dialog Editor 1.01; £500 for the MacProlog/Oracle Interface.

Contact: Logic Programming Associates Ltd., Studio 4, Royal Victoria Patriotic Building, Trinity Rd., London SW18 3SX, U.K., 44-81-871-2016; fax 44-81-874-0449.

Circle 1333 on Inquiry Card.

Access the IBM RISC System/6000

The HBX-PAD communications package provides the features of the CCITT X.3, X.28, and X.29 standards for asynchronous communication between user terminals and X.25 data networks via the IBM RISC System/6000 subsystem. The user interface provides standard CCITT packet assembler/disassembler functions, which give you access to the remote computer by emulating an asynchronous terminal. If you prefer, you can access the PAD through an application program.

The package provides multiple, simultaneous incoming and outgoing calls, local and remote PAD control, file transfer support, scripts for automatic calls and log-ins, logs of incoming and outgoing calls, and profiles for easy configuration of PADs. In addition, HBX-PAD supports reverse charging, closed user groups, packet- and window-size negotiations, fast select, and user data. The package also lets you transfer files to and from the remote device using common file transfer utility programs.

The security features of the HBX-PAD and AIX let you limit incoming and outgoing calls to specified callers, assign incoming calls to log-in or to a program, control reverse charging, and limit callers to specified functions within the IBM RISC System/6000.

HBX-PAD requires an IBM RISC System/6000, one to eight IBM X.25 Interface Co-Processor/2 Adapters, a modem and communications line to an X.25 network, and AIX 3.1 or higher.

Price: US$2000 per CPU.

Contact: Hugbunadur hf., P.O. Box 437, Engihjalli 8, 202 Kopavogur, Iceland, 354-1-641024; fax 354-1-46288.

Circle 1334 on Inquiry Card.

Run Eight Multimeters with No Mess

When you combine Blue Chip Technology's eight-channel scanner with the VIP board and software, it provides the facilities of eight intelligent multimeters linked to a PC. You can use the scanner for a variety of applications, including automatic testing, quality assurance, multipoint measurement, and electronics troubleshooting.

The scanner lets you select a different function and range for each channel. You can link as many as four scanners to provide up to 32 input channels for each VIP-DMM card (see January International Short Takes, page 72IS-10). In addition, the scanner can extend voltage and current input ranges to 1000 V and 10 amps.

Price: £175.

Contact: Blue Chip Technology, Hawarden Industrial Park, Manor Lane, Deeside, Clwyd CH5 3PP, U.K., 44-244-520222; fax 44-244-531043.

Circle 1335 on Inquiry Card.

With the eight-channel scanner for Blue Chip Technology's VIP-DMM card, you can select a different function and range for each channel for a variety of applications.

Cresco Data's High-Speed SCSI TRAM

The CD-SCSI transputer module (TRAM) forms a high-speed interface between external transputer networks and the host computer. The module interfaces to Hewlett-Packard and Apollo workstations by use of the CD-TSE (see March 1990 What's New International, page E&W 44).

The stackable Size 2 TRAM has an intelligent interface device (which can achieve a transfer rate of 5 MBps), a T222-20 transputer, and 64K bytes of static RAM and EPROM. You can use the module as a host interface or as a disk drive controller with any TRAM motherboard such as Cresco Data's CD-TB40/AT series (see December 1990 What's New International, page 72IS-41).

Price: US$950.

Contact: Cresco Data A/S, Oresundsvej 148, DK-2300 Copenhagen S, Denmark, 45-31-554270; fax 45-31-550153.

Circle 1336 on Inquiry Card.

Circle 422 on Inquiry Card.

Portable Parallel Processing

With the new PST360X Jet Series, Paratech Solutions has combined the flexibility and convenience of a laptop with the built-in power of parallel processing. The parallel-processing element is a 20- or 30-MHz, 32-bit T800 or T805 transputer with 4, 8, or 16 MB of zero-wait-state DRAM. With your choice of transputer, speed, and memory, performance ranges are from 10 to 20 MIPS.

With performance equal to a VAX 8600, and more than twice the performance of a 33-MHz 386 microprocessor with an 80387 coprocessor, the Jet Series laptops are ideal for high-performance processing in many areas of computation, simulation, and analysis.

Paratech Solutions' PST360X Jet Series laptops combine the flexibility and convenience of a laptop with the power of a 20- or 30-MHz 32-bit T800 or T805 transputer with 4, 8, or 16 MB of zero-wait-state DRAM.

The Jet laptop weighs under 9 kg and measures just 330 by 370 by 100 mm. It is available with a CMOS, 286, or 386 microprocessor. Standard features include a 3½-inch 1.44-MB floppy disk drive and a 40-MB hard disk drive (or, optionally, a 100-MB hard disk drive). Provision is made for an external 5¼-inch floppy disk drive as well as two standard ports for an additional IBM AT keyboard and monitor. Two serial ports and one parallel port allow the addition of peripheral devices, such as a modem, a scanner, a mouse, or a printer.

The tilt-and-swivel supertwist LCD screen is backlit with a resolution of 640 by 480 pixels and can run in any of four video modes: CGA, EGA, VGA, and

TOOLBOX WINTER '91 NOW AVAILABLE

ASSEMBLERS
386 ASM Link & Locate £550
Microsoft MASM v.5.1 £89
OPTASM £85
Turbo Debugger & Tools £99

BASIC
Mircosoft BASIC PDS 7.1 £270
BASIC Interpreter £215
Microsoft Quick Basic £60
True Basic £65
Power Basic £89

C
Crystal C (Lattice) v.6.01 £170
Microsoft C v.6.0 £250
Watcom C v.8.0 £255
C-terp £195
C86 Plus £325
Express C £65
High C-286 £385
High C-386 £585
Instant C £310
Instant C/16M £515
NDP C £385
Quick C £60
Quick C & Assembler £125

C++
Borland C++ £129
Borland C++ Professional £195
Guidelines C++ with book £275
Intek C++ 80386 £320
Zortech C++ Compiler v.2.1 £120
Zortech C++ Dev. Edition £270

COBOL
acucobol MS-DOS £900
acucobol Net-Bios £1250
acucobol XENIX-286 £1500
acucobol UNIX-386 £2000
acucobol *OTHERS* CALL
Microsoft COBOL v.4.0 *NEW* £585
Real Menu £210
RealCICS £750
Realia COBOL £750
RM/Cobol-85 £750

dBASE
Clipper Version 5.0 £325
DB Fast/PLUS £255
DB Fast/WINDOWS £255
dBASE III Plus £395
dBASE IV £515
dBMAN V £190
dBXL Diamond £165
dBXL/Lan £389
Foxbase+ v.2.10 £255
Foxbase+/386 £385
Foxbase+/LAN £385
Foxbase+ Runtime £445
Foxbase+ SCO XENIX £495
Quicksilver Diamond £389

DATABASE MANAGEMENT
Advanced Revelation £615
AskSam £190
Clarion Personal Developer £195
Clarion Professional £545
Informix 4GL £645
Informix 4GL for Xenix £900
Opus One £255
Oracle for 1-2-3 £195
Paradox 3.5 £595
PFS Professional File £165
R:BASE Ext. Report Writer £190
R:BASE for OS/2 £579
R:BASE for DOS £445
Reflex £89

FORTRAN
Microsoft Fortran v.5.0 £250
Fortran-F77L £385
NDP FORTRAN-386 £385
ProFortran £235
RM/Fortran £385
SVS Fortran £435

OTHER LANGUAGES
ACTOR £450
ACTOR Language Extension £65
CCSM Mumps Single User £65
PC Logo £65
RPG II Complete £1035
Smalltalk/V £65
Smalltalk/V 286 £129
Snobol 4+ £65
Toolbook £299
Trilogy £65

PASCAL
Microsoft Pascal £170
Oregon Pascal-2 £149
ProPascal £235
Metaware Professional Pascal £579
Metaware Prof. Pascal 286 £385
Turbo Pascal v.5.5 with objects £89
Turbo Pascal Professional £159

PROLOG
Arity Combination Pack £710
Expert System Dev. pack £190
Intelligence Compiler £299
MicroPROLOG Professional £645
MProlog £299
Professional Prolog II Plus £899
Professional Prolog £545
Prolog Advanced Toolkit £99
Prolog Compiler £129
Prolog Compiler/Interpreter £420
Prolog-86 Plus £165
SQL Development Pack £190
Turbo Prolog £65

AI AND OBJECT ORIENTED
C-Talk £99
C+ Objects Vol 1 with Source £275
CxPERT £515

CASE TOOLS
Easycase Plus £190
Easycase Plus professional £255
Visible Analyst £385
Visible Analyst Workbench £1535
Visible Dictionary £385
Visible Prototyper £385
Visible Rules £385

COMMUNICATIONS LIBRARIES
AdComm £190
C ASYNCH MANAGER £125
Communications Library £195
Comm Pak with Breakout £195
Multi Comm £89
Net Lib £129
NET-TOOLS £95
SilverComm £125
Comm Plus £65
Turbo ASYNCH PLUS £125

FILE MANAGEMENT
B-Tree £65
B+Tree for C £55
AXOS £255
Btrieve OS/2 £370
Btrieve Multitasking £370
Btrieve for DOS v.5.1 £395
Btrieve XENIX £370
C Index+ £255
c-tree £255
Faircom Toolbox Professional £710
Code Base 4 v.4.2 DOS & OS/2 £190
Code Base 4 + UNIX/XENIX £319
db_FILE/RETRIEVE £190
d-tree £320
dBC III £165
dBC III Plus £330
RealDL/I £645
WKS Library £129

GENERAL
C Tools Plus £99
C Utility £165
C*Lib C Function Library £120
DB/RA3 £125
dBase Program Utility £55
dBase Program Utility Vol 2 £55
dBase Tools For C £55
Functions with source £149
Integrated Dev. Libraries £99
Pascal Toolkit £85
Pascal Tools 1 £75
QuickPak Professional £99
Quick Tools Library £79
Spindrift Library £99
Spontaneous Assembly £255
Super Functions £195
Tom Rettig Help Combo £79
Tom Rettig Library £65
Turbo C TOOLS £99
Turbo Plus £129
Turbo PowerTools Plus £99
Turbo Functions £69

GRAPHICS
dBase Tools for C Graphic £55
dGE v.4.0 £190
EGA Toolkit £165
Essential Graphics £259
Flipper £129
FontWINDOW/Plus £170
GEOGRAPH Professional £210
Grafmatic CGA & EGA £135
GraphiC £255
GSS Graphics Dev. Toolkit £399
GSS Kernal £385
GSS Metafile Interpreter £225
HALO-88 £255
HOOPS Extended DOS £515
MetaWINDOW/Plus £210
scLASERplus £299
SilverPaint £65
SilverPak £179
Slate £195
Universal Graphics Library £130

OP. SYSTEM ENHANCEMENTS
DESQview API C Lib/Ref £129
Multi C £89
Multi Dos Plus w/source £65
OS/2 Programmer's Toolkit £215
OS/286 £320
OS/386 £320
Resident C £65
Time Slicer £190
VMFM £115
Wendin PC UNIX £60
Wendin PC VMS £60
Microsoft Windows v.3.0 £95
Microsoft Windows S.D.K v.3.0 £325

QUERY
CBTREE/SQL £255
CQL Query System £265
dQUERY/Lib £179
db_RETRIEVE £239
XQL £480
Xtrieve PLUS £395
Netware SQL £385

REPORT
CB/IQ Report £139
Coreports £179
Focus Report Writer £210
r-tree £179
R&R Relational Reportwriter £95
R&R Clipper Module £49

TEXT SCREENS
Animator COBOL £120
Application Manager £450
C-Worthy v1.2 Forms/CW £320
C-Worthy v1.2 Forms/CW+Src £450
Curses £105
Curses Window Dev. Kit £75
Data & Windows £149
DataWindow £179
dWindows for db3 £60
Face-it £65
Flash-up w/Toolbox £85
Forms II £179
Guido £165
HI-SCREEN XL £99
Multi Windows £179
On-Line Help £90
PANEL PLUS II £319
PC Forms £129
Pop Screen £59
POWER SCREEN £99
Pro Screen £65
SCREENIO £259
Screen Sculptor £75
ScreenStar £65
Screenplay £115
SoftCode £85
SoftCode Template £39
Softscreen/Help Source £150
Sourcewriter £645
UI Programmer Dev. Edition £345
V Screen £39
VCScreen £90
Vitamin C £135
VLib with Source £90
Vermont Views £245
Z View £149

DEBUGGERS & DISASSEMBLERS
386 Debug £125
Breakout-II £79
D'Scope 2 £159
dBug for dBase £125
DIS*DOC £79
Periscope II £110
Periscope II-X £90
Periscope III £875
Periscope I Rev 3 £435
Periscope IV (16 MHz) £1245
Periscope IV (20 MHz) £1435
Periscope IV (25 MHz) £1625
Plus Board with 512K £310
Plus Board with 0K £220
Serial Test £310
Soft Probe II/TX £245
Soft-X-plore £79
Sourcer/BIOS Pre-Proc. *NEW* £110

DOCUMENTORS
ASM Flow £69
C-Clearly £95
Clear+ for dBASE £129
Clear+ for C £129
dAction £55
dAnalyst £190
dFLOW £89
Documenter £190
Flow Charting III £149
Tree Diagrammer £65

EDITORS
BRIEF v.3.0 £159
BRIEF v.3.0 *UPGRADE* £60
BRIEF OS/2 £159
dBRIEF v3.0 *NEW* £79
BRIEF with dBRIEF £229
C-EDIT £255
EMACS £210
Epsilon £129
ME Editor with C Source £125
Norton Editor £49
Personal Rexx £99
PI Editor £129
SPF/PC £159
Vedit+ £120

HELP GUIDES AND TRAINING
dBASE on-line £65
Norton Guides for ASM £85
Norton Guides for BASIC £65
Norton Guides for C £69
Norton Guides for OS/2 £89
Norton Guides for Pascal £65
Programmer's Library £255

LINKERS & LIBRARIANS
ALINK *NEW* £129
Archive Link £239
Link & Locate ++ £255
LinkLoc £315
PLINK86 Plus *Now Polytron* £495
PolyLibrarian II £125
.RTLink £190

MAKE UTILITIES
PolyMake v.3.2 £205
MKS Make £99
MKS Make 5 User £320
MKS Make 10 User £515

PROFILERS & OPTIMISERS
Codesifter £79
DOSTRACE £65
PC Metric £129

PROTOTYPERS & GENERATORS
Automated Programmer £320
Cogen £290
COMPEDITOR £130
Dan Bricklin Demo II £129
Data Boss for Pascal £395
Genifer £255
Instant Replay III £99
Sycero db (U.K.) £595
Sycero db Net (U.K.) £745

SYNTAX ANALYSERS & LINTS
PC Lint v.4.0 £90
Pre-C £150

TEXT & UNIX TOOLS
C Programmers Comb. £75
C ToolSet £65
MKS LEX & YACC £165
MKS Toolkit v.3.1 *NEW* £165
MKS Toolkit v.3.1 *UPGRADE* £50
MKS AWK £65
PC Fortran Tools £99
QPARSER Plus £195
Spellcode £65
Turbo Professional £85

TRANSLATORS
BAS_C Commercial £320
Bastoc £515
dBx dBASE to C v.4.7 £389
dBx Library Source CALL
dBx UNIX/XENIX Source CALL
FOR_C v.2.0 MS-DOS *NEW* £565
FOR_C v.2.0 XENIX *NEW* £630
FOR_C++ XENIX/386 *NEW* £1195

VERSION CONTROL
M.K.S. R.C.S. £125
M.K.S. R.C.S. 5 User £485
M.K.S. R.C.S. 10 User £905
PVCS Professional £395
PVCS Network (5 User) £1395
PVCS/PolyMake OS/2 CALL

BACKUP - RECOVERY - REPAIR
dSalvage £65
Fastback Plus £125
Mace Utilities 1990 £95
Norton Utilities Advanced £95
PC Tools Deluxe £85
XTree Net £255

COMMS. & TERM. EMULATORS
Blast II £165
Blast II w/Remote Control £199
Carbon Copy Express £225
Carbon Copy Plus £129
Crosstalk Mark 4 £160
Crosstalk XVI £130
EM4105 £320
Mirror III £65
PC Anywhere III £95
Sidetalk II £79
SmarTerm 125 £190
SmarTerm 220 £129
SmarTerm 2392 £65
SmarTerm 240 £225
SmarTerm 320 £129
SmarTerm 400 £115
SmarTerm 4014 £145
VTek £125
Z Stem PC-VT100 £65
Z Stem PC-VT220 £99
Z Stem PC-VT240 £190
Z Stem PC-VT4014 £65

DISK MANAGERS & OPTIMISERS
HTest/HFormat £85
Mace Gold £99
Norton Utilities Advanced £95
SpinRite II £59

OP. SYSTEM UTILITIES
386MAX 5.0 £135
DESQview £85
DESQview/386 £125
Headroom £85
Move'Em £59
Norton Commander £99
Omni View £55
Qemm-386 £65
Qemm-50/60 £39
Soft Bytes 386 Max £45
Weiner Shell £195
Windows 3 £95

FAX OR TELEPHONE CREDIT CARD ORDERS VISA OR ACCESS

PRICING
All prices exclude V.A.T. but include Overnight delivery.

EDUCATIONAL DISCOUNTS
10% Educational discounts available on all products.

CATALOGUE & FACT SHEETS
Call for our new Winter '91 catalogue, over 155 pages of Software Development Tools.

THE SOFTWARE CONSTRUCTION CO. LTD.

1 THE MALTINGS, GREEN DRIFT, ROYSTON, HERTS. SG8 5DB (0763) 244114 FAX. (0763) 244025

Circle 466 on Inquiry Card.

Hercules monochrome.

A basic 286-based PST360X Jet laptop comes with a T800-20 transputer and 4 MB of zero-wait-state DRAM. The laptop supports most parallel compilers, including those for C, FORTRAN, Pascal, Helios, Occam 2, and Ada.

Price: £3280 and up.

Contact: Paratech Solutions Ltd., Sentinel House, 163 Brighton Rd., Coulsdon, Surrey CR3 2NX, U.K., 44-81-763-1540; fax 44-81-763-1534.

Circle 1337 on Inquiry Card.

More Memory for Your Epson EPL-6000

Micron Technology's Intensify EP6000 memory-expansion cards for the Epson EPL-6000 Laser Printer offer upgrades of 2 or 4 MB. The cards are designed to enhance the ability of the printer to store memory-intensive graphics, macro commands, and multiple downloadable fonts. You can upgrade the 2-MB card to 4 MB using industry-standard 1-megabit DRAM chips.

Price: £339 for the 2-MB card; £469 for the 4-MB card.

Contact: Micron Technology, Inc., Suite 17, Kinetic Centre, Theobald St., Borehamwood, Hertfordshire WD6 4SE, U.K., 44-81-905-1255; fax 44-81-905-1126.

Circle 1338 on Inquiry Card.

Print 'Effects' with Ventura Publisher

The vp-fx effects utility package enhances your Ventura Publisher documents. The package combines four types of effects: font-fx, text-fx, graphics-fx, and frame-fx.

With font-fx, you can choose any one of the existing fonts and give it one of the 20 predefined effects (e.g., neon, shadow, glow, soft, bubble, and silhouette). The text-fx utility lets you place a line of text in an arc or circle, rotate it, shear it, or expand and contract the font. With graphics-fx, you can outline or fill graphical or text objects with line tint, dot tint, or normal tint in any angle and vary the density in any angle. The frame-fx utility lets you modify (e.g., mirror, scale, shear, expand, or contract) any Ventura frame and position it horizontally or vertically. The package also lets you hierarchically combine the effects, so you could, for example, select a font-fx like shadow, apply a text-fx like shearing to it, fill it with varying line tints, and finally rotate its frame. The package lets you store any effects you have created in style sheets for future use.

The vp-fx package requires an IBM XT or AT, Ventura Publisher 2.0 or Ventura Professional, a hard disk drive, and a PostScript or compatible printer or interpreter.

Price: US$250.

Contact: Digital Studio, 222 Hiranandani Industrial Estate, Kanjurmarg, Bombay, India, 91-22-584727; fax 91-22-5605902.

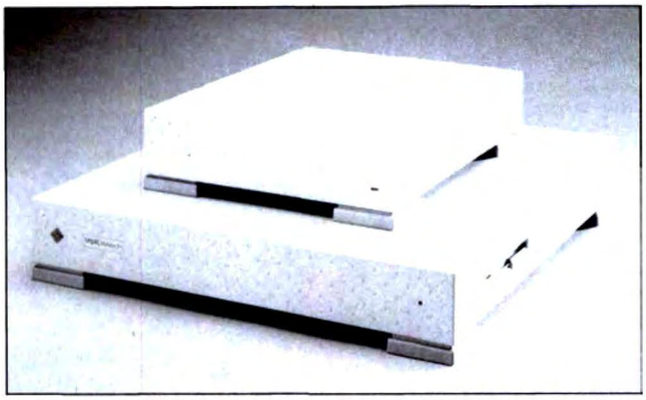
Circle 1339 on Inquiry Card.

Disk Expansion for Sun Sparcstation

The new disk drive subsystem for the Sun Sparcstation SLC, IPC, and Sparcstation 1+ provides substantial performance improvement for Sun networks with multiple diskless systems, says Computer International.

The disk drive subsystem incorporates a 104-MB hard disk drive into a pizza-box-style enclosure. A special feature of the subsystem is an identification switch in the rear of the unit, which dramatically simplifies installation.

Computer International offers a 250-MB disk drive subsystem or a 150-MB tape cartridge in the same enclosure.



Computer International's disk drive subsystem for Sun Sparcstations gives you a storage capacity of 104 MB in a pizza-box-style enclosure.

Price: £895 and up.
Contact: Computer International Ltd., 19 Farmbrough Close, Stocklake, Aylesbury, Buckinghamshire HP20 1DQ, U.K., 44-296-434911; fax 44-296-436965.
Circle 1340 on Inquiry Card.

The Ultimate File Manager

The dFile file manager for Microsoft Windows 3.0 lets you copy or move files or subdirectories (and, optionally, nested subdirectories) from one disk or directory to another, including or excluding files with names that match up to 10 user-specified wild cards and files with specific attributes or date-stamp ranges. The software lets you set or reset archive bits, so you can also use dFile for incremental backups to a network file server.

The software lets you copy or move read-only, system, and hidden files without loss of their attributes. You can carry out copy and move activities by simply clicking and dragging with the mouse. In addition, dFile lets you duplicate floppy disks even on single-floppy-disk-drive machines and copy floppy disks to alternative formats without loss of the floppy disk's label.

Build Your Network On A Solid Foundation

ReadyLINK . . . The First Step for Your PC Network.

Without the right software, your computer network may seem like a house without its foundation. With ReadyLINK from Compex, your network will be versatile, economical and easily expanded to NetWare.

Industry Standard Interface Cards
ReadyLINK doesn't need proprietary interface cards that must be discarded when you want to upgrade to NetWare. ReadyLINK uses most standard interface cards that have a NetWare driver including the complete line of Compex ARCNET and Ethernet controllers.

Low Cost
ReadyLINK's astounding $299 retail price is all the network software cost you need ever incur. There are no software charges as workstations are added. And, with Compex interface hardware retailing as little as $99 per workstation, your total network will be highly economical.

Software Compatibility
ReadyLINK uses the industry standard NETBIOS interface to insure maximum compatibility with applications programs including Microsoft's Windows 3.0.

So, when it's time to create a computer network, build it on a solid foundation. Anything less might leave you on shaky ground.

COMPEX ®

COMPEX, Inc.
4055 E. La Palma, Unit C, Anaheim, CA 92807
Tel: (714) 630-7302 • Fax: (714) 630-6521
Telex: 401987 COMPEX USA

Trademarks: ARCnet, Datapoint Corp; NetWare, Novell, Inc.

Circle 418 on Inquiry Card (RESELLERS: 419).

The file manager lets you view a directory listing as lists of names, names with details, or names with the text content of the first 80 characters of each file. In each case, you can arrange the directory in name, type, date, or size order. You can also include the size of directories in directory listings, making it a simple matter to see at a glance what is using up your valuable disk space. The dFile package lets you copy the whole directory listing in any of these formats to the Windows Clipboard for subsequent printing with Write or Notepad.

The dFile software can display the first 30K bytes of any file in ASCII, decimal, or hexadecimal form and can delete files or directories with optional prompting for deletion of subdirectories or read-only, system, and hidden files. You can mark or unmark single files or blocks of files as read-only, examine or change the attributes of any selected file, and rename any file.

The software helps you find files on a disk or network drive, using either an unambiguous name or a wild-card sequence, and you can examine, delete, or run any found file.

dLSoft also offers a new release of its scientist's graph-plotting software for Windows 3.0. The dPlot 2 package helps you produce quality graphs that can contain data points, error bars, lines, least-squares-fit lines, polynomial-fit curves, labeled axes, a title, a caption, a grid, and a frame. You can print the title, caption, axis labels, and scale labels in any of the fonts, sizes, and styles available on your installed Windows system and specify and position each part independently.

The new release uses style sheets to maintain your favorite graphing styles and permits instant conversions to logarithmic, exponential, square, and square-root scales. A variety of user-selectable point and line styles is available so that you can plot up to 10 data sets on a single set of axes, and you can move the origin of the graph to any position using the mouse. Scales and data points may be in integer, floating-point, or exponential format.

You can enter data (up to 1000 points) from the keyboard or by using a mouse, trackball, or tablet to position data points. Alternatively, you can import data from a spreadsheet (e.g., Microsoft Excel) or other source via the Clipboard, or from text files, in both cases using any one of the 12 available formats, including equally spaced y values, x and y coordinates, either of these plus a standard deviation for each y value, or y ranges (i.e., minimum and maximum values for each point). The ASCII data-file format also lets you create dPlot data files directly using most editors or word processors and permits the creation of data files from other experimental data files via user-provided file conversion programs, which you can write in BASIC or most other languages.

The dPlot2 software will print on Windows-supported graphics printers or plotters, and it retains printer information within the style sheet so that you do not need to adjust paper orientation when switching from a word processor to dPlot. The new release will also copy a graph to the Clipboard so that you can paste it into a Windows word processor (e.g., Word for Windows or Write) or desktop publishing system (e.g., Aldus PageMaker and Ventura Publisher). User-

selectable line thicknesses are provided to help you easily prepare overhead-projector transparencies.

Both dFile and dPlot2 require an IBM PC with 640K bytes of RAM and Microsoft Windows 3.0.

Price: £85 for dFile; £163 for dPlot 2.

Contact: dLSoft, P.O. Box 9, Buckhurst Hill, Essex IG9 5BE, U.K., phone and fax 44-81-559-0049.

Circle 1341 on Inquiry Card.

Keep Your Shop Open Even When You're Closed

With the Moonstone keypad, you can run presentation software through your shop window. The IBM-compatible keyboard can be used through approximately one-half inch of glass or plastic and plugs into an IBM PC from the standard keyboard interface. This allows you to run software such as Harvard Presentation Manager or Show Partner with users interacting through the shop window.

Presentations can include question-and-answer sessions that let customers leave inquiries or make bookings. The keyboard includes a microcontroller and can work stand-alone for door-entry systems, bank-teller machines, and industrial-control systems.

Price: £250.

Contact: Moonstone Designs Ltd., Southbank House, Black Prince Rd., London SE1 7SJ, U.K., 44-71-582-8182; fax 44-71-793-0626.

Circle 1342 on Inquiry Card.

The Distributed Version of Trans-RTXc

When you need a real-time kernel that gives you features such as preemptive scheduling, small memory requirements, multiprocessing, fast response, and distributed operation, the new version of Intelligent Systems International's Trans-RTXc real-time kernel for transputers may meet your requirements. The product combines the transputer's power of fast and distributed processing with real-time constraints for applications ranging from single-processor embedded systems to complex control systems with various degrees of fault tolerance and using tens of processors.

While you can use the stand-alone version of Trans-RTXc (see October 1990 What's New International, page 80IS-46) with multiple transputers if you can define your own communication protocols, the distributed version provides transparent distributed real-time processing without the need to change any of the source code when you are starting from a single-processor stand-alone version. The distributed version, therefore, can treat a cluster of transputers (each providing performance of 10 to 15 MIPS/2 to 3 MFLOPS) as a single real-time processing engine. For example, 10 transputers running at 25 MHz will provide 125 MIPS/25 MFLOPS with interrupt response times as low as 35 μs even if some of the transputer nodes are located several hundred meters or more apart.

Trans-RTXc comes as a system-generation utility with debugger, run-time monitor, and kernel library. The system-generation

utility specifies tasks, semaphores, memory partition, and system resources. The debugger lets you analyze the system at any time and interactively change the task status, while the run-time monitor lets you trace program execution. You create object modules for individual tasks with a standard transputer compiler.

All the Trans-RTXc calls are identical, whether you use them with the stand-alone version or the distributed version. Thus, the only modification you will need is a relocation of tasks.

Price: 179,000 Belgian francs for up to five processors; 239,000 BF for up to 36 processors; 359,000 BF for up to 128 processors.

Contact: Intelligent Systems International NV, Interleuvenlaan 62, 3001 Leuven, Belgium, 32-16-29-01-28; fax 32-16-20-80-57.

Circle 1343 on Inquiry Card.

Osicom's High-Resolution Monitor

Osicom's entry into the new high-resolution 1024- by 768-pixel graphics standard is its VG-1460 14-inch color monitor and VG-4000 Super VGA color graphics adapter.

The VG-1460 color monitor features a nonglare screen with a dot pitch of 0.29 mm. It supports scanning frequencies of from 31.5 to 35.5 kHz vertical and from 50 to 90 Hz horizontal and displays a full range of colors at a resolution of 1024 by 768 pixels. The VG-1460 comes on a tilt-and-swivel stand.

The VG-4000 Super VGA graphics adapter uses the Tseng Labs ET-4000 graphics processor with 1 MB of dedicated video RAM. The 8-bit card offers a resolution of 1024 by 768 pixels and 256 colors from a palette of 16 million shades. Oscillation frequencies range from 31.5 to 48 kHz.

Software drivers are provided for Microsoft Windows 3.0, AutoCAD, AutoShade, GEM, Ventura Publisher, WordPerfect, and Lotus 1-2-3. The VG-4000 also supports the IBM 8514/A graphics standard and provides an application programming interface.

Price: £575.

Contact: Osicom Technologies, Osicom House, Fortran Rd., St. Mellons Tech Base, Cardiff CF3 0LT, U.K., 44-222-778888; fax 44-222-796699.

Circle 1344 on Inquiry Card.

Protect Your Files

The latest version of The Safe, Integrated Computer Systems' file-protection software (see September 1990 What's New International, page 64IS-30) has two parts. The first part protects your files from unauthorized access and from accidental or deliberate alteration or deletion. The second part lets you restrict user access to specified directory areas. The Safe can operate as memory-resident or stand-alone.

The Safe has 25 setup functions that let you protect, lock, preserve, and secure your files and specify user names and access areas. The package records the status of your files and their associated passwords in an encrypted file within the files' respective directory areas.

The Protection operation encodes specified files and informs The Safe to decode those files when they are read and encode them when

 Circle 423 on Inquiry Card.

SAMPLE CONFIGURATIONS
(excluding carriage and VAT)

£9749

Netware 386 (State-of-the-art, up to 250 users)

PLUS

Elonex 486V/25E file server
25MHz 80486 processor, 32-bit EISA bus, internal cache memory, 8MB RAM, (optional 32MB), 1 Gigabyte SCSI Hard Disk (formatted), 32-bit (EISA) Ethernet server card, heavy duty Uninterruptable Power Supply.

£7413

SFT Netware 2.15 (Fault tolerant, up to 100 users)

PLUS

Elonex 386V/33E file server
33MHz 80386 processor, 32-bit EISA bus, 32k cache memory, 4MB RAM (max 32MB), 600MB SCSI Hard Disk (formatted), 32-bit (EISA) Ethernet server card, heavy duty Uninterruptable Power Supply.

£5568

Advanced Netware 2.15 (Up to 100 users)

PLUS

Elonex 486B/25 file-server
25Mhz 80486 cpu, internal cache, 4MB RAM (max 16MB), 300MB IDE Hard Disk, intelligent Ethernet server card.

£3090

ELS II v2.15 (Entry level, up to 8 users)

PLUS

Elonex 386B/25 file-server
25MHz 80386 processor, 64k cache memory, 4MB RAM, 200MB Hard Disk, 16-bit Ethernet card.

£2329

ELS I v2.12 (Entry level, up to 4 users)

PLUS

Elonex 386B/25 file-server
25MHz 80386 processor, 64k cache memory, 4MB RAM, 100MB Hard Disk, 16-bit Ethernet card.

£825

Elonex 386SXM slimline Workstation, 1MB RAM, Mouse, 16-bit Ethernet card and boot ROM.

£675

Elonex 286M slimline Workstation, 1MB RAM, Mouse, 16-bit Ethernet card and boot ROM.

Call Response Computer Maintenance (tel: 081-965 3225) for a free site installation survey and/or on-site support.

All trademarks are acknowledged. Elonex reserves the right to change specifications and prices without notice. All items are sold subject to Elonex's terms and conditions of trade.

NEW LONDON OFFICE
Elonex plc, 2 Apsley Way, London NW2 7HF
Fax 081-452 6422

SALES
Tel 081-452 4444

TECHNICAL SUPPORT
Tel 081-450 6262

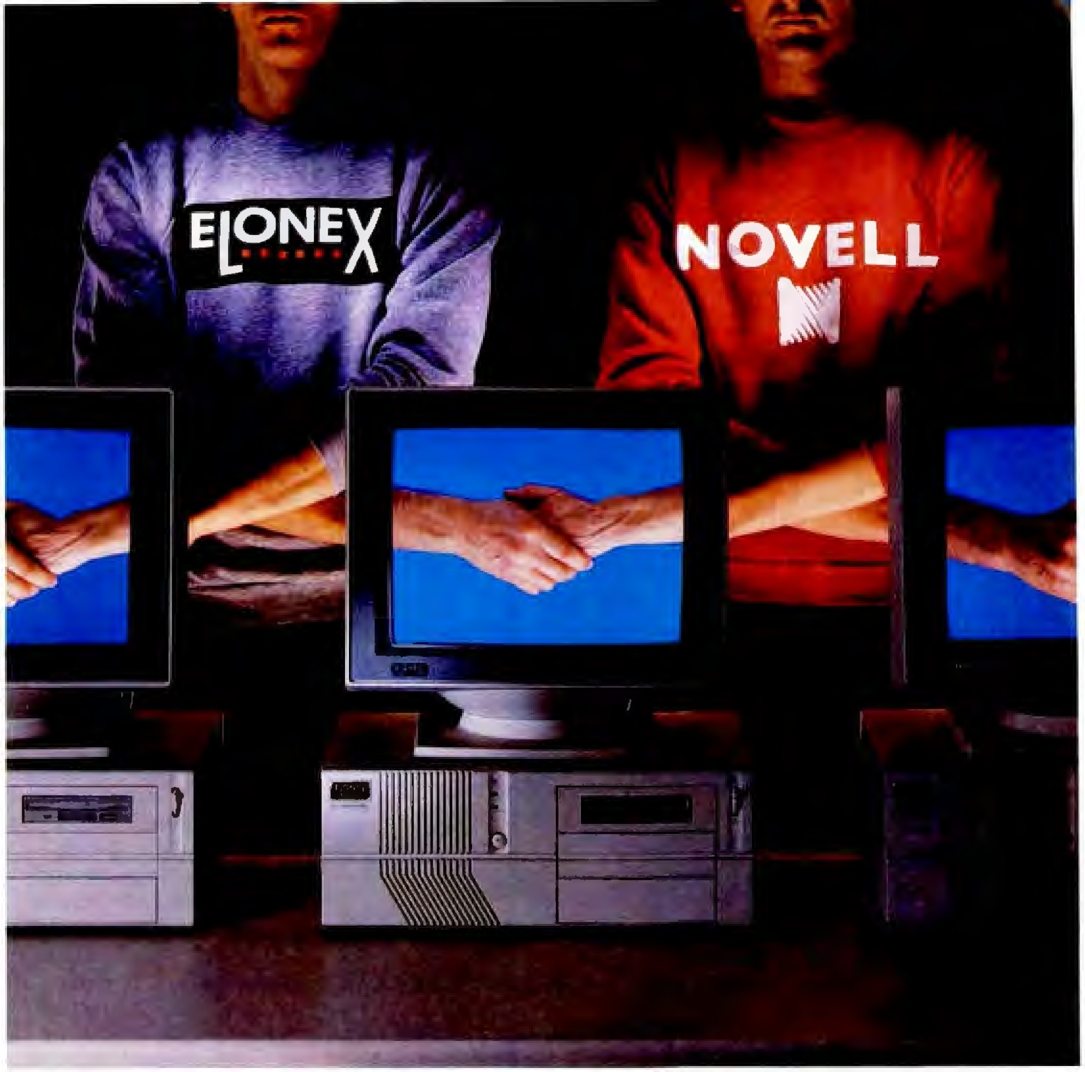
NORTHERN OFFICE
Elonex plc, 7-9 Campus Road, Listerhills Science Park, Bradford, West Yorkshire BD7 1HR
Fax (0274) 307294
Tel (0274) 307226

EIRE
ERS Computers, Merchant Court
24 Merchants Quay, Dublin 8
Fax 1-6791728 Tel 1-6797774/5

BELGIAN OFFICE
Marktech (Benelux) SA Route Provinciale 244, Bte 7, B-1301 Wavre (Bierges), Belgium
Fax 10-41 45 96 Tel 10-41 42 26

NOVELL

ELONEX



JOINT FORCES

Few companies can match our range of Personal Computers and our reputation for professional Technical Support.

Fewer still can also supply such a wide choice of powerful File-servers and Workstations, fully installed and ready to run under NOVELL's Netware.

Only a handful possess the in-house expertise to help you get the maximum out of connecting them together.

None offers complete solutions as flexible and cost-effective as ours.

***See Us at* The Which Computer Show**

Please send me information about the Elonex product range and services — JF/BYTE/4/91

COMPANY NAME ______________________

NAME ______________ POSITION ______________

ADDRESS ______________________

____

TELEPHONE ______________

they are written. The encoding prevents unauthorized access to a readable form of the data if The Safe is bypassed. Under password control, you can remove the protection of a file and import and export files from protected directory areas. The Locking operation provides the same facilities as the Protection operation but encrypts the files using a more complex algorithm.

When you have The Safe running and your application package requests a file to be opened, The Safe checks whether the file is protected or locked. If either situation exists, The Safe asks for the password before it grants access to the file. It also decrypts any subsequent reads of the file and encrypts any subsequent writes to the file.

The User operation gives you access to three disk drives and parent directory areas when you log on and enter the password, whereas the Operator operation gives you unlimited access to all disk drives and directory areas. You can use The Safe on a network system provided that the network disk accesses pass through the operating system. If the network uses separate operating-system and network system software, you should place The Safe between the operating system and the network system.

To secure your system against eavesdropping, viruses, and logic bombs, The Safe has a series of disk drive, printer, and serial port intercepts. Eavesdropping intercepts place themselves in memory and record specified inputs and outputs to and from the resources of the computer. The intercept then records the information in a disk file for future access or transmission or transmits it directly to the external environment. The printer and serial port write intercepts prevent the transfer of data to the external environment by eavesdropping programs.

The security features prevent viruses from propagating themselves via the operating system. The operating-system and BIOS absolute disk write intercepts prevent viruses from attaching themselves directly onto the system tracks and prevent any direct destruction of disk data. The Preserve and Secure operations prevent destruction of files through the use of the operating system.

The Safe has an activity log that records all operations initiated and their associated security results, along with the date and time of the operation.

The Safe requires an IBM PC with DOS 3.1.

Price: $A 100.

Contact: Integrated Computer Systems, 212A Corinthian Rd., Riverton, Western Australia 6155, 61-9-457-9116.

Circle 1345 on Inquiry Card.

De-Cable for the Amstrad CPC 6128 and 664

ABC Holdings' De-Cable lets you connect an external 5¼-inch floppy disk drive to your Amstrad CPC 6128 or 664 computer and allows the drive to function as the A drive. The De-Cable also lets you access both sides of the 5¼-inch disk in the external drive simply by flicking a switch on the cable. The De-Cable supports Amstrad BASIC, AMS-DOS, CP/M, and Multiface II.

Price: £24.95.

Contact: ABC Holdings, 4 Westmeads Rd., Whitstable, Kent CT5 1LR, U.K., 44-227-265641.

Circle 1346 on Inquiry Card.


How long will it be
before you discover
CADKIT
entry level price* $ 4.999
the electronic drafting board that signals the dawn of a new era in CAD/CAM technology
CADKIT® is comprised of hardware boards and CAD software that can be installed on any AT-compatible i 286 based PC. Using the HW and SW facilities provided by CADKIT inexpensive PCs are transformed at low cost into sophisticated, high-end, turn-key professional CAD workstations.
HARDWARE
AT-compatible CPU board
Motorola MC 68020.30 •
Motorola MC 68881 82 •
2-8 MB DRAM •
8-16 bit AT-bus I/F •
2 output connectors •
HARDWARE
AT-compatible GRAPHICS board
• AMD QPDM
• 4-8 graphics memory planes
• 1024x768 or 1280x1024 pixel resolution
• RS 170 RGB not interlaced I/F
• 2 RS232C I/F
HANNOVER MESSE CeBIT '91 HALL 19 STAND A 18
CAD/CAM SOFTWARE
FAST®
2D-3D Mechanical Engineering •
DRIVER®
2 1/2 axis CAM •
FAST®
BUILDER®
DRIVER®
TRIDENT®
CAD/CAM SOFTWARE
BUILDER®
• 2D-3D Building Engineering
TRIDENT®
• 3D Surface Modeler
Distributors wanted
* Distributor price
vds
VIDEO DISPLAY SYSTEMS
BUILDER CADKIT DRIVER FAST TRIDENT are registered trademarks by V D S VIDEO DISPLAY SYSTEMS S p A
AT is a trademark by IBM corp
Circle 478 on Inquiry Card.
V.D.S. VIDEO DISPLAY SYSTEMS SpA Via Mozzo Clementi 10 50127 FIRENZE/ITALY Phone

The Perfect Office Printer

The Star Micronics LC24-200 has a multipart mode that lets it print four high-quality carbon copies in addition to the top copy of your document. The printer also offers printing speeds of 167 cps at 10 cpi, 200 cps at 12 cpi, and 66 cps at 12 cpi in letter-quality mode. For continuous lists, the LC24-200 offers a high-speed draft mode in which the new 24-pin dot-matrix printer reaches a maximum speed of 222 cps at 10 cpi.

The LC24-200 dot-matrix printer offers a high-speed draft mode that reaches a maximum printing speed of 222 cps at a resolution of 10 cpi.

When it comes to paper management, the LC24-200 features a paper-park function, a semi-automatic and a bottom paperfeed, and an automatic tearing-off facility for fanfold paper. In addition, the printer comes with a variable tractor, which you can use as a push or pull tractor as required. To change over, you simply flip a switch.

The LC24-200 has electronic DIP switches, which replace the old, mechanical DIP switches. To change the printing mode, you simply select the mode you want electronically via the control panel.

You get a choice of five fonts—TMS Roman, Sanserif, Courier, Prestige, and Script—for creating an individual appearance for your documents. This range of fonts also includes further variations that make it possible to produce italic, proportional, double-height, double-width, quadruple-height, quadruple-width, shadow, and outline print for each font. The LC24-200 offers ESC/P, IBM Proprinter X24, and NEC P6 emulations. It comes with a parallel interface and a 30K-byte buffer.

Star Micronics also offers the LC24-200 Colour, an identical printer to the LC24-200 but with an option for color printing. Besides black, the LC24-200 Colour offers red, blue, and yellow. By mixing these primary colors, you can produce three additional colors automatically, making seven colors altogether.

Price: 998 deutsche marks for the LC24-200; DM 1098 for the LC24-200 Colour.

Contact: Star Micronics Deutschland GmbH, Westerbachstrasse 59, D-6000 Frankfurt/Main 94, Germany, 49-69-789990; fax 49-69-781006.

Circle 1347 on Inquiry Card.

A General-Purpose Parallel Computer

The Hathi-2 is a general-purpose, multiple instruction/multiple data (MIMD) type of parallel computer designed so that you can attach it to an IBM AT, Sun, or Mac II host computer for single- or multiuser environments. The computer is intended for scientific computing, simulation, modeling, and execution of demanding industrial control or monitoring software.

The machine supports a parallel programming model of communicating asynchronous processes and operates under the supervision of 25 T212 control processors. Each processing node can be an Inmos T414 or T800 transputer. The processor has 2K or 4K bytes of

8051 & 68HC11

PC-Based In-Circuit Emulators

Nohau Covers All Your Development Needs for the 8051 and 68HC11 Families!

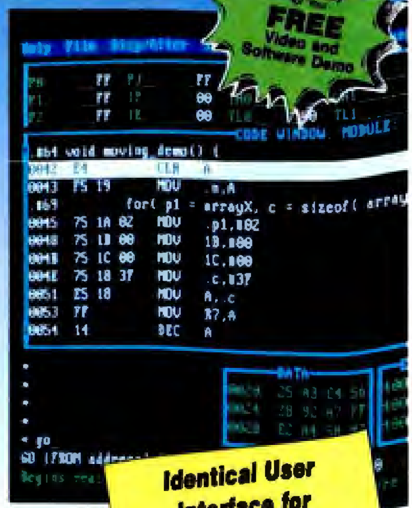
Free Demo

You can start your debugging with this FREE demo simulator. You can load up to 512 bytes of code, assembler, C, or PL/M and do full debugging/simulation in assembly and source level. A great way to get started for FREE. Fantastic for schools! Just call and we'll send it!

Call Today for Your FREE Video and Software Demo

Full Simulator

The full-blown simulator is an extension of the DEMO. You can load up to 64K of code and use 64K of XDATA space. You can program an "external environment" to interact with your code to simulate your target system. The emulator is the hardware extension of the simulator!



In-Circuit Emulation

The 24MHz real-time emulator has been the industry standard for years. With its complex breakpoint logic and advanced trace, nobody can beat it for performance. Plug-in or RS-232 configuration. All 8051 derivatives are supported!

Identical User Interface for All Three Products — You Can't Go Wrong!

NOHAU
CORPORATION
51 E. Campbell Avenue, Campbell, CA 95008
(408) 866-1820 • FAX (408) 378-7869

Australia (02) 654 1873, Austria (0222) 38 76 38, Benelux +31 1858-16133, Canada (514) 689-5889, Denmark (42) 65 81 11, Finland 90-452 1255, France (01)-69 41 28 01, Germany 08131-25083, Great Britain 0962-73 31 40, Hungary 01-137 2182, Israel (03) 48 48 32, Italy (011) 771 00 10 Korea (02) 784 784 1, New Zealand (09) 392-464, Portugal (01) 81 50 454, Sweden, Norway (040) 92 24 25, Singapore (065) 284-6077, Spain (93) 217 2340, Switzerland (01) 740 41 05, Taiwan (02) 7640215, Thailand (02) 281-9596, Yugoslavia 061-57 19 49.

Circle 483 on Inquiry Card.

NEWS

INTERNATIONAL

50-ns memory and 256K bytes of external 250-ns DRAM. In addition, each processor has four standard 10-Mbps transputer links.

The basic processor is a fast RISC-type microprocessor, executing instructions at a rate of 10 MIPS. Parallel-processing operating-system primitives are directly supported by the microprocessor hardware. The T800 processors have a powerful internal FPU capable of a 1.5-MFLOPS scalar rate on 32-bit numbers. Each processor has a parallel bus-expansion connector for additional memory or peripheral interfaces.

The computer is modular and scalable in four processor modules. Within a module, each node processor has a parallel expansion connector. An expansion board may have additional memory (up to 4 MB per processor) or high-speed peripheral interfaces. You can connect Hathi-2 to other systems via serial transputer links.

The processor interconnection network is based on standard bidirectional transputer links operating at 10 Mbps. The connection network is a combination of a fixed 2-D torus configuration and embedded programmable 32- by 32-channel matrix switches. A 16-bit T212 control transputer controls the matrix switches, and the control transputers form a chain to configure and monitor the entire computer.

Each card module holds four node processors with 256K bytes of memory each, a T212 control processor, a matrix switch module, and monitoring and synchronization hardware. Indicator LEDs show the status of processors and communication links.

The present 100-processor version has an aggregate instruction rate of 1000 MIPS. With T800 floating-point transputers, the maximum data rate is 150 MFLOPS. The working memory size is 26 MB, expandable to 400 MB.

Application software implemented on it includes performance monitoring, full-text database retrieval, fluid dynamics, parallel execution of production systems, and geometric image transformation of satellite data.

The basic programming language for transputers and Hathi-2 is Occam. Other available programming languages are C, Pascal, FORTRAN, and Prolog. You use the hosts and the transputer development system to bootstrap the computer, for software development, and to hold the basic mass-memory storage. The Hathi-2's architecture preserves the basic properties of its transputer node processors. This means that you can transfer existing transputer software, such as compilers, operating systems, and utility programs, to Hathi-2.

Price: About 800,000 to 1,300,000 Finnish marks.

Contact: Technical Research Centre of Finland, Computer Technology Laboratory, Kaitoväylä 1, P.O. Box 201, SF-90571 Oulu, Finland, 358-81-509-111; fax 358-81-509-680.

Circle 1348 on Inquiry Card.

If you would like your new product considered for publication in the international section of BYTE, send press releases to BYTE, Attention: Martha Hicks, One Phoenix Mill Lane, Peterborough, NH 03458, U.S.A., (603) 924-9281, fax (603) 924-2550; or BYTE/McGraw-Hill, Wimbledon Bridge House, One Hartfield Rd., Wimbledon, London SW19 3RU, U.K., 44-81-543-1234, fax 44-81-540-3833. All press releases must contain price information, address, and telephone number.

Object-Oriented Management Planning

Ark is an easy-to-use yet sophisticated data management program with a spreadsheet-style user interface

COLIN BARKER

Ark, a new program from Ambit Research, is a planning tool that adopts a genuinely new approach to information management. Its basic principle is to let you store information in a format that has similar attributes to a spreadsheet but that also gives you some of the functionality of a relational database.

Ark stores information in a relatively unrestricted format, treating each piece of data as an object. A data dictionary stores information about each object and the sets of objects to which it belongs. Usually just a single keystroke will let you see the origin of each item of data and the relationships between items of data.

The upshot is a package that is easy to use and requires little original organization, but has a powerful system for finding data and linking different units and sets of data.

Strength in Consolidation

With the use of Ark, you can build up consolidated spreadsheets based on an underlying database structure. Its use of a spreadsheet format makes it familiar to most managers, but the underlying database structure ensures data integrity between the linked spreadsheets. It also gives a full and readily accessible audit trail showing where each piece of information comes from, when it was entered, and by whom. It also features a sophisticated consolidation tool that can read in text files created by mainframe databases or microcomputer spreadsheet programs.

But a question arises: Who needs a new consolidation program? Most up-to-date spreadsheet programs let you link information in a multiplicity of ways, or you can use a database system and output information to a spreadsheet.

The answer has to do with the way spreadsheets are linked. When you consolidate information in a spreadsheet, you take data from one spreadsheet and incorporate it into another. The data generally exists only as a cell, a single piece of information, such as the total sales of one item of stock in one subsidiary of a large company. Unfortunately, most spreadsheet packages will not let you establish a logical link between that information and another cell that, say, equates to the sales of the same item of stock in a different subsidiary.

Ark's designers concluded that when you consolidate spreadsheets, you are basically manipulating data in an unstructured fashion. By imposing a database structure on the data, you can build a consolidated spreadsheet out of logically connected parts. (For instance, in my example above, sales of a particular stock item becomes a data type, and

ILLUSTRATION: BETSY BRUEMMER © 1991

sales of that item in a particular subsidiary becomes a piece of data logically connected to sales of the same item in other subsidiaries.) But databases are usually complicated and require a lot of time to set up. With Ark, you can build the database easily by using the spreadsheet format.

Setting Up the System

To start with, say you want to set up a series of worksheets to cover three retail outlets that sell the same lines of products. You want to display forecast and actual sales broken down into quarters with year-end totals. You want to set up a worksheet for each outlet and one for the whole group, a total of four worksheets. Standard practice with a spreadsheet would be to set up a couple of templates, start entering the data for the worksheets covering each outlet, and then set up the links for the consolidated worksheet for the whole group.

With Ark you do something similar but with different results. You first set up a worksheet and then enter the data. The data, however, is not stored in several worksheets, but in a single database. As you enter the data, it gains attributes, depending on where in the spreadsheet you place it. When you need to retrieve it, you bring up the blank worksheet and then add the context (e.g., forecast sales for the whole group for 1990) at the top of the worksheet. Ark searches for all the relevant data with attributes that match the context and then displays it. In other words, it does the consolidation for you.

Ark recognizes three different *concepts* that govern the data: entities, attributes, and labels.

Entities are concepts that are being measured in some way, such as sales, profits, or production volumes. Sales as an entity may have many different values depending on, for example, the year, the products being sold, or whether the figure is forecast or actual.

Ark treats each piece of data as a unique object.

BYTE ACTION SUMMARY

Ark of the Convenient

A new software program, Ark, is designed to help managers to consolidate spreadsheet data. The £1950 program is actually a database with an easy-to-use spreadsheet front end. Data is stored as objects, allowing users to quickly determine where the data originated from. The program could be useful for many types of computer users, and it may influence many other software developers.

An attribute is used to qualify an entity and could include information such as the date, location, or product type. For example, in "sales in 1989," *sales* is an entity qualified by the attribute *year*, which has the value 1989.

Labels are simply explanatory pieces of information that accompany data.

The best way to explain how to work with these concepts is with an example. Say you begin to enter your data, and you start with "sales." After telling Ark that sales is a concept, you are launched into the program's data dictionary. You give the concept a name and specify the type (i.e., entity, attribute, or label), the format it takes on a worksheet, and the heading that will appear at the top of the column. As sales is an entity, you need to give it attributes, which you begin defining at this point. In the example, you set up the attributes *location* (this will have three values for the three shops); *product group* (as many values as there are types of products); and *year*, *quarter*, and *analysis* (is this an actual sales figure or a forecast one?). The result is a full-scale data dictionary with data sets, and Ark is close to being an object-oriented database.

Once you define the attributes, you can use the data in powerful ways. But Ark manages to disguise the complexities of this process from you. While there are some fairly sophisticated computational principles involved here, Ark is aimed at line management. This is a system that any reasonably computer-literate line manager should be able to set up alone.

Having defined your attributes, you continue to build up the worksheet, defining the concepts and specifying the attributes. You can now go to the next piece of data and start to build up the database.

Constructing a Worksheet

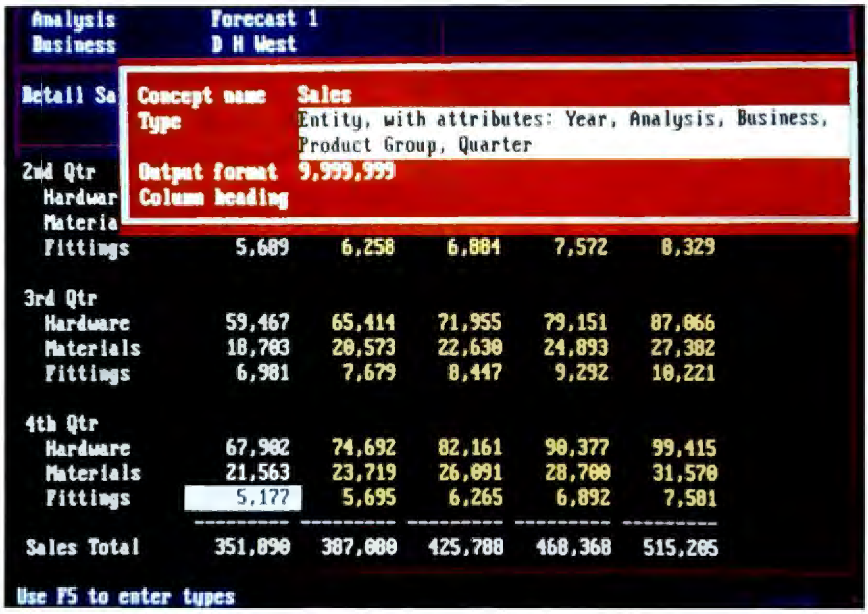
In the original example I mentioned, I was building up a series of worksheets, showing forecast and actual sales by quarter and year for three retail outlets. The left column for such a worksheet might appear as follows:

```
Sales
  First Quarter
    Product 1
    Product 2
    Product 3
    Product 4
    [etc.]
  Second Quarter
    Product 1
    Product 2
    [etc.]
  Third Quarter
    [etc.]
```

The next concept you would need to introduce to Ark is "First Quarter," which is not an entity but an attribute (*quarter*) that has already been defined. You then go on to the first product, give it a name and the attribute *product type*, and repeat this for the other products. The indentations on the worksheet are important, as Ark will recognize them as a hierarchy. In other words, "First Quarter" is a figure governed by the indented figures below it.

Once your column is completed, you have to specify the context for the worksheet. The same column of data types may appear in different worksheets. The headings across the top of a worksheet specify the context (e.g., Forecast and Actual Sales for Outlet 1 in the years 1986 to 1991). You define the context in much the same way that you define the data. Once you have finished, you have a complete template with blank cells for the data. Now you enter the data just as you would with a normal spreadsheet. But the position of the data on the spreadsheet now defines it, since you have filled in the information about entities, attributes, and so on.

Because of its data dictionary, Ark in a



Ark's data dictionary stores information about each piece of data as an object and the sets of objects to which it belongs.

sense knows what the data in a spreadsheet means. When you enter a particular item, Ark files it not as, say, value 500 in cell C6, but as actual sales of 500 in outlet 1 in the first quarter of 1990. You can also enter formulas, just as you do with a spreadsheet, so you can have, say, the total of cells B2 to B19. But this formula is not stored as the total of a set of cells, but as, say, the total sales for all products in outlet 1 in the year 1990.

Because Ark treats each piece of data as a unique object, which may or may not be dependent on other objects, it is easier to vary the way in which this information is mixed together than it is with a conventional spreadsheet. This is because the spreadsheet is a convenient way of displaying and defining information, but it is not an iron-disciplined road map showing where the information is located. Ark, by contrast, remembers where the data is; you just tell it what you want.

As Complex As You Need

You can build up the layers of worksheets in as complex a manner as you wish. Ark is ideally suited for companies, large or small, that have operating businesses with different profit centers and projects all running simultaneously. For example, Ark is already being used by an exhibition company that has several operating businesses organizing hundreds of seminars and exhibitions every year.

The more complex things get, the more useful Ark's two most powerful features, provenance and implication, become. Provenance lets you trace the source of information with just a couple of keystrokes. For example, if you are working on a consolidated worksheet and you wish to check a figure, you highlight the figure and select provenance. If it displays the data in red, then it originated on another worksheet, and Ark will take you to the worksheet from which your current worksheet took the data. In the case where a cell may represent a total of cells from different worksheets, you can go to all of them in turn. When Ark brings you to another worksheet, it automatically highlights the particular item you are tracking.

Provenance also tells you whom the data came from. Each user has to log onto Ark before using it, and Ark keeps a record of who did what. So you can check a piece of information with the person who entered it.

While provenance takes you down the hierarchy, implication takes you up. If you wish to change a piece of information, Ark tells you exactly which worksheets it will affect and how.

Controlled Access

Ark works on a hierarchical system, and the hierarchy can be imposed by the senior manager. You can control exactly who is allowed access to which areas of the system and who can change things and who cannot.

The package is ideal for the business user who wants to keep track of several different companies or activities. It provides an "object-oriented" approach, but it would be unfair to weigh it down with the notion of sophisticated computing concepts. It basically takes many current computing ideas on databases, spreadsheets, and object management and successfully applies them to a particular business task.

Although Ark is not as simple to set up as a spreadsheet, Ambit Research has taken considerable steps to make the setup as simple as possible. The definitions of ideas such as entities, attributes, relationships, context, and concepts are kept on a business level and are introduced only in a relevant context. Once it is set up, you have an extremely powerful business tool that, in a simple way, lets you explore every nook and cranny of your business and plan prodigiously.

Ark can read text files from programs such as Lotus 1-2-3 or dBASE or from a mainframe. It has a full set of spreadsheet functions, and it makes use of Graph-in-the-Box to provide business graphics. You can also export data in .WKS files for further manipulation in Lotus 1-2-3.

Although Ark is now available only in the U.K., Ambit Research is trying to set up distribution channels in other countries in Europe, Asia, and the Americas.

As evidenced by Lotus Improv for the Next computer, many people are examining ways to develop beyond the traditional spreadsheet. Ambit Research has come up with a system that offers some advanced features in a simple package. ■

Colin Barker is a former BYTE editor based in London. He can be reached on BIX c/o "editors."

THE FACTS

Ark 1.0
£1950
Each additional copy, £550; multiuser version for five users, £4950

Requirements:
IBM PC with 640K bytes of RAM, DOS, EGA or VGA graphics, and a hard disk drive.

Ambit Research Ltd.
London House
100 New Kings Rd.
London SW6 4LX
U.K.
44-71-731-8199
fax: 44-71-731-8312
Circle 1235 on Inquiry Card.

Now 4 can share HP's LaserJet III printer...

...with BayTech's LaserShare® — expansion is made easy!

LaserShare is an expansion card that allows four users to connect simultaneously to one laser printer. Just check out our outstanding features:

- ✔ **HP LASERJET III COMPATIBILITY**
  Also works with HP LaserJet II, IID, Canon LPB8II, LPB8III, Brother HL8e, and Wang LDP8 laser printers.
- ✔ **256KB, 1MB OR 4MB BUFFER**
- ✔ **SIMPLE INSTALLATION**
- ✔ **AVAILABLE MODELS**
  - 4A - 4 parallel ports
  - 4C - 4 serial ports
  - 4E - 2 parallel/2 serial ports
  - 4CB - 4 serial (256KB, Brother)
- ✔ **SAVES MONEY AND TIME**
- ✔ **UNMATCHED PRODUCT SUPPORT**

With several users having access to one laser printer, the per-user cost of your laser printer is dramatically reduced. And there's no more waiting for the printer. With LaserShare, everyone's printing needs are accommodated. BayTech's LaserShare — it's worth checking out! Call now for details!

UP TO 4MB!

Because Resources Should Be Shared.

BayTech

Data Communications Products Division
200 N. 2nd St., P.O.Box 387 Bay St. Louis, MS 39520
Fax 601-467-4551   Phone 601-467-8231 or toll-free

800-523-2702

*All product or company names are trademarks of their respective holders.

INTERNATIONAL DISTRIBUTORS

Australia
Melbourne
Shuttle Technologies, Ltd.
(03) 587 4920

Melbourne
Goya Tech, Pty., Ltd.
(03) 747-8455

Belgium
Multiway Data Belgium
016-29 22 78

The Netherlands
Multiway Data Netherlands
079-424 111

Denmark
Trend Communications
53 65 23 46

Finland
Genine Oy Impdata
(921) 335700

France
Suresenes
Komdex International
(1) 47 72 63 11

Paris
Gradco France
(1) 42 94 99 69

Germany
Munich
AMS Computech GmbH
(089) 126806-0

Dusseldorf
Multiway Data Germany
0211-25 18 75

Italy
Torino
BRM Italiana
(011) 771.00.10

Milano
I.T.D.
(02) 749 0749

Norway
A/S Kjell Bakke
47-6-832000

Singapore
Mark Systems (FE) Pte., Ltd.
65-2261877

Spain
Vidmar Control
(93) 2454803

Sweden
Solna
Microcom/Maldata
(08) 7344100

Sollentuna
Beon Data
08-626 92 26

Switzerland
Sengstag Computers AG
0041.1.950.54.44

United Kingdom
Leicester & London
A-Line Dataspeed Devices, Ltd.
0533-778899

Buckinghamshire
Trend Datalink, Ltd.
(08285) 30611

Circle 410 on Inquiry Card (RESELLERS: 411).

Document Imaging System Sources

Below are listed, by country, international distributors of the U.S. products mentioned in this issue's State of the Art section on Document Imaging Systems.

AUSTRALIA

Bull HN Information Systems, Inc.:
Bull HN Pty. Ltd.
124 Walker St.
P.O. Box 660
North Sydney 2060
61-2-923-9660
fax: 61-2-923-9644
Circle 1077 on Inquiry Card.

FileNet Corp.:
Olivetti Systems & Networks Australia Pty. Ltd.
Olivetti House
93 O'Riordan St.
P.O. Box 244
Alexandria NSW 2015
61-2-317-2555
fax: 61-2-317-3982
Circle 1079 on Inquiry Card.

Flagstaff Engineering:
Miden Pacific Pty. Ltd.
200 Arden St.
North Melbourne
Victoria 3051
61-3-321-0000
fax: 61-3-321-0123
Circle 1080 on Inquiry Card.

LaserData, Inc.:
Systems House
45 Frederick St.
Ryde NSW 2112
61-2-809-6222
fax: 61-2-809-6400
Circle 1084 on Inquiry Card.

Metafile Information Systems, Inc.:
Data No. 3 Group
165 Moggill Rd.
Taringa, Queensland 4068
61-7-3718088
fax: 61-7-3710188
Circle 1085 on Inquiry Card.

Micro Dynamics, Ltd.:
Delairco Group
Office Automation Division
12 Barcoo St.
East Roseville NSW 2069
61-2-415-0300
fax: 61-2-417-4383
Circle 1086 on Inquiry Card.

Optigraphics:
TCG Systems Automation Pty. Ltd.
39 Balfour St.
Chippendale NSW 2008
61-2-699-8300
fax: 61-2-698-1339
Circle 1089 on Inquiry Card.

Summit Software Corp.:
Aarque Systems Pty. Ltd.
Corner Espon Rd. and Joyton Ave.
Zetland NSW 2017
61-2-662-4222
fax: 61-2-662-8383
Circle 1092 on Inquiry Card.

Xerox Corp.:
Rank Xerox Ltd.
970/980 Pacific Highway
Pymble NSW 2073
61-2-449-0449
fax: 61-2-488-9613
Circle 1096 on Inquiry Card.

Xionics, Inc.:
Mitsui Computer Ltd.
1/14 Aquatic Dr.
P.O. Box 234
Frenchs Forest NSW 2086
61-2-452-0452
fax: 61-2-452-0481
Circle 1097 on Inquiry Card.

AUSTRIA

Bull HN Information Systems, Inc.:
Bull A.G.
Linke Wienzeile 236
A-1150 Vienna 15
43-222-853-6010
fax: 43-222-853-3317
Circle 1077 on Inquiry Card.

Wang Laboratories, Inc.:
Wang Austria GmbH
Linke Wienzeile 234
A-1150 Vienna
43-222-891110
fax: 43-222-894-1714
Circle 1095 on Inquiry Card.

Xerox Corp.:
Rank Xerox Austria GmbH
Nussdorfer Lande 29-31
A-1190 Wien
43-222-373511
fax: 43-222-373511-310
Circle 1096 on Inquiry Card.

PHOTO: BEN GARACCI/UNIPHOTO PICTURE AGENCY

DATATRONICS

V32 MODEM G3 FAX

DISCOVERY 9632AM ERROR-CORRECTION AND DATA COMPRESSION V32 INTELLIGENT MODEM WITH PASSWORD PROTECT AND AUTO BACK-UP DIALING.

Meeting the reliable data communications requirements on track with the international V32 standard, the Discovery 9632AM is designed for serious users who are looking for innovative modems with friendly features such as password protect, auto back-up dialing, power-on leased line connection, user definable function keys, and many more.

Yet, the Discovery 9632AM allows error-free data communications at a transmission rate of up to 19,200 bps with MNP Class 2 through Class 5 and CCITT V.42 compliance. It also supports lower speeds of 1200 bps and 300 bps, as well as 1200/75 bps for Videotex connection used in many countries.

AUTOMATE G3 FAX COMMUNICATIONS DIRECTLY FROM YOUR PC TO OTHER PCS AND MILLIONS OF INSTALLED FAX MACHINES WORLDWIDE.

Using the Discovery faxmodem, documents sent from your PC to other PC's or fax machines around the world are much clear because no scanning distortion is involved. Furthermore, schedule sending, broadcasting, and group sending can be more flexible and productive.

Now, you can integrate both modem and fax transmissions (sending as well as receiving) into one device with our faxmodem. We support VARs for customer software modifications to the particular applications.

We also provide low speed modem products in standalone, internal card, pocket, and rack-mount packings. For regional distributors information or custom requirements, you are weleome to contact:

Datatronics Technology, Inc.
15/2F, Lane 768, Pa-Teh Rd. Sec.4
Taipei 10565, Taiwan.
Phone: (02) 782-0002
Telex: 28440 DTXMODEM
Fax: 886-2-782-0305

Circle 425 on Inquiry Card.

Datatronics and Discovery are trademarks and brandnames of Datatronics Technology, Inc. MNP is a trademark of Microcom Inc.

BELGIUM

Bull HN Information Systems, Inc.:
Bull S.A.
41 Avenue de Tervueren
B-1040 Brussels
32-2-739-2639
fax: 32-2-739-2891
Circle 1077 on Inquiry Card.

FileNet Corp.:
Olivetti S.A. Belge (DOTS)
Place Madou 1, P.O. Box 11
B-1030 Brussels
32-2-210-9560
fax: 32-2-210-9200
Circle 1079 on Inquiry Card.

Flagstaff Engineering:
Infomaco
Boulevard A. Reyers Laan 159
B-1040 Brussels
32-2-736-6064
fax: 32-2-736-3847
Circle 1080 on Inquiry Card.

Kofax Image Products:
Avenue Moliere 510, B 8
B-1060 Brussels
32-2-536-8631
fax: 32-2-536-8600
Circle 1083 on Inquiry Card.

LaserData, Inc.:
CAPCOM
Vosterielaan 2
B-1170 Brussels
32-2-660-2040
fax: 32-2-660-6079
Circle 1084 on Inquiry Card.

Wang Laboratories, Inc.:
Wang European Headquarters
6 Rue Du Planeur
B-1130 Brussels
32-2-727-2921
fax: 32-2-727-2529
Circle 1095 on Inquiry Card.

Xerox Corp.:
NV Rank Xerox S.A.
Leuvensesteenweg 555
B-1930 Zaventem
32-2-722-5511
fax: 32-2-722-5559
Circle 1096 on Inquiry Card.

BOLIVIA

Bull HN Information Systems, Inc.:
Coasin Bolivia, SRL
Avenida 6 de Agosto 2300
Casilla 7295
La Paz
591-234-3245
Circle 1077 on Inquiry Card.

BRAZIL

Bull HN Information Systems, Inc.:
ABC Bull Telematic
Avenida Angelica 903
CEP 01227 Santa Cecilia
Sao Paulo
55-11-2405488
fax: 55-11-617849
Circle 1077 on Inquiry Card.

CHILE

Bull HN Information Systems, Inc.:
Binaria S.A.
Teatinos 20 Oficina 83
Santiago
56-2-696-2133
fax: 56-2-696-9368
Circle 1077 on Inquiry Card.

CYPRUS

Bull HN Information Systems, Inc.:
Bull Middle East Ltd.
70 Makarios Ave.
Nicosia
357-2-312117
Circle 1077 on Inquiry Card.

Wang Laboratories, Inc.:
Infotronics Ltd.
117 Athalassa Ave.
P.O. Box 3655
Nicosia
357-24-20101
fax: 357-24-20104
Circle 1095 on Inquiry Card.

DENMARK

Bull HN Information Systems, Inc.:
Bull A/S
Dalbergstroget 5
2630 Taastrup
Copenhagen V
45-43-717273
fax: 45-43-42998777
Circle 1077 on Inquiry Card.

FileNet Corp.:
Edata Systems A/S
Stamholmen 149
DK-2650 Hvidovre
45-36-771110
fax: 45-36-770900
Circle 1079 on Inquiry Card.

Flagstaff Engineering:
BCP Diskettehandling APS
Helsingorsgade 52
Hillerod 3400
45-2-251122
fax: 45-2-250999
Circle 1080 on Inquiry Card.

Wang Laboratories, Inc.:
A.S. DataLog
Produktionsvej 40
DK-2600 Glostrup
45-42-919555
fax: 45-42-915556
Circle 1095 on Inquiry Card.

Xerox Corp.:
Rank Xerox A/S
Borupvang 4/5
DK-2750 Ballerup
45-42-654444
fax: 45-42-654813
Circle 1096 on Inquiry Card.

ECUADOR

Summit Software Corp.:
Ecuasistemas S.A.
Alejo Lascano
1511 y Tulcan
Guayquill
593-4-396907
fax: 593-4-323478
Circle 1092 on Inquiry Card.

EGYPT

Wang Laboratories, Inc.:
Egyptian Advanced Technologies Co. (Balsam)
3 Osman IBN Affan St.
Mohandesseen, Giza
Cairo
20-2-344-3001
fax: 20-2-344-7704
Circle 1095 on Inquiry Card.

ETHIOPIA

Wang Laboratories, Inc.:
National Consultants
270 Africa Ave.
Addis Ababa
251-1-444191
fax: 251-1-651245
Circle 1095 on Inquiry Card.

FINLAND

Bull HN Information Systems, Inc.:
Nokia Information Systems
P.O. Box 780
SF-00101 Helsinki
358-0-5671
fax: 358-0-5061639
Circle 1077 on Inquiry Card.

FileNet Corp.:
Edata Oy
Sinikalliontie 10
SF-02630 Espoo
358-0-502-1155
fax: 358-0-502-1157
Circle 1079 on Inquiry Card.

Optigraphics:
Viltec Oy
Nihtisillankuja 1
P.O. Box 9
SF-02631 Espoo
358-0-524755
fax: 358-0-529517
Circle 1089 on Inquiry Card.

Wang Laboratories, Inc.:
Instru Data Systems Oy
Vitikka 1
P.O. Box 65
SF-02630 Espoo
358-0-5281
fax: 358-0-529895
Circle 1095 on Inquiry Card.

Xerox Corp.:
Rank Xerox Oy
PL55 02631
Espoo 63
358-0-52511
fax: 358-0-524739
Circle 1096 on Inquiry Card.

FRANCE

Bull HN Information Systems, Inc.:
Bull S.A.
1 Au 11 Ave. Du Val De Fontenay
94133 Fontenay Sous Bois
33-1-439-46060
fax: 33-1-439-6005
Circle 1077 on Inquiry Card.

FileNet Corp.:
FileNet S.A.
Velizy Plus
1 bis rue du Petit-Clamart
78147 Velizy-Villacoublay Cedex
33-1-40-940505
fax: 33-1-40-940075
Circle 1079 on Inquiry Card.

Flagstaff Engineering:
Compusol
11 Rue Rosenwald
75015 Paris
33-1-453-00737
fax: 33-1-453-00531
Circle 1080 on Inquiry Card.

Kofax Image Products:
Micro Technologie Electronique
69 Rue Henri Barbusse
95100 Argenteuil
33-1-396-18228
33-1-396-17375
Circle 1083 on Inquiry Card.

LaserData, Inc.:
MC2
4 Chemin De Malacher Zirst
38240 Meylan
33-76-902200
fax: 33-76-411461
Circle 1084 on Inquiry Card.

Metafile Information Systems, Inc.:
International Resources & Management
Z.I. Petite Montagne Sud
1, rue des Cevennes
B.P. 1717
91017 EVRY Cedex
33-1-607-79644
fax: 33-1-607-83413
Circle 1085 on Inquiry Card.

Optigraphics:
Lascom
383, avenue du Gal. de Gaulle
92140 Clamart
33-1-463-10505
fax: 33-1-463-14210
Circle 1089 on Inquiry Card.

TMS, Inc.:
Micro Distribution Services
25bis, rue Vigier
91600 Savigny Sur Orge
33-1-692-41000
fax: 33-1-692-40926
Circle 1093 on Inquiry Card.

Wang Laboratories, Inc.:
Wang France
Tour Gallieni 1
78-80 Avenue Charles de Gaulle
93174 Bagnolet Cedex
33-1-48-970606
fax: 33-1-43-625926
Circle 1095 on Inquiry Card.

Xerox Corp.:
Rank Xerox S.A.
12 Place de L'Iris
Cedex 38
92071 Paris La Defense
33-1-4762-1000
fax: 33-1-4762-1803
Circle 1096 on Inquiry Card.

Xionics, Inc.:
Xionics Ltd.
38 Avenue Franklin Roosevelt
77210 Avon
33-1-6422-0405
fax: 33-1-6422-0304
Circle 1097 on Inquiry Card.

GERMANY

Bull HN Information Systems, Inc.:
Bull A.G.
Theodore-Heuss-Strasse 60-66
Postfach 9
D-5000 Cologne 90
49-2203-305620
Circle 1077 on Inquiry Card.

FileNet Corp.:
FileNet GmbH
Dietrich-Bonhoeffer-Strasse 4
D-6380 Bad Homburg
49-6172-3081-0
fax: 49-6172-3081-78
Circle 1079 on Inquiry Card.

Flagstaff Engineering:
Grünbichler Software
Westend Strasse 34
Kufering 8912
49-8191-66991
fax: 49-8191-65250
Circle 1080 on Inquiry Card.

Kofax Image Products:
Macrotron A.G.
Stahlgruberring 28
D-8000 Munich 82
49-89-42080
fax: 49-89-429563
Circle 1083 on Inquiry Card.

LaserData, Inc.:
ALOS GmbH
Dieselstrasse 17
5000 Koln 40
49-2234-40080
fax: 49-2234-400823
Circle 1084 on Inquiry Card.

Metafile Information Systems, Inc.:
SAS System-Anjwendungs-Software GmbH
Karl Marx-Strasse 24
D-4600 Dortmund 1
49-23-157-9446
fax: 49-23-152-9805
Circle 1085 on Inquiry Card.

Optigraphics:
debis Systemhaus GmbH
Max-Stromeyer Strasse 160
Postfach 100133
D-7750 Konstanz
49-7531-852048
fax: 49-7531-852774
Circle 1089 on Inquiry Card.

Wang Laboratories, Inc.:
Wang Deutschland GmbH
Lyoner Strasse 26
6000 Frankfurt/Main 71
49-69-66750
fax: 49-69-667-5500
Circle 1095 on Inquiry Card.

Xerox Corp.:
Rank Xerox GmbH
Heesenstrasse 70
4000 Dusseldorf, Heerdt
49-211-50860
fax: 49-211-50861
Circle 1096 on Inquiry Card.

GREECE

Bull HN Information Systems, Inc.:
Bull A.E.
AV. Syngrou 44
B.P. 2527
Athens 403
30-1-923-9991
fax: 30-1-923-7812
Circle 1077 on Inquiry Card.

Wang Laboratories, Inc.:
Lantec S.A.
Atrina Center
Leoforos Kifissias 32
15125 Marousi
30-1-685-1102
fax: 30-1-684-5271
Circle 1095 on Inquiry Card.

HONG KONG

Bull HN Information Systems, Inc.:
Bull HN Ltd.
Fourth Floor, Shui on Centre
6-8 Harbour Rd.
Wanchai
852-864-4111
fax: 852-865-2141
Circle 1077 on Inquiry Card.

ICELAND

Wang Laboratories, Inc.:
Heimilistaeki H/F
Saetuni 8
P.O. Box 5340
125 Reykjavik
354-1-691500
fax: 354-1-691555
Circle 1095 on Inquiry Card.

ABTECH **THE SIGN OF EXCELLENCE**

GET A POWER LAPTOP WITH 120MB H.D.

PRACTICALLY NEVER RUN OUT BATTERY

LAPTOP

- 286-16 CPU
- 1 MB ON BOARD
- EXTENDABLE TO 4 MB
- 120 MB HD
- 1.44 MB FD
- VGA LCD DISPLAY
- BATTERY
- 2 SERIAL PORT
- 1 PARALLEL PORT
- EXTERNAL MONITOR CONNECTOR
- SMALLER H.D. MODEL AVAILABLE AT LOWER PRICE

$ 2,195

- 8086 OR 80386SX MODELS AVAILABLE

DESK TOP

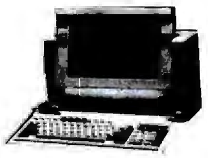
FROM 8088 SYSTEMS
TO 486-33 SYSTEMS
ISA OR EISA
AT A VERY REASONABLE PRICE
386-33 SYSTEM FROM

$ 999

486 SYSTEM STARTS FROM

$ 1,995

LUNCH BOX POTABLE



BOTH
LCD OR GAS PLASMA DISPLAY
VGA, OR VGA +
SYSTEM CONFIGURED FROM
286 TO 486-33 ISA SYSTEM
HARD DRIVE SIZE UP
TO 345 MB
386-33 SYSTEM START FROM

$ 2,195

486 SYSTEM START FROM

$ 3,195

JOIN OUR MANY ALREADY SATISFIED EUROPEAN CUSTOMERS ORDER YOUR OEM SYSTEMS FROM ABTECH. OEM ORDER START FROM 100 UNITS A YEAR. ORDERS MAYBE CUSTOMERIEED TO YOUR NEEDS. FROM CREATING A COMPANY LOGO TO MAKING A SYSTEM MANUAL.

FOR MORE INFORMATION CALL:

ABTECH INC.
1431 N. POTRERO AVE. UNIT B
S. EL MONTE, CA 91733 U.S.A.

ORDER: 818-575-0007
FAX: 818-575-1500

OFFICES IN:
ARGENTINA, BRASIL, CHINA, ROMANIA & TAIWAN

Circle 403 on Inquiry Card (RESELLERS: 404).

INDIA

Bull HN Information Systems, Inc.:
PSI Data Systems Ltd.
Corporate Office
2 Victoria Rd.
Bangalore 560047
91-812-567607
Circle 1077 on Inquiry Card.

LaserData, Inc.:
BiTech
3 Moores Rd.
Madras 600 006
91-44-479466
fax: 91-44-8250588
Circle 1084 on Inquiry Card.

INDONESIA

Bull HN Information Systems, Inc.:
Bull S.A. Office
Central Plaza, Third Floor
Jendral Sudirman #47
12930 Djakarta
62-21-520-7400
fax: 62-21-515966
Circle 1077 on Inquiry Card.

LaserData, Inc.:
P. T. Graha Informatika Nusantara
Setia Budi Building II Lt. 1
Ji. H. R. Rasuna Said Kuningan
Jakarta Selatan
62-21-516085
fax: 62-21-511610
Circle 1084 on Inquiry Card.

IRELAND

Bull HN Information Systems, Inc.:
Bull HN Ltd.
29/31 South William St.
Dublin
353-1-794278
fax: 353-1-794278-205
Circle 1077 on Inquiry Card.

FileNet Corp.:
AT&T International
Corke Abbey
Bray, County Dublin
353-1-822333
fax: 353-1-822864
Circle 1079 on Inquiry Card.

LaserData, Inc.:
Fintra Associates Ltd.
26 Belgrave Square East
Monkstown
County Dublin
353-1-807930
fax: 353-1-806172
Circle 1084 on Inquiry Card.

Wang Laboratories, Inc.:
Wang Ireland Ltd.
Wang House, Harcourt Centre
Harcourt St.
Dublin 2
353-1-757931
fax: 353-1-783098
Circle 1095 on Inquiry Card.

ISRAEL

Bull HN Information Systems, Inc.:
Medan Computers Ltd.
3 Efal St., P.O. Box 3005
49130 Petach Tikva
972-3-922-9541
Circle 1077 on Inquiry Card.

Flagstaff Engineering:
Comtec
42 Aliat Hanor
Tel Aviv 67450
972-3-263141
fax: 972-3-260490
Circle 1080 on Inquiry Card.

LaserData, Inc.:
ITTI OptiData
Hayarkon 39
Bnei Brak 51024
972-3-719-5721
fax: 972-3-719-3413
Circle 1084 on Inquiry Card.

Wang Laboratories, Inc.:
Koor Communications
Atidim 10 T.A.
Never Sharet
P.O. Box 13022
Tel Aviv 61130
972-3-548-3304
fax: 972-3-481-267
Circle 1095 on Inquiry Card.

ITALY

Bull HN Information Systems, Inc.:
Bull HN S.p.A.
32 Via Pirelli
20124 Milan
39-2-67791
fax: 39-2-67792360
Circle 1077 on Inquiry Card.

FileNet Corp.:
Olivetti Italia
Direzione Sviluppo FileNet
Via Meravigli 12
20132 Milan
39-2-883-62280
fax: 39-2-883-62394
Circle 1079 on Inquiry Card.

Flagstaff Engineering:
Datamatic S.p.A.
Via Agordat 34
Milan 20127
39-2-282-9105
fax: 39-2-282-5882
Circle 1080 on Inquiry Card.

Kofax Image Products:
Fujitsu Italy
Via Melchiorre GIOIA 8
20124 Milan
39-2-657-2741
fax: 39-2-657-2257
Circle 1083 on Inquiry Card.

LaserData, Inc.:
SPS
Viale Della Tecnica, 24
00040 Pomesia (Rome)
39-6-911-0048
fax: 39-6-911-2681
Circle 1084 on Inquiry Card.

Optigraphics:
Consorzio Nazionale per L'Informatica
Via E. Vittorini 129
00144 Rome
39-6-501-8201
fax: 39-6-501-1587
Circle 1089 on Inquiry Card.

Wang Laboratories, Inc.:
Wang Italia S.p.A.
Centro Terziario
Strada Statale Padana Superiore
20090 Vimodrome
Milan
39-2-250-4021
fax: 39-2-250-4870
Circle 1095 on Inquiry Card.

Xerox Corp.:
Rank Xerox S.p.A.
Via Andrea Costa 17
P.O. Box 3095
20131 Milan
39-2-28831
fax: 39-2-288-3321
Circle 1096 on Inquiry Card.

JAPAN

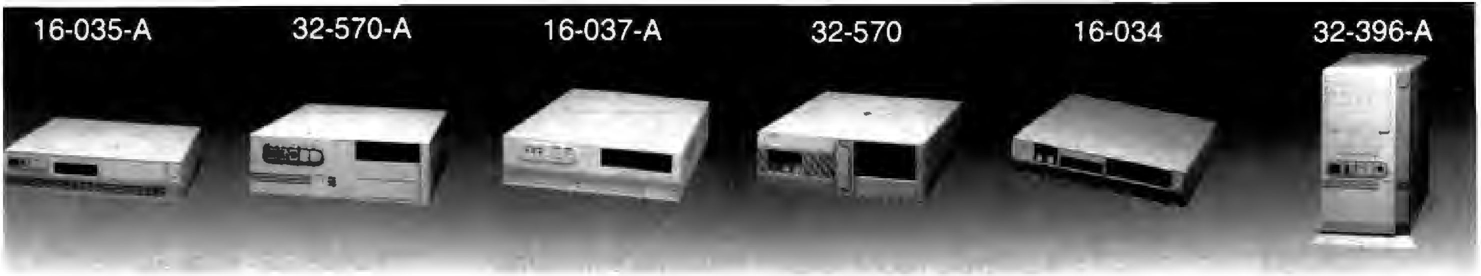
Bull HN Information Systems, Inc.:
NEC Computer Systems Ltd.
Hatano Building
2-2 Kanda Jinbou-Cho
Chiyoda-ku
Tokyo 101
81-3-265-6161
fax: 81-3-265-4047
Circle 1077 on Inquiry Card.

FileNet Corp.:
Toyo Officemation Inc.
Daisan To-un Building
13-10, Shibaura 1-chome
Minato-ku
Tokyo 105
81-3-454-0811
fax: 81-3-451-8198
Circle 1079 on Inquiry Card.

Metafile Information Systems, Inc.:
Computer Resources Corp.
Magnolia Building, Second Floor
1-6-12 Sugamo
Toshima-ku
Tokyo 170
81-3-394-28811
fax: 81-3-394-28814
Circle 1085 on Inquiry Card.

KENYA

Wang Laboratories, Inc.:
Computer Applications Ltd.
Sarit Centre
Westlands
P.O. Box 53441
Nairobi
254-2-748300
fax: 254-2-750131
Circle 1095 on Inquiry Card.

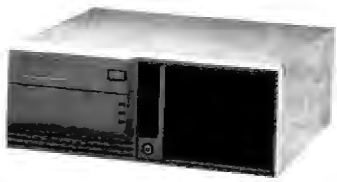


Backed Up By Strong Capacities, We Keep Growing.

We do all stages of prouction ourselves – from designing, molding and pressing to manufacturing – and we enforce rigorous QC. Our full range is comprised of over 20 models.

If you're looking for a powerful partner to team up with, get in touch with us today!

32-302



101

	POWER SUPPLY	DRIVE SPACE	MAIN BOARD	DIMENSION (D x W x H)	TYPE	CHASSIS THICKNESS
486	350 watt to 375 watts standard AT size with rocker type power switch	fourteen 5.25" half-height FDD	80286/80386/ 80486 or 8088 standard size	60.3 x 27.4 x 82.4 cm (height of base not included).	slide-in	1.4mm
32-301 Meet FCC	standard AT or square type baby AT with extension cable and push-in button power switch	six 5.25" half-height FDD	80286/80386/ 80486 full/baby size	41 x 22 x 47 cm (height of base not included)	slide-in	1.4mm
32-302	standard AT type or square type baby AT with extension cable and rocker type power switch	seven 5.25" half-height FDD	80286/80386/ 80486 full/baby size	42.6 x 19 x 65 cm (height of base not included)	slide-in	1.4mm
32-398 32-386 32-386-A	standard AT type or square type baby AT with extension cable and rocker type button power switch	six 5.25" half-height FDD	80286/80386/ 80486 full/baby size	42.6 x 19 x 62 cm (height of base not included)	slide-in	1.4mm
32-396-A	PS/2 type (14 x 15 x 8.6 cm) with extension cable & push in button power supply	two 3.5" half-height FDD three 5.25" half-height FDD	80286/80386/ 80486 full/baby size	42 x 21.5 x 38 cm (height of base not included)	slide-in	1.4mm
32-570 32-570-A	square type baby AT with paddle type power switch	one 3.5" half-height FDD and three 5.25" half-height FDD	80286/80386/ 80486 baby size or 8088	42 x 43.7 x 15.7 cm	slide-in	1.4mm
16-034	made to install the power supply with the dimension: 14 x 15 x 8.6 cm with extension cable	one 3.5" FDD + one 5.25" FDD + one 5.25" or 3.5" HDD	can use baby AT/ XT/all-in-one main board.	38.5 x 41.8 x 10.3 cm	slide-in	1.2mm
16-035-A	PS/2 type (14 x 15 x 8.6 cm) with push-in button power switch	one 3.5" half-height FDD and two 5.25" half-height FDD	AT/XT/all-in-one baby size	42 x 41.8 x 10.3 cm	slide-in	1.4mm
16-037-A	made to install the power supply with the dimension: 4.3 x 13.6 x 18.8 cm with extension cable	one 3.5" FDD (1"-height) and one 3.5" HDD (1"-height)	16MHz mini-286	32 x 27 x 8.2 cm	slide-in	1.2mm
16-396	made to install the power supply with the dimension. 14 x 15 x 8.6 cm with extension cable	Three 5-1/4" half-height disk drive and one 3-1/2" H.D.D. bays.	can use 80386/80286 normal/baby size or 8088 main Board	42 x 21.5 x 39 cm	slide-in	1.4mm
101	PS/2 type (14 x 15 x 8.8 cm) with extension cable & push in button power supply	Three 5.25" FDD + one 3.5" FDD	80286/80386/ 80486 baby size or 8088	40 x 16 x 40 cm	slide-in	1.2mm

All brand names are registered trademarks of their respective owners

Manufacturer & Exporter
LOYALTY FOUNDER ENTERPRISE CO., LTD.
NO.5 CHI LIN N RD., CHUNG-LI IND.PARK, TAOYUAN, TAIWAN, R.O.C.
TEL: 886-3-4511772 FAX: 886-3-4520888 TLX: 35363 LOYALTY

Circle 455 on Inquiry Card.

KOREA

Bull HN Information Systems, Inc.:
Bull HN Office
Second Floor, Lucky-Goldstar Mapo Building
275 Kongdok-Dong
Mapo-Ku
Seoul 121
82-2-701-1114
Circle 1077 on Inquiry Card.

FileNet Corp.:
Korea Computer Corp.
8-61, Galweol-Dong
Yongsan-ku
Seoul
82-2-804-9844
fax: 82-2-804-8357
Circle 1079 on Inquiry Card.

Kofax Image Products:
Koryo
46-1, Dohwa-Dong
Mapo-ku
Seoul
82-2-718-4411
fax: 82-2-718-4473
Circle 1083 on Inquiry Card.

Optigraphics:
SsangYong Computer Systems Corp.
60-1, 3-Ga, Ghungmu-Ro
Jung-Gu
Seoul 100-705
82-2-273-4416
fax: 82-2-277-2385
Circle 1089 on Inquiry Card.

ViewStar Corp.:
SsangYong Computer Systems
60-1, 3-Ga, Ghungmu-Ro
Jung-Gu
Seoul 100-705
82-2-273-4416
fax: 82-2-277-2385
Circle 1094 on Inquiry Card.

KUWAIT

FileNet Corp.:
BayaNat
Sharg. White House
No. 1, First Floor
P.O. Box 36220
Al-Ras 24753
965-242-6273
fax: 965-242-6275
Circle 1079 on Inquiry Card.

LaserData, Inc.:
Bader Al Mulla Group
P.O. Box 177
Safat 13002
965-244-5040
fax: 965-243-6079
Circle 1084 on Inquiry Card.

Summit Software Corp.:
Diyar United Trad. & Cont. Co.
Areal St., 17M Block 14
P.O. Box 44240
Daiyah 32057
965-2-521269
fax: 965-2-527919
Circle 1092 on Inquiry Card.

LUXEMBOURG

Bull HN Information Systems, Inc.:
Bull S.A.
Kalchesbreck, 2A
L-1852 Luxembourg
352-43858541
fax: 352-422242
Circle 1077 on Inquiry Card.

MALAYSIA

FileNet Corp.:
Olivetti (M) SDN BHD
Large Account Systems & Networks
Seventh Floor, Wisma Tong Ah
No. 1 Jalan Perak
P.O. Box 11229
50450 Kuala Lumpur
60-3-2612277
fax: 60-3-2615610
Circle 1079 on Inquiry Card.

LaserData, Inc.:
Computer Systems Advisers
Wisma CSA
Jalan SS 22/25
Damansara Jaya
47400 Petaling Jaya
60-3-719-5721
fax: 60-3-719-3413
Circle 1084 on Inquiry Card.

Metafile Information Systems, Inc.:
SilverLake System SDN BHD
Lot 20.5 Menara Maybank
100 Jalan Tun Berak
50050 Kuala Lumpur
60-3-230-1685
fax: 60-3-230-1901
Circle 1085 on Inquiry Card.

MEXICO

Bull HN Information Systems, Inc.:
Bull HN S.A.
Hamburgo 64
Col. Juarez
06600 Mexico City
52-5-259-1966
fax: 52-5-570-2985
Circle 1077 on Inquiry Card.

FileNet Corp.:
Microformas, S.A. de C.V.
Melchor Ocampo #158
Col. Sta. Catarina
Coyoacan
Mexico D.F. 04010
52-5-554-9177
fax: 52-5-554-3654
Circle 1079 on Inquiry Card.

THE NETHERLANDS

Bull HN Information Systems, Inc.:
Bull Nederland N.V.
Vliegtuigstraat 26-(BP 9039)
1006 CL Amsterdam
31-20-510-1891
Circle 1077 on Inquiry Card.

FileNet Corp.:
Olivetti Nederland B.V.
Verbeekstraat 19-21
2301-ED Leiden
31-71-3199-31
fax: 31-71-312049
Circle 1079 on Inquiry Card.

Flagstaff Engineering:
Coza B.V.
Polakweg 15B
GG Rijswijk (Z-H) 2288
31-70-390-7779
fax: 31-70-399-3912
Circle 1080 on Inquiry Card.

Kofax Image Products:
ACAL Auriema
Auriema Nederland B.V.
Dornakkersweg 26
31-40-816565
fax: 31-40-811815
Circle 1083 on Inquiry Card.

LaserData, Inc.:
DatelCare B.V.
28 Huis Ter Deideweg
3700 AA Zeist
31-3404-27211
fax: 31-3404-27201
Circle 1084 on Inquiry Card.

Metafile Information Systems, Inc.:
Desisco Nederland B.V.
Stationsplein 9
2801 AK Gouda
31-1820-80188
fax: 31-1820-80040
Circle 1085 on Inquiry Card.

Optigraphics:
Teser Holland B.V.
Poldermolen 4
3352 TH Papendrecht
31-78-412020
fax: 31-78-150454
Circle 1089 on Inquiry Card.

Plexus Software, Inc.:
Recognition Equipment Nederland B.V.
Buikslotermeerplein 418
NL-1025 WP Amsterdam
31-20-327877
fax: 31-20-328438
Circle 1090 on Inquiry Card.

Wang Laboratories, Inc.:
Wang Nederland B.V.
Costerweg 12, P.O. Box 4
4100 AA Culembourg
31-34-507-0911
fax: 31-34-501-9752
Circle 1095 on Inquiry Card.

Xerox Corp.:
Rank Xerox B.V.
Handelsweg 1
3707 NG Zeist
31-3404-80211
fax: 31-3404-20434
Circle 1096 on Inquiry Card.

Softline International Division

Special Volume Discounts
Latest U.S. Versions at U.S. Prices

1333 60th Street
Brooklyn, N.Y. 11219
Fax: 718-438-2315
Telex: 627-30170 or 910-240-3918

WE'VE MADE THE WORLD OUR BUSINESS.

Software

Word Processors/Editors

*Ami Professional	$312
Lotus Manuscript	343
MS Word 5.0	227
*MS Word for Windows	329
Multimate 4.0	255
Norton Editor	49
Professional Write	161
Sage Professional Editor	205
Wordperfect 5.0 Xenix 1-5 User	496
Wordperfect 5.1	269
Xywrite III Plus	213

Desktop Publishing

*ABC Flowcharter	189
Arts & Letters Composer	246
Form Filler	88
Formtool	61
Freedom of Press	249
Gem/3 Desktop Publisher	169
*Jetform Design	276
*Per:Form	167
Publishers Type Foundry	309
*Softtype	115
Ventura Publisher Gold	549
*Ventura Pub Gold Windows	549

Database & Tools

Advanced Revelation	521
B-treve for OS/2	384
B-trieve Single User	160
C-tree	297
C-tree/R-tree/D-tree Toolkit	825
Clarion Professional	470
Clipper 5.0	499
Dataease 4.2	435
Dbase IV	506
Dbase IV Developer Version	882
*Dbfast/Windows	197
DBXL	143
Foxbase Plus	198
Foxpro	471
Informix 4GL Compiled—DOS	882
Oracle Professional	881
Oracle Professional for OS/2	881
Paradox	463
Paradox 386	619
Paradox 386 for OS/2	499
PC-File Single User	76
Professional File	191
*Pubtech File Organizer	115
Q&A	232
R-tree	222
Rbase for DOS	481
Rbase for OS/2 1-3 User	619
SCO Foxbase+ 286/AT for Xenix	655
*Superbase 4 Windows	389
UI Programmer	338
X-trieve Plus	367
XQL Relational Data Manager	491

Spreadsheets

Lotus 1-2-3 Addin Toolkit 3.0	298
Lotus 1-2-3 Version 2.01	324
Lotus 1-2-3 Version 2.2	354
Lotus 1-2-3 Version 3.1	425
Lotus 1-2-3/G for OS/2 Std Ed	521
*Microsoft PC Excel	313
Microsoft PM Excel for OS/2	329
Quattro	94
Quattro Pro	333
Supercalc 5	312

Integrated Packages

Enable OA	437
Framework III	458
Lotus Symphony 2.2	499
Microsoft Works	105
Smartware II	452
*Wingz for PC	323

Graphics

*Adobe Illustrator	$296
*Adobe Sreamline	236
Autodesk Animator	237
*Charisma	339
*Corel Draw	338
*Designer	478
Draw Perfect	281
*Draw Plus	271
Freelance Plus	343
Gem/3 Artline	281
Gem/3 Presentation Team	281
Grasp	139
Harvard Graphics	309
Hijaak	109
Inset Plus (w/Hijaak)	149
Microsoft Chart	269
PC Paintbrush Plus	87
Pizzaz Plus	68
*Powerpoint for Windows	329
Quicktrace	215
Show Partner FX	224

Project Management

Harvard Total Proj. Mgr	449
*Project for Windows	463
Project Mgr. Workbench Adv.	777
Superproject Expert	437
Superproject Expert/2 for OS/2	500
Timeline W/Graphics	473

Communications

Carbon Copy Plus	118
Close-Up Customer/Suppt	124/153
*Crosstalk for Windows	123
Crosstalk MK4	137
*Dynacomm for Windows	146
Net Remote Single/Multi	208/412
Novell Netware Anywhere	244
PC Anywhere III	67
PC Anywhere IV	109
Procomm Plus	65
Reflection 1+/7+	315/370
Relay Gold	150
Smalltalk/V 286	119
Smalltalk/V PM for OS/2	299
Smartcom III	139
Smarterm 240	196

Desktop Environments

Desqview/Desqview 386	76/124
Sidekick Plus	139
*Windows 3.0	104
*Windows S/W Dev Toolkit	340

Languages & Programming Tools

Blaise C Tools+/Power Tools+	116
Blaise Pascal Tools I & II	132
Clear+ C/Clear+ Dbase	128
DBC III Library/III Plus	187/375
Interactive Easyflow	108
Lattice C Compiler	155
Matrix Layout	125
MS Basic/MS C Compiler	336
MS Fortran Compiler	306
MS Macro Assembler	106
MS Quick Basic/Pascal/C	70
MS Quick C w/Quick Assembler	135
MS-DOS 3.3	62
MS-DOS 4.01	70
Norton Guides	68
Object Professional	119
Turbo Assembler	110
Turbo Basic	73
Turbo C++/Turbo C++ Pro	90/145
Turbo Pascal/Prolog	109
Turbo Professional	102
Vermont Views W/Source Code	723
Zortec C++/C++ Developer	159/389

Computer Aided Design

Autosketch Enhanced	$96
Design Cad 3D	202
*Drafix Cad for Windows	432
Generic CADD Level 3	213

Statistics

CSS Statistical Package	348
GB-Stat	171
SPSS for OS/2	865
SPSS PC Plus	517
Statgraphics	564
Systat W/Sygraph Graphics	599

Network Operating Systems

Novell Advanced Netware	1995
Novell ELS I/ELS II	490/1158
Novell SFT/Netware 386	3085/5050
PC-MOS 386 5 User	458
SCO VP/IX for Xenix 1-2 User	309
SCO VP/IX for Xenix 3+ Users	558
SCO Xenix Devpt System 286	437
SCO Xenix Devpt System 386	501
SCO Xenix Oper System 286/386	437
VM/386	168

Network Utilities

Above Lan	69
Back-It Network	226
Disk Manager/N	105
Lan Assist	162
Lanschool	364
Lanselect	312
Lanshell	298
Lansight	249
Lanspace	312
Lanspool	225
Netback 2.0	149
Print Q Lan	247
PS-Print	233
PS-Print (for ELS II)	174
Q-DOS II Network	169
Queue It	95

Utilities

386 MAX Professional	75
Above Disk	64
*Asymetrix Toolbook	295
Check It	89
Copy II PC	26
Fastback Plus	111
Gofer	51
*HDC First Apps	56
*HDC Wind Express 3.0	56
Headroom	69
Hyper Access/5	125
Lotus Magellan	108
Mace Utilities 1990 Edition	88
Manifest	39
Move 'Em	56
*Multiscope Windows Debug	249
Norton Adv. Utilities 5.0	116
Norton Backup	88
Op*Tech*Sort	125
PC Globe	49
PC Kwik Power Pack	76
PC Tools Deluxe	90
Popdrop Plus	64
*QEMM 386 EMS Manager	63
QRAM 286	51
Spinrite II	64
Super PC-Kwik	51
Switch-It	69
*Tempo for Windows	75
V Cache	49
V Feature	65

Personal Information Managers

Info Select	$69
Instant Recall	75
Lotus Agenda	275
*Packrat	249
Who-What-When	159
WordPerfect Office PC	89

Hardware

Multifunction Boards

AST Rampage+ 512K (PCA or MCA)	387
AST Sixpack+/Sixpack 286	117/195
Boca Tophat 128K	77
Bocaram PS/2 50/60 (0K)	117

Display Boards

AST VGA Plus 16 bit	183
Hercules Graphics Station 1MB	679
Hercules Graphics Station 3MB	988
Hercules VGA Card 8 bit	125
Paradise 8514/A (AT)	639
Paradise Auto EGA 480	91
Video 7 VGA 1024i (512K)	251

Emulation Boards

AST 5251-11 Enhanced+	509
DCA IRMA 2 (PCA or MCA)	726
DCA IRMA 3 Convt (PCA or MCA)	441
Megahertz 3270 Laptop Cd	572
Megahertz 5250 Laptop Cd	572

Modems

Prac Periph 1200 Int/Ext	67/80
USR Sprtstr 2400 Int/Ext	136/164

Laser Printers & Accessories

HP Deskjet 500	507
HP Laserjet III	1675
HP Laserjet IIP	1038
Pacific Data 1MB Mem Exp Bd	139
Pacific Data 2MB Mem Exp Bd	199
Pacific Data 4MB Mem Exp Bd	336
Pacific Data 25-in-1 Cart	275
Pacific Data Headlines Cart	209
Pacific Data Plotter Cart	252
Pacific Page Postcript Cont	371

Network Boards

3COM Etherlink II (PCA)	240
3COM Etherlink/MC (MCA)	348
Megahertz Laptop Ethernet Cd	251
Novell NE1000A Ethernet (PCA)	159
Novell NE2000A Ethernet (PCA)	188
Novell NE3200 Ethernet (EISA)	969
Pure Data Laptop Arcnet Cd	375
SMC 3200-C Busmaster (EISA)	799
SMC Active Hub 8 Port	262
SMC PC130E Arcnet Coax	125
SMC PC500FS Arcnet Server	295
SMC PS110 Arcnet (MCA)	313
Tom Conrad Active Hub 12 Port	829
Tom Conrad TR MAU 16 Port	686
WDC Ethercard Plus 16	232
WDC Ethercard+/A (MCA)	249

Hard Disks/CD ROMs

Miniscribe 40MB IDE (28MS)	309
NEC CDR 72 Ext CD ROM W/Intfc	861
NEC CDR 82 Int CD ROM W/Intfc	791
Seagate II 320MB ESDI (14.5MS)	1764
Seagate II 150MB ESDI (16.5MS)	943
Seagate II 80MB MFM (15MS)	684

Input Devices & Accessories

Logitech Series 9 w/Paint	93
MS Mouse w/Paintbrush	113
MS Mouse w/Windows 3.0	158
PC Mouse II w/Paint	91
Summasketch 12X12 W/4 Button	370
Catchword OCR S/W (Scanman)	139
HP Scanjet Plus W/Intfc	1626
Logitech Scanman+ PCA/MCA	180/230
ReadRight OCR S/W (Scanjet)	313

✔ LOW PRICES ✔ SHIPPING EXPERTISE
✔ VOLUME DISCOUNTS ✔ KNOWLEDGEABLE STAFF

*MS Windows compatible

MasterCard

To Place your order by telephone, please call **Fay Chayne** • Intl. Sales Mgr.

1-718-438-6057

VISA

TERMS: ALL RETURNS REQUIRE PRIOR AUTHORIZATION. 20% RESTOCKING FEE ON RETURNS. ALL PRICES SUBJECT TO CHANGE, CALL FOR CURRENT PRICES. PAYMENTS MAY BE MADE BY BANK CHECK, WIRE TRANSFER, L/C, AMERICAN EXPRESS, MASTER OR VISA CARD (3% HANDLING FEE ON CREDIT CARD ORDERS). GOODS ARE SHIPPED VIA AIR MAIL (RECOMMENDED FOR SMALL ORDERS) OR AIR FREIGHT. ADD FREIGHT COSTS TO PREPAYMENT OR GOODS ARE SHIPPED FREIGHT COLLECT.

NEW ZEALAND

Bull HN Information Systems, Inc.:
Bull HN Ltd.
61-63 Taranaki St.
P.O. Box 6324
Wellington
64-4-85-3225
fax: 64-4-85-3234
Circle 1077 on Inquiry Card.

FileNet Corp.:
Trilogy Business Systems
500 Queen St.
P.O. Box 3323
Auckland
64-9-798345
fax: 64-9-394142
Circle 1079 on Inquiry Card.

Metafile Information Systems, Inc.:
Creative Solutions Ltd.
Level 2
Saatchi & Saatchi House
101-103 Courtenay Place
Wellington
64-4-854161
fax: 64-4-854165
Circle 1085 on Inquiry Card.

NIGERIA

Bull HN Information Systems, Inc.:
Worldwide Information Systems Ltd.
1B Ozumba Mbadiwe St.
Victoria Island
Lagos
234-1-613589
Circle 1077 on Inquiry Card.

Wang Laboratories, Inc.:
Datamatics Company (NIG) Ltd.
284 Ikorodu Rd.
P.O. Box 864 Ikeja
Lagos
234-1-967778
fax: 234-1-876332
Circle 1095 on Inquiry Card.

NORWAY

Bull HN Information Systems, Inc.:
Bull A/S
Tollbugaten 32
P.O. Box 47, Sentrum
0105 Oslo 1
47-2-575600
fax: 47-2-571010
Circle 1077 on Inquiry Card.

FileNet Corp.:
Edata A/S
Sinsenveien 47 C
P.O. Box 165, Refstad
0513 Oslo 5
47-2-711470
fax: 47-2-713425
Circle 1079 on Inquiry Card.

Flagstaff Engineering:
Aladdin Software A/S
Hvamstubben 17
Skjetten 2013
47-6-845400
fax: 47-6-844860
Circle 1080 on Inquiry Card.

Metafile Information Systems, Inc.:
MetaTech A/S
P.O. Box 65
7090 Storen
47-74-31864
fax: 47-74-31860
Circle 1085 on Inquiry Card.

TMS, Inc.:
EDB A/S
P.O. Box 139 Okern
0509 Oslo 5
47-2-728000
fax: 47-2-720723
Circle 1093 on Inquiry Card.

Wang Laboratories, Inc.:
GPI A/S
Karihaugveien 89
P.O. Box 12, Furuset
1001 Oslo 10
47-2-309000
fax: 47-2-308585
Circle 1095 on Inquiry Card.

Xerox Corp.:
Rank Xerox A/S
P.O. Box 905
N-1301 Sandvika
47-2-986800
fax: 47-2-980408
Circle 1096 on Inquiry Card.

OMAN

FileNet Corp.:
OHI Telecommunications
Telecom House, 87 Dohat Al Adab
Medinat Quboos
P.O. Box 889
Muscat
968-603606
fax: 968-603608
Circle 1079 on Inquiry Card.

LaserData, Inc.:
Almadina Co.
Hatat House, First Floor
Office No. 106
P.O. Box 4181
Ruwi-Muscat
968-564353
fax: 968-562663
Circle 1084 on Inquiry Card.

Wang Laboratories, Inc.:
Oman Computer Services
Dar Al Hasibaat
P.O. Box 7917
Muttrah
968-698352
fax: 968-698356
Circle 1095 on Inquiry Card.

PERU

Bull HN Information Systems, Inc.:
Telectron S.A.
Prolongacion Arenales
452 San Isidro
27 Lima
51-14-408200
Circle 1077 on Inquiry Card.

PHILIPPINES

Bull HN Information Systems, Inc.:
Distributed Processing Systems Inc.
Second Floor, Casmer Building
Salcedo St.
Legaspi Village Makati
Metro Manila
63-2-855713
fax: 63-2-8155627
Circle 1077 on Inquiry Card.

PORTUGAL

Bull HN Information Systems, Inc.:
Bull Portuguesa LDA
Avenida 5 de Outubro, 35-6
1000 Lisbon
351-1-534181
fax: 351-1-577704
Circle 1077 on Inquiry Card.

FileNet Corp.:
Panodata
c/o Elotecnico
Av. de Republica, 52
1000 Lisbon
351-1-970336
fax: 351-1-970488
Circle 1079 on Inquiry Card.

Wang Laboratories, Inc.:
Datinfor
Rua Luciano Cordeiro 90-3
1100 Lisbon
351-1-530933
fax: 351-1-522502
Circle 1095 on Inquiry Card.

Xerox Corp.:
Rank Xerox Portugal
Rua Pedro Nunes, 16
1000 Lisbon
351-1-577110
fax: 351-1-577110
Circle 1096 on Inquiry Card.

SAUDI ARABIA

Blueridge Technologies, Inc.:
Saudi Systems Corp.
P.O. Box 22232
Riyadh 11495
966-1-462-6622
fax: 966-1-462-7985
Circle 1076 on Inquiry Card.

FileNet Corp.:
M. Al-Moammar & Partner Co. Ltd.
Olayia Main St.
Khaldeih Building, Mezzanine Floor
P.O. Box 16116
Olayia, Riyadh 11464
966-1-463-0078
fax: 966-1-465-9035
Circle 1079 on Inquiry Card.

More For Less

Laptops/Notebooks to LAN

CONNECT TO MORE NETWORKS

The D-Link Pocket LAN Adapters now offer you more: coaxial and 10BASE-T Ethernet, coaxial and twisted-pair ARCnet, five models of U.S. and European versions are immediately available, in quantity. And, there's more software support: NetWare, NetBIOS, PC-NFS, TCP/IP, NDIS, and much, much more.

Supported Driver Programs	Ethernet	ARCnet
NetWare 286	•	•
NetWare 386	•	•
NetBIOS	•	•
3Com 3+ Share	•	
3Com 3+ Open	•	
LAN Manager	•	
Banyan Vines	•	•
NetBIOS	•	
D-Link LANsmart	•	•
IBM PC LAN Program	•	•
FTP PC/TCP	•	
Wollongong WIN/TCP	•	
Locus TCP/IP	•	
D-Link TCP/IP For DOS	•	
PC-NFS	•	
DECnet PCSA	•	
DSC Nexos	•	

SPEND LESS

But they take much less from you. Less installation hassle, less space, less weight, and of course less dollar. No configuration siwtches. Connection to a network by one simple plug to a printer port. The D-Link Pocket LAN Adapters are still by far the smallest, lightest and least expensive LAN adapters for laptop and notebook PCs.

COMPLETE SUPPORT

The benefits just don't stop there. You'll be more than pleased with the complete support that D-Link provides, as the Pocket LAN Adapters are only part of D-Link's complete range of Ethernet & ARCnet adapters, accessories, network operating system and software utilitis.

D-Link®

link smarter

D-Link will be in Infabo, Hall 24, Booth 2442.

D-Link Systems, Inc.
5 Musick
Irvine, CA 92718
U.S.A.
TEL: (714) 4551688
FAX: (714) 4552521

D-Link (U.K.) Ltd.
Denmark House Staples Corner
The Broadway
London NW9 7BW U.K.
Tel: 081-2039900
Fax: 081-2036915

D-Link Canada Inc.
3075 Ridgeway Drive, Unit #26
Missisauga, ONT L5L 5M6
Canada
TEL: (416) 8280260
FAX: (416) 8285669

Circle 426 on Inquiry Card.

OEM and ODM versions also available

Specifications subject to change without prior notice. All names & trademarks belong to their proprietors.

LaserData, Inc.:
MoseCo
P.O. Box 1938
Riyadh
966-1-476-5117
fax: 966-1-465-0813
Circle 1084 on Inquiry Card.

Summit Software Corp.:
Riyadh House
Establishment
King Faisal St.
P.O. Box 317
Riyadh
966-1-405-5558
fax: 966-1-401-2417
Circle 1092 on Inquiry Card.

Wang Laboratories, Inc.:
Jeraisy Computer Services
King Fahad Rd.
P.O. Box 317
Riyadh 11411
966-1-462-4000
fax: 966-1-462-5191
Circle 1095 on Inquiry Card.

SCOTLAND

Bull HN Information Systems, Inc.:
118 Bath St.
Glasgow G 2 2EF
44-41-333-9484
fax: 44-41-333-9484-241
Circle 1077 on Inquiry Card.

SINGAPORE

Bull HN Information Systems, Inc.:
Bull HN Pte. Ltd.
78 Shenton Way (Unit 26-02)
65-22-44133
fax: 65-22-50461
Circle 1077 on Inquiry Card.

FileNet Corp.:
Olivetti Singapore Pte. Ltd.
8, Ayer Rajah Crescent
65-777-5111
fax: 65-779-5111
Circle 1079 on Inquiry Card.

LaserData, Inc.:
Computer Engineering
750 Chai Chee Rd., #03-01
Chai Chee Industrial Park
65-441-2788
fax: 65-441-2811
Circle 1084 on Inquiry Card.

Metafile Information Systems, Inc.:
Data DPS (S) Pte. Ltd.
Block 71 Ayer Rajah Crescent
#06-03/06
Ayer Rajah Industrial Estate
65-778-9090
fax: 65-778-7177
Circle 1085 on Inquiry Card.

Optigraphics:
Strategic Information Systems Pte. Ltd.
26 Horne Rd., #05-00
65-291-9288
fax: 65-291-3266
Circle 1089 on Inquiry Card.

Plexus Software, Inc.:
Recognition Equipment Inc.
250 North Bridge Rd.
Raffles City Tower, #30-07
65-339-7177
fax: 65-339-2812
Circle 1090 on Inquiry Card.

SOUTH AFRICA

Optigraphics:
The Vector Group
Vector House
105 Conrad Dr.
Blairgowrie 2194
Johannesburg
27-11-886-4880
fax: 27-11-886-4192
Circle 1089 on Inquiry Card.

SPAIN

Bull HN Information Systems, Inc.:
Bull S.A.
Arturo Soria 107
28043 Madrid
34-1-413-1213
fax: 34-1-415-6149
Circle 1077 on Inquiry Card.

FileNet Corp.:
Hispano Olivetti S.A.
Division Grandes Sistemas
Conde De Penalver, 84
28006 Madrid
34-1-402-3100
fax: 34-1-401-0260
Circle 1079 on Inquiry Card.

Flagstaff Engineering:
Control Systems
C/Oviedo 30
Madrid 28010
34-1-535-3935
fax: 34-1-534-7924
Circle 1080 on Inquiry Card.

LaserData, Inc.:
Proco S.A.
Clara Del Rey, 33
28002 Madrid
34-1-416-5700
fax: 34-1-413-6813
Circle 1084 on Inquiry Card.

Micro Dynamics, Ltd.:
Anaya Systems
Calle Miguel Yuste 26, 1°
Madrid 28037
34-1-304-6003
fax: 34-1-327-2680
Circle 1086 on Inquiry Card.

Optigraphics:
Empresarios Agrupados S.A.
Magallanes, 3
28015 Madrid
34-1-445-6000
fax: 34-1-445-0113
Circle 1089 on Inquiry Card.

Plexus Software, Inc.:
Recognition Equipment Iberica S.A.
Rafael Calvo 18, Floor 5-A
E-28010 Madrid
34-1-319-9115
fax: 34-1-319-9116
Circle 1090 on Inquiry Card.

Wang Laboratories, Inc.:
Wang Espana S.A.
Autopista Aeropuerto
Barajas KM 13
28042 Madrid
34-1-337-1100
fax: 34-1-747-6335
Circle 1095 on Inquiry Card.

Xerox Corp.:
Rank Xerox Espanola S.A.
Josefa Valcarcel 26
28027 Madrid
34-1-585-3100
fax: 34-1-320-3217
Circle 1096 on Inquiry Card.

SWEDEN

Bull HN Information Systems, Inc.:
Bull A.B.
Sveagen 163
P.O. Box 23 137
S-104 35 Stockholm
46-8-728-4200
fax: 46-8-338074
Circle 1077 on Inquiry Card.

FileNet Corp.:
Edata Sweden
Svardvagen 3 A
S-182 33 Danderyd
46-8-7533075
fax: 46-8-7551388
Circle 1079 on Inquiry Card.

Plexus Software, Inc.:
Recognition Equipment A.B.
Strandbergsgatan 47
P.O. Box 30173
S-10425 Stockholm
46-8-618-0200
fax: 46-8-618-7287
Circle 1090 on Inquiry Card.

Wang Laboratories, Inc.:
Wang Svenska A.B.
Dalvaegen 8, P.O. Box 1196
S-171 23 Solna
46-8705-8500
fax: 46-827-2210
Circle 1095 on Inquiry Card.

Xerox Corp.:
Rank Xerox A.B.
Domnarvsgatan 11
163 87 Stockholm
46-8-795-1000
fax: 46-8-795-1440
Circle 1096 on Inquiry Card.

SWITZERLAND

Bull HN Information Systems, Inc.:
Bull A.G.
Wengistrasse 28
CH-8021 Zurich
41-1-295-8111
fax: 41-1-241-7141
Circle 1077 on Inquiry Card.

LONGSHINE N300 IS YOUR BEST CHOICE.

Introducing LONGSHINE N300 Notebook Computer

The LONHSHINE N300 Notebook Computer packs a 32-bit 386SX/ CPU with 2.5" 20MB (/40 /60MB) hard disk into a true A4 size, high-performance, and battery- powered system. Each system weights only 6.2 lbs. It includes a number of sophisticated features such as math coprocessor option, more I/O interfaces, password security, memory expansion option, power management,personal notebooker and more. Plus, ShineModem 2400bps MNP5 Pocket Modem and Pocket LAN Adapter are available from us to create your communication capabilities.

Memory Expansion Options
N300 comes with 2MB of standard memory. Additional memory up to 4MB supports user to increase the system performance and expandability. Also EMS LIM4.0 function is supported for manipulation of large amounts of data.

Password Security Function
It can prevent unauthorized user to accesss the system or files on you hard disk. So your data are secured.

More I/O Interfaces
Built-in interfaces on N300 allows you to connect with a wide variety of devices, including one parallel port, one serial port, one PS/2 mouse port, one external VGA port,one modem slot and one 100-pin mini I/O expansion slot.

Intelligent Power Management
N300 comes with a rechargeable Ni-Cad battery pack providing up to 3 hours of operations. Plus,the Power Management of N300 can conserve the battery life by automatically shutting down hard disk drive, LCD display/ backlit and reducing processor speed when there is no system activity.

Personal Notebooker
Specially, this function can let you organize your daily business activity effectively and efficiently. It includes card file, appointment calendar, memo pad, calculator and world time table.

Communication Capabilities
Options of ShineModem 2400bps MNP5 and Pocket LAN Adapter could give you qualified data commuincation and meet convience needs during your travel.

LONGSHINE

Headquarters (Taiwan)/LONGSHINE Electronics Corp. 6F, 245, Sec. 3, Roosevelt Rd., Taipei, Taiwan, R.O.C. Tel: 886-2-3634958 Fax: 886-2-3626810 **USA Office**/Tel: 408-9421746 Fax: 408-9421745 **Hong Kong Office**/Tel: 852-4206186 Fax: 852-4205252 **Germany Office**/Tel: 49-0211-656014 Fax: 49-0211-654283 **UK Office**/Tel: 44-0923-249355 Fax: 44-0923-224595 **JP Office**/Tel: 81-03-38399719 Fax: 81-03-38399729

Compulink Management Center, Inc.:
Baggenstos & Co., S.A.
Chemin Industriel
1261 Chavannes De Bogis
VD
41-22-776-6060
fax: 41-22-776-6015
Circle 1078 on Inquiry Card.

FileNet Corp.:
FileNet A.G.
Rennweg 32
8001 Zurich
41-1-214-6275
fax: 41-1-214-6203
Circle 1079 on Inquiry Card.

LaserData, Inc.:
ALOS A.G.
Raffelstrasse 12
0045 Zurich
41-1-463-0355
fax: 41-1-468-7100
Circle 1084 on Inquiry Card.

Wang Laboratories, Inc.:
Wang S.A./A.G.
Talackerstrasse 7
CH-8152
Glattbrugg/Zurich
41-1-829-7111
fax: 41-1-810-8481
Circle 1095 on Inquiry Card.

Xerox Corp.:
Rank Xerox A.G.
Thurgauerstrasse 40
8050 Zurich
41-1-305-1212
fax: 41-1-305-1472
Circle 1096 on Inquiry Card.

TAIWAN

Bull HN Information Systems, Inc.:
Bull HN Ltd.
Chan-Kwo Building
Tenth Floor, 350 Min-Sheng E. Rd.
Taipei
886-2-501-3090
fax: 886-2-505-5439
Circle 1077 on Inquiry Card.

FileNet Corp.:
First International Computer
Sixth Floor, Formosa Plastics Building
201, Tung Hwa N. Rd.
Taipei
886-2-717-4500
fax: 886-2-712-0231
Circle 1079 on Inquiry Card.

THAILAND

Bull HN Information Systems, Inc.:
Siam Teltech Co. Ltd.
White Group Building
75 SOI Rubia
Sukhumvit 42 Ram IV Rd.
Bangkok 10110
66-2-390-24445-54
Circle 1077 on Inquiry Card.

Metafile Information Systems, Inc.:
Technology Supply Company Ltd.
2096/35-36 Soi Ramkamhaeng
26 Huamark
Bangkapi, Bangkok 10240
66-2-314-6759
fax: 66-2-318-5530
Circle 1085 on Inquiry Card.

TURKEY

Bull HN Information Systems, Inc.:
Eltek Elektronik Teknologi
Buyukdere Caddesi 121
Yeniercan Han
Gayrettepe
Istanbul
90-1-174-2088
Circle 1077 on Inquiry Card.

FileNet Corp.:
Metro A.S.
Yerebatan Ceddesi
Muhterem
Efendi Sokak No. 15
34410 Sultanahmet
Istanbul
90-1-511-8240
fax: 90-1-511-2099
Circle 1079 on Inquiry Card.

LaserData, Inc.:
BILTEK
46 Kizilay
06420 Ankara
90-4-135-4960
fax: 90-4-135-2244
Circle 1084 on Inquiry Card.

Wang Laboratories, Inc.:
Transcom Komputer Sistemleri
San. VE TIC. A.S.
Piyalepasa Bulvari Kastel Is Merkezi
A Blok Kat. 2
Posta Kodu 80370
Piyalepasa, Istanbul
90-1-153-6225
fax: 90-1-153-4956
Circle 1095 on Inquiry Card.

UNITED ARAB EMIRATES

FileNet Corp.:
Gulf Computer Establishment
Second Floor, DNATA Airline Centre
Flame Roundabout
P.O. Box 12866
Dubai
971-4-213250
fax: 971-4-213278
Circle 1079 on Inquiry Card.

Optigraphics:
CAD-Gulf
P.O. Box 16958
Jebel Ali
Dubai
971-84-55508
fax: 971-84-55507
Circle 1089 on Inquiry Card.

Wang Laboratories, Inc.:
Emirates Computer Establishment
Ali Bin Ahmed Building, Fifth Floor
Al Nasr St.
P.O. Box 7222
Abu Dhabi
971-2-331280
fax: 971-2-331487
Circle 1095 on Inquiry Card.

U.K.

Bull HN Information Systems, Inc.:
Bull HN Ltd.
Computer House
Great West Rd.
Brentford
Middlesex TW8 9DH
44-81-568-9191
fax: 44-81-568-1581
Circle 1077 on Inquiry Card.

Compulink Management Center, Inc.:
ProCAD Ltd.
Premier House
10 Greycoat Place
London SW1P 1SB
44-71-222-8866
fax: 44-71-233-0742
Circle 1078 on Inquiry Card.

FileNet Corp.:
FileNet Ltd.
Hill Place House
55A High St.
Wimbledon Village
44-81-944-1140
fax: 44-81-944-1146
Circle 1079 on Inquiry Card.

Flagstaff Engineering:
The Professional Connection
Fountain Court
44 High St.
Fareham
Hampshire PO16 7BN
44-329-230870
fax: 44-329-236532
Circle 1080 on Inquiry Card.

Kofax Image Products:
Headway Computer Products
Headway House, Christy Estate
Ivy Rd.
Aldershot
Hampshire GU12 4TX
44-252-333575
fax: 44-252-314445
Circle 1083 on Inquiry Card.

LaserData, Inc.:
Commercial Computers
7 Soundwell Rd.
Staple Hill
Bristol BS16 4QG
44-272-701575
fax: 44-272-701189
Circle 1084 on Inquiry Card.

Circle 481 on Inquiry Card.

NEW Genus GX Support

graphics-MENU 3.0

A sophisticated graphical user interface for Turbo Pascal, Turbo C, Turbo C++ & Microsoft-C.

Automatic use of EMS (expanded memory) if it is available to save the underlying image.

MENUS: several types including horizontal & vertical nested to any depth, supporting keyboard and mouse. Auto save of underlying image.

ICONS: beveled or not, can be used as buttons or as application holders. Can be automatically aligned within a window or isolated.

BUTTONS: automatic arrays allow easy placement in or out of a window. Multiple modes allow use as radio buttons or check boxes.

WINDOWS: optional beveled look. Automatic drag and resizing. Vertical and/or horizontal scroll bars. Title and status lines - easily changed.

FORMS: true data-entry forms available with add-on module. Data validation, range-checking, pop-up menus, help lines, dBASE-like picture strings.

CASE TOOLS: on-screen design tools for complete code generation of menu structures and data-entry forms.

SOURCE: library source is available in all languages.

TASKING: Fore & background tasking capability allows GUI tasks to proceed as a background activity.

Multiple Graphics Environments: Works with BGI (Borland Graphics Interface), Microsoft native graphics, Genus GX graphics or MetaWindow (from Metagraphics Software Inc)

NO RISK: 30-day money back warranty, free technical support, no licensing, no royalties.

$179 graphics-MENU
$379 graphics-MENU with source
$ 99 Data-Entry
$224 Data-Entry with source
$549 Pro-Pak (full source & lib's)

Specify variant: BGI, Microsoft Graphics, Genus GX Graphics or META
Languages: Turbo Pascal 5.5 and 6.0, TurboC 2.0, TurboC++, MicrosoftC 5.1 (META only), and MicrosoftC 6.0 (META or MS graphics).

Island Systems
7 Mountain Road
Burlington MA 01803
VOICE (617) 273-0421
FAX (617) 270-4437

DEMO AVAILABLE

VISA and MASTERCARD accepted

Circle 482 on Inquiry Card.

The Stork™

The next generation of installation software.

Installation software for your software application with unprecendented ease for you the developer as well as your customers.

Comprehensive set of CASE tools deal with all facets of product installation.

Facilitates both creation and maintenance of your product installation. No more hassles during a product revision.

Minimizes technical support for new users by presenting a professional, user friendly installation sequence that any user can follow.

Flexible end-user menus utilizing mouse or keyboard.

Allows a high degree of flexibility and customization to the user interface.

Works in standard IBM text mode - color or monochrome.

No programming.
No script files.
No royalty.
No banner.
No nonsense.

30 day money back warranty.

The Stork Delivers only $175

Island Systems
7 Mountain Road
Burlington MA 01803
VOICE (617) 273-0421
FAX (617) 270-4437

Mastercard & Visa Accepted

The Stork is a trademark of Island Systems. Other brand and product names are the trademarks of their respective companies.

Metafile Information Systems, Inc.:
Image Systems Europe
Sheffield Technology Park
60 Shirland Lane
Sheffield S9 3SP
44-742-420419
fax: 44-742-445197
Circle 1085 on Inquiry Card.

Micro Dynamics, Ltd.:
Callhaven
74 Rivington St.
London EC2A 3AY
44-71-410-9191
fax: 44-71-410-9195
Circle 1086 on Inquiry Card.

Optigraphics:
Cad-Capture Ltd.
Whitebirk Industrial Estate
Blackburn
Lancashire BB1 5UD
44-254-583534
fax: 44-254-665528
Circle 1089 on Inquiry Card.

Plexus Software, Inc.:
Plexus Computers Ltd.
15-18 Cherry Orchard West
Kembrey Park
Swindon, Wiltshire
SN2 6UY
44-793-614110
fax: 44-793-614297
Circle 1090 on Inquiry Card.

Wang Laboratories, Inc.:
Wang U.K. Ltd.
1000 Great West Rd.
Brentford
Middlesex TW8 9HL
44-81-568-9200
fax: 44-81-847-1352
Circle 1095 on Inquiry Card.

Xerox Corp.:
Rank Xerox Ltd.
Bridge House
Oxford Rd.
Uxbridge
Middlesex UB8 1HS
44-895-51133
fax: 44-895-54095
Circle 1096 on Inquiry Card.

Xionics, Inc.:
4 Dollis Park
Finchley
London N3 1HG
44-81-346-0247
fax: 44-81-346-1447
Circle 1097 on Inquiry Card.

URUGUAY

Bull HN Information Systems, Inc.:
Ave. Luisa de Herrera
2802 Montevideo (R.O.U.)
598-2-819156
Circle 1077 on Inquiry Card.

YUGOSLAVIA

Bull HN Information Systems, Inc.:
Electronska Industrija
Honeywell
Masarikova 5/18
11000 Belgrade
38-11-684888
Circle 1077 on Inquiry Card.

Flagstaff Engineering:
Boman ZG
D. Cesarica 17
Zagreb 41000
38-752394
fax: 38-412-50321
Circle 1080 on Inquiry Card.

Wang Laboratories, Inc.:
Astra
41000 Zagreb
Gajeva 5
38-41-427145
fax: 38-41-426070
Circle 1095 on Inquiry Card.

Inclusion in the resource guide should not be taken as a BYTE endorsement or recommendation. Likewise, omission from the guide should not be taken negatively. The information here was believed to be accurate at the time of writing, but BYTE cannot be responsible for omissions, errors, or changes that occur after compilation of the guide.

GREY MATTER

2 Prigg Meadow, Ashburton, Devon TQ13 7DF

TEL. (0364) 53499

GREY MATTER

2 Prigg Meadow, Ashburton, Devon TQ13 7DF

TEL. (0364) 53499

Reach Over 130,000 Buyers!

BYTE Gives You Buyers *Today* for the Europe of *Tomorrow*

BYTE's Pan-European/International Section is a special advertising and editorial section bound into all copies of BYTE that are distributed outside of North America. *The editorial focuses exclusively on the latest computer products available in Europe making this section—including the advertisements—extremely well-read among the European buyers!*

The European Computer Market is One of the Fastest Growing Computer Markets in the World!

In fact, behind the U.S., it's the largest microcomputer market in the world! Not to mention that by 1992, trade restrictions will be removed within the European Community resulting in unprecedented activity and expansion. *Consider that, unit shipments of PCs in Western Europe are expected to increase by 17% in 1991 over 1990 shipments!*

And, More Europeans Read BYTE Than any Other Pan-European Computer Magazine!

BYTE's paid circulation outside of North America has doubled in the past five years bringing the total to an impressive **134,763.**

- BYTE's European paid circulation alone has grown to over **95,000.**
- BYTE is read and passed along to three additional readers, resulting in a total Pan-European readership of **525,575!**

BYTE Covers All the Bases in Europe, Consider the Options!

- *Advertisements in the Pan-European/International Section,* reaching a total audience of **525,575** European buyers!
- *International Direct Response Postcard Section*—bound into the Pan-European/International Section, these postcards give advanced business buyers direct access to retrieve information on your products.
- *BYTE EURO-DECK*—the first computer postcard deck targeted exclusively to **50,000** European computer professionals.

BYTE is Your Global Tie to the Expanding Pan-European/International Computer Arena!

International
Uwe Kretzschmar, European Advertising and Marketing Manager, 44 81 545 6268
England: Roz Weyman, 44 81 545 6269
Germany: Uwe Kretzschmar, 44 81 545 6268
France: Zena Coupé, 44 71 281 4116
Italy: Amanda Blaskett, 44 71 281 4116
The Netherlands: Ellen Pardede, 31 34 02 49496
Sweden: Media Marketing AB, 46 8 301280
Japan: Masaki Mori, 81 33 581 9811
Taiwan: Summer Chien, Acer TWP, 886 2 713 6959
Israel: Dan Ehrlich Communications, Ltd. (972) 3 449823
Hong Kong: Steven Marcopoto, Seavex, Ltd., 852 868 2010
Republic of Singapore: Jocelyn Domingo, Seavex Ltd., 65 734 9790
Korea: Jeong-Gwon Seo, Doobee International Ltd., 82 2 776 2096
Domestic
Ellen Perham, (603) 924-2598
Jim Bail, (603) 924-2533

Call Your Local Sales Representative Today!

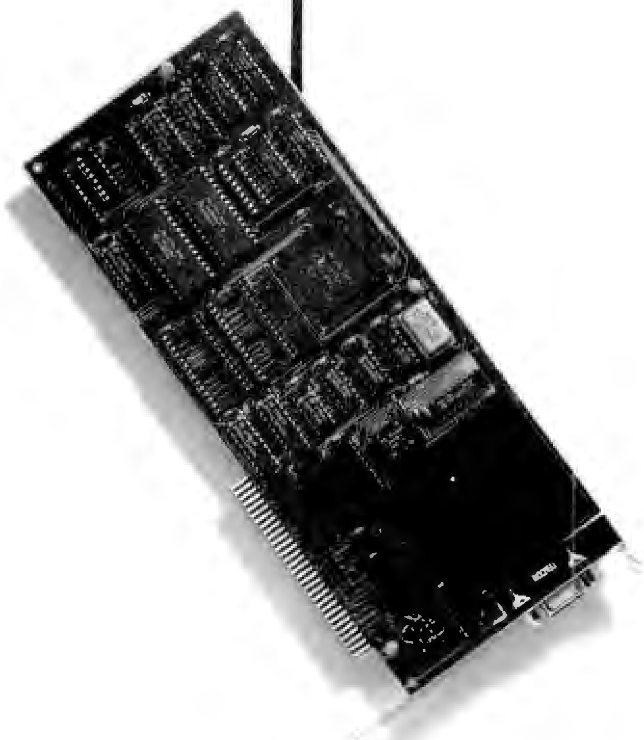
BYTE
Technically Advanced
Business Buyers Setting
Product and Technology
Standards for the 90s

Circle 415 on Inquiry Card.

Circle 436 on Inquiry Card (RESELLERS: 437).

LAN'S IN, SNEAKERS' OUT.

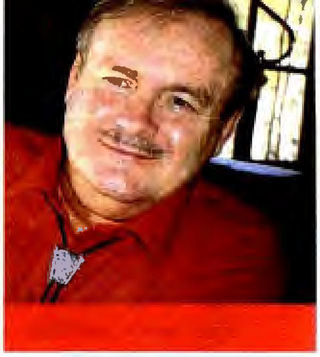
You've been connecting your computers by sneakers for years. Now you can say good bye to them. Because at Digitech, Lan Business, Fax Lan, and high speed modems are offered at a low price and unbelieveable performance, especially the V.32bis modem. That's why it's time to get rid off your sneakers and plug in Digitech. With Digitech, the world seems being shrinked.



DIGITECH COMPUTER CO., LTD.

3 FL., NO. 2, HSIN SHENG S. RD. SEC. 2,
TAIPEI 10618, TAIWAN, R.O.C.
CABLE: "DIGITEC" TAIPEI
TEL: 886-2-321-7001
FAX: 886-2-394-4680
TLX: 24886 DIGITEC
ATTN: DIGITECH

Circle 428 on Inquiry Card.



JERRY
POURNELLE

USER'S CHOICE AWARDS

It's the end of the year, meaning that it's time for the annual User's Column Orchid and Onion Parade, Awards, and Trend Analysis. I know: everyone else did their end-of-year stuff months ago. It happens that I believe a year ends on December 31, not back in October in time for the January issue. So it goes.

A lot of things happened in 1990. The i486 chip became more commonly available, and there was some movement in pricing on the 386. The 386 instruction set is the wave of the future, and this is a healthy trend.

Windows 3.0 showed what Windows will be like once they get it done properly. Apple dropped Mac prices and put it into the mainstream. MS-DOS 5.0 went out to beta testers, and DR DOS 5.0 is shipping. These are all important events because they bring some healthy competition in the part of the industry that most needs better technology: the development environment. We don't really care what our operating system costs (within reason), since we buy it only once; the more it supports software developers, however, the less we'll pay for applications software; money spent on a good operating system is an investment in keeping total computer costs down. Of course, it won't hurt if the operating system is easy to use....

Lotus won an important lawsuit, and Ashton-Tate lost one. Memory prices quietly fell to where they'd been before the U.S. government decided to "help" us with a trade agreement. Alas, there was no break in the unrelenting war the FCC wages on lower prices and start-up companies. So it goes.

Programming languages got better, and Borland's object-oriented Turbo Pascal showed there can be objects for the rest of us—yes, even those who refuse to learn any variant of C. The trend toward powerful languages learnable by users continues.

Two Cheers

With all that and more happening, it's no easy task deciding where to begin, but I'll open with a new feature: the Two Cheers list. I leave it to you to imagine what kind of cheers I have in mind.

Two Cheers to John Sculley for keeping Apple prices high all these years, and thus ensuring the instant success of Windows 3.0. Without Apple's untiring efforts to keep up prices, Microsoft wouldn't have had to come up with a graphical user interface for the rest of us, and they wouldn't have been able to sell the one they did develop.

Two Cheers to Ashton-Tate for getting a sensible judgment in a look-and-feel case. It may not have been quite the judgment they were looking for, but the effect on the industry will be good. Congratulations.

Two Cheers to Symantec for fixing Norton Utilities 4.5 when it wasn't broke. Norton Utilities 5.0 has some new and valuable features, but it leaves out some of the most used utilities of the old version. Also, Two Cheers for Norton Safe Format: we all use it, we all need it, but why couldn't it let us tell it to blast away instead of endlessly analyzing the disk information we don't want anymore?

Jerry hands out his awards for the best products of 1990 in a variety of categories

Two Cheers to TurboTax, who make a product that people swear by, but managed to ship copies missing a critical file just before tax time last year....

Two Cheers to whoever at Microsoft reads bug reports. If you send a bug report fax, they'll read it, but it can take as long as two months.

Another Two Cheers to Microsoft: they're busily adding features to MS-DOS and Windows, when they're at the ragged edge of being able to support what they already make. What will they do, hire more support people? They already account for some incredible percentage of the phone calls to Washington state.

And finally, Two Cheers to Prodigy, whose ads have got a lot of people using on-line services, but whose policies then sent great numbers of subscribers to all the *other* electronic information utilities. What the heck, the more people on-line, the better....

Three Cheers with Orchid

Three Cheers and an orchid to Mouse Systems for adding high-order IRQ interrupts to their bus mouse card. It won't matter to 8-bit system users, but a lot of us 286 and 386 users are running out of interrupts; Mouse Systems mice can be set to IRQ 15 or even a higher number, and thus won't interfere with scanners and serial ports.

Three cheers to LANtastic: Artisoft sells a network, not a religion. And it installs easily and works.

A big orchid to Bill Gates, who pioneered the fight to get CD-ROM technology out into the industry and stuck it out when Philips and others tried to rain on his picnic. This is the year CD-ROM came of age, and it wouldn't have happened without Bill's investment of time and energy. I hope Microsoft's Bookshelf makes a bundle; it deserves to.

A small orchid to Commodore, who continue work on the new operating system for the Amiga. If the Amiga got half the support the hardware deserves, it would be a formidable competitor in the business world.

A large orchid to Hewlett-Packard for the LaserJet IIp, the laser printer for the rest of us. If it's as rugged as my ancient LaserJet I Plus (the Printer That Will Not Die), the IIp will be around in the next millennium.

An Onion Parade

A large generic onion to all the companies that don't pay any attention to their Install software. I get very weary of having to fight installation programs. As an example, we recently set up a Gateway 2000 386 (a good solid machine) and decided to equip it with a Logitech TrackMan Trackball.

The trackball works fine, and the control software is excellent, but the software comes on a 3½-inch floppy disk and will install only from the A drive. Since the Gateway 386 has a 5¼-inch drive A and a 3½-inch drive B, trying to install from B produces a disk selection error. Sure, there are ways around that—for that matter, the program isn't copy-protected, so you can simply make a 5¼-inch installation disk—but why should we have to?

Logitech gets only a small onion because TrackMan is a pretty nifty device. I find, to my surprise, that I prefer mice to trackballs; but for those who don't, TrackMan is a good choice, unless you are left-handed: unlike Rollermouse (which is also a good trackball, but much larger than TrackMan), TrackMan is relentlessly right-handed.

One large onion goes to Acer for their "smelly" scratch-and-sniff ad; and a clove of garlic to the BYTE ad salesperson who accepted that dumb thing.

A fair-size onion to Jensen & Partners International, who thought it might be interesting to turn Modula-2 into C. The old JPI compiler was pretty good; the new one borders on the absurd.

There were the traditional nominations of a small onion for BYTE's subscription department, but the good news is that they're getting it under control. Maybe next year I can leave this one off. I haven't had a complaint about BYTE subscription services being really *awful* in six months. . . .

The Big Onion

And the Onion of the Year, with Garlic Clusters, goes to Special Agent Tim Foley of the Chicago office of the U.S. Secret Service. While I have good reason to know that many Secret Service people are conscientious and highly competent, Mr. Foley's actions in Austin, Texas, regarding Steve Jackson Games not only exceeded his authority, but weren't even half competently done.

All told, a sorry chapter in the history of the Secret Service, and no service at all to those genuinely concerned with electronic fraud and computer crimes.

The Big Orchid

The Orchid of the Year goes to Mitch Kapor, for funding the Electronic Freedom Foundation and providing legal help and support to Steve Jackson, whose business was nearly ruined by the Secret Service in Austin. I hold no brief for electronic thieves and snoops, but many of last year's government actions were worse than the disease.

Thanks, Mitch, from all of us.

The Long List

A number of great products showed up at Chaos Manor last year. My goal has always been to think of a way to organize the annual User's Choice Awards, but I haven't been able to do that. I suppose it's appropriate that I do this chaotically.

Backup and Data Storage

First, in the category of data storage: Colorado Memory Systems tape units are low in cost, high in performance, and very reasonable in price. Installation is so simple I won't bother to describe it: just follow the directions. I used the DJ-10 120-megabyte tape unit to back up 48 MB from the Gateway 386: it took under 10 minutes. The Colorado Memory Systems tape units can be installed internally—they take up about the space of a half-height 3½-inch floppy disk drive—or externally.

In my case, the drive is mounted externally, with a controller in the Gateway 386 and another in a machine out back; this allows easy data transfer as well as backup. Alex has installed a lot of these for clients and never has any problems with them. The Colorado Memory Systems tape units win a User's Choice Award. Highly recommended.

Machine of the Year

There's always stiff competition for the "most useful" system at Chaos Manor. Certainly the most spectacular system, and winner of a User's Choice Award, is the Cheetah Gold 486. This machine is so fast it scares you. Larry Niven has been using it as his workstation as we pound out *Fallen Angels* and *The Moat Around Murcheson's Eye*, and sometimes when he saves a chapter, the Cheetah 486, working through a Perceptive Solutions, Inc. (PSI) HyperStore caching hard disk drive controller (more on that in a moment), saves the file so fast that Larry doesn't think it saved at all, and he does it again.

I named my Cheetah 386 Big Kat; with that name taken, I suppose I have to call the 486 Real Big Kat? In any event, we've beefed it up. The hard disk drive controller is by PSI, with 4 MB of cache on the controller; this gives such lightning performance that most benchmarks are meaningless. Let's just say that no matter what the task, including enormous AutoDesk Animator jobs, this system is spectacularly fast.

The only real rivals to PSI controllers come from Distributed Processing Technology; I've had a DPT SmartCache controller working in Big Kat for over two years without a glitch. This controller is solid and reliable and works with all the software we know of.

Both DPT and PSI get User's Choice Awards; but PSI gets the Best Controller

of the Year for their HyperStore. The deciding factor is that the PSI controllers use single in-line memory modules (SIMMs) for the caching memory; thus, you can buy the controller itself and shop around for more memory to fill it up. DPT controllers require their own proprietary add-on memory cards, which runs the cost up. Also, PSI controllers can be configured with their Mediadaptor board, a piggyback board that lets the controller function as ESDI, SCSI, or other. This makes it much easier to use the PSI controller with your older hardware.

As for machines, the workhorse I do nearly all my writing on—I'm using it now—remains Big Kat, my older Cheetah 386/25 with the DPT SmartCache, Priam hard disk drive, Video Seven VGA board, Northgate OmniKey Plus keyboard, Maximum Storage WORM (write once, read many times) drive, Zenith Flat Technology Monitor, and USRobotics Courier HST 9600-bps modem. It's powered through a Clary uninterruptible power supply. I'm running Quarterdeck QEMM-386 and Desqview under MS-DOS 3.3; I expect at some point I'll change over to MS-DOS 5.0 and Windows 3.1, but I feel no pressure to do that. This machine is clearly the "most useful" one at Chaos Manor, in that I make my living with it, and it certainly gets hard usage. On the other hand, it's hardly new.

The other candidates for machine of the year are the Cheetah 486, the Arche Legacy 386/33 (which is certainly the fastest 386 in the house), the Gateway 2000 386, the Ergo Brick, and a small GoldStar GS-310 386SX.

You can say something special about every one of those. Begin with the GoldStar GS-310. This small-footprint machine sells for less than many 286s. It's easy to add memory—it takes standard SIMMs—and it runs both Desqview and QEMM-386 just fine. My son Phillip has been using it as a kind of portable, carrying it to various colleges in support of his debate team, so it gets hard usage; and it has yet to develop any problems. I have no trouble giving this the Most Bang for the Buck User's Choice Award for 1990.

I've already described the Cheetah 486. It's certainly the fastest and most powerful machine in the house. If you need 486 power for AutoCAD or Unix, or if you just like big, powerful machinery, it's hard to beat the Cheetah 486, which collects yet another User's Choice Award.

The Arche Legacy 386/33 is another powerful machine. It has been used as a test-bed for a lot of stuff, including Sound Blaster, the Kraft Thunderstick game controller, and Wing Commander, as well as LANtastic network cards, Rollermouse, the Pioneer CD-ROM six-pack drive, and Colorado Memory Systems tape drives and controller. Everything works just fine. The video card for the Arche Legacy is quite fast; we're able to keep up with Wing Commander's spectacular graphics. The Arche Legacy has the neat feature of slowing down to 8 MHz if you want it to do so; with some games, that can come in handy. It runs Desqview, QEMM-386, and our beta-test copy of MS-DOS 5.0 with no problems. It's faster than Big Kat. I have absolutely no hesitation in giving the Arche Legacy 386/33 a User's Choice Award.

The Gateway 2000 386 is a lower-priced machine, but it's very well made. The standard hard disk drive controller is an Ultrastor Ultra 12 ESDI controller, which is faster and more reliable than the usual Western Digital controller. The Gateway comes with surprisingly complete and well-written documentation. We have it running with MS-DOS 5.0 with no problems. There's a built-in game port; I plugged the Kraft Thunderstick into that and turned on Wing Commander, and it all ran fine without any tuning or tweaking. The Gateway is a bit slower than the Arche Legacy, but it's plenty fast enough, and the VGA board doesn't seem to have much trouble keeping up with Wing Commander's spectacular graphics. There is no hardware switch to slow the Gateway 2000 down.

A number of companies are selling computers by mail. None of them are perfect: I have letters of complaint about most of them. But I don't have any about Gateway, and all the Gateway users I've heard from are happy. We used this machine as a test-bed for the US Video and Willow boards, California Memory Systems tape drives, TrackMan, ScanMan, and Maximum Storage WORM drive. There have been no problems. I have no hesitation in recommending the Gateway 2000 386, which gets a User's Choice Award.

Finally, there's the Ergo Brick, which I have written about several times. It's small, it fits into a briefcase, it holds a lot, and it's fast. It is now my regular companion when we go down to the beach house.

The only problem with the Brick is that you can put only short boards in it, and that's no real problem since the only board I think of to go in it is a fax board,

and the Fax 96 fits in there just fine.

The Brick isn't cheap, but you get a lot for the money. I'm really fond of the little sucker, and I don't have any problems at all giving it a User's Choice Award.

Cheetah recently raised their prices, and by quite a lot. The performance is magnificent, and the cost, while high, is competitive for that much performance. I do wish they cost less, but the Cheetah Gold 486 gets the Machine of the Year award in the PC category.

I have added a new award category because now that Apple has lowered prices, Macs have become competitive throughout the cost/performance spectrum; and what Macs do, they do very well indeed. The Machine of the Year Award for 1990 goes to the Mac IIcx; it has easily become the most useful Mac system here, being used with Excel and WingZ to control a number of business operations and analyses.

The neat part about the Mac systems is that as long as you stay with the standard operations (e.g., Excel, WingZ, and Microsoft Word), you really can sit a newcomer down at it, show what you need done, and go away. The User's Choice Award and Machine of the Year, Macintosh Category, go to the Mac IIcx.

Video and Monitors

Video boards and monitors are improving weekly. They're getting faster and more spectacular. You can expect even more rapid developments in video graphics this year.

Meanwhile, the most spectacular addition to the Chaos Manor visuals is a Number Nine Graphics Xccelerator. It's *not* a stand-alone board: you need a VGA board to run with it. The Number Nine board takes a separate slot and attaches to the VGA board—nearly any VGA board will do—with an edge-connector cable. (Some video boards feed out through a pin connector, in which case you'd need the appropriate cable to connect the video card to the Number Nine board.)

Once the board is installed and connected to your VGA card, you can set up the Number Nine board to run at 1280 by 1024 pixels noninterlaced, with a palette of some 16 million colors. Many other resolutions are possible. Whatever you are running with it tends to look spectacular.

We put the Number Nine board into the Cheetah 486, where it happily runs AutoDesk Animator and a whole bunch of fractal software. The Number Nine board feeds into the Hitachi Accuvue 20-APF monitor (this is why Niven is using the Cheetah 486 as his workstation: he likes really big monitors because he doesn't have to wear his glasses to work with them). The combination is something to see. If this is where graphics are headed, I can't wait to get there.

If you're looking for high-end graphics capability, the Number Nine Graphics Xccelerator is a great way to go, and it looks great on a Hitachi 20-inch high-resolution monitor. Both Hitachi and Number Nine Computer get User's Choice Awards, and the Number Nine board is the choice for Graphics Product of the Year.

One last point: clearly not everyone will need to have a 20-inch high-resolution monitor costing more than they paid for their computer. My personal monitor remains the Zenith Flat Technology Monitor: the newest model isn't as heavy as the older ones and doesn't need a fan. The Zenith is a 31-kHz monitor, not a

Circle 275 on Inquiry Card.

multisync, and while it works with most video boards, there are a few that it can't work with.

We use a lot of monitors around Chaos Manor; machines often arrive without one. When that happens, the "standard" I generally hook up is the Princeton Graphic Systems Ultra-14 multisync monitor. Princeton monitors work with just about everything. They're rugged, they have good color, and they're very good value for the money.

A Significant Trend

I think one outstanding development for the year was one that no one else seems to have noticed at all: Hitachi is shipping a really fast CD-ROM drive, the CDR-1700S. That's important because CD-ROMs are becoming increasingly important. A couple of months ago I said that I wished every library in the country had a CD-ROM drive. A reader wrote to tell me that's very nearly true already: libraries are taking to CD-ROMs, which I suppose shouldn't surprise me.

Meanwhile, Dak and other quality high-tech mail-order houses are selling CD-ROM discs and drives direct to consumers; this in itself will raise the installed base.

CD-ROM technology won't be completely mature until the drives are both cheaper and faster, and some kind of easily portable reader screen is available. When it's as convenient to carry a CD-ROM reader as it is to carry a book—even a large hardbound—the book industry will really feel the impact of CD-ROM competition.

The screen hasn't been developed, although I understand that they now sell the Sony Bookman in Japan, which is getting closer to a real hand-held CD-ROM reader. No matter: long before we have portable CD-ROM readers, CD-ROM itself will have had a really significant impact on scholarship. Imagine, for example, exact and computer-enhanced images of the Dead Sea Scrolls taken in different light and contrast conditions and published on CD-ROM. This would give any scholar access to the primary documents: the entire cost of a high-resolution imaging system plus CD-ROM drive wouldn't come to more than the cost of a short trip to Jerusalem to view the documents themselves.

The same could be done for other rare documents and images. In addition, every word ever published on the subject could be indexed and included with the images—and the total production cost of the package would be a few dollars per disc. There's enormous potential for CD-ROMs in scholarship and business.

Hitachi's faster and cheaper drive will significantly increase the number of people using CD-ROM because it's easier to use; no more long waits for your data. As the installed base of CD-ROM drives grows, so will the effort put into making CD-ROM software. The result should be a satisfying positive feedback. When you couple fast drives with better retrieval software and new advances in the art of making CD-ROMs, you have the ingredients of a new phase in the computer revolution.

Hitachi makes (at least) two models of CD-ROM drives: one is shaped like a small shoe box, but, while faster than the older drive, it is no breakthrough. The other is shaped like a pizza box and is extremely fast. The pizza box model, alas, requires you to use one of those horrible jewel-box carriers for your CD-ROM. I really hate those carriers because not only are they expensive—several dollars at least—but about half the time they're extremely hard to open.

To get more information on the CD-ROM revolution, get yourself a copy of the catalog of the Bureau of Electronic Publishing (141 New Rd., Parsippany, NJ 07054, (201) 808-2700). The catalog is an education in itself: you won't believe just how many CD-ROM products there are already.

Because I think the rapidly expanding installed base of CD-ROM drives is extremely significant, and that speeding up the CD-ROM reading process will do much for the industry, the Product of the Year Award goes to Hitachi for their fast CDR-1700S CD-ROM drive.

CD-ROMs

There were a number of outstanding CD-ROM products last year. Quanta Press (2550 University Ave. W, Suite 245N, St. Paul, MN 55114, (612) 641-0714) continues to pump out an amazing variety of CD-ROM databases, including the CIA World Database, specialized stuff on agriculture, and so on. Their latest is Middle East Diary, a CD-ROM on the Middle East containing a great number of relevant documents on the history and culture of the area. The Bureau of Electronic Publishing put out a collection of documents, some rare, all interesting, on U.S. history. Grolier has improved their Academic American Encyclopedia.

There's also World Library's Library of the Future Series, First Edition. This one has a great collection of 450 books—all classic and most in the public domain, but an interesting set—and better-than-adequate retrieval software. When I started playing around with it, I found myself reading Samuel Butler's *The Way of All Flesh* until quite late into the night.

Not only that, but I went back to it rather than going to the bookstore and getting a copy, which tells me that they've made this easier to use than I thought it was. Library of the Future Series wins the User's Choice Award as CD-ROM of the Year.

The Software Scene

As I said above, I have mixed emotions about Norton Utilities. Version 4.5 was extremely valuable. Norton Utilities 5.0 did have a few improvements, but it left out some of what made version 4.5 so useful. I gather Symantec is fixing that now. Let's hope so.

On the other hand, if you have a Mac, you need Norton Utilities Mac. It's what Mac users have been needing for years, even if they didn't know it. Back on the PC scene, the latest version of Norton Commander has an imperfect, but very usable, MCI Mail management front end and several improvements.

I use Norton Commander and Norton Utilities a lot; indeed, I routinely install these, along with LapLink from Traveling Software, before I begin testing any new machine. If you don't have them, get them. Highly recommended.

A candidate for best software is Outside In. This is an extremely useful TSR program that lets you look into disk files of most popular word processors, spreadsheets, and databases (alas, Paradox and Q&A are not supported, although Q&A Write is, as are dBASE, FoxBase, Microsoft Works, and several others). It runs on a PC and works with both PC and Mac files. You can import stuff from your files into your word processor. This is one of those programs that once you have it, you'll wonder how you did without it. Definitely a User's Choice Award. Recommended.

One of the neatest programs of the year is Grammatik IV, the style and grammar checker. It's configurable, you can turn different rules on and off, and it works. I don't put everything that I write through it, but when I'm in a hurry, I find it valuable; it often finds errors I've missed. Grammatik IV won't teach an illiterate to be a professional writer, but it's amazing how much you can learn by using it. User's Choice. Recommended.

The two most valuable products I got this year were GrandView 2.0 and Info Select. That latter is the "improved" version of the Tornado free-form database; once again, some of the improvements weren't.

On the other hand, Info Select can save you a great deal of time, and it's a program you will actually *use* because using it is pretty simple. You do have to spend some time puttering around, but go ahead and do that: it's fun, and the best way to learn Info Select features.

GrandView, for those few who don't know, is Symantec's outline program. It works. I have GrandView outlines on my portables, and when we're at the beach house, I often retrieve an outline for character collection. GrandView can import and export to most word processors, although the results are likely to be a bit messy; the outline formatting gets in the way of conversion of the text. But that doesn't even matter. I'm pleased to give GrandView and Info Select the User's Choice Awards for Most Useful PC Software of the Year.

Accounting

I currently recommend Quicken for accounting. This is one of the few cases where I recommend something that I do not use: I still use the accounting package that I wrote back in CP/M days, largely for sentimental reasons, but of course I understand how it works. I don't recommend that anyone else try it.

Get Quicken. It's easy to set up, it does the job, and you can arrange to have it pay your bills through a modem. I know a number of people who do it that way, and I intend to set up that capability Real Soon Now. If I'd had Quicken, I wouldn't have bothered to write my own program. Quicken gets a User's Choice Award. Recommended.

Laptops

There were many new laptops in 1990, and I expect more this year. I used about 20 laptops in 1990 and find myself in agreement with the BYTE editors: the User's Choice Award for Laptop of the Year is the Texas Instruments TravelMate 2000 LT286. Fair warning: it is *not* the laptop to take outside on the beach at noon; under those circumstances, you won't be able to see the screen. Otherwise, though, the screen is quite visible, the power requirements are reasonable, and it's *light*. I like it.

Gadget of the Year

There wasn't any contest on this one.

Several years ago, Stefan Possony, Francis X. Kane, and I wrote a book called *The Strategy of Technology*. Colonel Kane was at that time Director of Plans for USAF Systems Division. One of the strategic concepts he developed and got started was GPS, the Global Positioning System: a series of navigation satellites that enabled those with suitable equipment to locate themselves within a few feet anywhere in the world.

The entire series of GPS satellites isn't up, but there are enough, and now comes

ITEMS DISCUSSED

Accuvue 20-APF $3545
Hitachi America, Ltd.
Office Automation
Systems Division
6 Summit Ave.
Montvale, NJ 07645
(201) 573-0774
fax: (201) 573-7660
Circle 1149 on Inquiry Card.

All ChargeCard...........$299
Mounting Adapter Kit ... $50
All Computers, Inc.
1220 Yonge St.
Toronto, Ontario,
Canada M4T 1W1
(800) 627-4825
(416) 960-0111
in U.S.: (216) 564-7875
fax: (416) 960-5426
Circle 1150 on Inquiry Card.

Amiga 3000 .... $4999
Commodore Business
Machines, Inc.
Computer Systems Division
1200 Wilson Dr.
Brandywine Industrial Park
West Chester, PA 19380
(215) 431-9100
fax: (215) 431-9156
Circle 1151 on Inquiry Card.

Arche Legacy 386/33... $5195
Arche Technologies, Inc.
48881 Kato Rd.
Fremont, CA 94539
(800) 422-4674
(415) 623-8100
fax: (415) 683-6754
Circle 1152 on Inquiry Card.

CDR-1700S.................$995
Hitachi Home Electronics
America, Inc.
Multimedia Systems Division
401 West Artesia Blvd.
Compton, CA 90220
(213) 537-8383
fax: (213) 515-6223
Circle 1153 on Inquiry Card.

Cheetah Gold 486 ....$10,629
Cheetah International
7075 Flying Cloud Dr.
Eden Prairie, MN 55344
(800) 243-3824
(612) 943-8690
Circle 1154 on Inquiry Card.

DJ-10........................$399
Colorado Memory Systems,
Inc.
800 South Taft Ave.
Loveland, CO 80537
(800) 346-9881
(303) 669-8000
fax: (303) 669-0401
Circle 1155 on Inquiry Card.

Ergo Brick $2495
Ergo Computing, Inc.
One Intercontinental Way
Peabody, MA 01960
(800) 633-1925
(508) 535-7510
fax: (800) 535-7512
Circle 1156 on Inquiry Card.

Grammatik IV $99
Grammatik IV for Windows..................... $99
Reference Software, Inc.
330 Townsend St., Suite 123
San Francisco, CA 94107
(800) 872-9933
(415) 541-0222
fax: (415) 541-0509
Circle 1157 on Inquiry Card.

GrandView 2.0............$295
Symantec Corp.
10201 Torre Ave.
Cupertino, CA 95014
(800) 441-7234
(408) 253-9600
fax: (408) 252-4694
Circle 1158 on Inquiry Card.

Graphics Xccelerator ....$895 to $2495
Number Nine Computer
Corp.
725 Concord Ave.
Cambridge, MA 02138
(800) 438-6463
(617) 492-0999
fax: (617) 864-9329
Circle 1159 on Inquiry Card.

GS-310 .... $1595
GoldStar Technology, Inc.
3003 North First St.
San Jose, CA 95134
(408) 432-1331
fax: (408) 954-1143
Circle 1160 on Inquiry Card.

HyperStore 1600......... $900
configuration modules ..$275 to $400
Perceptive Solutions, Inc.
2700 Flora St.
Dallas, TX 75201
(800) 486-3278
(214) 954-1774
Circle 1161 on Inquiry Card.

Info Select............... $99.95
Micro Logic Corp.
P.O. Box 70
Hackensack, NJ 07602
(800) 342-5930
(201) 342-6518
fax: (201) 342-0370
Circle 1162 on Inquiry Card.

the Magellan GPS NAV 1000 Pro to let all of us use the system. The Magellan is a hand-held, battery-powered gizmo considerably smaller than a shoe box. You use it by taking it outside, where it can see some satellites, and turning it on. It's nearly that simple: there are good instructions in the Training Guide, and more instructions are on the unit itself.

Once it has been set up, it will tell you where you are to within some 30 feet. It's a bit faster if you already know your altitude; if you don't, Magellan will find that for you, too. The unit comes with an auxiliary power source and software and cabling to let you use it with your laptop.

Magellan is the User's Choice Award Gadget of the Year.

Keep Them Flying

I don't know what category to put this in: All Computers' All ChargeCards will put new 386SX life into your old 286 machines. They work with nearly anything, including the Zenith Z-248; one of my old friends from ARPANET has used these to update about 50 of the government-model Z-248s and is very happy with them.

You probably don't have that many machines, but if you've got an AT and want to run Windows or Desqview, get the appropriate All ChargeCard for your machine; you won't be sorry. The All ChargeCard gets a User's Choice Award. Recommended.

Games

It was a good year for computer games. Two notable ones were Lucas Films' Secret of Monkey Island, which is both fun and hilarious, and Interplay Productions' Lord of the Rings, which has flaws but is well designed and can be fun. Centurion, Defender of Rome, from Electronic Arts is great fun, if a bit disappointing overall.

Koei improved their largely script adventure games and took the odious copy protection off. Koei games require a bit of patience: you won't win quickly, but there's considerable satisfaction in doing it. Harpoon from Microprose Software was easily the best modern war game of the year.

It was a good year for game equipment, too. We put a Sound Blaster sound board into the Arche Legacy 386/33, and the Ad Lib sound board into the Cheetah 486, and hung a pair of Radio Shack stereo speakers on each board. There's a lot of software that can take advantage of good speech and sound boards, and they enhance the fun of computer gaming.

With all that said, despite the general excellence of the games this year, there

ITEMS DISCUSSED

LANtastic 3.2
starter kits......$525 to $899
extra adapter cards......$249 to $399
Artisoft, Inc.
Artisoft Plaza
575 East River Rd.
Tucson, AZ 85704
(602) 293-6363
fax: (602) 293-8065
Circle 1163 on Inquiry Card.

LaserJet IIP $1495
Hewlett-Packard Co.
19310 Pruneridge Ave.
Cupertino, CA 95014
(800) 752-0900
(408) 725-8900
Circle 1164 on Inquiry Card.

Library of the Future Series, First Edition CD-ROM $695
World Library, Inc.
12914 Haster St.
Garden Grove, CA 92640
(800) 443-0238
(714) 748-7197
fax: (714) 748-7198
Circle 1165 on Inquiry Card.

Mac IIcx $4669
Apple Computer, Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(408) 996-1010
Circle 1166 on Inquiry Card.

Magellan GPS NAV 1000 Pro $3750
Magellan Systems Corp.
260 East Huntington Dr.
Monrovia, CA 91016
(818) 358-2363
Circle 1167 on Inquiry Card.

Modula-2
standard version.........$199
extended version.........$395
Jensen & Partners International, Inc.
1101 San Antonio Rd., Suite 301
Mountain View, CA 94043
(800) 543-5202
(415) 967-3200
fax: (415) 967-3288
Circle 1168 on Inquiry Card.

Outside In................... $99
network version..........$295
Systems Compatibility Corp.
401 North Wabash, Suite 600
Chicago, IL 60611
(800) 333-1395
(312) 329-0700
fax: (312) 670-0820
Circle 1169 on Inquiry Card.

PC Mouse III..........$149.95
Mouse Systems Corp.
47505 Seabridge Dr.
Fremont, CA 94583
(415) 656-1117
Circle 1170 on Inquiry Card.

Quicken 4.0 .... $59.95
Intuit
155 Linfield Ave.
Menlo Park, CA 94025
(800) 624-8742
(415) 322-0573
fax: (415) 322-1597
Circle 1171 on Inquiry Card.

Railroad Tycoon....... $59.95
Microprose Software
180 Lakefront Dr.
Hunt Valley, MD 21030
(800) 879-7529
(301) 771-1151
Circle 1172 on Inquiry Card.

SmartCache Model PM3011/70............... $1150
Distributed Processing Technology
132 Candace Dr.
P.O. Box 1864
Maitland, FL 32751
(407) 830-5522
fax: (407) 260-5366
Circle 1173 on Inquiry Card.

33-MHz 386 VGA....... $3195
Gateway 2000
610 Gateway Dr.
North Sioux City, SD 57049
(800) 523-2000
(605) 232-2000
fax: (605) 232-2023
Circle 1174 on Inquiry Card.

TrackMan Trackball
serial version.............$139
bus version $149
Logitech, Inc.
6505 Kaiser Dr.
Fremont, CA 94555
(800) 231-7717
(415) 795-8500
fax: (415) 792-8901
Circle 1175 on Inquiry Card.

TravelMate 2000 LT286 .... $3999
Texas Instruments, Inc.
P.O. Box 2022230
Austin, TX 78720
(800) 527-3500
Circle 1176 on Inquiry Card.

Wing Commander $69.95
Origin Software
110 Wild Basin, Suite 330
Austin, TX 78746
(800) 999-4939
(512) 328-0282
Circle 1177 on Inquiry Card.

wasn't much dispute over which ones are the games of the year. There are two: one, Microprose's Railroad Tycoon, is the next best thing to having a wonderful set of electric trains.

The other outstanding game is Wing Commander from Origin Software. This is the kind of game I generally don't like: it's a shoot-'em-up in space. However, they've got the story line down pat, and the game sucks you right into the action; once you start playing, you find—or at least I found—the darn thing irresistible.

Both these games can be played on EGA systems with standard IBM sounds, but that's not the way to enjoy them. For Wing Commander, get a Sound Blaster: it comes with a game control port, and I guarantee you will get a joystick if you get hooked. For Railroad Tycoon, either Sound Blaster or Ad Lib will do fine. You will also want to have VGA, and Wing Commander can take advantage of EMS memory.

Wing Commander and Railroad Tycoon tie for Game of the Year. I still play them both.

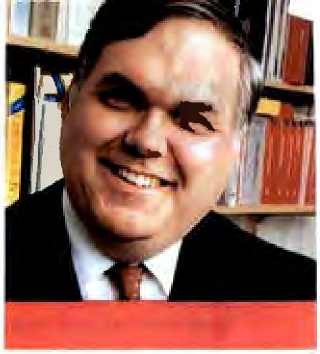
Winding Down

The book of the month is a new translation of *The Iliad* by Robert Fagles. I don't read Greek, but it's clear to me this is what Homer had in mind. It reads like—well, like a highly entertaining epic.

The computer book of the month is Bob Brant's *Build Your Own Macintosh and Save a Bundle* (Windcrest Tab Books). I once swore I'd never review another Tab book because of the horrible editing, but clearly the company has changed since being bought by McGraw-Hill. Brant's book is definitely worth having whether you contemplate building your own Mac or not, since it will also help you understand and maintain the machine. It goes into everything from the Mac Plus to the IIfx; accelerators; add-ons, including video; and more. Well written and easy to read.

Now back to work: Niven and I will finish *Fallen Angels* this week. ■

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 "jerryp."



WAYNE RASH JR.

WINDOWS AND THE BUSINESS WORKSTATION

There was once a time when picking out a computer for your business was relatively easy. You went down to the computer store and looked at all the machines on display. If you were lucky, the computer salesperson would show up to keep you company and tell tall tales. Eventually, your decision came down to how big you wanted the hard disk drive to be and whether you wanted a color monitor. For a while, at least, IBM-compatible computers were true commodity items.

Now, things have changed. While many machines can still be looked on as generic clones, the commodity nature of the computer business has been changed forever with the advent of graphical user interfaces. GUI packages require significant system resources, and the level and selection of resources depends heavily on the applications for which you plan to use the computer. It makes a great difference whether you use a machine for word processing or for massive spreadsheets and multitasking.

So what do GUIs demand of today's business workstation? Assuming that you're planning to use Microsoft Windows 3.0, and that you plan to use several applications concurrently, you'll need a large hard disk drive and a lot of memory. But that's not all.

Workstation for Windows

Here's how I have a Gateway 2000 386/25 configured for use as a platform for both networking and for Windows 3.0: 4 megabytes of RAM, a 150-MB ESDI hard disk drive, a Super VGA video controller, an 80387 math coprocessor, and a 3Com 3C503 Ethernet card.

A high-end machine? You bet, but I do a lot of multitasking, and the workstation must also communicate with Novell NetWare 386. Some users could do just fine with a 386SX-based machine if their multitasking needs were more limited. Still others could use a less-expensive 286-based machine, but they'd lose the ability to multitask DOS applications.

In general, the requirements for a useful workstation have changed greatly over the last few years. Where once a 640K-byte, 8088-based machine was fine, the advent of Windows 3.0 makes a 386- or 386SX-based machine more useful. Keep in mind, though, that the useful economic life of a personal computer is only three years, and the useful hardware life is about five years. For that reason, there's no point in worrying about requirements that might crop up more than a couple of years hence. The reason for this is that most companies amortize their computer purchases over three years, which is reasonable given the rate of change in the industry. For some companies, it takes five years to depreciate hardware, and by then most computers are only marginally useful if they are running at all.

A couple of the items on my standard Windows workstation aren't strictly necessary for all Windows users. One is the math coprocessor, but I'm using that in support of some graphics packages that I'll be telling you about in a few months. Meanwhile, a few other packages, such as Microsoft's Excel 3.0, also take advantage of the math coprocessor. Likewise, a hard disk drive as large as 150 MB may be overkill for some users, but many of today's applications, especially those intended for Windows, use many megabytes of hard disk space. Extra space costs relatively little, and you'd be surprised at how fast it can disappear.

GUIs such as Windows 3.0 complicate PC purchase decisions

One of the other facts that I've found in the months since Windows 3.0 was shipped is that the number of applications supporting Windows has increased dramatically. This was highlighted by the fact that I managed to fill up the entire 150-MB hard disk on the Gateway 2000 almost as soon as I began installing Windows-related software. The disk space on the file server offered some relief, but that's starting to fill up, too.

In some cases, the surge in applications designed for Windows has meant that the learning curve for users is less steep than it once was. Many applications use similar actions to create similar results, although the environment is not nearly as standardized as you would find on the Macintosh, for example. On the other hand, many applications work fine in a Windows environment but do not use the Windows interface. In many of these applications, the use of the software under Windows may cost you some utility. I have found, for example, that WordPerfect 5.1 cannot find the mouse when used under Windows.

Problems with Windows

When I wrote about some of the problems with Windows in the BYTE *IBM Special Edition* last fall, some readers took issue with my statements. This caused me to check more carefully, but in the process I found that problems were more widespread than I had previously suspected. In short, Windows can be fairly fussy about its hardware environment, and it won't run on everything or work with software or hardware you might already be using. Also, some things about the Windows environment seem to stretch the limits of knowledge for many users.

Some machines, for example, simply won't run Windows 3.0 at all. There are a couple of IBM PC clones in the BYTE offices in Peterborough that won't run Windows, despite the combined efforts of the BYTE staff. To this day, senior editor Ken Sheldon has to take our word for the existence of Windows, since he is one of the unfortunates who has been assigned a non-Windows-capable computer. There was a time when I didn't think that Windows would run on the Gateway 2000, either. In that case, it turned out that the Windows driver for the ATI video card installed in the machine was defective. When I told Windows that the card was a generic VGA card, the problems disappeared, but not before I became convinced that Windows multitasking bordered on the mythical.

A Taxing Problem

Some things still escape precise description with Windows 3.0. On New Year's Day, for example, I spent a few minutes installing MacInTax for Windows from SoftView. This is an excellent package that I began using last year after a few years of using PC Tax Cut. One of the things you do with MacInTax for Windows is install a slew of those fonts the IRS loves. The fonts are required for MacInTax to work with the HP LaserJet III and compatibles. Once I saw that the fonts weren't all that hard to install, I went ahead and installed more soft fonts for the LaserJet that I had on hand. Finally, in a fit of font fiddling, I installed ZSoft's SoftType, which has yet more fonts for use with Windows.

Once I did this, MacInTax for Windows would no longer print properly. A once-perfect tax form would now show odd blank spaces in some places and superimposed text in others. I still don't know why it's doing this, although I suspect that I'll have to reinstall MacInTax for Windows to cure it. While normal users don't go through font orgies, the fact that installation of unrelated software can have an effect on a Windows package is something that users need to be aware of and to look for if results are not as anticipated.

Networking with Windows

Just when you think you have a handle on the Windows challenge, there's always the challenge of networking. Once I got the Gateway 2000 up and running reliably with Windows, Unisys sent me its latest i486-based computer. Included with the machine was yet another copy of Windows 3.0. Since I was eager to use this machine, and since I have a certain upper limit on the amount of machinery that I have space for, I decided almost immediately that I'd need to add both machines to the LAN if I expected to be

ITEMS DISCUSSED

Gateway 2000 386/25 .... $3195
Gateway 2000, Inc.
610 Gateway Dr.
North Sioux City, SD 57049
(800) 523-2000
(605) 232-2000
Circle 1222 on Inquiry Card.

MacInTax for Windows 3.0 ... $99
SoftView
1721 Pacific Ave., Suite 100
Oxnard, CA 93033
(800) 525-1065
(805) 385-5000
Circle 1223 on Inquiry Card.

Manifest $59.95
Quarterdeck Office Systems
150 Pico Blvd.
Santa Monica, CA 90405
(213) 392-9701
Circle 1224 on Inquiry Card.

NetWare 386 .... $7995
Novell, Inc.
122 East 1700 South
Provo, UT 84606
(800) 453-1267
(801) 379-5900
Circle 1225 on Inquiry Card.

3C503 .... $295
3Com Corp.
3165 Kifer Rd.
Santa Clara, CA 95052
(800) 638-3266
(408) 764-5000
Circle 1226 on Inquiry Card.

Unisys Personal Workstation 2 486/25 ......$10,795
Unisys Corp.
P.O. Box 500
Blue Bell, PA 19424
(215) 986-4011
Circle 1227 on Inquiry Card.

Windows 3.0 .... $149
Microsoft Corp.
1 Microsoft Way
Redmond, WA 98052
(206) 882-8080
Circle 1228 on Inquiry Card.

able to print on the LaserJet with them.

This meant that I'd have to find a way to make Windows 3.0 work on a networked computer, and that I'd have to do it in the 386 enhanced mode. As it turns out, networking with Windows is not always easy, and it's not even always possible. While I was able to add both the Unisys 486 and the Gateway 2000 to the LAN, I had to change to new network interface cards to do it. In some cases, even that's not enough.

The first thing I did was try using a Micom/InterLan 5010 Ethernet card that was already installed in the Gateway 2000. I never found the proper combination of I/O addresses and interrupts to let the machine work with Windows 3.0 and the other peripherals that were attached. Since 3Com had sent me some of its 3C503 Ethernet cards at about that time, I tried those instead. The default settings didn't produce any better luck than I had had with the card that it replaced. One important difference, though, is that the only setting on the card that I had to set with jumpers was the I/O address. Everything else was set with software, which made finding a usable combination much easier.

As it turned out, the default I/O address of 300 hexadecimal conflicts with many VGA cards, including those in both the Gateway 2000 and the Unisys. This doesn't seem to matter unless you're running Windows 3.0, which meant that I could use either Windows or the network, but not both. I solved the problem after asking for advice on BIX and doing a bit of sleuthing with Manifest from Quarterdeck Office Systems. I changed the jumper to a new I/O address, 2E0h, and told the NetWare shell to use IRQ5. After that, everything worked fine.

Unfortunately, all such solutions are not so easy. Many users of Token Ring cards, for example, have found that they have to tell Windows 3.0's memory manager to exclude large segments of memory. Even worse, users of some Northgate Slimline computers have found that there is no way to use ARCnet and Windows at the same time. Because these machines have their video card on the motherboard, and because of the way they handle memory, the Windows 3.0 memory manager is unable to resolve the conflicts between the requirements of ARCnet cards and the requirements of the video hardware. At this point, a solution short of buying a third-party video controller apparently doesn't exist. Most Northgate computers don't have this problem, nor do all the company's Slimline machines, but some of them do.

Once you have Windows 3.0 and the network running at the same time, you can switch between network resources and those on your workstation easily, for the most part, although there still can be surprises. For example, Windows displays each virtual disk drive on your network as if it were a real drive, and when you use the File Manager to switch to that drive, it reads the entire file server so that it can get you a picture of the directory. This is fine on some file servers, but as hard disk drive sizes grow, the time required for this increases, and while it's going on, there is a fair amount of disk activity on the server.

In extreme cases, the File Manager can use up a significant amount of time, such as when you're using a good-size VAX as a file server. If the VAX is heavily loaded and traffic is slow because of that, you can wait for several minutes while the File Manager tracks down the VAX's directory structure. The added disk activity, meanwhile, can also slow down access for other users, especially if the computer that you're using for your server isn't quite big enough for the job.

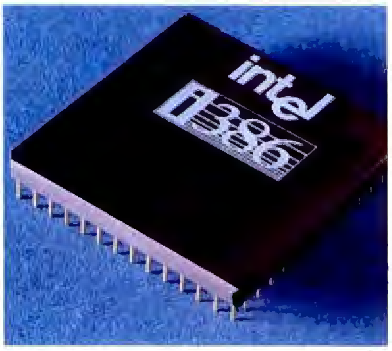
Despite the difficulties, the results can be rewarding for those who want to use Windows 3.0 in a networked environment. Keep in mind that you need to buy hardware that will support the needs of Windows, and you need to buy from a vendor that will offer adequate support. Part of this comes from making sure that all your requirements are met, rather than from simply buying whatever is cheapest or best known. Likewise, the solution to selecting the best workstation may take work and time, so be prepared for that as well. Finally, it all depends on clearly defining your requirements. That way, both you and the vendor will know what your goals are and will have a better chance of meeting them. ■

Wayne Rash Jr. is a contributing editor for BYTE and technical director of the Network Integration Group 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.

COMPUADD 333T: BEST
Look Inside the "Power User's Dream Machine"
PC Magazine, December 25, 1990
$2775
CompuAdd
Intel™ 33MHz 386 microprocessor, Phoenix BIOS, 64KB cache, math coprocessor socket (supports Intel 80387 or Weitek 3167)
Five half-height internal drive bays.
Four half-height front-access drive bays.
Parallel port and two serial ports built in to system board.
CompuAdd-exclusive "hot slot" designed for maximum performance with the CompuAdd HardCache ESDI controller.
Motherboard designed by CompuAdd engineers to stretch the 386 performance envelope with the optional high-speed SRAM card.
CompuAdd-exclusive "hot slot" designed to maximize performance with the CompuAdd Hi-Rez VGA card.
Room for up to 16MB DRAM on memory board.
FREE CompuAdd Windows 3.0, FREE CompuAdd MS-DOS 4.01 and FREE Microsoft Working Models preloaded on hard drive models.
FREE CompuAdd mouse
"The case features quality construction throughout." (PCM, 12/25/90)

CompuAdd's Hot Slots Boost 333T Performance



Look inside the CompuAdd 333T. You'll see what prompted *PC Magazine* to call it "a speed demon" and "a power user's dream machine" in its review of 45 leading 33MHz 386 computers.

You'll see **CompuAdd-exclusive "hot slots,"** two 16-bit expansion slots designed to maximize performance of the CompuAdd HardCache/ESDI controller card and the CompuAdd Hi-Rez VGA card. Each slot still works perfectly with a standard 16-bit expansion card, should you choose that option. And you'll see a motherboard designed by CompuAdd to take maximum advantage of the optional, ultra fast SRAM board.

Now, run the 333T. You'll see the speed that makes it the ***fastest 33MHz 386*** computer you can buy — as measured by top scores on *seven of nine* PC Labs benchmarks, including the 386 Instruction Mix Text. In its review, *PC Magazine* said the CompuAdd 333T "scored the best time in the group, or close to it, on every test we put it through, boasting the best overall performance in the field."

The CompuAdd 333T is the right choice when you need **full-scale multitasking capabilities** in either a reliable network file server or a powerful standalone workstation.

Compare the 333T. You'll see why *PC Magazine* praised its "top-notch expandability" and its "quality construction throughout," and why *PC Magazine* concluded that the 333T was the "best value in an intelligently designed PC."

You'll see that in value and performance, **the competition can't touch the CompuAdd 333T.** With the CompuAdd 333T at the heart of your network, you'll have the power, speed and expandability you need. Speed to keep your work flowing. Power to run today's — and tomorrow's — 32-bit software. Expandability to grow with your business. And the CompuAdd commitment to quality and service.

Call today for a CompuAdd value on the computer *PC Magazine* says "will be hard to beat at any reasonable price."

CompuAdd®

Customer driven, by design.

12303 Technology, Austin, Texas 78727

PC MAGAZINE
EDITORS' CHOICE
December 25 1990
CompuAdd 333T

CompuAdd 333T: Best Overall Performance

1990
- FINALIST -
PC Magazine Award
for Technical Excellence

PCS
CompuAdd 333 and 333T
CompuAdd Corp

CompuAdd 333T

The 333T is a proven winner, picked as Editors' Choice in *PC Magazine*, December 25, 1990! And picked as a finalist for *PC Magazine's* 1990 PC Technical Excellence award! It's the *fastest 33MHz 386 system you can buy* — as determined by top scores on seven of nine PC Labs benchmarks. In selecting the 333T as Editors' Choice, the editors credited the CompuAdd 333T with "the best overall performance in the field."

CompuAdd 333 Full Profile

The CompuAdd 333 Full Profile desktop system has the exact same performance as the 333T. Only the case is slimmed down. The Full Profile model sports three half-height front access and two half-height internal 5.25" drive bays, six 16-bit and one 8-bit expansion slots. So you have plenty of room to add extra drives and option cards.

Whether you use it as a network server or as a powerful standalone workstation for CAD/CAM, database management, spreadsheet applications or desktop publishing, the CompuAdd 333T or 333 gives you the fastest 32-bit computing power you can get in a 33MHz 386 system!

CompuAdd Value

CompuAdd built its reputation on giving you high performance computers at unbeatable values! Don't just take our word for it. An independent vendor-neutral survey of PC users asked people how satisfied they are with their PC purchases. *CompuAdd received the best endorsement any manufacturer could ask for* — CompuAdd ranked #1 for Value/Price, Quality, Commitment to the Customer and Overall Satisfaction!

The researchers did not use vendor-supplied customer lists. The independent, statistically valid survey ranked 25 leading PC manufacturers, including IBM, Compaq, Apple and Hewlett-Packard.

Call today for more details on CompuAdd's award-winning products and service!

CompuAdd 333T and 333FP Features

- 80386 microprocessor running at 33MHz
- 4MB DRAM expandable to 16MB
- 0 wait-state cache memory
- High-speed cache memory controller with 64KB SRAM cache
- 5.25" 1.2MB or 3.5" 1.44MB diskette drive
- Dual diskette controller
- Six 16-bit and one 8-bit expansion slots
- Four half-height front access and five half-height internal 5.25" drive bays (Full Profile has three half-height front access and two half-height internal 5.25" drive bays)
- One built-in parallel and two serial ports
- 80387 or Weitek 3167 math coprocessor socket
- *FREE* CompuAdd serial mouse *$24.95 value*
- *FREE* CompuAdd Windows 3.0 *$149 value*
- *FREE* Microsoft Working Models
- *FREE* CompuAdd MS-DOS 4.01 *$89 value*

CompuAdd 333T base system
$2775 - *66656*
CompuAdd 333 Full Profile base system $2595 - *66665*

Enhanced 333 systems upgrade base system features with: 150MB ESDI drive, CompuAdd HardCache/ESDI controller with 1MB RAM, 1024 x 768 color monitor, CompuAdd Hi-Rez VGA card with 512KB RAM and 640KB SRAM card.

CompuAdd Enhanced 333 Full Profile
$5395 - *66669*
CompuAdd Enhanced 333T
$5575 - *66660*

333 Monitor and Hard Drive Options

	MGA	CVGA
333T 80MB	66658 - $3575	66659 - $4055
333T 200MB	66661 - $3975	66662 - $4455
333 80MB	66667 - $3395	66668 - $3875
333 200MB	66670 - $3795	66671 - $4275

CompuAdd®
Customer driven, by design.

Call 800-456-6008 Key Code 814
Hours: Monday - Friday 7:00am to 9:00pm CST; Saturday 9:00am to 5:00pm CST
12303 Technology, Austin, Texas 78727

800-387-3266 *95-800-010-0401* *0800-373535* *0130-6009* *140-364-675*

Circle 67 on Inquiry Card.

ROUNDTABLE

B Y T E columnists, staff, and contributors debate the issues

WHITHER INNOVATION?

Roundtable is a forum in which BYTE editors, columnists, and contributors debate key issues that affect how you purchase and use hardware and software. The "conversations" take place on BIX.

DAVID FIEDLER
Contributing Editor

FRED LANGA
Editor in Chief

LARRY LOEB
Consulting Editor

TREVOR MARSHALL
Consulting Editor

STAN MIASTKOWSKI
Senior News Editor

JERRY POURNELLE
Senior Contributing Editor

WAYNE RASH JR.
Contributing Editor

KEN SHELDON
Senior Editor, Features

BEN SMITH
Technical Editor

KEN SHELDON: Looking back at the history of the personal computer, innovation sometimes came from large companies, which funded research through facilities such as the Xerox Palo Alto Research Center, but just as often it came from garage shop inventors (à la Jobs and Wozniak) who left large companies or who started their own companies (à la Gates). So where do people look for innovation today? Is it still possible for the mythical "little guy" to make a better mousetrap? Or do you have to be a highly funded company to make your mark now? What are the things stifling innovation? What can people do to encourage it?

JERRY POURNELLE: With better languages come better software. Today it is important to think of things for the computer to do and for the computer to do them well. With good enough languages, accountants can write accounting programs that are readable by other accountants, engineers can do engineering, and so forth. That trend is beginning to slowly emerge, but it has been much slower than I would have thought.

BEN SMITH: COBOL is still the best language for accountants. It was designed with the criteria that you mentioned, and it is definitely the standard. Look where it came from, though: the Navy! This brings up a point about innovation: This discussion should be about what comes from the big team and the little team. Unix, after all, originally came from the efforts of two folks at Bell Labs. COBOL, I think, came from one person in the Navy. Pascal came from a computer-science professor in, I believe, Switzerland.

WAYNE RASH JR.: The primary author of COBOL is Grace Hopper. I once had an interesting discussion with her about COBOL and the future of computing. She believes that COBOL ought to be scrapped as soon as possible. She's convinced that it's holding up innovation because of its limitations.

Innovation is a creative process that can exist in nearly any environment, but it will flourish in only a few. While there are many important factors to creativity, and therefore innovation, the size of the organization is not one of them. Hewlett-Packard's work on the calculator and DEC's work on the minicomputer show a great deal of innovation in the corporate arena. Today, you can see significant innovation at IBM labs in Zurich and elsewhere, where major strides are taking place in nanotechnology.

The innovators need time and financial support to devote to the innovation. For example, Visix's Looking Glass got its initial start-up capital from a company that funds a large number of research efforts. Other innovators start with personal funds and then find their own investors. Still others are purely corporate in origin.

In many cases, a lot depends on the scale of the project. While development of a software package is often within the grasp of an individual, a larger project might depend on corporate resources, simply because most people cannot afford to pay for it. There are two parts to innovation: creating the item and convincing people that it's useful.

TREVOR MARSHALL: Innovation invariably comes from a small organization or group—often from the mind of an individual. Big companies develop; they don't innovate. The aerospace industry is a good example. I don't know any engineering manager who goes to a meeting at, say, McDonnell Douglas and says, "Today I want you guys to make a major breakthrough in airfoil technology." Instead, he or she might say, "Let's work on the design of the airfoil and try to make it more efficient." That's what big organizations do well. The problem is that virtually no funds are available for entrepreneurial support these days. I formed YARC with my own savings. It is a $3-million-a-year company with some impressive contracts and further growth potential, yet not one venture capitalist has seriously thought about backing it. They want it to grow to $20 million a year and then organize a leveraged buy-out for a sure-fire financial investment with no significant risk.

LARRY LOEB: Innovation is an individual's provenance, not something that a committee can do well. The individual may, of course, draw on previous works to effect the innovation (why reinvent the wheel?), but those previous works alone won't make the innovative solution obvious. It takes a clarity of vision to see the whole of a problem beyond its individual parts that points the way to innovation. Large groups dilute this clarity by the introduction of extraneous structural factors; for example, writing reports instead of spending time doing what you are writing about. Yet, the financial and logistic resources of an organization are needed to popularize and produce any innovation that emerges.

One way to resolve this seeming impasse is the formation of "fellow" positions within an organization, much as Apple has done. This reduces the structural constraints so that the individual can spend more time productively.

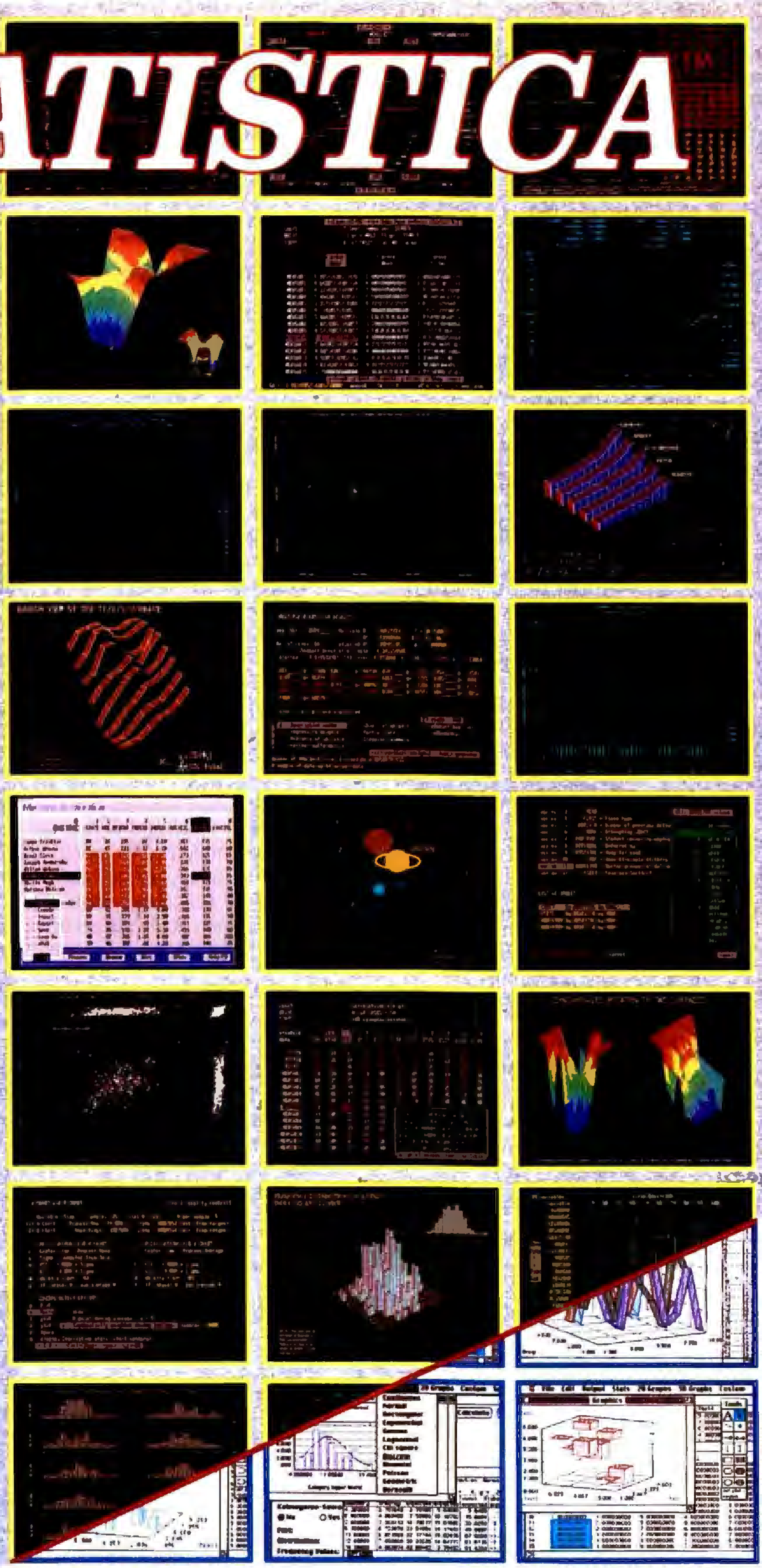
STAN MIASTKOWSKI: It all comes down to dollars and cents. Small companies usually operate on a shoestring. They just don't have the budget to compete with the huge advertising and promotional campaigns of large companies, despite the fact that many of the heavily promoted products are boring knock-offs or even inferior.

The industry's venture capitalists, who once kick-started this industry by backing true innovation, are no longer interested in really innovative products. As the economy stagnates, the situation is likely to get worse.

Fortunately, the current state of the economy is forcing both individuals and volume buyers to get the most value for their dollars. This opens a door for the companies that are selling truly innovative solutions. The most conservative buyers will stick with products that are "tried and true," but some will search for innovative value.

FRED LANGA: Don't we punish innovators? There is so much emphasis on

CSS:STATISTICA



CSS/3™ Complete Statistical System with over 1,000 presentation-quality graphs fully integrated with all procedures and on-screen graph customization ■ The largest selection of statistics in a single system; in-depth, comprehensive implementations of: *Exploratory techniques; multi-way tables with banners; nonparametrics; distribution fitting; multiple regression; general nonlinear estimation; logit/probit analysis; general ANCOVA/MANCOVA; stepwise discriminant analysis; log-linear analysis; factor analysis; cluster analysis; multidimensional scaling; canonical correlation; item analysis/reliability; survival analysis; time series modeling; forecasting; lags analysis; quality control; process analysis; experimental design (with Taguchi)*; and much more ■ Manuals with comprehensive introductions to each procedure and examples ■ Integrated Stats Advisor expert system ■ Extensive data management facilities (powerful spreadsheet with formulas; relational merge; data verification; flexible programming language) ■ Optimized (plain English menus/mouse) user interface: even complex analyses require just few self-explanatory selections (CSS can be run without manual; Quick Start booklet explains all basic conventions) ■ Macros, batch/commands also supported ■ All output displayed in Scrollsheets™ (dynamic tables with pop-up windows and instant graphs) ■ Extremely large analysis designs (e.g., correlation matrices up to 32,000x32,000) ■ Unlimited size of files; extended precision; unmatched speed (Assembler, C) ■ Exchanges data (and graphics) with many applications (incl. Excel®, Lotus 3®, dBASE IV®, SPSS®) ■ Highest resolution output on practically all printers (incl. HP, Postscript), plotters, recorders, typesetters ■ IBM compatibles, 640k or more ■ Price: **$595.**

Quick CSS™ Subset of CSS/3: all basic statistical modules (incl. data management) and the full, presentation-quality graphics capabilities of CSS/3 ■ Price: **$295.**

CSS:GRAPHICS™ A comprehensive graphics/charting system with data management ■ All graphics capabilities of CSS/3 and, in addition, extended on-screen drawing, 19 scalable fonts, special effects, icons, maps, multi-graphics management ■ Hundreds of types of graphs ■ Interactive rotation and interactive cross-sections of 3D graphs ■ Extensive selection of tools for graphical exploration of data; fitting; smoothing; spectral planes; overlaying; layered compressions; marked subsets ■ Unique multivariate (e.g., 4D) graphs ■ Facilities to custom-design new graphs and add them permanently to menu ■ Import/export of graphs and data, 15 formats ■ Optimized (menu/mouse) user interface; even complex graphs require few keystrokes: all graphs on this page can be produced from raw data in less than 20 minutes ■ Macros, batch/commands also supported ■ Unlimited size of files ■ Highest resolution output on all hardware (see CSS/3) ■ IBM compatibles, 640k or more ■ CSS:GRAPHICS is included in CSS:STATISTICA (available separately for **$495).**

Megafile Manager™ Comprehensive analytic data base management system ■ Unlimited size of files (up to 32,000 fields or 8 MB per record) ■ Megafile Manager is included in CSS/3 and CSS:STATISTICA (separately: **$295).**

CSS:STATISTICA™ A fully integrated system that combines all the capabilities of CSS/3 and CSS:GRAPHICS into a single extremely comprehensive data analysis system ■ Price: **$795.**

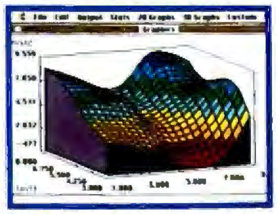
Domestic sh/h $7 per product; 14-day money back guarantee.

Circle 253 on Inquiry Card.

StatSoft™

2325 E. 13th St. • Tulsa, OK 74104 • (918) 583-4149
Fax: (918) 583-4376

STATISTICA/Mac™ A CSS-compatible, comprehensive data analysis and graphics system designed for the Macintosh ■ Large selection of statistical methods fully integrated with presentation-quality graphics (incl. EDA, multiplots, a wide selection of interactively rotatable 3D graphs; MacDraw-style tools) ■ Unlimited size of files ■ Exchanges data with Excel and other applications ■ Price: **$395.**



Quick CSS/Mac™ A subset of STATISTICA Mac all basic statistical modules and the full, presentation-quality graphics capabilities of STATISTICA Mac ■ Price: **$245.**

Overseas Offices: StatSoft of Europe (Hamburg, FRG), ph: 040/4200347; fax: 040/4911310, **StatSoft UK** (London, UK), ph: 0462/482822; fax: 0462/482855, **StatSoft Pacific** (Melbourne, Australia), ph: 613-866-1766, fax: 613-866-3318, **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 018-240035; Spain: ADDLINK, SRL ph: 34-3-459-0722 "compatibility" that innovation often gets lost in the shuffle. The Atari 800 had demonstrably superior graphics to the Apple II's, but it didn't support Apple's huge software base, so it didn't go anywhere. The Amiga offers lots of advances, but in nonstandard ways that doomed it to a niche. Look at the Next. It's not compatible—but it's innovative. Does the world really want innovation?

RASH: The world does want innovation, but on a realistic basis. The world has to protect its investment. We don't punish innovation, but we do make innovators find ways to fit their innovations into the way we live.

The Next is a good example. It's a nice machine that is innovative in some ways, but mostly it's innovative in ways that make life hard in the real world. For example, why ship a machine without a floppy disk drive? Innovation like that is like selling a car without wheels.

The problem with the Next system and many other machines is that the innovation is incomplete. The machine is black and cube-shaped, but the black-cube look is no more functional than some other color or shape. It also has a nifty version of Unix and a laser printer. But is its version of Unix better than what Sun or Apollo is using? Finally, it has Display PostScript, which is innovative, and for some functions (publishing, mostly) it's even useful. But other ways work well to achieve the same end for less money.

The other cases you mentioned prove that innovation isn't everything, but it is important. If the Amiga wasn't as innovative as it is, it would have died long ago. The fact that it still sells in large numbers shows that innovation can make up for poor marketing.

LANGA: Is the problem, then, that of telling real innovation from useless change? The Next comes with NextStep, a nice collection of object-oriented programming tools and class libraries; it's about the slickest environment going. But what gets attention is the matte-black finish and the shape. If NextStep were offered by itself, would it have fared better if everyone's attention hadn't been diverted by silly black paint jobs? Would we have paid more attention, or less, if no one had ever heard of Steve Jobs?

LOEB: Steve is a good hook to get Next noticed, because you know what Steve's already done. But that track record also colors the expectations you bring to the machine. You expect some innovation, so you are less surprised by it when it is there. Getting rid of floppy disk input may be one person's innovation, but the market didn't see it as that.

Innovation for its own sake, while interesting, simply isn't enough.

RASH: But that's the point: Innovation for its own sake, while interesting, simply isn't enough. The innovative product must still exist in the real world, solve real problems, and work for real people if it's going to have any direct effect on the world. Otherwise, it may serve only as a prototype or an inspiration.

Without Steve Jobs, I doubt that we would have noticed the Next at all. All the comments I hear about the Next in the business world rarely mention NextStep. It's looked upon as a flashy, but overpriced and rather slow, workstation.

DAVID FIEDLER: Take something even lower-tech than computers: TV. There is a big push on for HDTV, but a number of real-market factors are in the way of that. First, HDTV broadcasts are likely to be incompatible with today's TVs. Second, the American public has shown in the past that it is not unduly influenced by quality; what it wants is convenience (i.e., VHS versus Beta videotape format or 35mm versus Instamatic cameras).

LANGA: Jerry, you have stated many times how the FCC rules alone make it virtually certain no more garage start-ups will succeed. About the closest thing to a small start-up making good lately is Cheetah, and that's not a unalloyed success. Cheetah has produced some nice hardware, but it was often late and over the announced price. The company was bought by Northgate. Could a neo-Jobs and a neo-Wozniak succeed today?

POURNELLE: I don't see how in PCs; not with innovation. Northgate was a marketing success, but then it had to buy Cheetah to get innovative technology. The government, as always, operates to stifle initiative. The major enemy of capitalism is capitalists, who want to restrict entry into whatever they have developed, which means to stifle innovation. ■

C BEYOND 640K DOS

Let Phar Lap's new 286|DOS-Extender™ turn your Microsoft C compiler into a multi-megabyte power tool!

It's never been so easy to C beyond 640K DOS.

You've been hearing a lot lately about DOS Extenders and their ability to let you create large programs beyond the 640K DOS limit. Now Phar Lap® makes it easier than ever! With your copy of Microsoft C and our new 286|DOS-Extender you've got all the tools you'll need to quickly and easily build multi-megabyte protected-mode applications - often by simply relinking without making source code changes. 286|DOS-Extender enables you to build programs that have room for more features and capabilities without having to suffer with overlays or EMS. But the best news is you don't have to give up any of your Microsoft C tools, including your CodeView debugger.

And with 286|DOS-Extender you'll not only have plenty of memory for your applications but also for the Microsoft C 6.0 compiler itself. No more crippling "Out of Heap" messages when compiling under Windows or with networks.

Total Compatibility

Because 286|DOS-Extender is embedded into your program, it is invisible to the end-user. Your program looks exactly like any other DOS application. There's no new operating environment for your end-users to buy or learn. Any of the 30 million 80286, 386, or 486 PCs that can run MS-DOS or PC-DOS can run 286|DOS-Extender. And because Phar Lap products support the XMS, VCPI, and DPMI standards, applications built with 286|DOS-Extender can run under a variety of environments besides MS-DOS, including DESQview and all modes of Microsoft Windows.

Field Proven Technology

Phar Lap is also the developer of the award-winning 386|DOS-Extender™, which has been used in over 600 applications including AutoCAD 386 and IBM Interleaf Publisher.

386|DOS-Extender is designed for programs that require the ultimate in 32-bit speed and performance on 386 and 486 PCs. By utilizing either of our DOS-Extender technologies, industry leaders are keeping their competitive edge and delivering all the functionality and capabilities that their customers have been asking for.

So if DOS is looking smaller than ever, call Phar Lap today.

And C what it's like beyond 640K.

Phar Lap 286|DOS-Extender SDK $495.

We open a world of memory.

Phar Lap Software, Inc.
60 Aberdeen Avenue
Cambridge, MA 02138
617-661-1510
FAX 617-876-2972

Circle 214 on Inquiry Card.

Professional developers require

PerFORM Designer & Filler 2.1
by Delrina

Save money by automating your forms with this award winning forms processor.

- Design, fill-in and print professional looking forms.
- Imports, exports and looks up ASCII or dBASE files.

LIST: $149 **PS** Price: $119
FastFaxts 2093-001

SentinelScout
by Rainbow Technologies

The SentinelScout is a hardware key that attaches externally to the parallel port of an IBM PC or compatible to enable execution of authorized program copies. It does not interfere with printer operation, hard disk installs or backup copies. Featuring a fixed-response security system unique to each device, the economical SentinelScout offers a level of execution control perfect for lower-cost programs.
LIST: $295 (kit of 10 keys)
PS Price: **$265**
FastFaxts 1313-001

386 DEVELOPMENT

	Price
386 Max 5.1	$109
386|DOS Extender by Pharlap	479
DESQview 386	189
F77-EM32 + Ergo OS/386	1055
FoxBASE+/386	479
Metaware High C 386/486	919
MetaWare Pascal 386/486	839
NDP Fortran 386	829
NDP C 386	829
QEMM 386	89
VM-386	229
WATCOM C8.0 386 Prof.	1155
WATCOM C8.0 386 Stand.	795
Zortech C++ 386 Dev.	865

AI-LANGUAGES

ARITY Combination Package	989
LISPC	216
PC Scheme	105
TransLISP PLUS w/source	99
PDC Prolog Compiler	239

ASSEMBLERS

MS MASM	105
Spontaneous Assembly	179
Turbo Debugger & Tools	119
Visible Computer:80286	85

BASIC & ADD-ONS

BAS-C Commercial	829
dB/LIB Professional	179
MS QuickBASIC V4.5	69
QBase	189
QuickPak Prof. V3.21	189

C LANGUAGE COMPILERS

Instant C	769
Lattice C - 6.0 Compiler	195
Microsoft C 6.0	349
Microsoft QuickC	69
WATCOM C8.0 Prof.	439
WATCOM C8.0 Stand.	359

CASE & PROTOTYPERS

Demo II V3.0	239
EasyCase Plus	279
EasyCase Plus Prof. Pack	359
EasyFlow	135
Instant Replay III	139
Layout	239
MetaDesign	319
Pro-C w/Workbench	735
ProtoFinish by Genesis	289
Show Partner F/X	345
Visible Analyst	585

COBOL

MS COBOL V3.0	639
Realia COBOL	859

COMMUNICATIONS ADD-ONS

C Asynch Manager 3.0	159
C Communications Toolkit	145
Essential COMM	249
Greenleaf Comm Library	329
QuickComm	129

DBASE

Clipper 5.0	550
dBASE IV	549
dBFAST/PLUS	315
dBMAN V	219
dBXL	179
FoxPro	495
FoxBASE + - V2.1	279
QuickSilver	429

DBMS

Cause Professional	499
CLARION Prof. Dev. V2.1	549
D the data language	345
Magic PC	489
Paradox V3.5	553
R:BASE 3.1	595

DBMS TOOLS & LIBRARIES

AdComm for Clipper	279
Artful Two	289
BALER Spreadsheet Compiler	399
CLEAR + for dBASE	179
Comet Multiport	169
dBASE BlackBox	89
dBASE Online	129
BRIEF w/dBRIEF	Call
dBX/dBport w/source	895
dGE 4.0	279
dQUERY MU	179
dSalvage Professional	195
FLIPPER Graphics Library	279
FUNCky.LIB	239
Genifer	289
Net Lib	229
Pro Clip	185
R&R Relational Reportwriter	229
R&R Code Generator	129
Scrimage	139

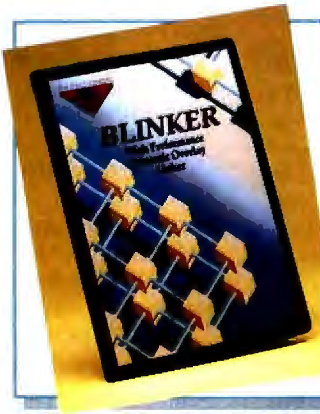
InstaPlan Standard
by InstaPlan

Your business has projects going on all the time. Some need coordination, have important deadlines and limited budgets. To make these projects succeed you need realistic plans. It highlights resource conflicts and problem areas ahead of time. It utilizes the outline approach to planning, has clear screen views, on screen help and highly presentable charts to ensure you manage your projects not your software.
LIST: $249
PS SPECIAL Price: $224
(while supplies last)
FastFaxts 1657-007

TIME *after* TIME
by ALDIA SYSTEMS INC.

Windows 3.0 event processor. Schedules Windows and DOS applications to run automatically at preset times & dates. Create automatic operation of DOS and windows applications. Schedule one-time events through Windows Calendar program. Record and replay at preset time with Macro Recorder.

LIST: $80 **PS** Price: $75
FastFaxts 3678-001



BLINKER 1.5
by Blink*inc*

"Fastest dynamic overlay linker for Clipper Summer '87 and 5.0. Automatically structures overlays and reduces program memory requirement by up to 50%. Features incremental linking in fractions of a second, dynamic overlaying of C & ASM, source code of Clipper profiler for performance analysis, memory defragmentation, "burning in" of Clipper environment variables/ serial numbers and creation of demo versions."
LIST: $249 **PS** Price: $235
FastFaxts 937-001

THE PROGRAMMER'S SHOP 1-800-421-8006

more than just products...

EDT+

by Boston Business Computing

EDT+ 5.0, the only complete emulation of DIGITAL's VAX EDT, is 50% faster than its predecessor and features multiple windows, interfaces for EVE, EMACS, vi and WPS, 132-column mode, status line and ruler, keystroke macros and much more. 30-day, money-back guarantee and free customer support and updates for 60 days. For MS-DOS and UNIX systems.

LIST: $295 **PS** Price: $279

FastFaxts 342-001

NEW! CO/Session 5.0

Triton Technologies Inc.

The new standard in remote communication software with better performance, lower memory requirements and more features than Carbon Copy or pcAnywhere. CO/Session 5.0 is the only remote-control package to support expanded memory, dial-in directory restrictions and remote mouse support. Requires as little as 5K on the host PC! Available in Single or Two PC Packages.

	LIST	PS Price
Two PC Package	$195	$179
Application / Host	$125	$109
Support / Remote	$135	$119
Host Ten Pack	$950	$895

FastFaxts 904-001

GET ONLINE WITH THE PROGRAMMER'S SHOP *Electronic Catalog*

Browse through The Programmer's Shop Catalog right from Your PC

Get up-to-date product and pricing information for thousands of software programs from leading publishers. Whether you're looking for applications software, programming languages, or development tools, The Programmer's Shop ***Electronic Catalog*** will meet you needs. **NOW ON:**

CompuServe In the Electronic Mall Section, now with no online usage costs. Type GO PS.

BIX The Byte Information Exchange. To access, call their host computer in the Boston area at 617-861-9767 or via Tymnet. For further information, call 800-227-2983 (in NH and outside the US, call 603-924-7681).

DELPHI To sign on, dial 1-800-365-4636, when connected press RETURN once or twice, at PASSWORD, type PSC and press RETURN. For more information, call 800-544-4005 or 617-491-3393.

PC WORLD BEST BUY

OPTune

by Gazelle

Got a case of "hard-disk slowdown?" Get OPTune, the fastest, most complete set of performance-enhancing utilities available. It features unmatched file defragmentation, low-level non-destructive interleave adjustment, and in depth media testing. OPTune will, quite simply, keep your disk spinning faster and longer than any other "so-called" optimizer . . . guaranteed.

LIST: $100 **PS** Price: $85

FastFaxts 726-017

Tom Rettig's Library	85
UI2 Developer's Release	449

DEBUGGERS/ DISASSEMBLERS

DASM	239
Dis Doc Professional	229
Multiscope for DOS	149
Periscope IV	Varies
RE:Source by Genesoft	139
SoftProbe 86/TX	295
Sourcer 486 w/BIOS pre-proc.	149
Trapper	189

DEVELOPMENT TOOLS

ASMFLOW Prof.	179
C-DOC	179
CLEAR+ for C	179
Codan	349
Buzzwords dANALYST Gold	199
The Documentor	229
HyperInterface II Combo	239
INSIDE!	119
MKS Lex & Yacc	199
MKS RCS	175
PC-Lint	115
Plink/LTO	439
PolyMake	159
PVCS Professional	439
ROM-Link	339
.RTLINK - by Pocket Soft	279
.RTLINK Plus	419
Source Print	89
TLIB 5.0 Version Control	125
Zortech C++ Tools	Call

EDITORS

BRIEF	Call
Cheetah	95
Epsilon	175
KEDIT	139
QEdit TSR	89
Sage Professional Editor	249
SPF/PC - V2.1	195
Vedit +	159

EXPERT SYSTEMS

Eclipse 386	560
Exsys Professional	695
Logic Gem by Sterling Castle	89
Personal Consultant Plus	2745

FILE ADD-ONS

Accsys for Paradox w/source	739
CBTREE	179
C-Data Manager	275
CodeBASE 4	279
CQL - w/ source	365
c-tree Plus by Faircom	529
C-TRIEVE	259
db_FILE/RETRIEVE - SU	279
Faircom Toolbox Prof.	1159
WKS Library	149
XQL	649

FORTRAN

FOR_C w/source	789
Lahey FORTRAN F77L	549
Lahey Personal FORTRAN	99
MS Fortran Opt. Compiler	309
RM/FORTRAN	499

GENERAL ADD-ONS

C Tools Plus - V6.01	119
C Utility Library	189
Greenleaf SuperFunctions	239
Opt-Tech Sort	139
Turbo C Tools by Blaise	109

GRAPHICS

Bar Code Library w/Source	369
Essential Graphics v3.0	349
GraphiC	319
graphics-Menu	165
GSS Graphics Dev't Toolkit	699
HALO	279
HSC Sunscan	289
LaserControl	129
MetaWINDOW	259
MetaWINDOW/PLUS	369
PCX Programmer's Toolkit	229

HARDWARE

Aegis	65
ALL Chargecard	229
Capital Equipment Corp.	
OS/RAM32 0M	225
OS/RAM8 0M	299
OS/RAM4 0M	179
DigiCHANNEL COM/8i	875
DigiCHANNEL MC/8i	949
DPT	
SmartCache ST506	1099
SmartCache RLL	1099
SmartCache ESDI	1099
Disk Mirroring Module	685
Emerson UPS	
Model 10 UPS	169
Model 20 UPS	319
Model 40 UPS	699
AccuCard	209
AccuSaver	69
EtherCard Plus	239
EtherCard Plus/A	349
Erasable Optical Drive	Call
Hardlock Kit by Glenco	369
IIT Adv. Math Coprocessors	
3C87-33	559
2C87-20	329
2C87-12	279
Intel Math Coprocessors	
80387-25	555
80387-33	675
J T Fax 9600	595
KickStart I	149
KickStart II	519
LANStor LAN150S	1599
LaserStor WORM Drive	3295
Personal Modem 2400	179
QX/12K Modem	699
QX/V.32c Modem	1349
Seagate ST-125-1 20M	299
Seagate ST-4096-1 80M	639
Seagate ST-251-1 40M	339
SentinelScout (kit of 10 keys)	265
SpeedStor AT 320S	1999
Smartmodem 2400 (Ext.)	359
The Shadow SVGA1024K	319
VGA WONDER 512K	359

NETWORKS

dBXL/LAN	489
Btrieve for DOS	479

THE PROGRAMMER'S SHOP 1-800-421-8006

The Programmer's Shop is

WindowsMAKER™ Professional New!
by Blue Sky Software™/Candlelight
The fastest way to create MS-Windows applications in C. Generates the Windows .EXE w/ complete source & production files (no royalties). Just Point & Click to define the Windows user interface. Lets you animate your design to instantly test look & feel and make changes on the fly wihout needing to compile. Custom code is perserved during code regeneration. This is the power-user version of the best-seller WindowsMAKER with a lot of added functionality.
LIST: $995 **PS** Price: $919
FastFaxts 2001-006

INTRODUCING
Essential Communications VERSION 4.0!!!
by South Mountain Software
Powerful asynchronus communications library. Supports interuppt driven communications up to 115,200 baud. Drives 34 ports with buffers to 500K. Supports V.32, MNP, Hayes compatible modems,XON/XOFF,XMODEM (CRC and Checksum),XMODEM 1K,YMODEM,KERMIT,ZMODEM protocols. Provides ANSI and VT 52/100 terminal emulations. Use with our /*resident_C*/ library to write background communication applications. Contains all source code, a BBS demo. No royalties.
LIST: $329 **PS** Price: $259
FastFaxts 42-011

Netware SQL	519
Netware C Interface	259

OBJECT-ORIENTED/C++

Borland C++	425
Intek C++ 80386	395
M++ by Dyad Software Corp.	279
M++ w/source	449
Smalltalk/V	79
Smalltalk/V-286	175
Turbo C ++	99
Zinc Interface Library	179
Zortech C ++ w/ source	269
Zortech C++ Debugger	90
Zortech C ++ Dev. Edition	399

OS SUPPORT

DESQview	109
OS/286	589

OTHER LANGUAGES

Modula-2 Dev. System	219
TopSpeed Modula-2	189
StonyBrookProf. Modula-2	249

OTHER PRODUCTS

Carbon Copy Plus	159
Dan Bricklin's PageGarden	89
Duplicator Toolkit - Pro 3.0	119
Fast!	89
Flow Charting III	199
HEADROOM	89
HiJaak	179
LapLink III	129
Link & Locate ++ - ROM MSC	295
Math Advantage	475
Norton Utilities 5.0	149
pcANYWHERE IV	159
PC Tools Deluxe 6.0	119
PC-KWIK Power Pak	119
Pre Cursor	89
Remote2	139
SpinRite II	89
System Sleuth	99
Time$heet Prof.	165

TURBO PASCAL

Turbo ASYNCH PLUS	159
Turbo Pascal 6.0 by Borland	107
Turbo Professional	109

TEXT SCREEN ADD-ONS

AEWINDOS	479
C Worthy w/Forms w/ARCH	359
Greenleaf DataWindows	339
HI-SCREEN XL Professional	289
MEWEL Window System	279
POWER SCREEN by Blaise	129
Vitamin C - source, menus	369
VC Screen - painter	129
Vermont Views Obj. + source	819

UNIX/XENIX

C++ for Unix 386 by Zortech	350
Computer Innovations C++	475
db_FILE/RETRIEVE MU	569
ESIX Systems	
ESIX/V 386 Dev. (2 user)	569
ESIX/V 386 Dev. unltd	795
Informix SQL	Varies
Interactive Systems	
Architect Wrkstn Platform	1199
Architect Wrkstn Developer	1850
M++ for Unix by Dyad	379
M++ for Unix w/ source	579
Norton Utilities for Unix	249
WordTech Quicksilver	1295
XENIX 386 Dev. Sys.	689

WINDOWS & OS/2

Actor 3.0	99
Brief for OS/2	Call
Case: W Corporate Version	969
Case: PM (for C or C+++)	1899
C_talk/Views	419
C-Trieve/Windows	349
dBFAST/Windows	395
Graphics Server SDK	455
Instant Windows V2.2	395
KnowledgePro Windows	589
M++ V2.0 by Dyad Software	279
M++ V2.0 w/source	449
MKS Toolkit V3.1	299
MS Windows 3.0	119
MS Windows DDK V3.0	365
MS Windows SDK V3.0	365
Multiscope OS/2 Debugger	315
Multiscope Windows Debug.	315
Object/1 V1.0	895
OS/2 PM Toolkit	369
Smalltalk/V PM	435
Tempo for Windows	89
Windows Maker	715
Windows Maker Professional	919

WATCOM C 8.0/386 Prof.
by WATCOM
WATCOM C 8.0/386 is 100% ANSI C optimizing compiler/runtime library for Intel's 80386 architecture, generating applications for 32-bit protect mode. Features include: protected mode version of the compiler; VIDEO full-screen source-level debugger; MS library- & source-compatibility; execution profiler; high performance linker; graphics library; supports MetaWare High C 386 runtime calling conventions; SAA compatible.
LIST: $1295 **PS** Price: $1155
FastFaxts 1044-005

HiJaak Release 2.0
by Inset Systems Inc.
HiJaak 2.0 is a graphics conversion and capture utility that translates more than 36 graphics file formats. HiJaak provides batch conversion capability from the DOS command line or from the user interface. Supported formats include GEM, PICT I&II, CGM, HPGL, PIC, DXF, PCX, MAC, TIF, and support for more than 16 group 3 fax devices. A 5K pop-up provides capture function of text screens, graphics screens, and laser printer output.
LIST: $199 **PS** Price: $179
FastFaxts 1085-003

CASE:W
by Caseworks
Announcing CASE:W 3.0 for Windows 3.0, the new Windows development tool for serious Windows Programmers. Interactively design your Windows interface and CASE:W generates the required C source code framework. Preserve user added code during interface changes with CASE:W's regeneration facility. No propietary languages or Runtimes required!!
LIST: $795 **PS** Price $719
FastFaxts 1502-004

THE PROGRAMMER'S SHOP 1-800-421-8006

your source for solutions!

The UnMouse - More Speed in Less Space
by MicroTouch

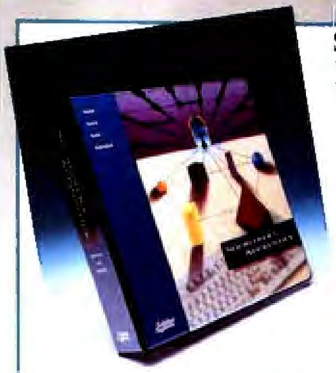
The UnMouse is a touch-sensitive tablet that gives you faster cursor speed - - in a fraction of the space a mouse takes up. Plus you can slip templates under its glass to access up to 60 Power KeyPad functions or use its stylus to draw, trace or input graphics.

LIST: $235 **PS** Price: $219
FastFaxts 2918-001

dBXL
by WordTech

A superior alternative to dBASE, dBXL relational database is an easy to use interpretive environment adding extended language (XL) features to the dBASE language. It includes WordTech R&R Relational Report Writer, full dBASE compatibility (files & syntax), and special menus for first time database builders. Also has memory swapping, advanced memo field handling, macros, true windowing multi-dimensional arrays, graphing and EMS support. Requires 440K memory.

LIST: $249 **PS** Price: $179
FastFaxts 971-017



Sourcerer's Apprentice–
Version Control for the Professional
by Solution Systems

From the company that brings you BRIEF: version control with single keystroke accessibility from BRIEF. Sourcerer's Apprentice tracks all changes, who made them, when and why. Easily recreate or combine previous versions of code. Experiment freely. Sourcerer's Apprentice can always bring you back. Teams Take note: Sourcerer's Apprentice prevents simultaneous updates to the same files.

LIST: $499 **PS** Price: $459
FastFaxts 732-137

BORLAND C++ 2.0
by Borland International

Borland C++ is the complete C and C++ professional programming environment for DOS and Windows. Use existing C applications or move them to object-oriented programming (OOP) with C++. Borland C++ has new features and tools including support for 286 processors, megabytes of extended memory, and large hard-disks. Borland C++ also includes Windows applications without purchasing the Microsoft SDK.

LIST: $495 **PS** Price: $379
FastFaxts 777-120

PC BLAST
by Communications Research

Puts powerful data transfer, remote control, scripting, terminal emulation, datacompression, & other communications magic into one product for PC, Unix, Xenix, VAX, Macintosh; even mainframe communications... all with the same look, feel, menu interface, protocol, & script language! Easy for developers to link into existing applications for automated, 100% error-free data transfer and fast, reliable remote control.

LIST: $250
PS SPECIAL Price: $151
(while supplies last)
FastFaxts 1674-001

ObjectVision
by Borland International

ObjectVision lets you create Windows applications... without programming! New Visual Programming technology uses graphical decision trees to represent and capture business rules. Non-technical users can easily create Windows business applications without traditional programming. ObjectVision applications are easily connected to a variety of popular databases, and operate in a multi-user mode over Windows-supported networks.

LIST: $495 **PS** SPECIAL Introductory Price: $99
FastFaxts 777-124

What is FastFaxts?

Access literature on any of our products via FAX machine. ***FREE!***

Call 617-740-0025 from any fax phone!

Follow the voice computer's instructions and enter your product's code number. Then await your instant print out of product literature.

THE PROGRAMMER'S SHOP

800-421-8006

National Accounts
800-446-1185

5 Pond Park Road, Hingham, MA 02043 • Canada 800-446-3846 • Mass. 617-740-2510 • FAX: 617-749-2018

Credit card orders processed *only* when product is shipped. All prices subject to change. Int'l. prices will vary.

BY491

COVER STORY

FEATURE

Computing in the U.S.S.R.

Soviet "informatics," suffering from years of official policy that has hindered hardware and software development, looks toward the future

IGOR AGAMIRZIAN

On December 7, 1988, the academician Andrei Petrovich Ershov died in a Moscow hospital at the age of 57. His death went unnoticed in a country concerned with the tragic consequences of the Armenian earthquake. However, for specialists routinely dealing with computer science in their work, the event signified the end of an era.

This article is not an obituary of Ershov. It may, however, be the obituary of Soviet computer science, a demise that threatens to become the straw that breaks the back of our collapsing economy.

In the Beginning...

The first computers appeared in the late 1940s and early 1950s in the U.S., Great Britain, and the U.S.S.R. The cold war between the East and West caused an avalanche in the development of military equipment, and the creation of new arms required ever-increasing calculations. Thus, the first generation of computers was intended to solve the problems of ballistics and nuclear physics.

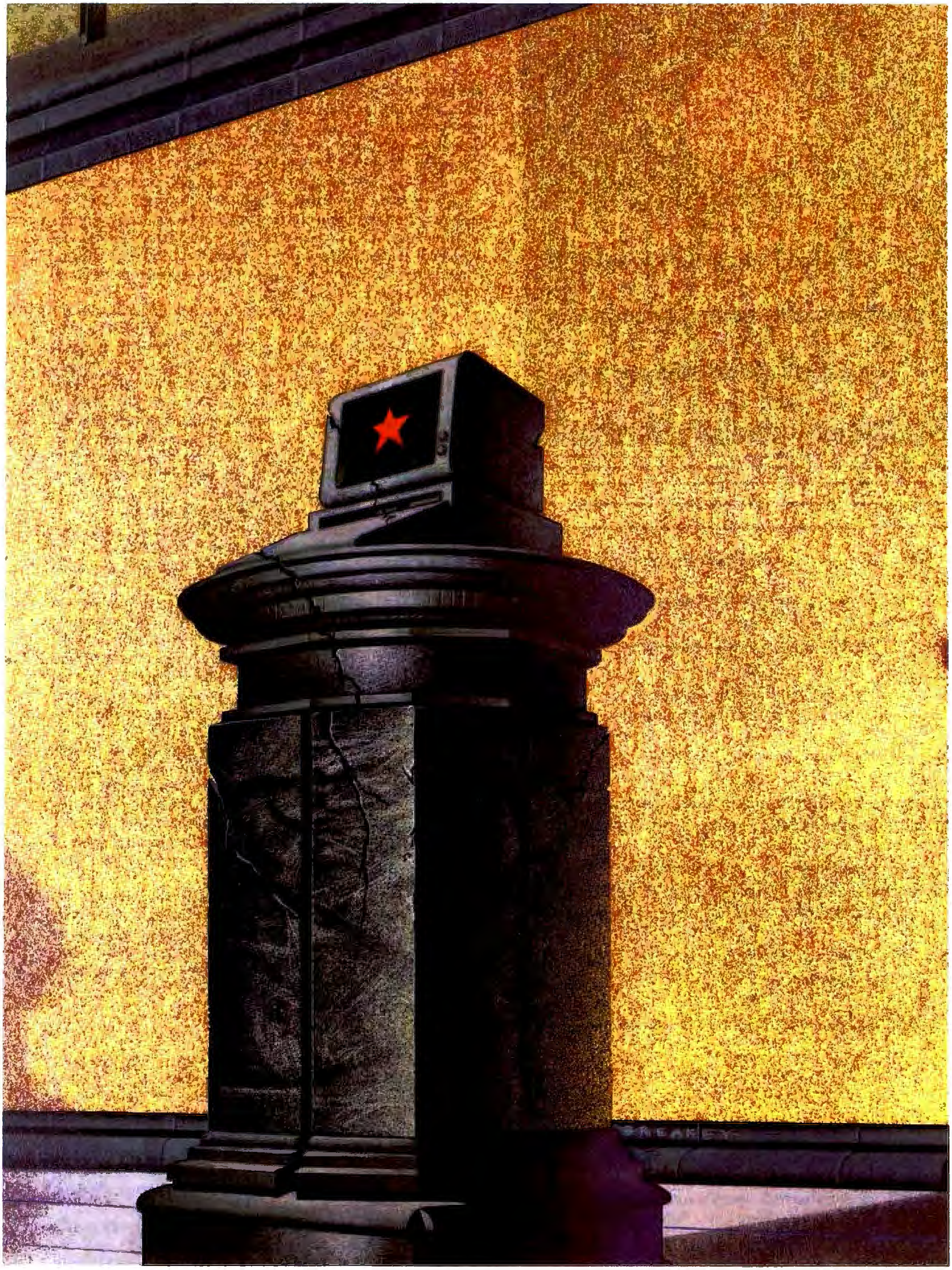
In the 1950s, however, the U.S. began using computers to solve business problems. Work began to automate programming and create high-level languages; programming in machine codes had become too time- and money-consuming. The first valve-operated monsters were replaced with solid-state devices. Backing, main, and internal storage volumes grew significantly. Performance became thousands of times faster.

Progress in the development of high-level programming languages and their compilers predetermined the look of programming. In the 1960s, ALGOL occupied the leading role in the U.S.S.R. Classical Soviet developments of compilers were associated then with ALGOL.

A series of computers called BASM (the Russian abbreviation for large electronic computing machines) was created under the guidance of S. A. Lebedev. In the mid-1960s, this led to the construction of the first line of Soviet program-compatible computers, called the M-20. The family included the M-20, BASM-3M, BASM-4, M-220, and M-222. The first compilers engineered for these computers were called Alpha, TA-1, and TA-2. Ershov, S. S. Lavrov, and M. R. Shoura-Boura headed teams of programmers that created the first Soviet ALGOL compilers for the family of M-20 computers.

In the late 1950s and early 1960s, the U.S.S.R. established centers for the

ILLUSTRATION: JOHN BREAKEY © 1991



development of informatics and computer science. (Informatics deals with information processing, including mass media, publishing, and intelligence activities. Here, however, I use the term to mean a sphere of problems associated with data processing involving the use of technical aids.)

In the U.S., the motivation for developments in computer science shifted from military applications to the search for methods of increasing labor productivity. Advances in microelectronics led to the creation of ICs, which permitted the development of a third generation of computers. Software became more complicated, and operating systems replaced the second-generation master-control programs.

At the same time, informatics and computer science in the U.S.S.R. again came under the influence of politics. (The golden age of Soviet informatics fell within the years of Khrushchev's thaw—you cannot imagine cosmonautics without computer science, and the attention Khrushchev paid to cosmonautics is well known.) Conservative forces that came to power were interested only in preserving the status quo and unavoidably contributed conservatism to policies regarding technology. Developments were curtailed all over the country. The American IBM Model 360 (1965) was suddenly adopted as the Unified Computer System by the Council for Mutual Economic Assistance (CMEA), or Eastern European countries.

The era of developments ended in 1968 with the appearance of the last computer in the BASM family, the BASM-6. After that, there was nothing. Millions of rubles were invested in the development of computer science to no end. The country once again took the fruitless road of copying Western models and assumed that by copying another technical innovation it would save so much that the products would surpass those of competitors. (Edsger Dijkstra, a classic software engineer who visited the U.S.S.R. in the late 1970s, said in a public speech delivered in the Grand Hall of the Academy of Sciences in Leningrad that he regarded the fact that the U.S.S.R. produced IBM computers as the biggest U.S. victory in the cold war.)

You might think that the history of informatics in the U.S.S.R. after 1965 is that of a thoroughly planned strategy against the Soviet people. But this strategy was planned not by bad Americans but by good and experienced Soviet leaders trying to improve the public welfare. The cause was indifference, selfishness, apathy toward tomorrow's problems, an absence of responsibility to the people—everything associated with what we now call the administrative system.

That system failed not only in informatics and computer science but in agriculture, industry, transportation, and communications. One example: Why did the shuttle *Buran* take off so late? Undoubtedly, one reason was the absence of the computers required to simulate its aerodynamics. Americans made calculations for their shuttle on computers of the 1970s, which surpassed Soviet computers of the 1980s.

The Soviet Seventies

In the early 1970s, the most popular computers in the U.S.S.R. were the M-222 and the Minsk-32. Scientists at the Nuclear Physics Institute in Dubna created one of the first Soviet FORTRAN compilers, and FORTRAN for the M-20 appeared. A new line of Soviet computers was announced—the Elbrus—whose design was suspiciously similar to that of systems from the American company Burroughs. Everyone looked forward to the appearance of ES ("Unified System") computers, which were to be compatible with the IBM Model 360.

I first saw an ES computer when I was studying informatics and computer science at the faculty of mathematics and mechanics at Leningrad University. My fellow students and I were

An American Programmer in Moscow

Alex Lane

Nearly 15 years had passed since I had been in the U.S.S.R., and the border guards were just as steely-eyed as ever. But I passed through the line with hardly a glance from the customs officer, met my driver, and headed for downtown Moscow. For the next few days, as part of the Borland team at the First International Computer Forum, I'd be showing off Borland products, talking with Soviet programmers, and seeing Soviet computing up close.

It should come as no surprise that Soviet programmers look and act very much like their American counterparts. They ask much the same questions, too. While waiting for a customs official to unlock a vault, several young programmers who had volunteered to help carry boxes of literature plied me with questions. What languages did I program in? What did I think of FORTRAN? What about upcoming Borland products? Windows? OS/2?

Not all questions were about computing. One fellow asked me how Americans went about finding jobs after graduation. My answer fascinated them, since the idea of going out on your own to look for work is quite foreign to the Soviet mind. Another naively asked if Americans really were taught to hate Russians.

When it comes to producing code, I found that Soviet programmers know their stuff. Their major stumbling block isn't the quality of hardware or software; it is the quantity. I saw mostly 286 and 386 hardware, obtained from Pacific Rim countries. Software is routinely pirated, and masses of accompanying

documentation are no barrier to piracy, despite the nonavailability of photocopy machines. Soviet programmers simply combine computer technology with the *samizdat* (self-publishing) technique of political dissidents to create complete versions of documentation for electronic distribution.

Ironically, copy-protection schemes are high on the list of software that Soviet programmers like to develop. I sat through several demonstrations of such schemes, complete with vague explanations of the modus operandi, and none of the programmers could be convinced that the schemes could be broken.

Closely associated with copy-protection software is work on antivirus programs. I was told viruses were a serious problem in the Soviet Union, especially since they were often aimed at "the system" by disgruntled individuals. One programmer was hard at work developing a virus-description language that would allow a programmer to easily create software to detect and neutralize newly identified viruses.

While most Soviet programmers understand English and work with English source code, a third major area of programmer involvement is the Russification of foreign programs. Efforts here range from some neat hacks by one-person shops to complete systems, such as the one developed by the ParaGraph joint venture for Paradox.

Of course, programmers everywhere dream of developing the next killer application—the one that will sell millions of copies and bring them fame and fortune. Soviet programmers are no different, and for the duration of the forum, there was a steady stream of hopefuls at the Borland booth wanting to show their pet applications. Technically, most of the programs were pretty sharp. However, virtually all of them had been developed with no market in mind and so were of limited interest.

Soviet computing is on the verge of an expansion akin to the growth in the U.S. in the 1980s. Soviet developers are becoming aware of the domestic and international markets. Don't be surprised to find the U.S.S.R. emerging in this decade as a major player in the computer revolution.

Alex Lane is a senior technical writer for Borland International. He can be reached on BIX as "a.lane."

proud of Soviet software engineering, convinced that there were positive aspects in our dated computer hardware: It was a training factor that enabled us to engineer applications that were better than American programs. Americans, we thought, did not care about efficiency, but we had to, so we were better programmers. (It was true, to a certain degree. At least, the West always treated Soviet programming schools with respect, and a Soviet programmer emigrating to the West could find a job with ease.)

At that time, programming was becoming a mass specialty in our country, and the need for automatic-control equipment for thousands of plants required new software. As the ES computers were put into use, more users preferred FORTRAN and PL/I, and the ALGOL traditions in the U.S.S.R. faded away.

continued

System programming became devalued, as Soviet clones of foreign computers and "borrowed" copyright software became available.

Few people realized that further progress in informatics was impossible without system developments. We naively hoped that small groups of highly qualified software engineers scattered all over the country would be able to withstand the powerful stream of copyrighted software. We did not understand that the creation of successful software is another science, for which understanding optimum translation algorithms is insufficient.

The late 1970s saw the development of CM computers, a family of small computers, bringing a CMEA program for the creation of computers modeled after the most successful American minicomputer, the PDP-11 from DEC. As the system's mass production was organized, the country soon filled with new Western software. There followed a period of conversion (i.e., the adjustment of Western software to Soviet computers, involving the translation of program messages into Russian.)

Soon, we forgot our own system development traditions. It was much more convenient and profitable to steal than to create something of your own. A whole generation of programmers was unable to create its own programs but could readily understand and improve other programs.

How could borrowing (or more honestly, stealing) foreign intellectual efforts become almost a state policy for informatics and computer science? The reason lies in the deepest contempt for intellectual creative work. In developed countries, copyright laws protect the humanitarian as well as scientific and technological spheres. In the U.S.S.R., the product of intellectual work does not belong to its author; it does not even belong to the organization within which it is developed.

Unfortunately, this is one of the main reasons for our decline in these disciplines. Why should we invest in products if we can obtain everything free? At first glance, it might seem more profitable to use stolen programs. Most Soviet software is only produced in a few copies, and some programs are used only by their authors or programming organizations. A special fund of algorithms and programs, state and regional, has existed for many years in the U.S.S.R. Programmers are well aware of the complications they must overcome to incorporate software into this fund.

Some readers may object to my thesis that the cause of all mishaps in Soviet informatics and computer science lies in copying. What about the international tendency toward unification of computer architectures and software? Clones of the Intel 8086 chip are produced not only in the Soviet Union (the KM1810BM86) but also in Japan, Hong Kong, and Taiwan. IBM PC-compatible computers are produced not only in the Soviet Union (where they are called Iskra-1030 and ES-1840) but by hundreds of companies in dozens of other countries.

But there are differences: Unlike companies in the U.S.S.R., other countries' companies buy licenses and technologies. Buying technologies gives them a lead in time (Southeast Asia begins to copy new American products within several months, while the U.S.S.R. waits several years) and quality (the reliability of Taiwan-made microcircuits surpasses that of masterpieces produced by the Soviet Ministry of Electronic Industry).

Long ago the U.S.S.R. brought itself into information dependence on the U.S. In the 1970s and 1980s, there was little support for the rare attempts at independent hardware and software development. The absence of competition led to the loss of objective quality criteria and the attempt to improve the product.

There is a saying among Soviet programmers: Programs may be bad, good, or working. We like good programs very much. Americans prefer working programs. Because the working

programs and hardware are useful, the Soviet dependence on American information technologies grew, and that dependence became marked when personal computers appeared on the scene.

Bypassed by the Personal Computer Revolution

With the advent of personal computers, a revolution broke out in the world, but it bypassed the U.S.S.R. Its leaders noticed nothing. Soviet industries, infamous for their immobility and habit of copying foreign models, failed to produce decent computers. Even substandard computers were manufactured in such small lots that you could not speak seriously about the computerization of the country.

Alarm was raised. Many famous specialists expressed apprehension and offered constructive steps. Legislative acts were issued, new departments were formed, production plans were set up and failed. Ershov, who was well aware of the danger of further decline in informatics and computer science, put forward a slogan: "Programming is the second literacy."

The personal computer revolution bypassed the U.S.S.R.

That slogan did the trick: It drew attention to the problems of computerization and education in informatics. A vast educational program was started, and informatics became an obligatory school subject. However, the pioneers of this process assumed that industry would provide schools with the necessary equipment within two to three years. Industry failed, and in most schools, the subject is taught on paper only. Students are lucky if they are able just to *look* at a computer two or three times a year. Thus, the students become indifferent, or they do not like the subject. In many cases, the teachers set the tone: Informatics and computer science are usually presented by teachers of physics or mathematics who often have only vague knowledge of the subject.

In a paper published in an American magazine several years ago, comparative figures were given on computerization in the U.S., Japan, Great Britain, and other countries. The author was disturbed that the U.S. did not occupy the leading position in the computerization of education. "We are lagging behind, which may lead to a tragic end," the author concluded—a funny and sad conclusion for the Soviet reader. The U.S.S.R. is not just lagging behind; it is facing the risk that a generation of Soviet citizens will be unable to understand citizens of all but the least developed countries. We Soviets risk separating ourselves with a new curtain—not an iron curtain this time, but a steel curtain of ignorance. We risk finding ourselves alone, because even our CMEA partners are ahead of us by more than two or three years (computerization in Poland, Hungary, and Bulgaria—although they do have certain problems—is decent enough and is improving much faster than the U.S.S.R.'s).

A Few Hopeful Signs

In recent years, some positive tendencies appeared. Unfortunately, all processes are too slow, and we lack time. Solutions to certain problems are not efficient and often hinder, rather than accelerate, resolution of the problem. However, fine efforts exist, such as the temporary science and technology team, Start, set up in 1985 to design a new generation of hardware and software. The result of this effort is a working model of an original and very promising multiprocessor computer and accompanying original software. Unfortunately, the project ended in spring 1988, and our industries seem to be uninterested in the results of this development.

Nor has there been much interest in the Soviet Academy of Sciences' project Shkola (School), headed by E. P. Velikhov. Shkola was a serious attempt to solve the problems of computerization. Regrettably, no progress has been made. That cannot happen until the national economy is restructured.

But most Soviet enterprises, even in modern spheres like microelectronics, are not interested in developing and improving their production capability. Unfortunately, developments in informatics and computer science require powerful material, information, and technological bases; and it is useless to hope that new Soviet computers may—even if the developers enjoy the most favorable conditions—be created in university laboratories or institutes of the Academy of Sciences.

When a successful model is made, there arises a need for large-scale ICs, whose design requires equipment the U.S.S.R. doesn't have. We cannot obtain CAD systems as our foreign counterparts do because we do not have adequate technical resources—that is, computers and peripherals (e.g., high-resolution displays). These systems belong to enterprises that are uninterested in the introduction of new products. The vicious circle is closed. It may be opened again only as a result of deep restructuring of the economy.

The beginnings of economic self-regulation (a socialist market) is the only chance to catch up in informatics. However, the market mechanism cannot correct the decline. Given the existing (or more accurately, nonexisting) copyright laws, it is more profitable for enterprises to copy products or to buy licenses for production from abroad, primarily from the U.S.

Therefore, together with economic changes (here, let me be a little naive and expect that the ruble will be convertible in two to three years), we urgently need state stimulation of promising areas of science and technology. The state should create economic conditions under which the use of domestic products would be more profitable than the use of foreign products. This may be achieved by a combination of actions, including judicial, financial, and tax measures. It should be done as quickly as possible; in fact, it should have been done yesterday.

While the creation of hardware requires considerable resources, personal computers greatly reduce such requirements for software. Unfortunately, the U.S.S.R. suffers from a deficit of equipment, and its prices are 150 times higher than those of the U.S. (neglecting the symbolic exchange rate and considering real wages, the state price for a professional personal computer is about 40,000 to 50,000 rubles, while a qualified programmer earns about 300 rubles a month).

This was why programming and mediator cooperatives and Centers of Scientific and Technological Creative Work of the Youth were created for the development of software products. It is curious that mediator organizations, although charging up to 50 percent of the contract cost for establishing relations

Introducing an inexpensive solution to America's savings crisis.

You've always wanted to own a tape drive. Unfortunately, one small thing has always stood in your way. Your savings account.

Well, now you can buy a complete tape system that can back up from 40-120 megabytes for as little as $419.

Our Irwin SX Series™ Tape Backup Systems are ready to go right out of the box. Unlike others, they're complete systems—with all the hardware and software you need—as well as a tape cartridge.

The Irwin SX Series also includes a model that can back up 80 to a whopping 250 megabytes.

But that's not all. Every Irwin SX drive comes bundled with Central Point Backup™ software. This award-winning program works with a wide array of IBM AT, PS/2 and compatibles. Whether you choose an internal or an external system, you can back up a 40 megabyte hard drive in less than 12 minutes.

Visual file selection, unattended backup and mouse support are just a few of the features that makes this the favorite backup utility of over one million PC users.

To save you even more money, we also include a coupon to let you buy Central Point PC Tools Deluxe™ for just $50. A $99 savings from its usual $149 price tag.

So if you want to back up on tape without emptying your bank account, pick up an SX Series system at your nearest Irwin dealer.

If you don't know an Irwin dealer, call 800-BACKUP1 and we'll put you in touch with one who can end your savings crisis.

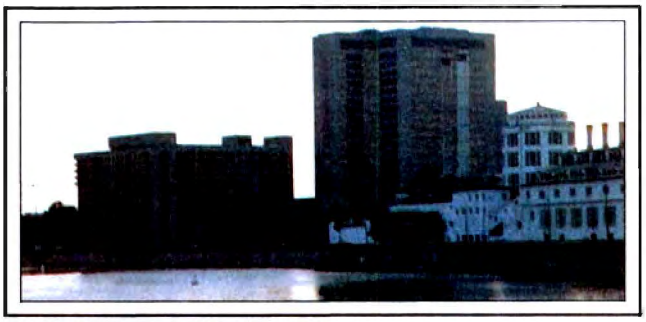
In more ways than one.

IRWIN
An Archive® Company

Circle 146 on Inquiry Card.

An Editor's View

Last year, BYTE's editor in chief, Fred Langa, was a guest at the First International Computer Forum in Moscow. He later attended the first East-West High-Tech Forum in Budapest, Hungary. Here are some of his impressions of Moscow and Soviet computing.



Moscow is a monochrome city, built primarily of beige bricks, with some concrete and red brick here and there. The city is amazing for what is there, and equally amazing for what is not there.

Looking out the window of my hotel, I could see four TV antennas, and that was all. There were no satellite dishes anywhere to be seen, and I saw only one pair of microwave dishes the whole time I was there.

In the shops, there were few cash registers. Some of them had a cash drawer and did all their accounting manually on a piece of paper. The high-volume shops—such as food vendors and theaters—used an abacus. It was ironic that one of the forum's themes was the need to lift the Coordination Committee on Export Controls restrictions so more advanced machines (including RISC machines) could be imported into the Soviet Union—this is akin to having a donkey and wanting it to go faster, so you feed it unleaded high-test gasoline.

It is simply not going to work. What is needed are basic calculators and simple computers in large numbers. That seems to be far more important in terms of fundamentally changing Soviet society than getting a very limited number of workstations into the hands of an elite. However, anything that brings more computers in and enhances a computer culture—with all the intercommunication and worldwide standards that implies—would help.

At the forum, Jack Byers, vice director of JV Dialogue, spoke of the many difficulties that joint ventures face. Each joint venture in the U.S.S.R. has to have a wide base of support: hotels, so you have a place to put international guests; food, so your workers won't have to stand in line at restaurants or food stores; groceries, so your workers will not have to worry about getting essential items for their homes; cars, to move workers around; gasoline and mechanics for the cars—the list goes on and on. A successful joint venture doesn't just provide a job or an opportunity; it has to build an entire minisociety for its workers. You can't take anything for granted.

Adventures in Soviet Software

The East-West High-Tech Forum was a kind of "Dating Game" for would-be partners in joint East-West high-tech ventures. Among the many attendees of the forum was Rusty Schweickart, president of NRS Communications. (You may remember him from his astronaut days.) Schweickart noted that computers in the U.S.S.R. are status symbols and are held tightly by those few who have them. A Soviet citizen added that it was like paper clips: Only 5 percent are used to clip papers; the other 95 percent are used in unexpected ways. In

---

between a customer and a developer, found themselves in very favorable conditions.

Currently in the economy, such mediators are necessary. However, in the future, programming should be recognized as a free, creative trade, and the organizations should be able to conclude direct contracts with the programmers. (This is possible today, but the job is paid from the organization's wage fund, and this is highly unprofitable for the organization.)

A Soviet ACM

In the U.S., public organizations like the Association of Computer Machinery have had a great effect on computer science. The absence of such an organization in the U.S.S.R. has hurt the development of informatics and computer science. The functions of such an organization were often borne by state working groups and committees of the Academy of Sciences, especially the Commission for System and Mathematical Software for Computers (the so-called Ershov's commission, headed by Andrei Ershov). Such organizations could deal with scientific and technical problems, but not with the social and judicial aspects of informatics development. Until recently, the creation of a public organization that could deal with all the existing problems was impossible, because such an organization could threaten the departments' monopolies.

On February 17, 1989, the All Union Society of Informatics and Computer Science was convened. About 200 voting delegates and 700 guests gathered for the inaugural congress and were handed the new society's draft charter (anonymous, as usual). Unfortunately, its authors thought traditionally; the charter did not address problems like the protection of authors' rights, public examinations, the organization of an information exchange, and so on. The only new idea was the creation of self-supporting Centers of Scientific and Technical Services run by the society; that is, another group of mediator organizations. The society was to be a consultative body of the State Committee for Informatics and Computer Science of the U.S.S.R., the same body that had initiated the formation of the society. The state committee had decided to create a society in its pocket, the same way, computers get used in very different ways. They are so flexible and valuable that they're snapped up and jealously guarded.

Irina Savelyava, a Soviet lawyer, told me that Hungary was the first Eastern-bloc nation to offer software copyright protection. The Soviet Union is one of the last remaining countries *without* such protection. A long discussion on intellectual property ensued, during which the Soviets' consensus was, "There is no piracy in the Soviet Union, because it is not illegal to copy software." This is not a trivial point; the U.S.S.R. has no history, mind-set, or legal basis for the private ownership of software. (They're even struggling with ownership of concrete items, such as land and factories. Ownership of intangibles like software is hard for them to understand.)

Stepan Pachikov, general director of ParaGraph, perhaps the most successful Soviet software company, says he runs into this issue every day: People buy one copy of a ParaGraph package and then call to ask for instructions on how to make copies for the other 100 or 1000 people in their firm. The idea of one-copy-one-user or a site license is unheard of.

Nevertheless, Pachikov maintains that "free copying" (not piracy) is good because it seeds the market and helps develop users and programmers who otherwise would have no access to Western software. Case in point: A software package that costs $400 in the West costs about *two years' wages* in the Soviet Union. Can you imagine spending two years' salary on, say, Microsoft Word? As Pachikov said, "Gorbachev makes 24,000 rubles per year, or about $1200. Gorbachev himself could only afford to buy three copies of Microsoft Word in a year."

In the West, product support is often used to discourage piracy: no registration number, no support. But in the East, says Pachikov, vendors really can't offer good support (although some are trying) because "it's harder to get a phone line than to get a nuclear submarine."

Hardware Hassles

Leonid Tomberd, a researcher at Estonia's Institute of Cybernetics, related some problems with the development of Soviet hardware. For instance, most U.S. chip leads are spaced $\frac{1}{10}$ inch apart. The Soviet ministry in charge of cloning Western chips mandated metric spacing, but $\frac{1}{10}$ inch works out to be about 0.254 millimeters, an odd metric size.

The Soviet solution? A *metric inch*—0.25-mm spacing. This means that Soviet clone chips can be exact electrical and functional equivalents of their Western counterparts, and look exactly the same—until you try to plug them into a Western socket. They won't fit.

That's more than an inconvenience. It means all Soviet chip assembly hardware won't work with anything but Soviet chips, and a fair chunk of the actual Soviet chip-fabrication equipment and its products are worthless on world markets.

To make their quotas, Soviet chip manufacturers pump out chips with little or no quality control. Tomberd says a typical DRAM shipment has 25 percent to 50 percent bad chips. For CPUs, he said, it's not uncommon to get a defect list with each chip—a list of instructions that chip will not run. Can you imagine trying to assemble a system from chips like that? Can you imagine programming for chips like that?

To force support for the Soviet computer industry, the government has mandated the use of Soviet equipment. For example, Tomberd says that ministries were forced to use Soviet IBM mainframe clones that cost 1 million rubles, took up precious office space, and required 30 people to operate and maintain—yet had a throughput roughly equal to about two Western personal computers.

Even now, the ministries can't get rid of these dud mainframes. No one wants them; no one will pay anything even close to the paper value of the machines. If they give them away or sell them at their real value, it will look as though the sellers are doing something illegal—dumping a machine supposedly worth a million rubles for virtually nothing. Until the laws of depreciation change, they're stuck with the old gear. Once again, there's no correlation between real worth and actual prices, and they have no easy way out.

---

and the draft charter left departmental interests associated with informatics and computer science intact.

The absence of openness and democracy at the congress resulted in an organization that was composed of delegates who had no idea how or when they were elected to their positions. I. N. Bukreev, a deputy chairman of the state committee, who is now the chairman of the presidium of the society, told one of the congress delegates, "You were elected by voting secret from you!" What resulted was a congress made up of delegates representing the leadership of large enterprises, institutions, or ministerial departments, while the areas of science and technology were poorly represented. Some of the leading scientists in informatics and computer science were not invited, while, as the report of the credentials committee stated, there were 14 delegates without higher education.

Time will show the vitality and usefulness of the All-Union Society for Informatics and Computer Science. I will be glad if it improves informatics and computer science in the U.S.S.R. For now, it seems that users groups—which in the 1970s played a significant role in spreading information, forming public opinion, and evaluating new software products—might be more useful. Perhaps they should take on another form, but public initiative is necessary to ensure consolidation of forces at the upper level. Some timid, positive attempts have been made, such as the creation of clubs of professional programmers in Leningrad and other cities, which may be the basis for uniting efforts by the leading qualified developers.

This article contains words of sorrow. The current state of Soviet informatics is not happy, and there are no promising perspectives for tomorrow. Those involved in informatics and computer science can only look to the future for some hope. ■

Igor Agamirzian received his undergraduate and doctoral degrees at Leningrad University. He is currently a senior research fellow at the Leningrad Institute of Informatics of the Soviet Academy of Sciences, as well as an assistant professor for the computer science department at the Electrical Engineering Institute, Leningrad. You can reach him on BIX c/o "editors."

Anti-Obsolescent. Forval Super High-Speed V.32bis/V.42bis Modems.

Enhancements for your modem are just a phone call away. Simply dial FORVAL's headquarters and FORVAL-Link™ assures speed or feature upgrades automatically. Your modem is protected against obsolescence.

With FORVAL Turbo Interface,™ data integrity is ensured even at speeds greater than 19.2Kbps.

Modem can be used horizontally–or vertically when you need to save desktop space.

Forval's super high-speed dial-up modems are currently the fastest full duplex modems on the market–up to six times faster than ordinary V.32 modems. And they are compatible with all lower speed modems.

Completely compatible with CCITT dial-up standards.

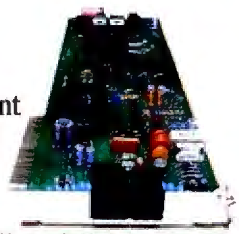
Controls and displays ensure complete visibility and management over modem operation.

Now you can get all this for the same amount you would spend on an ordinary V.32 modem.

Introducing the SA14400 from Forval. The first super high-speed modem designed to discourage obsolescence.

And don't worry about compatibility. Forval modems are compatible with all dial-up modem standards. So you can talk to anyone. Anywhere. No matter what the line conditions.

Your investment is also protected with a five-year warranty. And free high-speed communications software is included in the package.



Also available in board model for internal PC use.

So if you want a super high-speed modem that has it all, think of us.

Forval.

To learn more about our complete line of modems, call us today at **1-800-FORVAL-1.**

FORVAL AMERICA, INC., Modem Division, 6985 Union Park Center, Suite 425, Midvale, Utah 84047, Tel: (801) 561-8080, Fax: (801) 561-8777.

FORVAL

The Modem With A Future.™

Circle 115 on Inquiry Card (RESELLERS: 116).

FEATURE

A Talk with Intel

Designers of Intel's 386, i486, and future microprocessors talk about what lies ahead in CPU design, and the implications for personal computers

We recently spoke with three of Intel's top engineers about what lies ahead for the 80x86 family of microprocessors. John Crawford (right) was the chief architect for the 386, i486, and upcoming i586 microprocessors. Dave Vineer (center) led the design team for Intel's 386SL microprocessor. Bill Rash (left) is Intel's director of the Platform Architecture Center.

BYTE: Can you give us trends or movements that we can expect to see in the i586, i686, or i786 microprocessors?

JOHN CRAWFORD: I think there's a fair number of trends that we charted in the Micro 2000 project [Editor's note: *See the text box "Micro 2000" on page 132*], starting with the basic semiconductor technology: devices doubling every two years, frequency continually going up, number of pins going up, all these kinds of trends. All of that factors into, from a customer's point of view, overall performance doubling every 18 months. So we look back on that kind of a trend, historically, and project all the growth rates into the future, and say, "Ah, this is something like what we'll see at the end of the decade."

BYTE: One of the key things about the 486 was its integration of functions that were previously in separate ICs. Can we expect to see more of that kind of integration in future processors? And what kinds of functions can we expect to see?

DAVE VINEER: I think the 386SL is another example of integration. [Editor's note: *See "Portable Chips," December 1990 BYTE.*] If you look back a long time ago, back in the days of the 186 and 286, if you had suffered through any of Intel's product pitches, you would have seen two vectors, an integration direction and a performance direction. The 186 went in the integration direction, and the 286 went in the performance direction. The 486 was unique in that it actually went along both vectors—one of those happy situations where a higher-integration part performed better.

BILL RASH: In the Micro 2000 project, we talked about microprocessors with 50–100 million transistors on them, executing over a thousand MIPS, running at 250 MHz, having six different execution units all on the same die, sharing one memory that they're running out of. That's just sort of the ultimate point, as you carry the extrapolations to their

PHOTOGRAPHY MEL LINDSTROM © 1991

Micro 2000

Kenneth M. Sheldon

Intel engineers predict the shape of a twenty-first-century microprocessor

What will the microprocessor of tomorrow look like? According to Intel, it will be 10 times faster, have almost 100 times as many transistors, and incorporate more functions than the most powerful processors now available.

Last year, Intel engineers laid down the broad outlines for what they expect their leading microprocessor to look like in the year 2000. They drew on previous design experience, trends in chip fabrication, and expected advances in electronics technology to make their predictions. They called the anticipated chip the Micro 2000.

More Transistors

In 1975, Gordon Moore, chairman of Intel, predicted that the number of transistors that could be put on a chip would double every two years—a prediction that has proved quite accurate. According to Moore's Law (as it has come to be called), the Micro 2000 could have more than 50 million transistors onboard—20,000 times as many as Intel's original 4004 chip had, and 40 times as many as the i486.

Memory chips, which tend to be more densely packed with transistors than logic chips are, have increased in capacity at roughly the same rate. If the trend toward integrating more memory functions onto microprocessors continues (as a way of eliminating data bottlenecks), the number of transistors on the Micro 2000 could reach 100 million.

More Megahertz

Cramming all those transistors onto one chip will mean making them a lot smaller. The transistors in the Micro 2000 will be $\frac{1}{25}$ the size of current transistors, with a corresponding increase in the rate at which electrical current can be driven through them. The bottom line is that Intel expects the Micro 2000 to operate at a clock rate of 250 MHz.

Achieving that kind of speed will require developing new materials (e.g., tungsten) to interconnect transistors and new ways of arranging them (e.g., putting them in stacked multiple layers rather than a single large layer) to reduce the distance a signal has to travel.

More Power

What do you do with 100 million transistors? Intel engineers have detailed two possible scenarios for using them. The first is a high-performance multiprocessing chip (see the figure) that would incorporate four CPUs, each with 4 million transistors, each able to perform at 700 million instructions per second. That's a total of over 2000 MIPS, or 2 BIPS (*billion* instructions per second) for the entire chip.

This version of the Micro 2000 would include two *vector units* to perform vector processing, a technique borrowed from Intel's i860 RISC chip (which borrowed it from supercomputers) to perform floating-point calculations at high

extreme, of where we will find ourselves. And in the integration vector, we talk about having a single-chip PC in 1993. Then, further out in the decade, adding capabilities like speech recognition and full-motion video, all these kinds of things built into just a single die. All you would do is just hook up your memory to it.

JOHN CRAWFORD: And whatever else you need to be able to get input and output.

BYTE: Can you define what you mean by "PC on a chip"?

DAVE VINEER: Our definition of "PC on a chip" for 1993 is the [equivalent of the] IBM AT Model 339. So, what was an IBM 339, that will be our PC on a chip. It will be a 386 CPU, but functions that are included on that level of board will be on the piece of silicon.

BYTE: Memory will be extra?

DAVE VINEER: Memory will be extra. In my opinion, it's going to be a long time before we see memory integrated. The never-ending need for it continues to grow faster than the transistors. The people who are making DRAMs are having trouble keeping up with the sizes that we'd like to see, so that's not an area where Intel can greatly benefit the market in the short term, so I don't see that as something that we'd integrate. Cache RAM is something where we can give you better performance, and on the SL we integrated it because we also found that we could get better power.

Hitting the Wall

BYTE: As you get tighter and tighter integration, are you running up against physical barriers in terms of how small a trace can be?

BILL RASH: The process technology road map looks pretty clear-cut for us, for the decade. We don't see any real problems getting down to 0.3- or 0.2-micron features. In fact, there's been a whole flurry of articles out on how basically the semiconductor industry's convinced itself it doesn't *need* x-ray lithography for quite a while—we can continue with deep ultraviolet lithography and get down to those types of dimensions.

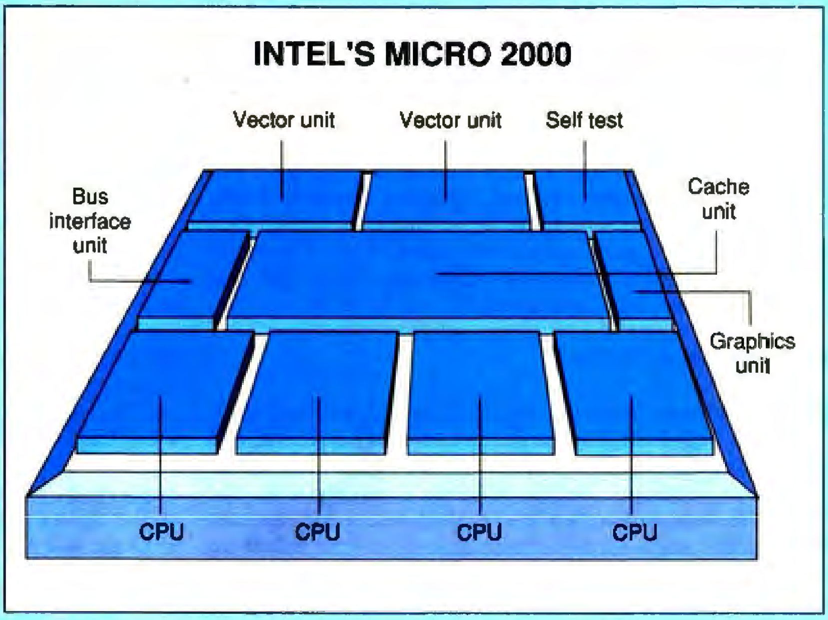
BYTE: Where do you hit the wall in terms of physical limitations? And then what kinds of other technologies come in to take you beyond that?

BILL RASH: To be quite honest with you, I think the biggest challenge we have is just finding the right kinds of features that speed. It would also have a 2-megabyte cache memory (compare that to the i486's 8K-byte cache) so that it won't often have to go off-board for data, as well as a graphics unit (made up of 4 million transistors) designed to provide high-resolution, HDTV-quality, full-motion graphics.

More Integration

The other possible design for the Micro 2000 would trade off some performance for even higher levels of integration; it would have only two CPUs, one vector unit, and a smaller cache. The remaining transistors would be used to incorporate on a single chip all the functions necessary for a personal computer.

Currently, the 386 microprocessor requires about as many transistors for support logic chips (250,000) as are on the chip itself (275,000). Extrapolating from that, Intel has allocated 8 million transistors for "miscellaneous PC" functions, such as controlling disk drives and memory and communicating with other systems. Engineers have also allotted 8 million transistors for the Human Interface Unit, which they admit is a black box: a yet-to-be-designed device that will make computers easier to use than ever before, perhaps by incorporating such technologies as speech recognition.



A high-performance multiprocessing version of the Micro 2000.

Compatibility

Ah, but all this new technology means we'll have to throw out all our old software, right? Not so, says Intel.

Intel claims that the Micro 2000 will continue to be upwardly compatible with the 386 and will run all software that currently runs on that processor. Of course, the availability of so much additional raw computing power could pave the way for new applications that make current programs look antiquated.

Kenneth M. Sheldon is BYTE's senior editor for features. He can be reached on BIX as "ksheldon."

really take advantage of all the transistors that we have and being able to partition a system in a way such that you take the things that have to be very, very fast—that have to communicate with each other—and put them together so that they can communicate all on a single die. Because the moment you have to go off-die, you sacrifice a tremendous amount of bandwidth capability, and you put this little bottleneck in the system where you try cramming data through.

Another challenge in general is just having the software develop in time to really take advantage of that level of performance as well. Obviously, you don't need 1000 MIPS to run the software that any of us have today. There has to be an awful lot of software developed between now and the end of the decade that's going to consume that much power [for] somebody to want to do it.

BYTE: How about multiprocessing? The 486 has some capabilities in that area. Are you looking to expand that capability in future processors?

JOHN CRAWFORD: From our perspective, that's probably more of a systems issue than a chip issue. I think we have enough basic hooks in the product line today to support that, and we see a number of companies—Sequent being one; NCR is another one—that have multiprocessor systems based around our product line. So, it's a question of taking advantage of that. There's a significant amount of work at the system level to get multiple processors working together.

BYTE: What do those hooks consist of?

JOHN CRAWFORD: Well, things like having the memory hierarchy stay consistent; that's certainly a very important one. Another key one is some kind of method for signaling between the processors. Some kind of memory-locking scheme is a typical one—that's the one that we use. Those kinds of things.

BYTE: There's going to have to be a fairly significant shift in software platforms for a multiprocessor chip to be useful. Do you foresee that being something that's going to have to go hand-in-hand with hardware development, or do you see either one driving that?

BILL RASH: I think we see a number of trends today that indicate the direction it's going in. Look at the way OS/2 is set up—by supporting multiple threads and multitasking, it gives you the ability to use those multiple processors. Obviously, if you're going to run two processors at once, [you use] one processor per program. But even in the case of the single application, in a single-user environment, multithreading means that, in your spreadsheet, while one processor is drawing the screen for you, the other processor can be recalculating the spreadsheet.

So we see a direction in products like OS/2 that says the software is going to be able to take advantage of multiple execution units in parallel. And even Microsoft talks about Windows long-term incorporating the capabilities of multiple threads, like OS/2 has. So this is an important feature that all the major operating systems in the world are moving toward.

Take a look at the kinds of applications that consume that performance. At Comdex, we had a demo of a speech-to-text conversion running on a portable 486 computer. It would transcribe continuous speech—you didn't have to pause between the words. [It had] a 1000-word vocabulary, and a 486 was doing the speech-to-text conversion.

BYTE: What was it running?

BILL RASH: It was running Dragon software. It wasn't doing it in real time; you'd talk for a while, and it would pause a bit, and out would pop the text. So a 25-MHz 486 isn't quite there yet for real-time performance. But the software's running now, and I'll admit the human interface isn't perfect, but give them time, and with some faster CPUs coming along, you'll be able to do the speech-to-text conversion in real time. But the issue of continuous recognition has been solved; you don't have to pause between the words, and multiple speakers could talk to it. It's not perfect—it won't take any accent and convert it—but it shows that the software really made a jump forward into what I view as a very critical human interface technology, the computer getting to the point where first it can transcribe the text. Then, of course, you let all the linguists go to work on figuring out the meaning of the words in the text; but first off, at least you get it into text so that the computer can start figuring out the meaning of it.

And certainly there are applications where just simple commands are useful. I'd love to have an answering machine I could at least give a few simple instructions to: "Is this person here?" The thing could say yes or no. "How can I get hold of them?" Those kinds of things. You can envision your computer on your desk becoming an answering machine that can actually talk to the people on-line and give some reasonable set of answers on a limited set of topics.

A Designer's Frustrations

BYTE: What's been the most frustrating thing about the software that runs on the hardware you've designed?

DAVE VINEER: I think the most frustrating thing for me has been the length of time that it's taken to finally take advantage of the 32-bit power. Still having 16-bit operating systems and programming interfaces is really hampering a lot of people.

BILL RASH: Both Dave and John are engineering users, so they run these monster programs that consume, what, 400, 500 MB of program space?

DAVE VINEER: Even running things like PowerPoint under Windows—it's slow at times, and it could be significantly faster if it was 32-bit.

We introduced the 386 in October 1985, and by November, we were all very frustrated that significant 32-bit applications hadn't yet surfaced and that Microsoft hadn't done a 32-bit DOS, etc. But clearly, there needs to be a critical mass of installed hardware, and there has to be a clear trend... well, there has to be a market for the 32-bit software in order for it to be produced. Particularly, the events of the last couple of years have really set in place that installed base, and it's just a question of time now until that takes over.

BYTE: Do you think that when OS/2 2.0 comes out, it will be significant enough that people will really start jumping on it? Will the performance difference of a full 32-bit implementation be significant enough to jump-start OS/2?

BILL RASH: In general, I don't know if the conversion will necessarily happen on OS/2. Windows will also go to 32-bit, but that transition will be really pushed hard by the fact that users are going to discover that, on a piece of hardware that used to work at a certain speed, when they get the 32-bit version of this application, all of a sudden the responsiveness goes up. That will motivate a lot of people to spend whatever the upgrade fee is to get the new release of the 32-bit application. There's a great business opportunity for all the application vendors out there to sell yet another upgrade to their favorite application.

BYTE: Are there features of your chips that have been overlooked or misinterpreted? Things that you would like to point out?

There's a significant amount of work at the system level to get multiple processors working together.
John Crawford

BILL RASH: Power management inside the 386SL. One of the things we've seen is that there has been a lot of interest in building desktop PCs [PC compatibles] that don't have fans, that are totally silent. So the idea of having power management in your desktop system is that the system shuts down when you walk away from your PC, and it cools off internally. When you sit down and start using it again, the fan may not ever turn on, even between keystrokes. And the way you do that is that you power down the PC as much as possible in the desktop.

DAVE VINEER: Anytime you take advantage of something like this, there's some big design effort that has to go into it. We've added a specific form of power management on this chip, a specific set of tools that you can use, and those tools are mostly implemented in the hardware. Now, you could totally ignore those and do it the old-fashioned way, but there are many


Crunch!
Nothing crunches numbers like the Advanced Math Co-Processors from Integrated Information Technology. They really speed up graphics, CAD/CAE, spreadsheets, and other calculation-intensive applications.
Three models provide a perfect match to your 286, 386, or SX PC, delivering up to twice the performance of other CoProcessors. No wonder hundreds of thousands have been sold. Five-year limited warranty. BYTE-rated. So plug in, and crunch!
Count on iit.SM
INTEGRATED INFORMATION
Advanced Math CoProcessor
INTEGRATED INFORMATION
Radically Reduce The Time Involved In Your CAD And Mathematical Calculations
Available at most local dealers.
SM (c) 1991 Integrated Information Technology, Inc. All rights rese
Circle 138 on Inquiry Card (RESELLERS: 139).

things that the old-fashioned way could not do. And without taking advantage of some of the tools that we gave specifically to solve some of these problems, they could make the same sort of machines that they have today—"they" being any particular company—and reach approximately the same level of power as they have today. It would be slightly lower because it's a static part. . . but to take full advantage of it, they would have to redesign and rethink how they're going to do their power management. The hardware—obviously, it can be smaller now.

BYTE: So, six months from now, we'll see a whole new crop of notebook portables coming out?

DAVE VINEER: I'm sure we will.

JOHN CRAWFORD: Higher performance, smaller package, lower power, longer battery life—which means lighter, because they'll have smaller batteries.

DAVE VINEER: That's really the trend that I think we're going to see for a while. We're not going to see longer battery life; we're going to see smaller, lighter machines, because they're going to make the batteries smaller to take advantage of the fact that we use less power.

BYTE: So we'll be sticking with the 2- to 3-hour battery life that we now have?

DAVE VINEER: I think so. There will be some that are going to go up. There are a few lunatics out there who say that as long as it needs to be plugged in, it's a worthless machine. Someday that may happen: [computers] powered by the electricity in your finger.

BYTE: Or a solar-powered panel?

BILL RASH: Or the heat of your body; you put it in your shirt pocket, and the heat of your body recharges the battery.

Again, it's interesting. The features of those notebooks translate to the desktop. Power management is one thing. Another thing is this idea of auto-resume. I mean, why does everybody have to boot their computer every day? It's really kind of crazy. They walk away, the system shuts down, they come back the next morning, and [the system is] back to where they left it off, and it wasn't consuming power all night, heating the building up.

The Hunt for Bugs

BYTE: When the 486 first came out, a couple of bugs were reported; there was some obscure arithmetic instruction that wasn't working right. Was that just a normal process of the chip being built?

JOHN CRAWFORD: Well, any of these products is extremely complicated, and although one of the keys to our success is making sure that we can build these things and eliminate these kinds of errors to produce a product that is reliable, we can build millions of them and sell millions of them—that's an extremely complicated thing.

Maybe a laptop will be nothing more than a Docking Station for a credit card.
Dave Vineer

I think there's a lot to be done in the world of software.
Bill Rash

BILL RASH: I think that what's interesting is that as the parts get more complex, the number of errors keeps going down with each generation. So we continue to refine our ability to essentially do zero-defect design so that the designs work from the beginning. That is our goal—zero defects; I'm not going to claim that we will get there next year, but we cut the number of errors by a factor of three in going from the 386 to the 486.

DAVE VINEER: There's a certain number of bugs that you can find before you "tape out," and a certain number that you find after [going to] silicon. On the SL, we tried for the first time to boot DOS on [a simulation of the 386SL running on] the mainframe. We have an IBM 3090. And it took approximately two weeks of continuous running to get to the C:> prompt. This is running a full logic simulation of the chip.

Now, all of us know that just because the DOS prompt comes up doesn't mean your PC's perfect; there are many machines that give you the DOS prompt that have lots of incompatibility problems. So you can see that, if we were to try to run Windows—which you know how long *you* wait for—we wouldn't be there yet.

So there's always a magic point where the design engineer says, "I've found as many bugs as is practical without seeing real silicon," and runs the real silicon. Now, whether the customer sees the bug or we see the bug is dependent on how soon our customers want to see the silicon. Everybody's chomping at the bit; they want to see it the same day we do, and we want to hold off and debug it and make sure it's as clean as possible before they get it, but nobody's willing to wait. That endless cycle of balancing the teeter-totter is what causes some customers to see bugs, and some not. And the ones who see bugs are the ones who know that they're getting silicon that we haven't gotten all the way through yet.

BILL RASH: This whole area of finding bugs in our silicon early has been a big area of focus for Intel in the last few years. We've really invested a lot of effort into developing some totally different approaches to try and find the bugs in our designs before they get to silicon, before they get to one of our OEM customers, and certainly before they show up on the shelf in a computer store.

DAVE VINEER: One of the interesting anecdotes is that we had 386-based workstations to develop the 486, and a lot of those are still in service. We also used the 386-based workstations for the SL—a nice incestuous relationship.

BILL RASH: Actually, I think there was an interesting story where we discovered that one of the idiosyncrasies of the 386 masked a bug early in the 486 design, because the workstation executing a certain instruction did it exactly the way the 486 would have.

BYTE: A kind of genetic flaw?

BILL RASH: We discovered it before the design went out, but I remember there was a story about the fact that we were using a microprocessor that was identical to the one that we were simulating.

New Technology

BYTE: What kinds of new technology do you see coming out of laboratories that will have an impact on the way you design chips?

DAVE VINEER: Well, our group has been kind of inward-focused, because we haven't figured out what to do with 100 million transistors. Offer me a billion, and I still don't know what to do with them.

BILL RASH: There are other things that are not related to transistors but that affect a lot—for example, different ways of packaging. Look at this board; see how thick it is? [Editor's note: *See the prototype laptop board shown in "Portable Chips," mentioned above.*] If you think about the silicon die on there, it's considerably thinner than those packages. By the time you want to start slipping something into your pocket, this kind of packaging is unacceptable. You've got to come up with much simpler ways of mounting the silicon dies themselves onto substrates that are thinner than this to interconnect things. So there is a lot of technology on packaging that's going to be critical in making computers into something that you can slip into your shirt pocket.

BYTE: More integration?

BILL RASH: Could be. The key is to eliminate all this plastic we put around the silicon die. More low-tech stuff.

DAVE VINEER: There's the "chip on board" that we've been doing a lot with in the last few years. Memory cards are another example. Possibly you are going to see CPU cards. Maybe a laptop will be nothing more than a Docking Station for a credit card.

BILL RASH: What's fascinating is that display technology is moving into the realm of semiconductors. If you think about what are the best displays that you can get today, they're all active displays, with literally a transistor per pixel, and it's almost semiconductor technology. Or four transistors per pixel in order to do color, with one redundant transistor in the group. Again, that's the kind of technology that will give me my handheld computer with a nice hi-res display. The trick now is to get the equivalent of a 50-MHz 486 all integrated in there, with enough memory to do speech recognition for me so that I don't need my "chicklet" keyboard; I can just talk to the silly thing to take notes and things like that.

JOHN CRAWFORD: I think that's where a lot of the more exciting stuff that we see is coming out of, not from the silicon technology per se, but in a lot of the peripheral equipment, if you will: displays, speech recognition, multimedia, all this good stuff.

BYTE: Do you think it makes sense to have a special chip for speech recognition?

BILL RASH: Speech recognition is an extremely software-intensive application. It takes megabytes and megabytes of data patterns and code, things like that. It's hard to imagine that as a dedicated chip, because the thing has to be trained for the vocabulary. I find it hard to believe that you could have a dedicated chip that you could magically feed an analog signal into and out pops a string of ASCII text, all in one chip. Maybe 10 years from now, but in between, there is going to be a need for an awful lot of software that a more general-purpose microprocessor grinds through in order to do the pattern recognition that is an essential part of speech recognition.

BYTE: It's intriguing that you don't know what to do with all those transistors.

JOHN CRAWFORD (*laughs*): *I* didn't say that; I've always got plenty of ideas.

BILL RASH: It is a challenge to make sure that we can really use those transistors, because if you don't use them effectively, what you end up with is, somebody else builds something with half the number of transistors that does the job just as well, and you're at a cost disadvantage.

DAVE VINEER: Or, more embarrassingly, does the job better.

JOHN CRAWFORD: I think it's also a fact that if you look out 10 years from now, it's very hard to predict exactly what we're going to build. If you look back 10 years, were we predicting that we'd have 486s and i860s and SLs in the marketplace? I don't think so. So predicting what we are going to be building 10 years from now is very risky. But I think that in terms of some of the raw technology numbers, the relentless march of

semiconductor technology is going to continue, and we can project from that. For next year's—1991 and 1992—product plans, we have a very good idea of what's going to be in the marketplace, at least from Intel. If you look out to the 1993, 1994, 1995 time frame, we have a *fairly* good idea of what we're going to build, what we'll have available. Of course, things will change as time goes on.

DAVE VINEER: That's part of my comment, too, of not knowing what to do with a hundred million transistors. If you really sit down today and say, "OK, I'm going to build this wild machine, and I'm going to put everything in it," I'll guarantee you can't spend a hundred million transistors. It's like spending a million dollars in a day or a month and walking away with nothing.

BILL RASH: Want me to tell you how, Dave?

DAVE VINEER (*holding up a notepad*): This is my laptop, today. I'm looking for something that replaces this. This is it. This is what I want. When I can do everything that I can do with this pad of paper and this pen, I might be happy. That means being able to tear things out and hand them to my secretary. It means being able to draw pictures, it means being able to put in text, it means being able to keep my calendar, and everything else. This is my calendar. So, this is how I live, and this is what I'm looking to replace. If you can imagine this as a laptop, this in electronics, that's how I can account for 15 million transistors. Now what do I do past that? I guess I can start talking to it.

JOHN CRAWFORD: Well, if you want to double the performance, I can tell you how to use 60 million.

DAVE VINEER: OK, 60 million. But I guess I'm against having it implanted in my head.

BILL RASH: [That brings up] this whole idea of the human interface that we have to the computer, and what happens when you really think about integrating audio into your computer, such that your computer can literally answer your telephone for you [and] file away your telephone messages. The laptop you carry with you: You set it next to your main computer, maybe on an infrared link, or an RF link, and the two update each other. You don't even have to hook it up—just sort of bring it close to your home computer, and they update each other as to what happened lately.

[It could] even give you your telephone messages and transcribe them from speech to text so you can see your E-mail messages on your little hand-held that you carry around, because they've been transcribed for you. Or you call up your computer and listen to your E-mail messages, which are transcribed from text to speech; you can hear what E-mail messages you've received while you're traveling.

People are going to really think through some of these scenarios of what people do, and what kinds of technologies have to be integrated into a PC to really make everybody more productive and [do] less drudgery work on their computers. And I think there's a lot to be done in the world of software. I think we're developing an awful lot of hardware here, to crank out the horsepower to do it. ■

BYTE staff members participating in this interview were Owen Linderholm, Rich Malloy, Andrew Reinhardt, and Kenneth M. Sheldon. You can reach them on BIX as "owenl," "rmalloy," "areinhardt," and "ksheldon," respectively.

SERIES 400™

High-Speed Caching Disk Controller

Unprecedented Hard Drive Performance at an Unbelievable Low Price!

SERIES 400 Features

- Models available for SCSI, IDE, ESDI, MFM* and RLL*
- Supports two floppy drives (5.25" or 3.5")
- WD 1003 emulation for driverless installation
- All Networks, UNIX, OS/2 and DOS compatible
- Easy installation
- 512 Kb-to-4Mb on-board cache RAM
- Uses low cost 100 nsec SIMMs
- Read and write cache for best overall performance
- On-board 16-bit parallel processor, and data bus with 56-bit ECC
- Dealer upgrades for disk mirroring and more*

Affordable, Lightning-Quick Disk Access

In today's high performance PC's, disk access is the number one system bottleneck. The SERIES 400 from SSDC is a new class of hard drive controller with its own powerful on-board parallel processor and memory to independently manage disk drive data. The SERIES 400 actually anticipates what information the PC is going to need and stores the data in its own high-speed cache RAM. Disk accesses are 100 times faster and large file transfers are up to 10 times faster. This means applications load and execute *fast!* Even the slowest and most cumbersome applications become lightning quick. All applications – Windows, CAD, large databases, desktop publishing – *become supercharged with near instant file access*. SSDC has broken the price barrier to hardware disk caching. No longer is powerful disk performance limited to mainframe systems.

SERIES 400 Benefits

- Tremendous increases in system performance
- Accelerates disk access over 100 times
- Increases file transfer rate 5 to 10 times
- Speeds up ALL disk -intensive applications
- Frees up system resources for increased performance

Across the Board Performance Advantage

	SERIES 400	DPT-3011	FTI 2410
Effective seek time	0.270 msec	0.360 msec	0.500 msec
Sequential read	2235 Kb/sec	1353 Kb/sec	824 Kb/sec
Sequential write	1892k	824k	617k

Feature Comparison

	SERIES 400	DPT-3011	FTI 2410
Retail Price	$845.00**	$1195.00	$1595.00
With 4-Mb RAM	$1245.00**	$2095.00	$2190.00
Max memory on-board	4Mb	4.5Mb	2 Mb
Memory type	SIMMS	Custom	Custom
WD-1003 Emulation	Yes	Yes	Yes
Custom drivers	Optional	No	Optional
Drive types supported	IDE,SCSI,RLL ESDI, MFM*	ESDI, MFM,RLL	ESDI
Networks, UNIX and multiuser systems	All	Most	Some
Boot drive	Any	"C" only	"C" only
1-to-1 interleave	Yes	No	No
Auto data repair	Yes	No	No
Parity check RAM	Yes	NO	Yes
12.5 bus speed	Yes	Yes	Opt.
Data look ahead	Track	Sector	Sector

CACHE IN

Call Today

Cash in on the time you'll save with the SERIES 400 High-Speed Caching Disk Controller from SSDC. You'll enjoy startling increases in system performance, at an affordable price. Installation is simple and the SERIES 400 is fully compatible with all 486, 386 and 286 systems. Call toll free 1-800-284-7732 for your nearest SERIES 400 dealer.

* 2nd quarter 1991

** Prices for ESDI, RLL and MFM are slightly higher. Prices subject to change without notice.

Circle 312 on Inquiry Card.

SPECIALIZED DEVELOPMENT CORPORATION
1001 Capital of Texas Hwy. South, Bldg. I • Austin, Texas 78746
512/327-8608 • FAX 512/327-5233

Where can you get every font you'll ever need for your LaserJet III?

Try the Library.

Our Complete Font Library Cartridge™ for the LaserJet III has 51 different typestyles, each scalable to virtually any size, so that you can make your point like never before.

Just as a library has books on every topic, our Complete Font Library Cartridge has a typeface for every kind of document you create. Choose from classic typefaces for proposals, letters, and presentations. Or from designer styles for flyers, invitations and advertising materials.

You see, each of your documents has a different message. And, the way that message is perceived depends greatly on the typeface and point size you choose. A CG Century Schoolbook means business. A CG Bodoni says style. While Cooper Black expresses creativity. Messages like this are difficult to portray on printed pages when you only have access to the one or two typefaces resident in your laser printer.

Our cartridge is unique. In fact, it's unlike any other cartridge for your LaserJet III. That's because our breakthrough windowing technology has allowed us to put what was previously in two separate cartridges, into a single cartridge. The result? Inexpensive and convenient access to every font you'll ever need for your LaserJet III.

For directions to the Library, call your nearest dealer or contact: Pacific Data Products, 9125 Rehco Road, San Diego, CA 92121, **(619) 597-4643**, Fax (619) 552-0889.

PACIFIC
DATA PRODUCTS

AGFA Agfa

High-Speed Safety

There are limits to standard PC serial communications caused by limitations of the port, the CPU, and the bus. There are also solutions.

KEN KRECHMER

With new communications capabilities, users are operating PC serial ports at higher data rates. Digital data communications services provide data communications at 56,000 and 64,000 bps, and ISDN basic rate interfaces providing 144,000 bps are now emerging. New data compression functions within modems and other data communications equipment (DCE) make 4-to-1 compression of text data possible. As a result, users are developing applications, such as CAD/CAM and LAN interconnect, that require serial communications at rates substantially above 9600 bps.

Unfortunately, at rates above 9600 bps, PC serial ports can operate unreliably, particularly when the operating system is multitasking (e.g., Windows, OS/2, or Unix). Even a TSR program can affect the reliability of serial communications. Windows 3.0 claims support for serial communications up to 19,200 bps. However, when users have problems with the integrity of data transmission, technical-support personnel as well as communications hardware and software vendors regularly suggest setting the maximum serial port rate at 9600 bps, assuming that the problems result from the inability of the communications channel to support the higher data transfer rates.

In fact, these particular data-integrity problems have nothing to do with the operation of external communications. The problems lie within the PC. Whether your computer communications system has such problems depends on its processor type (e.g., 286, 386, or i486), bus clock rate, and cache memory organization, as well as the actual serial data rate supported.

Within the PC

The serial communications process begins when an application or operating-system service requests the processor to transfer data on the PC bus to the serial port. If the computer bus is being accessed by another application at the same time, the communications process will be delayed. However, the serial port operates at a fixed data rate. If a delay occurs that exceeds the number of bits transferred per byte divided by the channel transmission rate in bits per second, the serial port sends a NUL character to the remote DCE. When transmitting from the PC, the NUL character only reduces the effective data transfer rate of the communications channel; it does not cause data loss.

The situation can become serious when data is received. Data loss can occur if the serial-to-parallel converter in the modem attempts to place data on the computer bus when the computer bus is active doing other tasks. If a data byte cannot be passed on to the PC communications application by

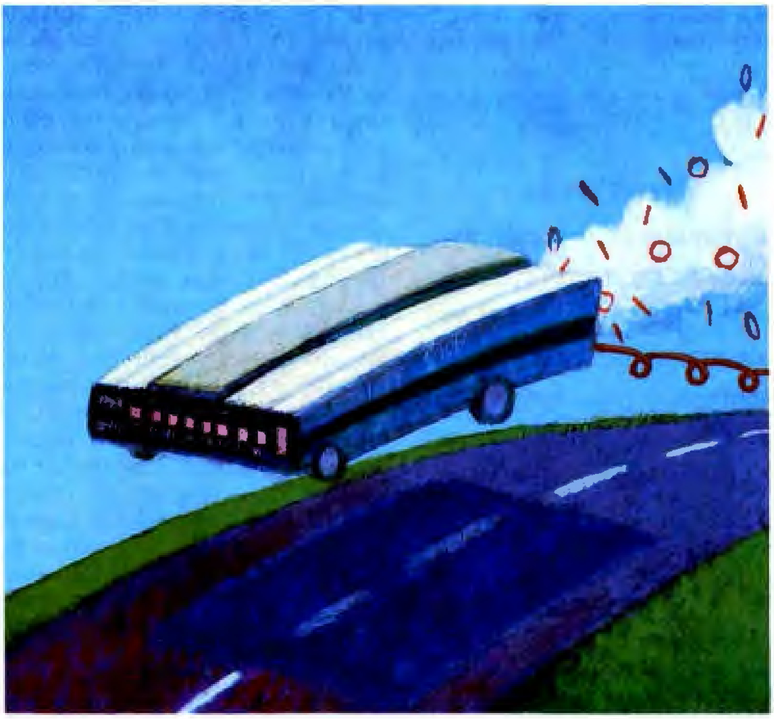


ILLUSTRATION: KEVIN HAWKES © 1991

MAXIMUM DELAY ALLOWED FOR DATA RATES

The table assumes the most efficient communications software supporting 8-bit bytes. It is possible that the effective serial port rate (in bytes per second) on the personal computer bus may be different in either direction.

Delay before data is lost/delayed	Serial port (bytes per second)	Communications channel (bps)
6.6667 ms	150	1200
3.3333 ms	300	2400
0.8333 ms	1200	9600
0.5556 ms	1800	14,400
0.4167 ms	2400	19,200
0.2083 ms	4800	38,400
0.1428 ms	7000	56,000
0.1250 ms	8000	64,000

millisecond (ms) = .001 second

the time the next data byte is assembled from the modem, then data is lost. The amount of data that gets lost depends on the type of serial-to-parallel converter connecting the modem and the computer bus (e.g., what size buffer is operational) and the length of time the computer bus is occupied with other tasks.

A data compression function can also make the symptoms of a data-integrity problem more confusing. When transferred data is not compressible, data loss problems may not appear. In some cases, only when compressible data is being transferred does the effective data transfer rate exceed the physical limits of a PC system—a more difficult situation to troubleshoot, and all the more reason to test the capabilities of a system before it is placed in service.

Data-integrity problems rarely occurred when communications took place at 2400 bps and PCs worked on one application at a time. At those rates, interruptions of 6 or 3 milliseconds, respectively, would not cause a problem in an IBM AT.

BYTE ACTION SUMMARY

Speed Traps

Despite the claims of many vendors to the contrary, modems often do not deliver data throughput in actual applications at rates even close to the ones attested to. Here's how to test your applications environment to identify when data throughput is less than that desired and, if so, how to improve it.

An 8-MHz AT requires about 0.25 ms to support a single serial port interrupt. Modems operating at 9600 bps and using data compression can cause data to transmit four times faster (4800 bytes per second). When the maximum delay before data-integrity problems occur is 0.2083 ms, a single interruption of 0.25 ms will cause data loss. Such interruptions are common in a computer system that supports multiple applications.

The table above shows the maximum delay allowed for various data rates. If the communications software application is designed to work with asynchronous modems without data compression, it may transfer data to the serial port (transmit direction) at one-tenth the transmission rate. The software anticipates the transmission-rate reduction that occurs when the start and stop bits are added in the serial port.

When data is lost as it passes between a modem and a computer, it is not corrected by an error-controlled modem (using either MNP level 4 or V.42). Error-controlled modems can only detect and correct data errors that occur between the DCE devices (e.g., on the communications channel). The data-integrity problem is particularly distressing for users who have modems with error control, because even with that, you cannot be certain if you are losing data or not.

True Throughput

The text box "Determining Serial Throughput" on page 147, describes the issues that affect serial port throughput. Although determining the speed of the modem is reasonably straightforward, determining the actual compression performance and any data transfer problems between the serial port and the microprocessor is more difficult. Only when you consider the sum of these items can you determine the actual throughput of the communications system.

Communications Test Program from R. Scott Associates (Raleigh, NC) is a good tool for evaluating the true communications throughput (including the effect of compression) provided by modems and the communications channel. If you use CTP with the same PC configuration as the communications application, you can start identifying possible computer-related communications performance problems. To accurately project performance by the compression used, you need to send the same type of files as you do when running the application.

Unlike common communications programs, which poll the serial port for received data at a fixed rate, CTP responds to each interrupt (single byte) on the serial port. This provides a more accurate indication of the communications channel throughput without considering degradation from the limitations of the PC.

Even though CTP is designed to test the maximum throughput of the communications channel, using it on a single PC in a loopback test is valuable. To perform this test, set up one PC with the same configuration (but with two serial ports) that you will use for the application (see figure 1). Establish a local connection using two modems and two telephone lines and invoke CTP. Or, you can bypass the local phone system by patching between the modems with RJ11 cable and using the Hayes modem ATO (originate) and ATA (answer) commands on the originating and answering modems, respectively.

The throughput tests are best run over a long enough time span to provide a realistic metric of the data being transferred between the transmitting and receiving applications. Measuring the throughput over a long time span is a better metric of the throughput than you could anticipate through practice. For example, if the test file takes less than 5 minutes to transfer, make a file consisting of multiple copies of the original file and transfer the larger file.

Don't make the mistake of measuring throughput by the time it takes to transmit from the first to the last byte. The correct way to measure throughput is from the first byte transmitted to the last character received. This accurate measure of throughput requires the use of a common time reference in the receiving and transmitting applications, easily done when you use CTP and a single PC.

CTP allows you to perform the test in a single direction (half-duplex) or in both directions at the same time (full-duplex).

continued

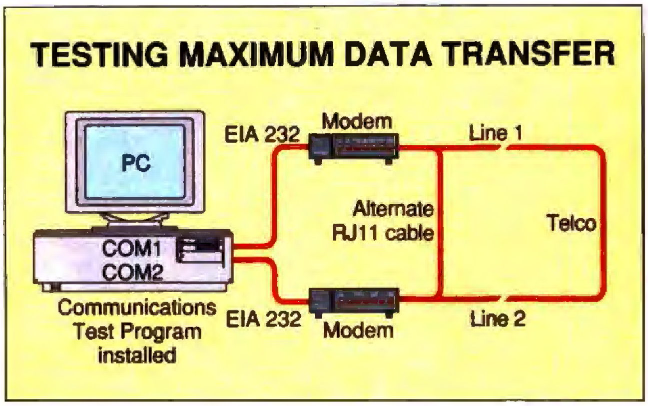


Figure 1: *To test the maximum data transfer rate using the Communications Test Program, use a single PC with two serial ports and two modems. The modems can be tied together by traditional phone connections and dialing or by a direct RJ11 connection and the Hayes modem commands ATO (originate) and ATA (answer).*

Choose half- or full-duplex depending on the requirements of the communications application that you implement. It is far easier and more accurate to perform such an analysis when the transmitter and receiver are in the same device. Other test approaches transfer the information between two PCs and require a means of maintaining a time reference between them.

To use CTP at high data transfer rates (e.g., 57,600 bps), you may need to disable "send data display" if you are using a 12-MHz, zero-wait-state 286 PC or less. (You can disable "send data display" as a CTP option.) Even at rates of 19,200 bps with less than 65 characters per line, you may not be able to transfer serial data and video data at the same time, because writing to the video monitor interface uses BIOS calls that create too much CPU activity. The added load on the PC processor and bus interferes with communications port activity.

Checking for Data Loss

If the testing suggests that you have data loss at the data rates required by your application, you need to do more testing. You need to identify if any data may be lost in actual practice.

Using two PCs, configure both systems with the computer software and communications hardware identical to that of the application environment. The simplest communications channel that allows the two DCE devices to be interconnected will suffice.

Transfer files between the two systems and store the data on the destination system's floppy disk. At the completion of the transfer, use the DOS COMP command to compare the data. Differences in the files indicate data loss in the computer, since error control is provided over the communications channel.

Organize this test methodically. Use one standard test file for the first test and this second one. First, send the file exactly as the production application would. Next, send the file (assuming a multitasking environment) while other applications are operating on the receiving computer. As discussed earlier, data loss may occur in the receiving computer. The transmitting computer can only cause reduced throughput. Then, send the file in both directions at the same time (assuming this could occur in the real application).

A little creative testing now will prevent hours of painful troubleshooting later. Format a blank floppy disk, and recalculate a spreadsheet or generate a database report, all while re-

Determining Serial Throughput

The actual throughput between two PCs over a telephone line using any data communications equipment depends on three parameters: (1) the transmission rate between the DCE (see the figure below); (2) the data compression used, if any, and its efficiency on the data being transmitted; and (3) the ability of the PC systems to pass information rapidly between the software and the modem. When these effects have been considered, an analysis can be made of the true data transfer rate between two PCs. Testing is the only reasonable means to determine the actual operation and data integrity of a communications system.

The Transmission Rate

The transmission rate is part of a modem standard (see table A). Full-duplex standards are indicated, but many manufacturers also provide standard or nonstandard half-duplex modems.

After a call from an originating modem is connected to the answering modem, the answering modem sends a high-pitched tone (answer tone). On receipt of this tone, the originating modem starts a process termed *handshaking*. It is during the handshaking process that the two modems will determine what modulation type(s) each is capable of and agree to use a common modulation. The usual handshaking implementation generates a connection at the fastest common transmission rate.

The Data Compression Mechanism

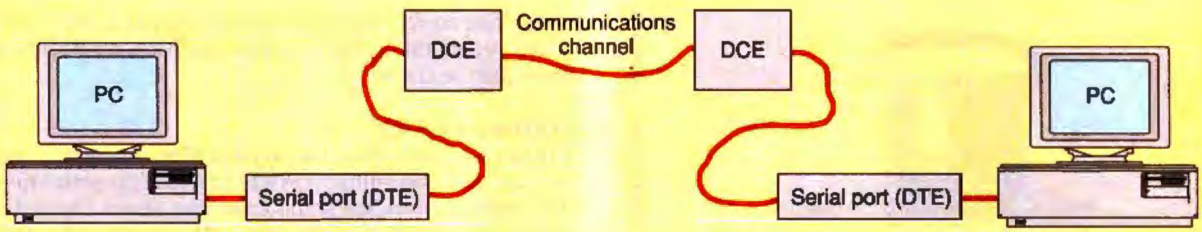
Several data compression algorithms are available for use in modems and other DCEs. The compression ranges shown in table B take into account the effect, in asynchronous transmission, of removing the start and stop bits. Postulating a continuous fixed data compression rate allows a view of the potential compressed data rate. Assuming a factor of 4 compression:

$$9600 \times 4 = 38{,}400 \text{ bps}$$
$$14{,}400 \times 4 = 57{,}600 \text{ bps}$$

Determining the exact compression that will occur in a transmission is usually not possible, because it depends directly on the exact bit patterns that are being transmitted. Patterns with high redundancy, such as ASCII text, can be compressed more than a binary file.

The use of data compression makes it more difficult to determine the exact data transfer rate. When data is not very compressible, the serial port operates at lower data rates. Additional complication comes from the fact that the communications software application may transfer data to the modem at one-tenth the data rate, anticipating the reduced rate caused by adding the start and stop bits. This effect reduces the actual data transmission rate by 20 percent.

SERIAL COMMUNICATIONS SYSTEM



DCE = Data communications equipment (e.g., modem)
DTE = Data terminating equipment (source and destination of signals in communication link)

COMMON MODEM STANDARDS

Table A: *The transmission rate is described as part of a modem standard.*

Common modem standards	Main rate (bps)	Alternative rate (bps)
CCITT V.32bis	14,400	12,000/9600/7200
CCITT V.32	9600	4800
CCITT V.22bis	2400	1200
Bell 212	1200	n/a
Bell 103	0-300	n/a

DATA COMPRESSION PROTOCOLS

Table B: *The computing resource required is a relative indication of the performance of the hardware. A 1 is a low-performance system, such as an 8088 system, and a 4 might be a 386 system.*

Protocol	Nominal compression rate	Computing resource required	Comments
MNP level 5	2	1	Proprietary
MNP level 7	2-4	4	Proprietary
V.42bis	2-4	2	CCITT standard

ceiving the test file. Such processor-/bus-intensive activities should indicate if data loss can occur.

When you compare the original and transferred files, any discrepancies indicate data loss. If there is data loss, several possible approaches will prevent it. First, you can reduce the maximum allowed serial port data rate of the connection. While this is certainly not desirable, it is better than running the risk of undetected data loss. Alternatively, use a faster computer.

Next, you can prevent, by software design or user instruction, the operation of simultaneous applications that cannot be supported without the risk of data loss. Disk formatting is an example of a processor-/bus-intensive task that can be avoided during communications. However, avoiding other simultaneous applications can be difficult to enforce and more difficult to accept.

Finally, you can obtain hardware and software that corrects or prevents this type of problem without degrading system performance. This is the best approach.

Application Software Error Control

If the communications application software offers a means to detect and correct errors through to the remote end system, then any bytes that are lost on the computer bus would be detected and corrected. Protocols such as Kermit, XMODEM, YMODEM, and other PC-based error-control protocols perform this function. There are several caveats, however:

1. The protocols (especially earlier versions) used by communications application software may not be communications-efficient.
2. Many software communications applications do not have access to an error-control protocol within them.
3. The software-based protocol has to be available at both ends of the communications, which may not be possible in PC-to-host communications.

Rather than correcting errors by retransmission, the communications system throughput would be higher with a solution that eliminates the errors.

A Different UART

In IBM-compatible PCs, the original 8250 universal asynchronous receiver/transmitter (UART) provided the serial-to-parallel connection from the serial communications channel to the parallel computer bus. The latest 8250 version, the 16550A, includes a small (16 bytes in each direction) buffer. Newer computers and serial cards, including the larger IBM PS/2s, use the 16550A. The 16550A assists greatly in preventing data loss, but the communications software needs to turn on the buffering for it to perform any differently from the 8250.

Manufacturers of communications software applications are starting to deliver software products that check whether the UART is a 16550A, and, if it is, they turn on the buffer. Verifying that communications applications implement the 16550A buffer can be a way to solve the computer bus data loss problem. Be sure to verify that the communications application actually enables the buffer; then, test your communications system to be sure. However, if the 16550A isn't available, or if computer bus delays might be longer than 15 byte times, a different solution may be in order.

Hayes ESP/ESD/ESI

Hayes is one of several high-speed modem vendors that is offering solutions to this kind of problem. Hayes recently announced

"With on-site service included, these Zenith Data Systems PCs give me total confidence for the future."

ZENITH DATA SYSTEMS INNOVATES AGAIN™

Now the Total Performance • TotalCare Bonus gives you on-site TotalCare™ Service with eligible Zenith Data Systems PCs!

Today, you need confidence that the PCs you choose can carry your business into the future and stay up and running when you need them. That's why some of our most advanced desktop PCs are now available with a very special feature—one full year of on-site TotalCare Service* at no additional charge.

TotalCare protects your PC investment. Just one toll-free call to our 24-hour National Response Center puts you in touch with a North American network of over 2000 employees. And if you need on-site service, an experienced Customer Service Engineer will travel to your business to make things right—the next day in most cases! You can even purchase TotalCare contracts to cover other manufacturers' products.

ON-SITE Service

This special offer includes hard drive models of the Z-386SX/20™ PC, the Z-386/20™ and Z-386/25™ Workstations, the Z-386/33E™ File Server and the Z-486/25E™ Personal Workstation. All come with MS-DOS® 4.0 and Microsoft® *Windows™ version 3.0* pre-installed, plus a Microsoft Mouse.

THE SEAMLESS SOLUTION

Add our award-winning Flat Technology Monitor, or our advanced 16" (15" v) high-resolution monitor for our Z-486/25E, and you've got *The Seamless Solution*—our formula for total performance in today's graphical computing environment.

But you'll have to hurry to take advantage of the *Total Performance • TotalCare Bonus*—offer ends May 24, 1991.

For more information and the name of your Zenith Data Systems Representative, call 1-800-523-9393.

Z-386SX/20 PC

ZENITH data systems

Groupe Bull

*See TotalCare Service agreement and call your Zenith Data Systems representative for details. One year on-site service also good on monitor when purchased with eligible PC. A predetermined cash amount may be substituted for one year on-site service. Graphics simulate Microsoft *Windows version 3.0*, a product and trademark of Microsoft Corporation. Intel386SX, 386 and i486 are trademarks of Intel Corporation. MS-DOS is a registered trademark of Microsoft Corporation. TotalCare is a trademark of Bull HN Information Systems, Inc.

Circle 305 on Inquiry Card.

its Enhanced Serial Port; the related serial communications software driver, Enhanced Serial Driver; and a public definition of the interface between them, the Enhanced Serial Interface. The ESP board is a plug-in card (both EISA and PS/2 versions) that has a 1000-byte buffer in each direction to prevent data loss. It interweaves with the software ESD to be sure all bytes transferred across the bus reach the intended local destination.

In fact, the Hayes ESP/ESD/ESI solution supports the following four ways of solving the serial port data-integrity problem:

• First, support for the 16550A, which requires that the communications application software utilize the additional buffer.

• Second, an enhanced 16550A mode that uses separate logic in the ESP around the 16550A to identify when the received data is overrunning the capacity of the PC. It will then exert flow control (RTS or DSR) to prevent data loss. This mode does not attempt to ensure more efficient line utilization in the transmit direction, nor does it require that communications software applications support the 16550A.

• Third, an enhanced buffered mode that supports buffered transfers between the PC and the ESP card, utilizing a Hayes-supplied software driver. In this mode, bidirectional flow control utilizing RTS/CTS, DTR/DSR, XON/XOFF, or transparent XON/XOFF is supported.

• Fourth, a true DMA mode. DMA is a specific high-speed transfer mode designed into the ISA, EISA, and Micro Channel architecture versions of the IBM computer bus. By utilizing DMA, efficient data transfers can be made with minimum use of the PC/bus resources. Hayes provides software drivers for use under Windows and OS/2 to support a DMA transfer mode.

Because it requires purchasing a new serial port card and a special software driver, the Hayes solution is quite an expensive one. But it minimizes the use of expensive PC resources, because the communications between the modem and the microprocessor memory use DMA. DMA is significantly faster and more efficient using the computer bus resource than using the polled character-by-character access that normally takes place. The most significant deterrent to the use of DMA is the few communications software applications that currently support it.

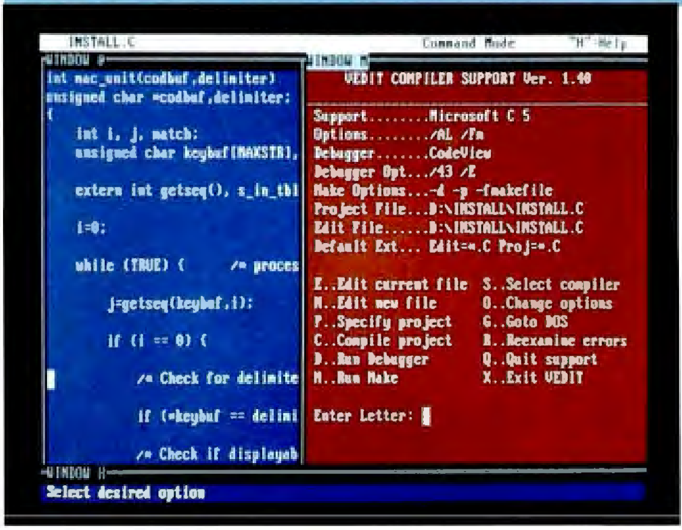
The Multi-Tech Intelligent Serial Interface

Multi-Tech Systems (Mounds View, MN) also offers several alternative approaches to maintaining data integrity through the serial port. The most innovative approach, the Intelligent Serial Interface (ISI), borrows from the de facto standard for connecting asynchronous serial ports to LANs. The developer of this interface, Network Products, calls it Network Communications Services Interface, and the company that promulgates its use, Novell, calls it Network Asynchronous Services Interface. Since a wide range of communications software for LAN interweaving supports it, this standard offers an existing solution to maintain data integrity across the serial port. NCSI provides the connection between the LAN software and the higher-layer application or external communications.

The NCSI interface transfers blocks of data across the computer bus in response to an interrupt request and is only a slightly less efficient use of the computer/bus resources than is a DMA transfer. A drawback is that ISI requires communications applications designed for LAN communications, even if you are not planning on using it for a LAN, as is shown in figure 2.

An issue that may affect the NCSI performance is that many current software applications with NCSI support the interface

Finally, a fast, powerful text editor that integrates your favorite programming tools and uses no memory!



The new VEDIT family of text editors offers stunning performance, versatility and ease of use. Completely written in assembly language, they are small and lightning fast. (3 to 30 times faster than other editors on large files where speed really counts.) Edit text and binary files of any size, even 100+ megabytes. Installation is trivial; VEDIT.EXE and an optional help file are all you need - no overlays, no configuration files, no environment variables.

For programmers, the new compiler support in VEDIT and VEDIT PLUS is a breakthrough. Run not only popular compilers, but debuggers and your favorite tools from within the editor. When shelling to DOS, VEDIT swaps itself and any desired TSRs out of memory to give you more memory than when you entered VEDIT. Only VEDIT offers you the advantages of a powerful editor without giving up the convenience of an integrated environment.

Call for your free, fully functional, evaluation copy today. See why VEDIT has been the choice of 100,000 programmers, writers and engineers since 1980.

VEDIT Jr. - Unmatched performance for only $29.

All VEDIT editors include a pull-down menu system with "hot keys", context sensitive help, pop-up status and ASCII table, a configurable keyboard layout and flexible, unlimited keystroke macros. Perform block operations by character, line, file or column. Undo up to 1000 keystrokes - keystroke by keystroke, line by line, or deletion by deletion. Automatic indent, block indent and parentheses matching speed program development. Word wrap, paragraph formatting, justification, centering, adjustable margins and printing for word processing. Run DOS programs.

VEDIT - A best value at only $69.

VEDIT can simultaneously edit up to 36 files and split the screen into windows. Search/replace with regular expressions. The most integrated compiler support available. Run VEDIT PLUS macros.

VEDIT PLUS - Ultimate programmer's tool for only $185.

VEDIT PLUS adds the most powerful macro programming language of any editor. It eliminates repetitive editing tasks and permits creating your own editing functions. The macro language includes testing, branching, looping, user prompts, keyboard input, string and numeric variables, complete control over windows plus access to hardware interrupts, memory and I/O ports. Source level macro debugging with breakpoints and tracing.

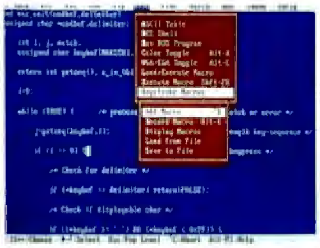
VEDIT PLUS - $185 for DOS, $285 for UNIX/XENIX. 30 Day Money-back guarantee. Discount pricing for multiple users, schools and OEMs. VEDIT Jr. site licenses start at only $250.

VEDIT PLUS

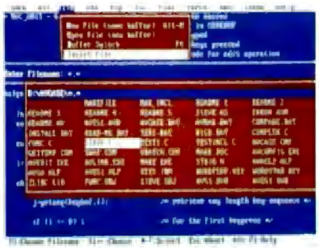
FREE
Fully Functional
Evaluation Copy
Call 1-800-45-VEDIT

- Mouse Support
- Pull-down menus
- Columnar blocks
- 1000 Level Undo
- Regular expressions
- Small 70K size, fast
- Emulate Wordstar, Word Perfect, Brief, vi, others
- Edit text and binary files of any size and line length
- Powerful macro programming language for instant "off-the-cuff" macros

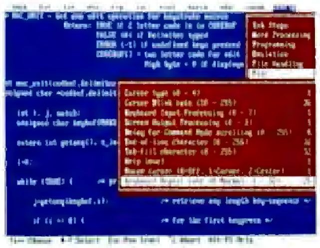
DOS XENIX UNIX QNX FlexOS



An intuitive user interface with pull down menus, hot keys, mouse support and context sensitive help make VEDIT easy to use, easy to learn.



Point and shoot file selection makes it a snap to edit new files, merge and split files, run macros and much more. Select files with the cursor keys or the mouse.



Just about everything about VEDIT is configurable, from the keyboard layout, to the screen colors, to the way control characters, tabs and the end of lines are displayed. Configure VEDIT with easy to use menus.

BENCHMARKS IN 3 MEG FILE

	VEDIT	BRIEF	Sage	QEdit
Simple search	57 sec	1:17 min	28 sec	Cannot
Save and continue	52 sec	3:52 min	1:47 min	Cannot
Load, modify, save, exit	21 sec	49 sec	1:38 min	Cannot
Block-column copy (40x200)	2 sec	30 sec	2 sec	2 sec
Delete one column in file	**9:58 min**	**1:50 hour**	**1:03 hour**	Cannot
60,000 replacements	**3:18 min**	**1:44 hour**	**1:32 hour**	Cannot

VEDIT is a registered trademark of Greenview Data, Inc. BRIEF is a trademark of UnderWare, Inc. Sage Profession Editor is a trademark of Sage Software Inc. QEdit is a trademark of SemWare.

* DOS version also supports Concurrent DOS, DESQview, Microsoft Windows, PC-MOS/386 and most networks. Special CRT terminal version runs over serial lines and modems.

* Free evaluation disk is fully functional and can edit small files.

Greenview Data
P.O. Box 1586, Ann Arbor, MI 48106
(313) 996-1299, Fax (313) 996-1308

Circle 121 on Inquiry Card.

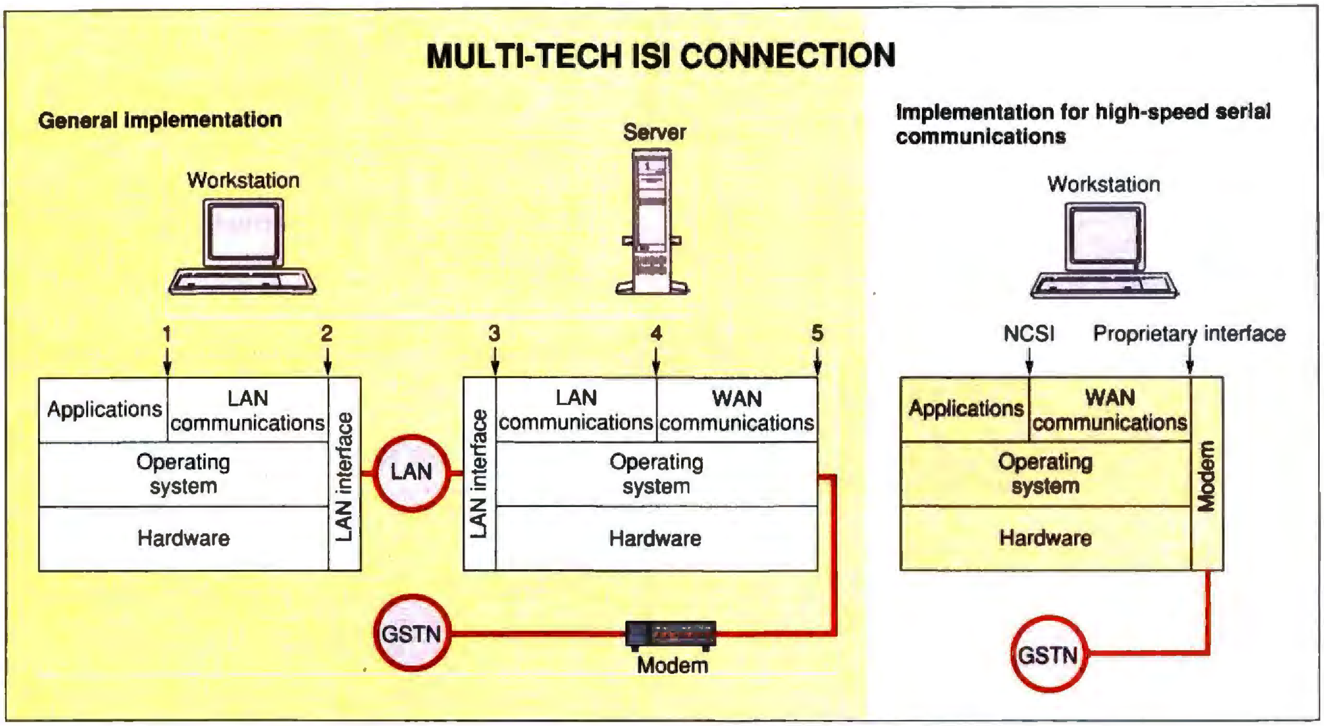


Figure 2: *The Network Communications Services Interface provides the connection between LAN software and the higher-layer application or external communications. Essentially, you are taking advantage of an established network standard to do high-speed serial communications. Interfaces 1 and 4 are possible NCSI interfaces. Interfaces 2 and 3 are proprietary interfaces currently. Interface 5 can be a serial port or a bus interface (with an internal modem).*

only at 19,200 bps, but 38,400 bps is desirable for use with data compression and 14,400-bps modems. In the future, more NCSI will likely offer support for 38,400 bps.

The drawback to the NCSI approach is that it will operate only with a Multi-Tech internal card or a Multi-Tech serial card. It is, therefore, potentially as expensive as the Hayes ESI approach.

Forval Turbo Interface

Forval America (Salt Lake City, UT), a new high-speed modem manufacturer, has taken a different approach to handling the problem of data loss within the computer. The company calls its solution the Forval Turbo Interface (FTI).

An FTI looks exactly the same to the PC bus as an 8250 on the modem card plugged into the bus. In fact, it actually operates more like a large 16550A that does not need to be turned on by the communications application software. The FTI has a built-in buffer of 1000 bytes in each direction. However, each byte is delivered to the computer bus and an interrupt request generated. If the byte is accepted by the computer bus, the next byte is delivered. If the byte is not accepted by the computer before the next byte is assembled from the communications channel, the first byte remains, and the second byte is stored in the second location in the buffer. The third byte is stored in the third location in the buffer, and so forth. In this way, the FTI can hold data that cannot be accepted by the computer bus until the bus has time to accept it. Since the FTI is designed into the Forval modem, it can also provide flow control to the opposite end of the communications channel should the 1000-byte buffer begin to fill.

The advantage of the FTI is that it provides reliable and compatible operation at high data transfer rates with existing communications software applications in existing IBM-compatible PCs. The disadvantage is that the FTI is only available in Forval modems and that the interface is interrupt-driven and not as efficient a use of the computer bus resource as is the Hayes ESP or Multi-Tech approaches.

General Solutions to Data Integrity

Since each manufacturer's solution to PC data integrity is manufacturer specific, each solution requires its own communications software (or driver). A general solution for all hardware communications devices, or DCE devices, requires an accepted standard. The Telecommunications Industry Association TIA TR-29.2 is the U.S. standards committee that develops digital interfaces to PC fax devices. Work has been under way for over a year to develop a standard transfer method for high-speed serial communications for fax applications. It is possible that a standard way to support high-speed PC fax applications could also be used for other high-speed serial applications.

But communications software companies have not been active in this work, and communications hardware vendors are often interested in popularizing their proprietary solutions to the data-integrity problem. Gaining consensus from competing companies to create a TIA standard thus remains an elusive solution to data integrity. ■

Ken Krechmer is the principal of Action Consulting in Palo Alto, California, a firm involved in data communications standards and product development. He is also the technical editor of Communications Standards Review, *a technical newsletter of the activities occurring in wide-area network standard groups worldwide. He can be reached on BIX c/o "editors."*

Take a lightweight presenter to your next presentation.

In fact, LiteShow II makes slideshows look amateurish by comparison.

You can display 256 brilliant colors at 640 x 480 resolution.

Animate your images with wipes, dissolves, timing effects, windowshades that reveal bullet points one by one, and more.

In addition to dramatically increasing the impact of your presentation, LiteShow II dramatically reduces presentation costs.

An image displayed on LiteShow II costs about 6 cents compared to $1.00 for an overhead transparency or $15 for a color slide.* And LiteShow II itself costs less than a VGA laptop.

LiteShow II works with any multi-sync monitor or video/data projector. But for the most dramatic presentation team, couple LiteShow II with an In Focus PC Viewer® LCD projection panel. Its 640 x 480 resolution supports CGA, EGA, VGA, and Macintosh video standards.

When you consider presentation impact, image quality, ease-of-use, flexibility, the freedom to make last minute changes on the fly, the easy portability and the final, bottom-line cost, LiteShow II is the most persuasive and cost-effective way to make your point.

And there's nothing lightweight about that.

It weighs under four pounds.

It fits into an ordinary briefcase.

But if your living depends upon making presentations, the LiteShowII™ is no lightweight.

LiteShow II is a radical, new technological breakthrough from In Focus, the industry's leading innovator in LCD projection panels and presentation technologies.

LiteShow II makes dynamic, brilliant color computer-generated presentations—without the expense or baggage of a computer. Or the hassle and expense of overhead transparencies or color slides.

Create your presentation on any IBM/compatible, PS/2 or Macintosh computer. Then capture your presentation on a standard 1.44 MB, 3.5″ floppy disk. Save as many as 50 images per disk. You can even mix and match images created in DOS, OS/2, Windows and Macintosh applications.

Using LiteShow II's built-in software, organize your images in any order you like. Just like a slide carousel. But unlike a slide carousel, LiteShow II gives you a host of special effects.

IN FOCUS SYSTEMS®INC.

*Prices may vary although they'll never equal the economy of LiteShow II.

In Focus Systems® Inc. 7770 SW Mohawk Street, Tualatin, Oregon 97602. 1-800-327-7231. In Oregon, 503-692-4968 Fax: 503-692-4476.

Circle 135 on Inquiry Card.

Pretty.

Mission Critical Workstation 1448
9 option slots and 2 drive bays

A PC that looks good in your office won't look good for long out in the plant.

Heat murders microprocessors. Dust decimates disk drives. Vibration victimizes video cards.

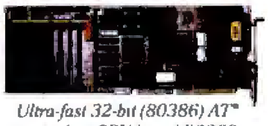
Any or all can wreck your entire operation.

Texas Microsystems line of rugged, reliable ISA Bus products and systems are specifically engineered for those brutal industrial environments that eat pretty PCs for breakfast.

To ensure maximum reliability we design and manufacture from scratch practically everything that goes into our systems, like passive backplanes which we pioneered for microcomputers in 1983. These backplanes accommodate a full compliment of convenient, plug-in components, all compatible with IBM®. They're why our Mean Time To Repair (MTTR) is a phenomenal 10 minutes.

You won't find passive backplanes — or lower MTTR — in any of the leading office PCs.

We also build industrial-strength option cards to handle myriad functions, in addition to our 286, 386™ and 486™ CPU cards in a full range of processor speeds. Our CPU card designs use Very Large Scale Integrated circuits and programmable array logic devices to reduce component counts by 50-60% which enhances reliability and resistance to physical stress. Ultimately, the design contributes to our remarkably long Mean Time Between Failures (MTBF): 70,000-100,000 hours, calculated against the MIL Standard Handbook 217E.



Ultra-fast 32-bit (80386) AT™ equivalent CPU board B386S
Available at 16, 20, 25, 33 MHz.

You won't find that kind of card selection — or MTBF — among the leading PC makers.

You won't find them torturing their systems like we torture ours, either. Not only do we perform extensive "shake, rattle and roll" tests on each new design, we pretest all our systems before they leave our dock. We burn them in at 55°C/131°F for 48 hours straight just to make sure they can take the heat at your plant.

Mission Critical Benchtop 2003
10 option slots and 2 drive bays.

Pretty reliable.

What's more, we shock-mount our disk drives to stand up to vibrations surpassing Richter scale proportions and we use only high-reliability power supplies that can go 100,000 hours MTBF.

With all that reliability designed into our products, is it any wonder that we guarantee better support than the other leading PC makers? Every system we offer comes with a full one-year, on-site warranty. Theirs don't. We also offer a toll-free number for technical and sales information, a regional network of sales engineers, engineering support for systems integration and a guarantee to meet shock specs. Of the leading PC makers, Texas Microsystems has the longest history of design using Intel microprocessors: 15 years in all. You' ll find our systems hard at work in harsh operating environments at 70 of the Fortune 100 companies.

It's- No- Comparison	Texas Microsystems	COMPAQ	IBM PS/2
Passive Backplane	Yes	No	No
100,000-hour MTBF power supply	Yes	No	No
Shock-mounted disk drives	Yes	No	No
Maximized MTBF	Yes	No	No
Positive pressure, filtration	Yes	No	No
Operation at 55°C/131°F	Yes	No	No
48-hour burn-in at 55°C/131°F	Yes	No	No
Maximum expansion slots available	14	5	5
1-year, on-site warranty	Yes	No	No
Toll-free support number	Yes	No	No
Regional sales support	Yes	No	No
"Shake, rattle and roll" testing	Yes	No	No

Granted, the leading office PCs may be prettier than ours, but our industrial-strength systems are designed to be more reliable. That reliability makes our systems look a lot better where it really counts:

Your production line .

Mission Critical Rack-mount 2001. 10 option slots and 3 drive bays.

For technical or sales information, call

1-800-627-8700

TEXAS MICRO SYSTEMS

Texas Microsystems, Inc.

Circle 267 on Inquiry Card.

ILLUSTRATION BARTON STABLER © 1991

THE PAPERLESS OFFICE

One of the ironies of the personal computer revolution is the amount of paper it has produced. Back in the mid-1970s, many people thought that one of the effects of personalization of computer technology would be the obsolescence of paper. (Little did they comprehend the attraction of seeing our words in 37 fonts and type styles, all on the same page.)

The effect of computers, of course, has been to increase the amount of paper we put out. When it is so easy to create decent-looking output, there is little reason to exercise restraint. This has created its own problem: the care, feeding, storage, and retrieval of all those paper documents. It has also created a new technology called *document image processing* (a.k.a. the paperless office) to handle the mass of paper documents we've buried ourselves in.

In "The World of Documents," Gerald P. Michalski describes how the concept of a document has been radically changed by computer technology. He outlines how you can integrate imaging with many different technologies, such as text management, hypertext, and groupware, to garner the greatest utility from your information system. Two of the satellite technologies described by Michalski are described in detail in a couple of related text boxes. In "Moving Data Using EDI," Sharon Fisher describes electronic document interchange, an ANSI standard for the automatic transfer of business information. In "Warm for Forms," Mark Skapinker describes how electronic forms processing can go a long way toward making the paperless office a reality.

The central technology of the paperless office is document image processing. Paper documents are scanned into image files stored (usually) on optical disks. The documents are then available for retrieval, viewing, and printing. In "Catch the Wave of DIP," David A. Harvey takes a close look at the technologies that build an imaging system.

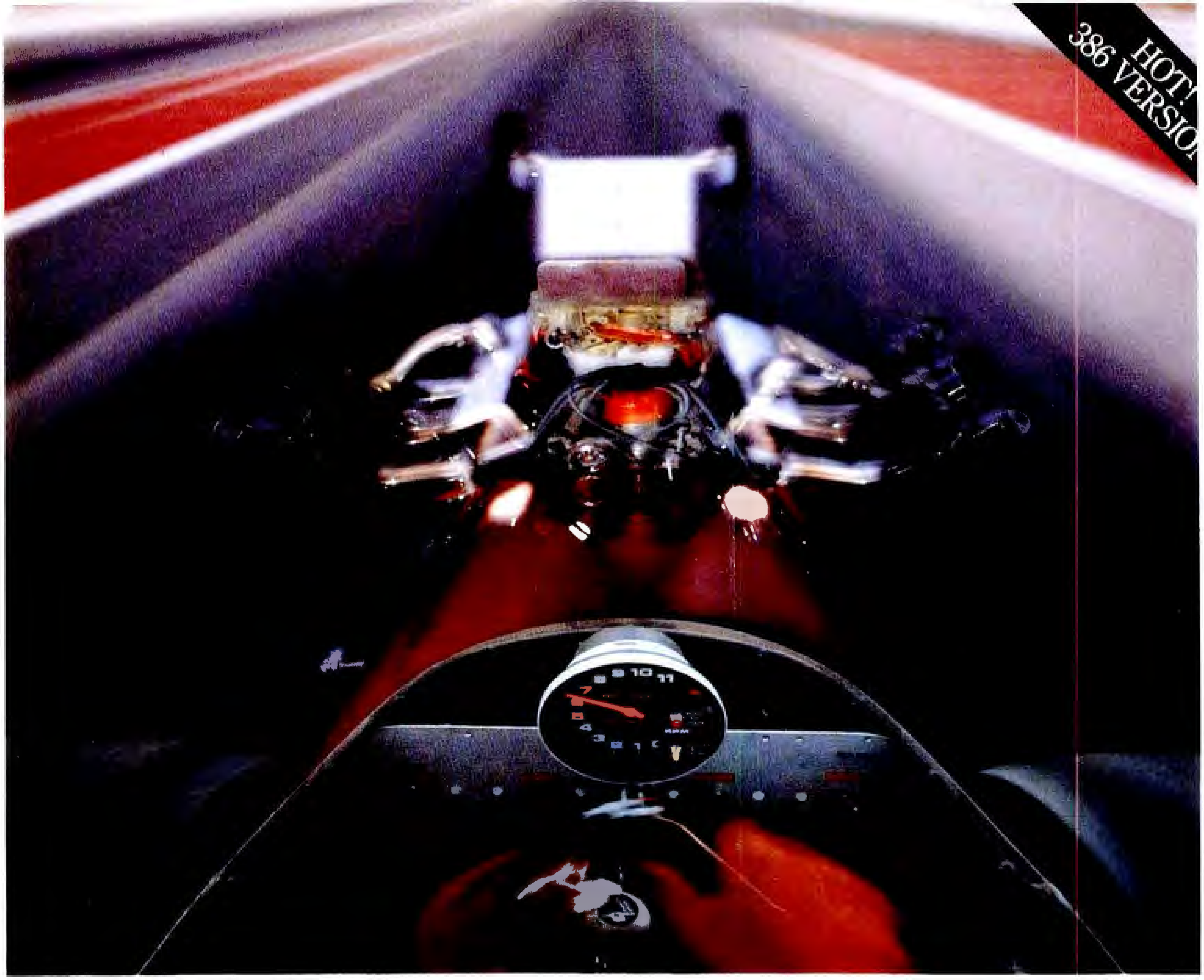
DIP is more than a technology. In "Practically Paperless," David A. Harvey and I examine some DIP success stories: companies that have implemented document imaging to solve very real problems. The cases examined range from simple network configurations to enterprisewide, mainframe-based imaging Goliaths. In a related text box titled "The Evolution of DIP," David Silver traces how DIP has changed from the days of microfilm.

It is easy to get carried away by technology, and DIP is no exception. In "The Dark Side of DIP," Christopher Locke brings into focus the problem of indexing as it relates to the storage and retrieval of stored images. Locke stresses that indexing documents is not a low-level task but rather one akin to knowledge engineering. He is also leery about assigning documents using rigid classification schemes; he views an archive as a vein of information to be mined, not as a static, lifeless entity. In a related text box, Locke describes some of the numerous products available that reveal the challenge of indexing.

In "Divide and Conquer," David P. Wright and Christopher L. Scofield describe an optical character recognition system based on neural network technology. They see a bright future for this technology in the paperless office, particularly in forms processing. In a related text box called "Recognizing Script," Jane Morrill Tazelaar describes an innovative handwriting-recognition system from the Soviet Union.

A completely paperless office is not yet a reality and may never become one. Regardless, the myriad ways that computer technology lets us view and link documents will enable us to see information in new and different ways. And that's worth a lot more than an office without paper clips.

—*Bob Ryan*
Technical Editor
State of the Art



JUST HOW FAST IS PROGRAMMING IN APL★PLUS?

This fast. APL★PLUS streamlines the whole programming process and screams through complex data manipulations with turbo speed.

APL★PLUS notation is like the math you already know. So you can solve problems the way you think about them, instead of wasting time figuring out *how* to solve them. And it's concise. A few lines of APL★PLUS can replace pages of code written in other languages.

Explore complex "what if" scenarios using built-in functions that manipulate tables of data like single objects. Prototype solutions and quickly put them to the test. Develop complete applications in record-breaking time with editing, graphics, screen windowing and communications facilities, mouse support and interfaces to spreadsheets and subroutines written in other languages.

Use our tutorial to jump start the whole programming process. Then, use APL★PLUS' speed and power to zoom through your development cycle so fast it's almost illegal. APL★PLUS. The programming language to use when you have miles of data. And the need for speed. Call today and we'll rush you a *free* demo disk.

See us at The Which Computer? Show, Booth #4322

APL★PLUS®

(800) 592-0050 Ext. 875

In Maryland (301) 984-5123 Outside The U.S., Call (301) 984-5412
For The Name Of Your Authorized Dealer.

Circle 258 on Inquiry Card (RESELLERS: 259).

THE WORLD OF DOCUMENTS

No system is likely to need all the technologies of Intelligent Document Management, but you may well need more than one

GERALD P. MICHALSKI

The world of documents as we know them is disintegrating before our eyes. The mental map we typically use that equates a file object with a document is fast being replaced by a more complex mapping. Hypertext and "hot" or "active" links between objects are blurring the differences between one file object and the next. In a well-engineered system, these objects and their links can all look like a single document.

One working definition for a document would be the following: A document is a snapshot of some set of information that can

- incorporate many complex information types;
- exist in multiple places across a network;
- depend on other documents for information;
- change on the fly (as subordinate documents are updated);
- have an intricate structure, or complex data types such as full-motion video and voice annotations; and
- be accessed and modified by many people simultaneously (if they have permission to do so).

Each of the people accessing a document may have a different purpose for doing so. For example, a customer-service representative may need to view a complaint letter to tell its author its current status. A manager may need to view the same document alongside other letters about the same issue to diagnose the problem.

continued

ILLUSTRATION: BARTON STABLER © 1991

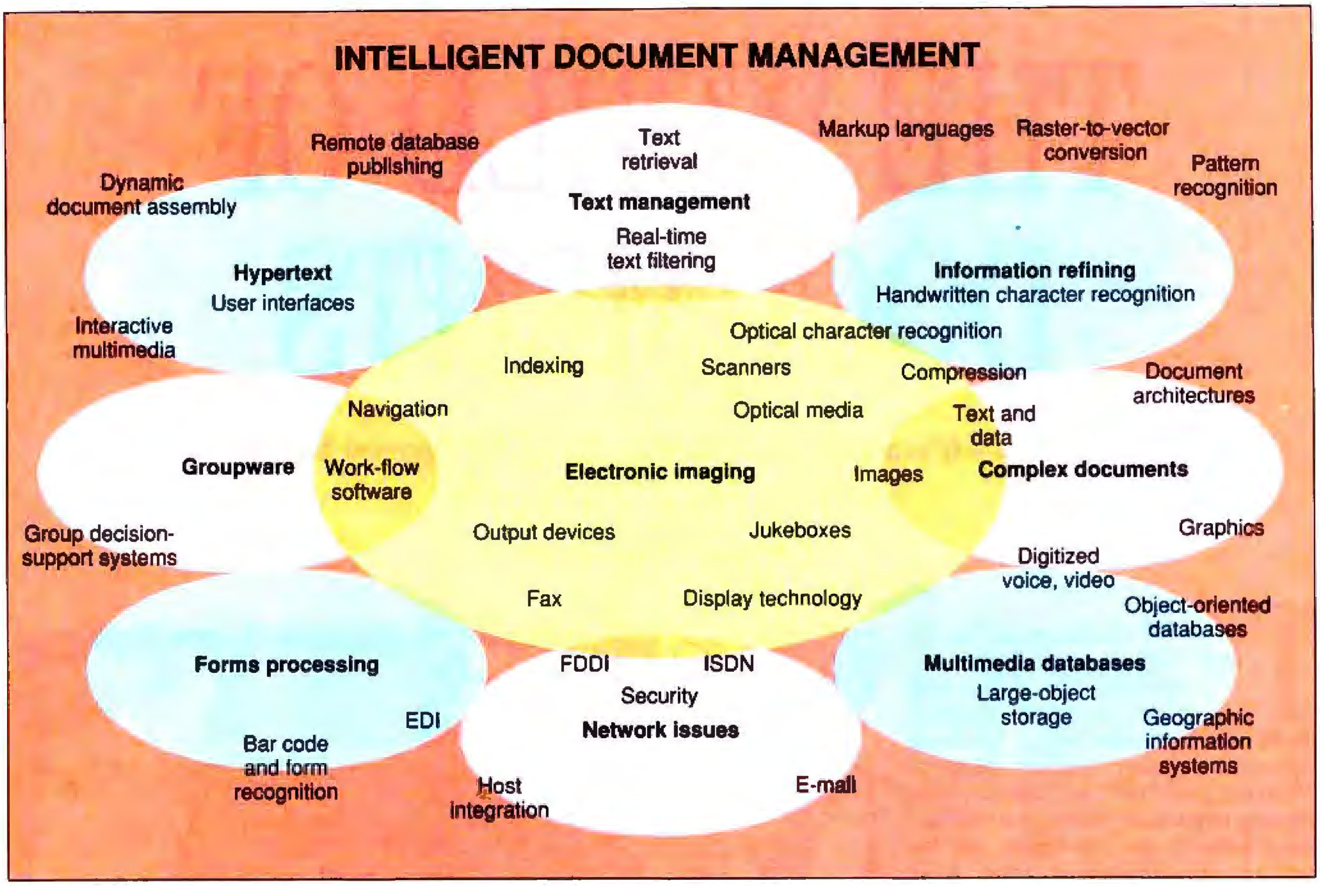


Figure 1: *The scope of imaging systems extends into other related technologies under the concept of IDM. The location of the various technologies does not imply a formal structure; it simply reflects their relationships to one other. (Courtesy of New Science Associates)*

Intelligent Document Management

Few tasks in today's business environment revolve around the task of filing and then retrieving a document. Thus, many of today's imaging offerings have incorporated functions like database lookups, integrated word processing, and predefined work flows. But few vendors present a complete and integrated solution to the problems of creating, storing, managing, manipulating, and disseminating information. Most vendors extend the architectures that they developed in response to another need.

The umbrella term *Intelligent Document Management* (IDM) extends the scope of imaging systems into other, related technology areas, as shown in figure 1. This diagram is conceptual, not formal. The technologies it shows are placed near one other in a way that reflects their relationships.

For example, much of the early research in hypertext was also research about what is now called *groupware*. Doug Engelbart's work on the Augment/On-line System and the work on Zog at Carnegie Mellon University intended to provide a seamless browsing environment for academics and researchers to enhance their collaboration.

Assume that figure 1 is a three-dimensional model, richly interconnected, and that you are looking at it from the perspective of electronic imaging technology. Just because a topic like "text retrieval" is located across the diagram from database technology doesn't mean that the two are not related and interconnected. In fact, they are. No relationship is simple. Each topic has an effect on others; the effects just weaken as the topics become more distant.

The technologies shown are not categories, but sets of features and functions. Some systems require only one or two of them; others will need a rich mixture.

Imagine a research laboratory that wants to move from keeping records in spiral-bound notebooks to an integrated system that catalogs the activities of the researchers and aids them in creating innovative products. Laboratory work has changed a lot from the early days when all notes and calculations could be kept in notebooks. Now, researchers have computer models on disk.

A successful laboratory system might rely on multimedia databases to store data, texts of various kinds, electronically scanned photographs, and data streams representing the results of experiments or test tabulations. The researchers might need full-text access to each other's research papers, and the ability to comment on each text and circulate those comments to others in their field or company.

A hypertext information environment would help to cross-reference all the relevant works and provide a browsing mechanism to help bring previously unseen relationships to the fore. Such a system would probably require high-resolution displays, much mass storage, and high-bandwidth communications. If information to be stored on the system adhered to a common set of storage standards at the file and data-stream level, it would vastly improve the ease of interchange among tools.

continued

"...simply stunning and incredibly fast!"

"highly recommended" by John Dvorak, Inside Track, PC Magazine, Nov. 13, 1990

PC Magazine's
Editors' Personal Best 1990

Byte's
Best Products of 1990,
Award of Merit

PC World's
Best Buys in
Windows Hardware
Optimal Workstation

Here's what the experts are saying about the hottest high performance graphics board available – the Hercules Graphics Station Card™!

"At $1,024, the Hercules Graphics Station Card is state of the art at an exceptional price."
InfoWorld, Hercules' 34010 Graphics Board is State of the Art, Eric Azinger, Sept. 3, 1990

"...1024 x 768 non-interlaced 256 colour mode is the only way Windows should ever be run."
Personal Computer World, Guy Swarbrick, Hercules Graphics Station Card, June 1990, UK

"If you do a lot of different kinds of graphics but don't want to spend too much, the Graphics Station Card is for you. Highly recommended."
CADalyst, Ralph Grabowski, August 1990

"The Hercules Graphics Station Card combines an extraordinary set of features designed to handle your most...well... *Herculean* graphics tasks."
PC Magazine, Tom Unger, Best of 1990, January 15, 1991

"...Hercules will have proved, twice, that you don't have to be IBM to set standards."
Personal Computer World, Guy Swarbrick, Hercules Graphics Station Card, June 1990, UK

Hercules Graphics Station Card

For Windows, CAD, DTP and Color!

- Up to 1024 x 768 resolution
- 8, 16, 24 bit color*
- TI 34010 processor-60MHz
- Built-in VGA for compatibility
- 1 megabyte VRAM
- 2 megabytes DRAM (Model GB1024+2)
- Includes TIGA 2.0, Microsoft Windows 3.0 (256 colors) and ADI 4.0/4.1 drivers

To find out where you can buy your Hercules Graphics Station Card, call **800 532-0600, ext. 745.**

For People With High Standards!

Hercules

Circle 125 on Inquiry Card.

Moving Data Using EDI

Sharon Fisher

Some say that the paperless office is as much of a pipe dream as the paperless bathroom. But one technology making real contributions toward reducing the amount of paper in today's offices is the Electronic Data Interchange standard.

The EDI protocol, also known as ANSI standard X.12, lets business organizations exchange data in a standard format, reducing the need for many standard forms like purchase orders, invoices, and even tax returns.

In addition to reducing the volume of paper, EDI also greatly reduces the amount of rekeying or repunching a company must do; this lets you spend your time on other tasks, saves the rekeying time, and eliminates errors introduced through rekeying. Consequently, some major user organizations require the use of EDI not only in-house but also by all their suppliers—an action that's contributing to the spread of EDI.

Roots of EDI

EDI was first developed by users in groups representing their various industries (e.g., purchasing, transportation, and financial applications); this is unlike many of today's standard's bodies, which are composed primarily of vendor representatives. At first, the groups focused on developing standards within their industries, but gradually they moved to transindustry standards.

EDI took its first steps toward becoming a bona fide standard in the late 1970s; in 1983, it was published by ANSI as a group of five distinct standards. New standards for forms are being added all the time; the 1989 release included 32 standards, while the 1990 committee has approved development for nearly 100 additional standards.

Some 18,100 organizations use EDI worldwide, according to estimates by EDI, Spread The Word!, a consulting firm specializing in EDI. The firm publishes a directory that includes 9400 U.S., 1000 Canadian, 1000 European, and 600 Asian companies; moreover, it estimates that an additional 2500 U.S., 100 Canadian, 2300 European, and 1200 Asian companies have not registered. According to EDI, Spread The Word!, the number of EDI users is also growing at a galloping 45 percent annually, from 1465 registered user organizations in July 1987 to the current 12,200 registered user organizations.

Continuing EDI's heritage, nearly 60 industry-specific groups help promote EDI's use among their members. In addition, almost 20 geographically based users groups help their members work with EDI.

What Is EDI?

The EDI protocol itself specifies only the format in which the data is transmitted—for example, specifying that the purchase order number will always be in a particular location. The protocol's format is based on a group of *data elements*—the smallest named units of information in the standard. Data elements are identified by a reference number, and the data-element dictionary specifies the name, description, type, and minimum and maximum lengths of each. In addition, data elements that are codes rather than textual fields include lists of the valid code values and definitions in the dictionary.

The X.12 standard is actually made up of four parts: the X12.3 data-element dictionary; the X12.5 interchange control structures, the EDI equivalent of an "envelope"; the X12.6 application control structures, or the formal description of the EDI architecture; and the X12.22 segment directory, which defines segments. Segments themselves are a list of related data elements, such as multiple lines of an address.

Other EDI components are the transaction set (the actual data that EDI is to transmit) and the functional group (a collection of similar transaction sets). Several purchase orders, for example, are collectively a functional group but are individually a transaction set. Headers and trailers lead and follow transaction sets and functional groups.

Other than the headers and trailers, the data format itself is fairly simple: the name of the field—which might be BT for "bill to" or ST for "ship to," for example—followed by the information, such as the lines of the address. Each address line is separated from another by a data-element-separator character. A segment terminator comes at the end of each related group of data, such as a four-line address.

The Parts of EDI

Because the EDI protocol itself specifies only the format in which the data is

Few research labs can afford to move to such a system today. Most are working to provide some of the functionality where they sense their priorities lie. For example, many pharmaceutical companies have submitted their documentation to the U.S. Federal Drug Administration on optical disks, hoping that electronic storage of page images will speed the approval process. It will, but only insofar as the approval process involves looking up static documents. It ignores the need of clinical experts to review tables of test results and run their own analyses; it ignores their need to search the full text of the document database. More broadly, it does not supply the interactive analytic capabilities that regulators need in order to give approval.

Navigating Around the IDM Chart

Here's a tour of figure 1, starting with the word *navigation*. This term is placed near the confluence of four technology areas (electronic imaging, text management, hypertext, and groupware) because it describes the commonalities between these feature sets. For example, the fields chosen as indexes in an imaging system provide the means to navigate to the documents you need, typically by entering a case number, social security number, or client's last name.

In work-flow applications (with predefined document-routing instructions prescribing that documents move from desk transmitted and does not address the way in which two companies establish the communications link, you can implement EDI on a wide variety of computers—from Apple IIs to DOS PCs to Unix workstations to mainframes—and transmit the data using a number of existing data transmission protocols, including asynchronous communications and several IBM communications protocols, such as 3780.

On the PC level, some 30 vendors offer software that lets you implement EDI, according to a list distributed in the EDI Yellow Pages International directory. Prices of the PC software generally range from $500 to $6000; most are between $1000 and $2500, but one is as much as $18,000.

EDI is similar to the X.25 communications protocol in that both computer software and a network are required to transmit data and you can either make use of a public data transmission network or set up your own. At present, about 18 vendors, including such familiar network names as Sprint Telenet, BT Tymnet, and CompuServe, offer EDI network services, according to the EDI Yellow Pages International directory. Costs for EDI networks vary. Factors determining the price include a monthly fee, hourly on-line charges, per-document or per-character charges, and volume discounts.

In general, the network services offer three types of transmission: Asynchronous, supported by nearly all the vendors, lets you call in over a standard dial-up line with a modem; bisynchronous, provided by all the services, uses existing but older IBM communications protocols; and Systems Network Architecture, provided by most of the networks, uses more up-to-date IBM communications protocols. Transmission speed ranges from 1200 bps to 9600 bps, but most companies use 2400-bps bisynchronous transmission.

Setting up your own EDI network is far more complex and expensive—the software costs as much as $128,000. It's generally done only by very large organizations that plan to embrace EDI in a big way.

Getting into EDI

You can move into EDI gradually, on a department-by-department basis, says Bob Payne, a partner in EDI, Spread The Word! "A lot of new users start by just licensing software for the PC, having it receive purchase orders, printing those out, and then keying those into any order-processing system they might have," he explains. This allows you to receive purchase orders faster than you might using the U.S. Mail, although it is more costly, and it is probably the cheapest way to fulfill an EDI requirement. (The EDI Yellow Pages International directory also includes a 12-step "paperholics anonymous" list of suggestions for implementing EDI.)

A way to take greater advantage of EDI is to integrate it with your company's order-processing software, says Payne. "Some PC software packages do a pretty complete job of preparing a file that a user could bring into an order-processing system," he notes. Unfortunately, he says, few vendors have integrated EDI functionality, so you have to do it yourself. But that final step is what you should plan for, according to Payne. "You can integrate that final step, eliminate manual operation, and do EDI with other customers," and gradually leverage the investment by expanding to other customers, he says.

"If you're Levi Strauss, you have software to receive purchase orders in that format, and you can use that same software with any department or any apparel retailer," Payne explains. "That's the beauty of it, and that's where the standard really comes into play."

As a bonus, EDI can make even small companies look "big," Payne says, in the same way that letterhead and word processing adds a professional look. "They can look as good as somebody like Levi Strauss does," he says.

FOR MORE INFORMATION

Data Interchange Standards Association, Inc., 1800 Diagonal Rd., Suite 355, Alexandria, VA 22314, (703) 548-7005. (Ask for the X12/DISA Information Manual, ASC X12S.)

EDI, Spread The Word!, P.O. Box 811366, Dallas, TX 75381, (214) 243-3456. (Ask for the EDI Yellow Pages International.)

Sharon Fisher is a San Francisco-based freelance writer specializing in computer communications. She can be reached on BIX as "sharonfisher."

to desk as tasks are completed), documents actually navigate their way around an organization. A work-flow environment is much more distributed than a central-control model. It's like having a roomful of autonomous crews that work at their own pace, pulling work off the queues and sending it on as they finish.

Sometimes people are not sure where they want to navigate. They want to bump into things, learn, and get new ideas, often without needing one specific document. What they require is a rich browsing environment, and that's what a well-authored hypertext system is.

Text management falls on both sides of the navigation issue. On one hand, text-retrieval systems (similar to indexes in imaging systems) help you navigate to specific documents. On the other hand, text-filtering systems can be loaded with individual user profiles that map their interests. Thus, the filtering system continuously watches a stream of information (e.g., a newswire feed or E-mail messages) and pipes only the relevant ones into the appropriate "to read" folder.

These two sides of navigation highlight two facets of IDM: You can manage intelligent documents, like those that move themselves around an organization, or you can manage documents intelligently—for example, by not scanning documents that are not likely to be retrieved. Because these technologies are not yet inexpensive enough and powerful

GROUPWARE LAYERS

Same . . .	Tool types	Examples
Network	Conferencing E-mail message filtering	Participate, EIES Andrew, Object Lens
Project	Project management Interpersonal coordination	I*Star Action Technology
Department or task group	Work-flow software Shared-document databases	Workflo, Workhorse Notes
Document	Document tracking Group document creation	docuForum ForComment
Time	Videoconferencing Shared-image workstations	Cruiser, VideoWall Databeam, Aspects
Place	Meetings, group decision-support systems Brainstorming aids	CoLab, Capture Lab Meeting Machine, Elmer
Nothing the same	Personal information managers Personal productivity tools	Agenda, Current WordPerfect

Figure 2: *Various groupware features cluster together according to the workgroup that tends to use them. (Courtesy of New Science Associates)*

BYTE ACTION SUMMARY

Intelligent Document Management

Intelligent Document Management extends the scope of electronic imaging into other, related technology areas: hypertext, groupware, information refining, multimedia databases, network issues, text management, complex documents, and forms processing. All these areas are related and interconnected, some of them more closely than others. Some document imaging systems may require only one or two of them; others will need a rich mixture.

enough to be widespread, you must make careful economic choices to get 80 percent of the desired effect for 20 percent of the cost and effort, where possible.

To complete the tour, I will move to forms-processing systems. In the IDM perspective, Electronic Data Interchange is a subset of the forms world: In essence, EDI standards are predefined forms exchanged electronically, full of information, instead of being mailed out the door on preprinted stock (see the text box "Moving Data Using EDI" on page 162).

If the forms are still in a paper state and EDI is not readily achievable, marking the forms with things like bar codes and buying scanners with built-in bar code recognition can dramatically speed the sorting of inbound mail.

Finally, electronic forms, whether front ends to a database, enhanced forms software, or forms built with Lotus Notes' built-in forms editor, can bind workers together more closely by facilitating their work across the corporate network as well as between organizations. This is why forms processing is so near to groupware (see the text box "Warm for Forms" on page 166).

Workgroups

The term *groupware* has been much maligned of late, but it still has value. You can replace it with "computer-supported cooperative work" or "workgroup computing," if you wish. But the term covers features in software that help people accomplish work together, whether they are sitting next to each other, across the country from each other, or in the same seat (at different times). Figure 2 illustrates the different features of groupware that become handy when people have certain things in common; several features can come in handy at once.

For example, work-flow software features, like those that are found in FileNet's systems, are typically used at a departmental task-group level to move work around. Such a group may want to create a database of shared documents—as you can, for instance, with Notes from Lotus Development (Cambridge, MA). Notes also has other features, including text filtering, forms building, and multimedia E-mail.

If group members are working more closely (perhaps assembling a single document, such as a bid or a market study), they may need software that manages the component parts of the document, as well as software that allows one member to make comments on another's document. The author, on reviewing the comments, can either approve them (in which case the document is permanently altered) or refuse them (in which case the document is left intact).

If you bring workers together more, by working at the same time, they may want to view the same document in real time. Videoconferencing and shared-screen systems (e.g., the Aspects system for Macs from Group Technologies in Arlington, VA) provide such help. Meeting-room enhancements developed by Xerox Palo Alto Research Center provide similar tools to people in one location.

You should not ignore personal-productivity tools and personal information managers, even though these are usually designed for one person only. If you hook an application like Lotus Agenda to your E-mail network, it can help filter your mail—a groupware function.

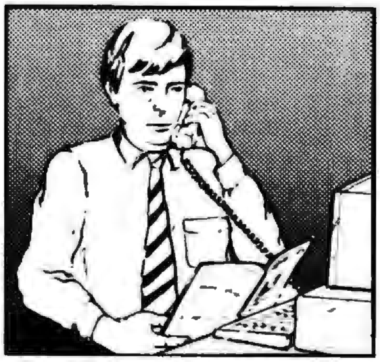
WordPerfect (Orem, UT) has been advertising the groupware capabilities of WordPerfect Office recently. That's a word processing company broadening into office automation and advertising groupware. The walls are all tumbling down, and that's why it makes sense to view these features as just that: features.

Above work-flow systems are features that enhance the coordination of work across the enterprise and even between enterprises. As more people get on-line accounts and send messages, intelligent filtering features, like those in the Object Lens project at MIT, will enable you to cope with the volume and accomplish more work.

continued

Buy with

Confidence



In an effort to make your telephone purchasing a more successful and pleasurable activity, The Microcomputer Marketing Council of the Direct Marketing Association, Inc. offers this advice, "A knowledgeable buyer will be a successful buyer." These are specific facts you should know about the prospective seller before placing an order:

Ask These Important Questions

- *How long has the company been in business?*
- *Does the company offer technical assistance?*
- *Is there a service facility?*
- *Are manufacturer's warranties handled through the company?*
- *Does the seller have formal return and refund policies?*
- *Is there an additional charge for use of credit cards?*
- *Are credit card charges held until time of shipment?*
- *What are shipping costs for items ordered?*

Reputable computer dealers will answer all these questions to your satisfaction. Don't settle for less when buying your computer hardware, software, peripherals and supplies.

Purchasing Guidelines

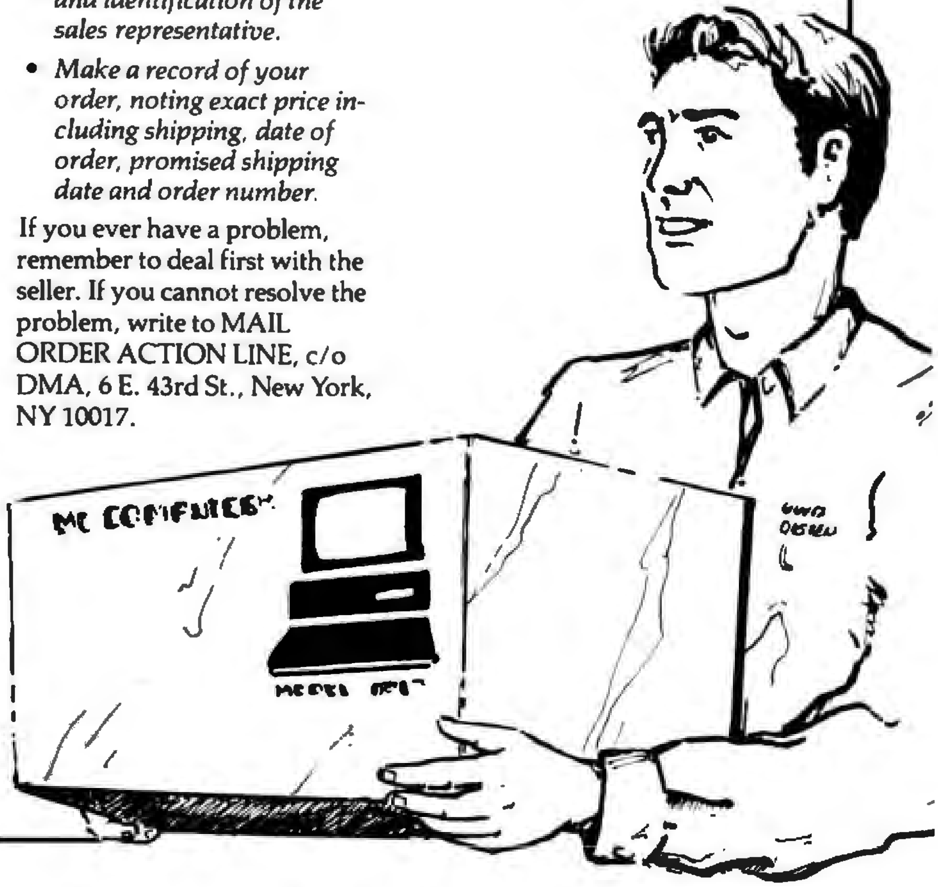
- *State as completely and accurately as you can what merchandise you want including brand name, model number, catalog number.*
- *Establish that the item is in stock and confirm shipping date.*
- *Confirm that the price is as advertised.*
- *Obtain an order number and identification of the sales representative.*
- *Make a record of your order, noting exact price including shipping, date of order, promised shipping date and order number.*

If you ever have a problem, remember to deal first with the seller. If you cannot resolve the problem, write to MAIL ORDER ACTION LINE, c/o DMA, 6 E. 43rd St., New York, NY 10017.

This message is brought to you by:

the MICROCOMPUTER MARKETING COUNCIL of the Direct Marketing Association, Inc.
6 E. 43rd St.,
New York, NY 10017

MMC
MICROCOMPUTER
MARKETING COUNCIL
of the Direct Marketing Association, Inc.



Warm for Forms

Mark Skapinker

In any study of the *paperless* office, you need to look carefully at what paperwork makes up the *paperful* office. Forms represent a significant part of office paperwork. In fact, much of the savings you can realize in creating a paperless office comes from the computerization of business forms.

The issues are enormous. According to Datek Information Services of Waltham, Massachusetts, forms make up over a third of all business documents; U.S. companies spend more than $6 billion every year on preprinted forms; U.S. companies *waste* $2 billion in preprinted forms; and U.S. businesses spend from $94 to $120 billion per year to distribute, store, and process forms. While most organizations measure the cost of business forms by the cost of buying a paper form, it has been found that for every $1 spent to buy a paper form, $60 is spent to process it!

The Forms-Processing Domain

When examining the paperless office and forms, you need to consider two issues: the storage and recording of "paper filled" forms using techniques such as imaging, and the creation of "paperless" forms via electronic forms processing. Here, I am examining this second issue: the state of forms processing today and the impact of this emerging market. While much effort is going into imaging paper forms, it is obviously preferable to create a paperless form in the first place. The economic and ecological benefits are evident.

High-end forms-processing software products are made up of a number of necessary components. Designing and filling forms are two distinct functions: Designers design, and fillers fill.

The forms designer software must include all the power and control needed to define what a form looks like from a desktop publishing graphics-standard perspective. The designer also needs to specify where the filled-in fields will appear and what their attributes (e.g., numeric data only or a mask) will be. Designers also define the relationship between fields via calculations, lookups to databases or lists, and other database information, such as indexes and relational links between forms.

Entering Data

Forms fillers, on the other hand, tend to be relatively unsophisticated computer users. The filler program needs to be easy to use, but it has to include sophisticated print and data-entry capabilities. Often, fillers can be filling in forms on multiple platforms, so the fill software has to be available on different types of machines. There is also a need for batch-type filling for printing forms directly from other applications. Given its graphical nature, forms design software is best suited to a graphical environment like Windows 3.0. The filler software should run on both graphical and text-based machines.

With forms being created, distributed, and filled electronically, you may wonder why you need a print capability at all. The answer is simple: Changes in forms processing, like any changes in office procedures, do not happen all at once. The software must cater to the evolution from a manual system to a completely automated one. Another reason is the need for signatures. By signing a paper form, fillers take responsibility for the contents of the form.

Some products, such as PerForm Pro from Delrina Technology (Toronto, Ontario, Canada), include an electronic signature capability for forms fillers. This security system includes the ability to include a private key for signing and locking any data on the form, as well as a public key system for verifying or unlocking the data. Electronic signatures are more secure than paper signatures because they can lock fields from tampering. Because of government users' high degree of interest in forms software, this electronic signature should be a government-approved type.

Many other more obvious features are needed in a forms processor, including the ability to share data. This is done by storing the data separately from the form, allowing different sources to access the data in both forms and tabular format. Once the filled form is saved, it is important for it to be available to other users, via printing, fax, networks, or E-mail.

The Form of the Future

A number of forces are speeding up the acceptance of forms processing. One important development is the standardization of corporate computing in the form of standard graphical interfaces like Windows 3.0, standard communications, and database standards such as Structured Query Language. Other technologies, such as pen-based systems, should add a significant boost by making electronic forms filling a portable exercise.

Over 50 percent of large corporations have started using forms-processing software, and the technology is now cost-effective for many businesses. Forms processing represents an evolutionary software technology that ultimately leads to huge savings in costs and paper.

Mark Skapinker is cofounder and president of Delrina Technology, Inc., of Toronto, Ontario, Canada, publisher of PerForm and PerForm Pro forms-processing software. He can be reached on BIX c/o "editors."

Black Gold

Images are dumb. If you want to do anything with them, you either have to tag them with additional, searchable information, such as an index, or continue to process the documents to turn the images into useful electronic information.

Figure 3 shows a stair-step model illustrating a concept called *information refining* that was coined by John Clippinger (Coopers & Lybrand, Boston). As with petroleum refining, information refining assumes the existence of "deposits" of raw materials (i.e., information) that someone makes economic decisions about investing in to derive a higher-value product (i.e., searchable documents).

The stair-step model shows the steps people go through—and they vary widely—to get more value out of documents. The *x* axis (or run of the steps) indicates how much money is spent to process a given batch of documents; the *y* axis (the rise) represents how much understanding of the document the computer system contains (versus the need for someone to read the document and try to understand its content).

The information refining scenario, then, goes like this: A piece of paper is scanned and ends up as a bit map in the computer. If there is text on the page, chances are that an optical character recognition (OCR) system can make sense of it, but not 100 percent accurately.

If accuracy is needed (and there exist text-search tools that search inaccurate text, so 100 percent accuracy does not have to be a design goal), then someone or some application has to proof the results. The proofing can involve lookups against a dictionary or client list, or potentially some AI as an aid to discern context and create full sentences. This may well be enough. The computer does not need to fully "understand" every document.

Finally, some interpretation of the words often needs to be made. Within limited domains, such as resumés or wire transfers of funds, AI can be helpful today. EDI messages are a special case. They enter this model at an extremely high level of understanding, because two parties have agreed on the exact nature of the contents of each of the fields.

With slight changes to the steps, this model also works for graphics. For instance, instead of using OCR, you might invoke a raster-to-vector converter to isolate known objects and derive their attributes.

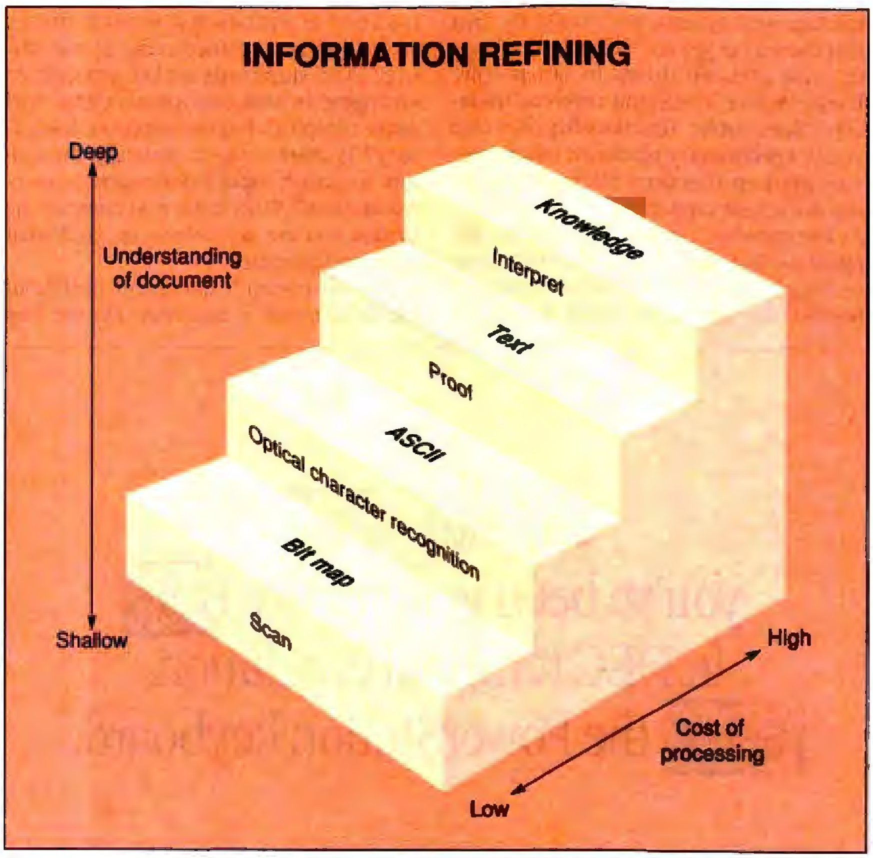


Figure 3: *This stair-step model illustrates information refining—the steps that people go through to get more value out of documents. The* x *axis indicates the cost, and the* y *axis represents how much the computer "understands" the document. (Courtesy of New Science Associates)*

Planning Issues

As you decide whether to process the documents hiding in your organization, you should also consider what format you want them in. If multiple people or applications need to access these documents, it's considerably easier if they all conform to a single format. Several compound-document formats exist today, in various stages of completion and sophistication.

Another issue that is sure to come up as you evaluate imaging systems is the effect that storing and moving such large objects has on your database and network capabilities. For example, a normal alphanumeric database record requires about 2000 bytes, while the compressed image of an attached business letter might need 50,000 bytes. (Imagine your family sedan with a 10-car freight train attached.)

While network protocols do their best to packetize the information and route it efficiently, the image still has to be reconstructed at the other end. In any event, objects of this size will have a significant effect on the network.

Consequently, most imaging systems use not only large stores of magnetic disk, but also optical-disk storage—often jukeboxes. And, network administrators who might contemplate putting 30 users on a single LAN pull back to 10 or so when constant image traffic is involved. These size factors complicate performance tuning, backup, and disaster-recovery techniques.

Many technology features and functions remain undiscussed. Special-purpose databases, such as those with an object or geographic orientation, are slowly claiming their place next to text and more traditional DBMSes. The object-oriented variety may make it a great deal easier to store documents with very complex structures, as well as documents that contain unusual data types (e.g., video and sound).

Scanners, displays, and printing devices are all key elements to the success of document imaging. As their prices go down, your deployment strategy may change substantially. For example, low-cost laser printers on LANs may well be a good alternative to centrally located, much more expensive page printers. If the distributed printers are also fax servers (there are some fax devices that can now double as laser printers, and vice versa), the added benefit may sway your decision.

Where to Start?

In choosing a document imaging system, consider these points:

1. Understand all the technical features and functions required by a document

management system, and accept the fact that there is as yet no "silver bullet" system that does all things for all people. Every vendor's offering involves tradeoffs. Some offer functionality but trap you in a proprietary platform; others provide markup functions but no engineering-document support.

2. Examine the business around the application that you want to automate with an imaging system. Ask some questions beyond the immediate application. For instance, is this business about to change radically? Is a restructuring in the offing? Are standards either present or emerging in this environment that will make complex imaging systems unnecessary? Is there a way to redesign the system to obtain input information in electronic form? Who is the real client of the system you are contemplating, and what is its real purpose?

3. Do an in-depth document profile of the department in question. Do not stop at counting the piles of paper on people's desks and in the file drawers. Examine how the information is actually used. Is full-text search needed? Model the document life cycles. How often are documents accessed within five days? Within 15 days? Within 90 days? How secure should the documents be? Who will have access privileges? How many versions will have to be kept?

4. Pick your technical features carefully. Decide on the minimum drop-dead feature set (i.e., if they don't have *x*, you won't buy the system) and then broaden it to include the features that changes in the application environment are likely to require in the near future.

5. Match that feature set to current vendor offerings and their stated platform, product, and market strategies.

The likelihood that any system you build will require all the technologies represented in the scope of IDM is slim; conversely, the likelihood that you will need more than one is high. Which ones you need depends, as usual, on your environment and your applications. But it is impossible to make an educated decision about which system to select without an understanding of the base technology features and functions and the way they affect one another.

The Next Plateau: Mainstreaming

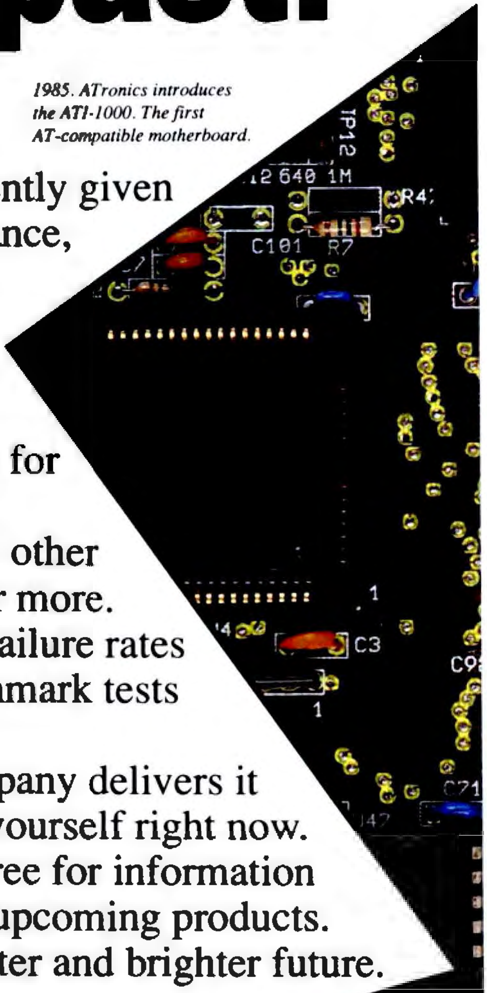
The computing community is now nearing the end of an epoch that can be called the Federal Highway Projects (FHP) phase of the Information Society. Just as the U.S. government sponsored and funded the construction of a nationwide infrastructure of roads, tollways, interchanges, and bridges, most organizations are focused tightly on designing and building their own infrastructures.

These new infrastructures consist of networks (local area, metropolitan area, or wide area), platforms (with the ensuing messy operating-system and user-interface issues), and connections (gateways, bridges, routers, and various hybrids).

The major problem is that there has been no decree from "on high," wherever that is, about how wide to make the roads, how long to make the ramps, or what color to paint the signs. Indeed, each organization is fending for itself amid the jungle of offerings, all of which at least try to say that they can interoperate.

Once the FHP phase has passed, imaging systems will be regarded as mainstream technologies, not as the specialized systems that they are today. In the

To see the future of motherboards, look at the past.



1985. ATronics introduces the ATI-1000. The first AT-compatible motherboard.

You'll discover since 1985, one company has consistently given both resellers and endusers the highest level of performance, quality and support at the lowest possible price.

ATronics.

In fact, we were the very first company to produce AT-compatible motherboards.

The result is ATronics delivers the best choice for quality U.S. designed-and-made products.

And with standards that meet or exceed other motherboards that would cost you far more.

ATronics offers one of the lowest failure rates in the business. Standard benchmark tests prove their performance.

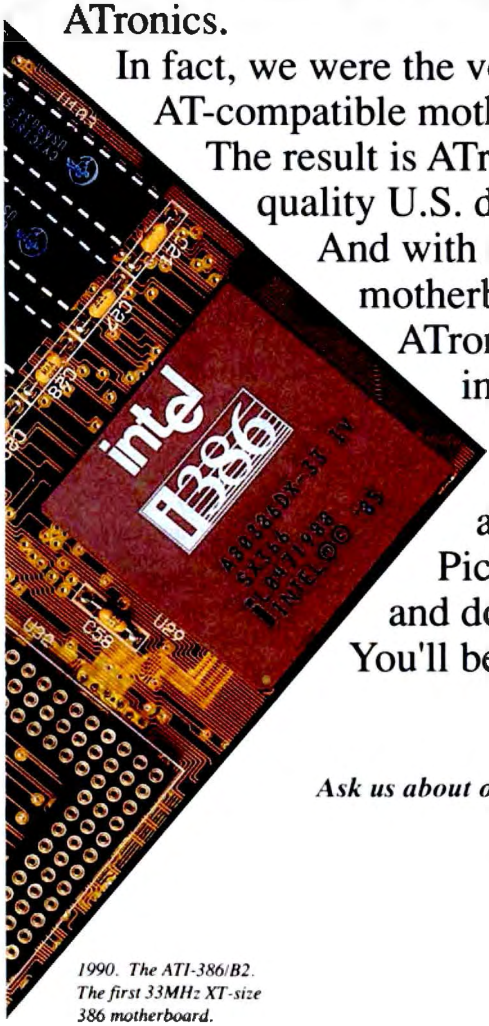
No other motherboard company delivers it all like ATronics. Prove it to yourself right now.

Pick up the phone and call toll free for information and documentation on current and upcoming products.

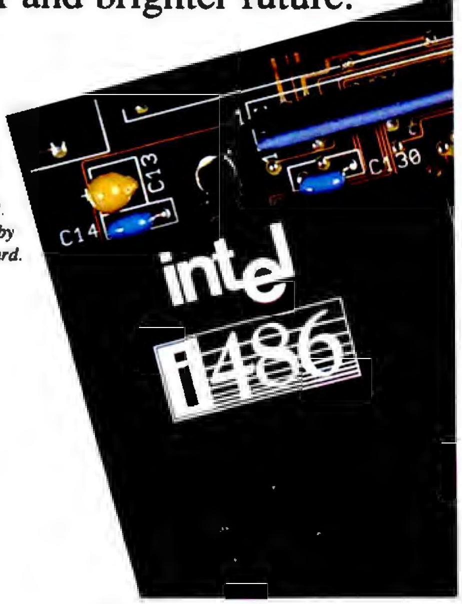
You'll be on your way to a bigger, better and brighter future.

1-800-488-7776.

Ask us about our FCC Class B Bare-bone Systems!



1990. The ATI-386/B2. The first 33MHz XT-size 386 motherboard.



1991. The ATI-486/B2. The first 33/50MHz baby AT-size 486 motherboard.

ATI® ATronics

1830 McCandless Dr., Milpitas, CA 95035-6844,USA
Tel. (408)942-3344. Fax (408)942-1674

Circle 30 on Inquiry Card (RESELLERS: 31).

early days of imaging technology, there were two major market segments, located at opposite ends of the spectrum of complexity and cost. I'll call them the high end and the low end.

The high end of the spectrum involved high-speed item processing—generally, checks, credit-card slips, and passenger flight coupons—and avoided long-term storage of the images, preferring instead to lift the images, read them, and discard them. High-end systems from companies like BancTec (Dallas, TX) and Teknekron Financial Systems (now TRW Financial Systems in Berkeley, CA) could cost $10 million or more.

The low end involved stand-alone storage and retrieval systems that used early optical disks. Although these systems were much less expensive than those at the high end, they still could not break the $100,000 barrier, and costs per document retrieved were too high to justify widespread use.

With the advent of FileNet's Workflo system in 1985, a new market emerged between the two ends. Today, this market is rich with offerings that not only include specialized image-processing vendors like FileNet and Plexus Software, but also most of the major hardware vendors (e.g., Bull, DEC, Hewlett-Packard, IBM, NCR, Unisys, and Wang) and some smaller, innovative vendors like ViewStar and Micro Dynamics.

Over the next five years, the offerings in this middle imaging market will integrate more fully with standard office environments and E-mail packages. Until then, however, buying and installing imaging systems will require careful study, experienced people, and special tuning to obtain performance up to expectations. Companies that can do this have begun to change the nature of competition in their industries, turning time and information into allies.

Once past the FHP, companies will be free to harness the benefits of the next epoch of computing by adopting new data types (e.g., image, voice, and video), by finding new ways of looking at existing information, and by moving into new computing paradigms. Most notably, this means moving from a world of personal and central computing to a world of social computing. ■

Gerald P. Michalski is a vice president of New Science Associates, a retainer market research firm based in Southport, Connecticut. He holds an MBA from the Wharton School of the University of Pennsylvania. You can reach him on BIX c/o "editors."

CATCH THE WAVE OF DIP

Document image processing is a working and usable technology helping more and more offices attain a near-paperless state

DAVID A. HARVEY

At last year's fall Comdex, Bill Gates unveiled his vision for the future of personal computing. *Information at Your Fingertips*, playfully presented as a *Twin Peaks* take-off, featured a truly integrated PC environment that incorporated fax, remote pen-based input, E-mail, and multimedia.

One of the challenges along the road to the integrated desktop is dealing with the piles of information that exist in paper form. American business alone produces close to 1 trillion pages of paper a year. Charitably assuming that it's letter-size paper, that's enough to blanket the surface of the earth, with some to spare. In an age when concerns about deforestation, the erosion of the rain forest, and the mounting solid-waste-disposal crisis have become reality, finding ways to conserve paper has become imperative.

Not only does American business waste paper, but according to various sources, it costs about $25,000 to fill a four-drawer file cabinet and $2160 to maintain that cabinet for a year. In addition, about 3 percent of all documents are incorrectly filed or lost, and the average cost to recover a document is around $120. Finally, the average executive spends a grand total of about four weeks per year waiting for documents to be located. You know how it goes—you spend 20 minutes pawing through the file cabinet and a half hour looking through the various unsorted piles in the storeroom.

Not so long ago, the term *paperless office* was likely to engender very little except ridicule; that's not true anymore. The lengthy strides made within the last few years by the underlying technology

ILLUSTRATION: BARTON STABLER © 1991

make document image processing (DIP) systems a reality—today.

In the end, the goal of a thoroughly paperless office may remain unattainable. People will forever continue to scribble random notes on paper, generate ideas on index cards, and so on. But given the state of the art of DIP, people can now move closer and closer to that goal.

If *Information at Your Fingertips* is the vision, the reality is the often problematic integration of disparate technologies, operating systems, CPU platforms, and software.

Multiuser, multithreaded, and multitasking operating systems, such as Unix and OS/2, offer the promise of a "document-centric" approach. So, too, do integrated graphical operating environments, such as Presentation Manager, Microsoft Windows 3.0, and the various Unix graphical user interfaces.

The promise shows in the way these systems use Dynamic Data Exchange (DDE), Multiple-Document Interface (MDI), Electronic Data Interchange (EDI), Installable File System (IFS), and voice technology, and in improved integration of device drivers. However, the ground has barely been broken.

With no "killer" application looming on the horizon, defining a paperless-office environment becomes more a function of technology than of any set standards. For example, at the lowest level, a paperless office could simply be one that employs scanning technology to store and index invoice and billing information.

At higher levels, you find integrated networked systems that manage fax, E-mail, scanner input, optical character recognition (OCR), full-text and keyword indexing, EDI, and data collection from the field. You can then make this information available to anyone on the network from within a variety of applications. While both of these examples remain true to the overall vision, they are far from presenting as seamless and transparent an implementation as Gates's *Twin Peaks* takeoff.

To arrive at a reasonably consistent definition of the technology behind a paperless office, I'm going to put aside the differences between operating systems and platforms and deal with the essential components.

The figure illustrates the basic components of a paperless office. The model I've used here shows the highest level of integration of all technologies and software possible with today's technology. The various groupings in the figure illustrate modular components that you can remove or add to achieve varying levels of complexity and integration.

The basic hardware of a paperless office is essentially the same across different levels. From the simplest single-user installation to the multimillion-dollar mainframe-based system, DIP hardware boils down to inputting via scanner, storing on optical media, and outputting via video display terminal, printer, or fax.

BYTE ACTION SUMMARY

Document Image Processing

The current state of the paperless office is basically the same as that of DIP. The components include input via scanner, storage on optical media, and output via a video display terminal, printer, or fax. In a large implementation, the system can exist as part of a network. Wherever your system lies, from the simplest single-user installation to a multimillion-dollar mainframe-based system, DIP can significantly reduce your dependence on paper.

The Eyes of DIP

Scanning a document into electronic format as a simple image is a fairly mundane task, supported by a well-established technology. The only real difference among the different levels of complexity is the speed and resolution of the scanner. All things being equal, the real choice is volume-dependent, not resolution-dependent.

Given current display, printing, and fax technology, scanner resolutions of 200 dots per inch for text and 300 to 400 dpi for graphics images are more than adequate. And remember, the final quality of a scan is dependent on the quality of the original document.

The only times that you might consider using 600-dpi and higher-resolution scanners are in cases where extremely high-quality (Linotronic) output is necessary, or where users at a site wish to store ultrahigh-resolution images in anticipation of improvements in fax and monitor technology. Given that the current state of the art in fax technology only allows the transmission of 200-dpi images and that even the highest-end monitor delivers essentially the same resolution, I don't see high-resolution scanning as a major concern for the average DIP installation.

Resolution aside, the speed improvements that a high-end scanner provides come from the scanner engine and from the use of hardware-based compression schemes. Midrange and high-end scanners use dedicated controllers with their own processors to manage the chores of scanning and compressing the data.

A typical midrange installation might include a 286-based microcomputer scanning station along with a central RISC-based server. The images would be scanned and compressed on the workstation and transmitted to the server, where they might or might not be decompressed and then passed on to the archives. At the simplest level, documents will, in all likelihood, be scanned, rasterized, and stored with little or no compression, other than that offered by TIFF, Publisher's Paintbrush (from ZSoft in Marietta, GA), and bit-map file formats.

As the complexity of the system increases, so do its compression needs. The trend, in general, is toward storing images using CCITT Group 3 or Group 4 compression. These algorithms provide a size reduction of approximately 10 to 15 times that of the original.

For easy installations, software compression is doable but relatively slow. According to Pawan Gupta, product marketing manager for Kofax Image Products, software compression approaches hardware speeds when you start using 33-MHz 386-based or faster microcomputers. The advantage to using CCITT compression is that by adding the appropriate header and decompressing when necessary, you can fax the image without any conversion or rasterize it into a TIFF file as needed.

The input needs of DIP systems are not limited to paper, however. A growing number of installations have found it necessary to import microfilm archives using specialized scanners.

Another way to get paper information into a DIP system is with transparencies. By using high-speed photography to shoot the documents on-site, you can send the developed slide film to a scanning house, where images are grabbed directly off the film.

continued

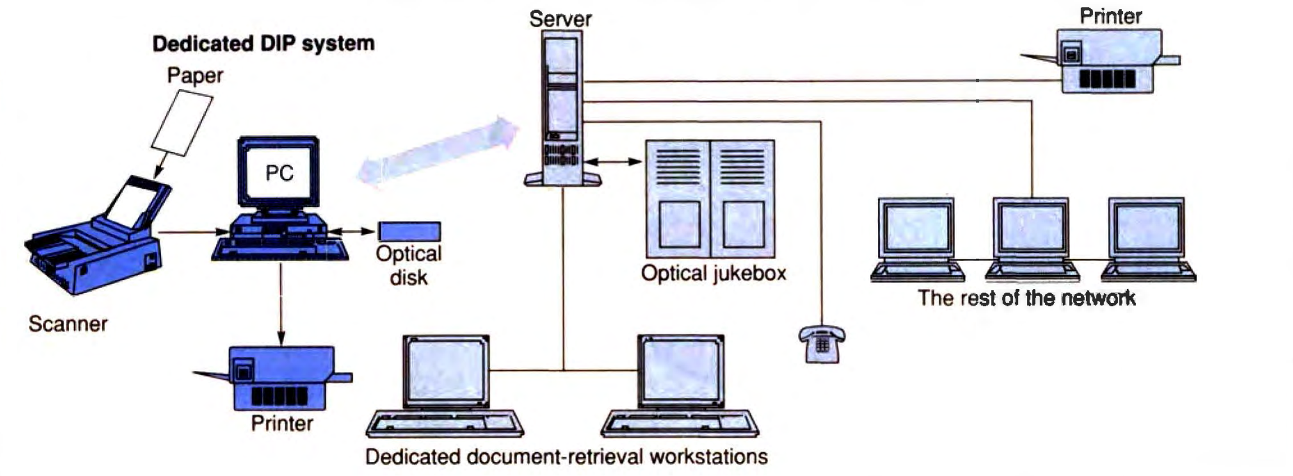
SINCE WE COULDN'T REINVENT THE HAND, WE REINVENTED THE MOUSE.

Introducing the world's only mouse specifically designed to fit the human hand. New MouseMan from Logitech comes in both right-handed and left-handed models. Its sculpted, ergonomic shape comfortably fits into your hand. And its ingenious, three-button design can save you thousands of keystrokes. Of course, MouseMan is totally plug compatible with Microsoft.® There's a version for IBM personal computers or compatibles and one for Macintosh® systems.

LOGiTECH

Tools That Power The Desktop.

AN ALMOST-PAPERLESS OFFICE



A high-level, integrated, networked DIP system. The highlighted grouping at left represents the lowest level of DIP implementation. In the high-level system, this grouping becomes one of several dedicated scanning stations that send compressed files to the server.

In the future, DIP systems (especially those used in the medical arena) will need to combine with imaging systems and allow the indexing, storage, and retrieval of medical images like those created by nuclear magnetic resonance, CAT scans, x-rays, EKGs, and EEGs.

Optical Drawers

The storage requirements for even the lowest-level DIP system are tremendous. Even with CCITT Group 3 or Group 4 compression, a typical business document takes up about 40K bytes to 50K bytes per page. Sheer volume aside, DIP requires an archival storage medium that is relatively stable and insensitive to physical disruption, something that conventional hard disk drives are not.

The long-term storage technology of choice for DIP systems is optical. You can use local hard disk drives, in conjunction with optical technologies, for indexes and temporary storage of documents that are being processed. CD-ROM, WORM (write once, read many times), and rewritable technologies each offer a different set of advantages for DIP installations.

The advantages of CD-ROM technology are not realized until you have to distribute the information to several remote sites over a dispersed geographical area. CD-ROM offers several distinct advantages as a distribution medium.

According to Rick Holt of OnLine Computer Systems (Germantown, MD), "CD-ROM is useful for distributing information that needs to be under revision control." Because you can't modify a compact disc, it is easy to resolve any issues that arise from claims of outdated specifications; for example, OnLine Computer Systems has developed a Computer-Aided Product Selection system that includes the parts' specifications, parametric searching, and searches by part type. Publishing and distributing documentation is a task to which CD-ROM is particularly suited.

Hewlett-Packard now publishes much of the documentation for its operating systems on CD-ROMs. With the advent of CD-WORM technology (see the text box "A Marriage of Convenience: CD-WORM" on page 178), you can make use of published CD-ROMs and have most of the functionality of a WORM—all in one box.

WORM drives are well suited to archival storage. A copy of a document on a WORM drive is considered a legal copy, which means that you can eliminate the corresponding paper document or microfilm.

In addition, most WORM file systems have built-in audit trails. As a result, they can track a document throughout its life cycle, from creation to final approval. DIP software can take advantage of this feature to enable you to instantly examine changes made in various versions of a document, as well as keep track of revision and approval dates.

In DIP systems that allow document annotations, the entire history of the document can be made immediately available, including proposed—but not implemented—changes, who reviewed and created the documents, and suggestions for future revisions.

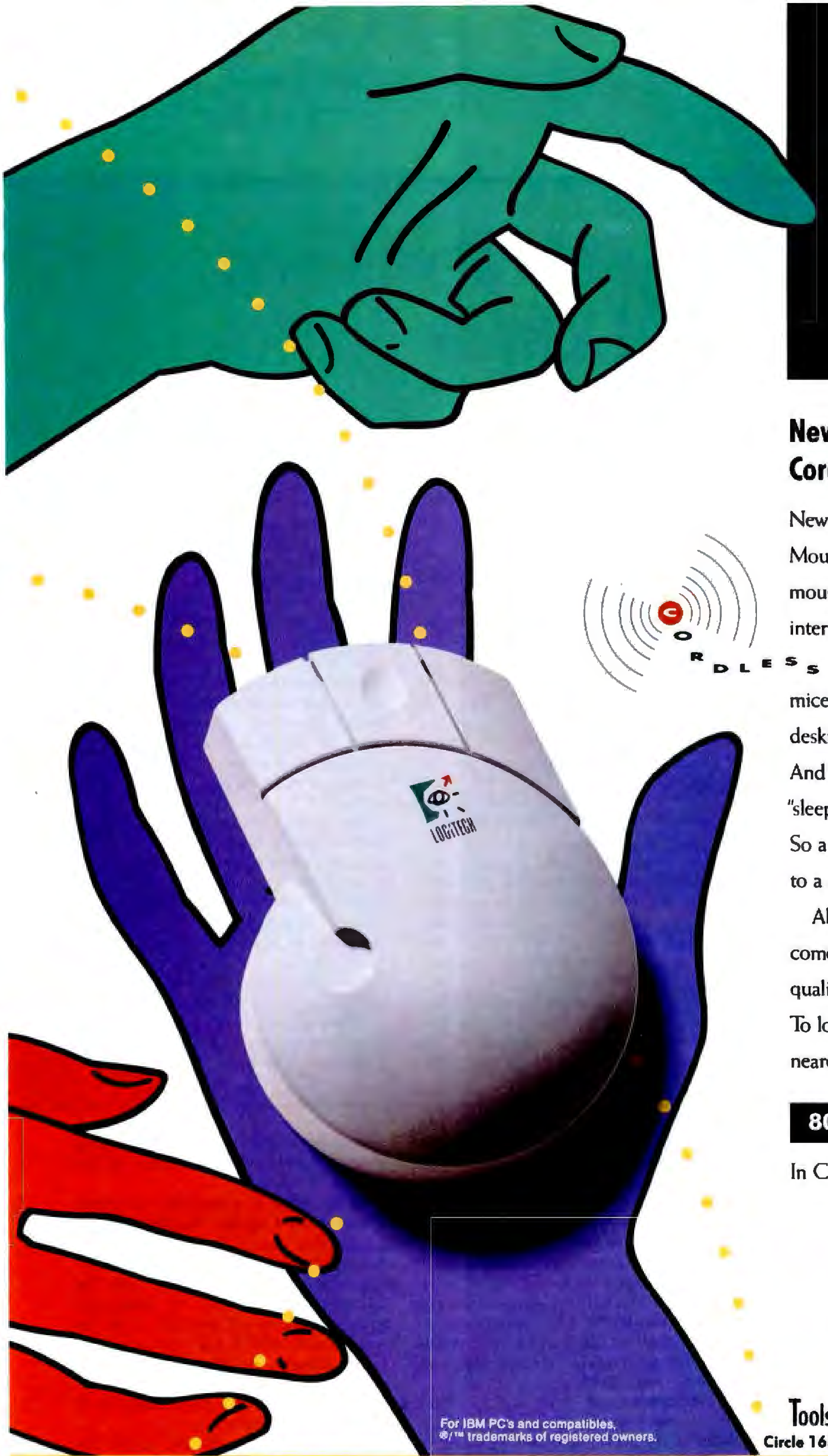
WORM media both automate and centralize this information, which offers substantial cost and labor savings over traditional paper-bound filing systems. In traditional systems, cross-indexed folders with notes scribbled in the margins must be located, sorted, and then recombined into a report.

What CD-WORM promises is a standardized WORM file system. The immediate benefits will be tremendous. This technology will allow not only multiple sourcing of drives, but also data transfer via "sneaker net" to remote sites and the generation of multiple copies of archival disks that anyone can read.

Rewritable drives are much more standardized and much faster than WORMs, and you can alter or delete files on them. This makes rewritable media useful where archival permanence is not vital. By using IFS technology like Write-Once File System software from N/Hance Systems (Dedham, MA), it is possible to create a virtual WORM on a rewritable drive and bypass the permanence issue. However, the legality of a copy created under such a file system is uncertain.

Whichever optical technology is used, it is clear that single drives are probably useful and appropriate only for the lowest-level implementations. Optical jukeboxes, which consist of a multiple-drive

Then, We Pulled The Plug On It.



New MouseMan™ Cordless Radio Mouse

New MouseMan™ Cordless Radio Mouse is a different kind of mouse. It avoids the annoying interference problems that plague infrared cordless mice. So you can roam your desktop with total freedom. And new MouseMan Cordless "sleeps" when you're not working. So a common battery lasts up to a year.

All MouseMan products come with Logitech's legendary quality and lifetime warranty. To locate the Logitech dealer nearest you, call:

800-231-7717 ext. 344

In CA call: (800) 552-8885.

LOGITECH

Tools That Power The Desktop.

Circle 163 on Inquiry Card (RESELLERS: 164).

A Marriage of Convenience: CD-WORM

An exciting new development promises to package the functionality of a CD-ROM and a WORM (write once, read many times) drive in a single box. Called CD-WORM, the technology will allow the multifunction drive to read current ISO-9660- and High Sierra–format CD-ROMs, as well as write CD-ROM- and CD-WORM-format disks.

According to Wink Saville, vice president of research for Meridian Data (Scotts Valley, CA), a major developer of the technology, the CD-WORM drives should be available in about 18 months. You can expect CD-WORM prices to be comparable to the price of current CD-ROM drives.

Current systems, such as Meridian Data's CD-Professional, are capable of writing to a compact disc using either Yamaha or Sony CD-writable drives, and they are compatible with either the Yellow or Red Book standards. The downside is that the system costs upwards of $30,000, and it can only write to the entire disk at once. When data is written "disk-at-once," the system writes to the entire disk, leaving no free space, and you cannot write to that disk again.

Understanding how a CD-WORM functions necessitates a little backtracking. On a standard hard disk, data is organized into a series of concentric rings known as *tracks*. Tracks are divided by a series of angular lines running from the center to the outside of the disk. These lines subdivide the tracks into sectors. Data can be written to a conventional hard disk a sector at a time.

A WORM disk uses a similar pattern of organization, but because the data is stored in a series of pits burned into the media by a laser beam, a bit written to a WORM disk is unalterable. One of the biggest drawbacks to WORM media is the lack of a standard file structure. The result: Data that is written by one manufacturer's drive can usually only be read by that company's equipment, and no one else's.

On the other hand, CD-ROM is highly standardized. Initially, a group of companies got together and established the High Sierra format. An international committee then reviewed and modified this format and finalized what is known as the Yellow Book specification. Consequently, any CD-ROM conforming to this standard can be read by any CD-ROM drive.

Data on a CD-ROM is organized in a continuous spiral, which is further subdivided into sectors. Although it's not ultimately important, location on a CD-ROM is measured in minutes and seconds. CD-ROM drives seek to a given location on a disk; they use information contained in a key channel to determine the rough location and then step quickly over the transitions in the spiral to that area. Once there, they use the information contained in a 4-byte header to determine the precise location.

Information contained within the spiral on a CD-ROM is written in a 4-to-1 interleave. This means that to obtain a piece of data located in one sector, five sectors must be read. Meridian Data calls a unit consisting of four sectors a *packet*. Due to the nature of the interleave, the CD-WORM won't be able to write data in a sector-at-a-time format; instead, it will write its data a packet at a time.

The packet size can vary from one sector to all the sectors present on the disk. According to Saville, "If a packet is one sector in size, you're going to waste four others. In other words, data written with a packet size of one sector would end up wasting 80 percent of the disk."

While a conventional WORM can update each sector once, a CD-WORM will only be capable of appending sectors when writing in the packet-at-a-time mode. With disk-at-a-time writes,

---

array fed by a robotic arm, are quickly becoming commonplace. Most major optical-drive manufacturers offer jukebox systems that you can use in conjunction with everything from a PC to a minicomputer or a mainframe.

Optical jukeboxes allow constant online access to many gigabytes of data, eliminate the need to manually switch cartridges, and, more important, deal with the intricacies of addressing multiple drives.

While the digitization and storage of data is relatively consistent among the various levels of DIP systems, the software is not. Software ranges in complexity from simple DOS or DOS/Windows-based single-user applications to multitasking, multiuser packages that are designed to run on RISC and mainframe-based platforms.

The Brains of DIP

As with hardware, the various software modules necessary to implement a DIP system are relatively consistent across the various levels. The essential components of a DIP software package consist of document input, manipulation, retrieval, and indexing.

Input software varies widely among the various levels. While the base process of document input and indexing remains relatively constant, adding OCR and using object-oriented file systems greatly increase the complexity of the process.

At its simplest, a package like Paper Tamer from Flagstaff Engineering lets an operator control the scanner, designate scanning batches, preview the image on-screen, and manually index the document by keywords. In these systems, documents are generally stored as compressed CCITT files or as simple raster images. Batch control lets you group documents contextually, and keyword indexes enable a rudimentary level of retrieval and indexing.

As complexity increases, so do the various strategies for manipulating docuonly one write is physically possible per disk.

What needs to happen in the near future, according to Saville, is the development of a media standard that will be a superset of the Red and Yellow Books, and a plan for a file-system standard that supports packet-oriented writing and reading.

At the time of this writing, Saville said that "a group of companies has gotten together and looked at the problem and will be submitting a document within the first quarter of this year to an international body, which will then standardize it." Also, he hopes that this will ultimately turn out like the High Sierra format, where people implemented the standard before the ISO had fully worked it out.

Ultimately, Saville sees CD-WORM technology as having the potential to replace current WORM drives. He cites higher storage capacity (640 megabytes versus about 200 MB for WORM) and lower costs for blank disks. Although disks are currently priced between $50 and $100, Saville sees prices coming down to about $10 per disk due to the availability of the same type of technology for recording audio CDs.

Perhaps the loudest cries coming from those who use optical technologies have consistently been for the implementation of multifunction drive technology and, of course, for lower prices. These cries are being answered, however, with CD-WORM's ability to read existing CD-ROMs and write both disk-at-a-time and packet-at-a-time WORM disks, and with the projected price of $2000 per CD-WORM drive.

ment input. One thing that remains constant is the need for a human presence to feed the machine, generate the simplest level of keyword indexing, and verify the quality of the scan. One trick that On-Line Computer Systems uses for automating the indexing process is to create a mask that uses OCR to recognize the page number of the document that is being scanned.

Retrieval in a simple system is enhanced by searching the keyword index for matches and selecting the document or group of documents to be displayed. You can then view or print the documents as necessary.

What is constant about these kinds of storage and indexing schemes is that they ultimately lead to the creation and storage of a document image. Things become really tricky when you start to add elements like full-text copies of a document and object-oriented filing systems.

When Is a Document Not a Document?

For the simplest systems, where the need is primarily one of maintaining an electronic filing cabinet of document images, you really don't need to convert the text in the document into ASCII or other machine-readable formats. As complexity increases, however, this conversion becomes a significant factor in designing and implementing a DIP system. Machine-readable text is a necessity where you must share the information contained in the document, when you perform text searches, or where you need to make changes to a document or forms.

Information sharing is especially important when dealing with various generations of a specification, for example. In these cases, you want the ability to take portions of previous specifications and import them into a new proposal. For lawyers, the ability to cut and paste text from one brief to another could eliminate a great deal of redundant clerical effort. In business, the ability to drop sections from, for instance, regional sales reports generated several years ago into a current report not only would save time but also might facilitate new and innovative analysis.

While information sharing is more or less possible without a complex DIP system, the ability to perform text searches is not. Once a document has been converted and stored as a text file and then indexed, the advantages of ASCII become distinct. In a situation where an engineer needs to find every instance of the use of a particular piece of hardware, the primary advantages become those of speed and convenience.

Other applications, however, provide advantages that actually improve performance and lead to solutions that may have been previously unrecognized. An epidemiologist utilizing a text search on a medical-records database could quickly find all the cases manifesting the symptoms of the disease under question. In addition, information in arrays suggesting patterns that a simple paper or microfilm-based search would have missed might be retrievable.

Stand Up and Be Recognized

The thorn in the side of DIP is OCR. While OCR algorithms have radically improved in terms of recognition and speed, especially in hardware implementations such as True Scan from Calera Recognition Systems (Santa Clara, CA) and fast software-based OCR packages such as OmniPage Professional from Caere (Los Gatos, CA), they still suffer from enough inaccuracy that they cannot be fully automated.

True, a good OCR package is trainable; an even better OCR package recognizes simple handwriting, letting you input annotations on documents and notes. However, OCR is still not at the point where you can rely on it to fully recognize a complete document without error. This is not a major problem if the text is relatively consistent and uses fonts that the package can handle without trouble.

OCR is well suited to handle documents that have multiple graphical images along with running text. Since it's necessary to scan the graphics, it's probably worthwhile to use masking and implement OCR at the same time. The crisis emerges when the OCR system needs to recognize multiple documents with dissimilar vocabularies and typefaces—not to mention the problems inherent in recognizing printed text in which characters touch each other.

Even when processing relatively simple documents, an OCR system requires an operator. Furthermore, that person must have some degree of specialized knowledge about the subject of the documents to make informed decisions about misrecognized text. When errors occur, even with only one or two per page, it may well be more cost-effective to use standard data entry (which doesn't require specially trained operators and the process of double-keying to ensure accuracy) than it is to use OCR.

According to Holt, "Our experience with OCR is that it's really very, very slow and prone to error, even with 10-point-type text. The time and cost it takes an editor to bring up the OCR output and then correct one or two errors per page is about the same time that it takes to have it keyed by a high-volume contractor."

Regardless of how it arrives, once the text is in the system, you must store and link it to the appropriate images. The traditional approach used on a document search lets you bring up the text, the image, or both. This approach is more than adequate for installations that aren't dealing with graphical images and don't need to use and manipulate text or have a legal copy of the document archived in electronic format.

When you must store and manipulate

multiple graphical images, as well as text and archival copies of the document, this method begins to suffer from performance problems. But while the next step toward resolving these problems may be a small one for the hardware, it's a giant leap for DIP.

OLE: Taking On the Bull

One of the shiny new buzzwords around Microsoft these days is *OLE* (for object linking and embedding). Basically, OLE takes an object-oriented approach toward documents and information.

According to Russ Werner, general manager of systems marketing at Microsoft, "The compound document is a metaphor for this type of work. People want to be able to incorporate data from multiple sources, data types, and physical locations into different kinds of objects, whether it be a word processing object or some other object. Sometimes you want the information to be a part of the document; sometimes you want it to be in other places (i.e., embedded or linked)."

The power of this approach allows a framework to be set up in an application or document that is data-type independent. Windows will be one of the first places where OLE turns up; demonstrations of OLE have already been shown in conjunction with Lotus Notes and Microsoft Excel.

Werner says that along with OLE, Microsoft is "taking a look at the file systems and what's necessary to make them more object-oriented." This may include maintaining object links, change notification, and more attributes. Within the next few years, says Werner, you'll be seeing a major change in the file system architecture, either in the file system itself or in the elements that manage the file system.

If Windows is not your platform of choice, take heart. With the introduction of WLO (pronounced "willow," for Windows Library for OS/2), Microsoft's strategy will be geared toward taking the Windows application set and hosting it on DOS, Windows, and OS/2.

The important aspect of treating different elements of a document as objects allows you to manipulate, edit, and view documents in a variety of ways. In addition, you can use each object (while still retaining its identity) with a variety of different objects, and you can edit each object in the context of those objects. Add OLE to the DDE and MDI facilities of Windows, and the possibilities for designing DIP applications become practically endless.

Kofax's Ko-App, included as a component of the Kofax Image-Processing Platform, is a full-featured Windows imaging application that allows scanning, faxing, and image manipulation. It supports DDE and will incorporate OLE in the future.

More Than One Way to Say OLE

While OLE may be new to Microsoft, it's old hat in the DIP field to Interleaf (Cambridge, MA). OnLine Computer Systems uses Interleaf's active-document technology to implement an object-oriented approach to the components of the documents.

The dawn of object-oriented documents gives a new vision of the paperless office.

Using Interleaf's display technology, which embeds the formatting logic, you have the ability to reassemble and display a document at viewing stations on the fly. Bit-mapped images are scanned in and stored as CCITT Group 4 elements; vector images are stored as computer graphics metafiles; and text is saved as ASCII. When reassembling the document, a TIFF header is attached to the decompressed CCITT; the appropriate vectors, text, and tables are retrieved; and the document appears the same as when it was scanned in.

Not only does this process facilitate updating single elements of a document, but it also lets the system create hyperlinks between text and graphical objects. Markers are embedded in the text stream and are used to provide an anchor for the software that displays this information, letting it call up the linked images.

Regardless of the specific approach, the dawn of object-oriented documents promises an entirely new vision of the paperless office that is daily moving closer to the dream of *Information at Your Fingertips*. The final task of DIP software is to allow the retrieval, output, and manipulation of the stored images.

The View from the Top

The layer of the application that provides an interface to the management, creation, viewing, and editing of stored documents is perhaps the most critical, as it is the main layer you will work with.

At the lowest level, you must be able to retrieve documents by date, scan batch, and keywords. This is where the indexing software shows its mark. More sophisticated applications need to allow you to index documents and objects both by context and content, as well as allow document retrieval by revision level, creator, and status.

At the next level, you must integrate documents from a variety of sources. Incoming faxes, documents that have been created electronically, and scanned documents must all coexist under a common index. This task requires sophisticated tools that work on a network. You have to be able to create and save documents locally, while at the same time saving them as part of the archive. In addition, you must file incoming faxes and make them available for immediate viewing.

Finally, the DIP system must be able to output the documents in several formats. On a simple level, this means that a dedicated document workstation lets you locate and then print or fax a document. Things become more complicated when you have to provide the information to one of several dedicated terminals or globally to every workstation on the network.

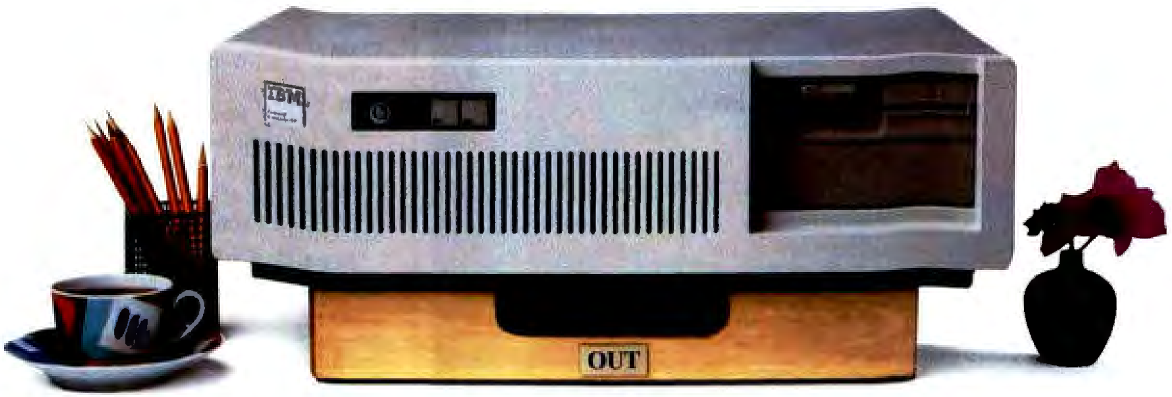
In high-end systems, a central server (or multiple servers) combines with the network to form a distributed DIP system. Professional Image from Computer Signal (San Ramon, CA) is a good example of this sort of system. What all high-end systems have in common is the ability to seamlessly incorporate high-speed printing (often through the use of SCSI printers), fax, and retrieval into a networked environment.

A Working and Usable Technology

At the lowest level, setting up a DIP system involves using a simple document-imaging software package in conjunction with a high-capacity storage device and a scanner to create an electronic filing cabinet. From this level up, the basic methods and hardware employed to manage information on paper remain relatively constant. What changes are the levels of sophistication in the software and the speed and capacity of the hardware.

A kind of modularity exists in DIP that lets installations migrate up through the various levels without needing to start over. Perhaps the most important thing

BIG IS OUT.



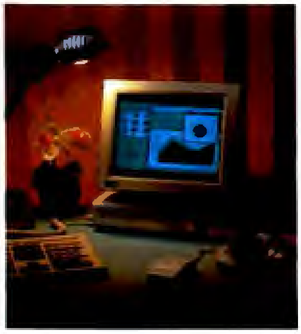
SMALL IS IN.

Introducing the Falco Infinity Desktop Computer.
The Smallest 386SX Desktop.

If you're sizing up desktop computers, you'll immediately see the advantage of the Falco Infinity™ Desktop. It gives you 386™SX power and performance without dominating your deskspace.

Half the size of a standard PC, the Infinity Desktop has everything you need on-board: Peripheral interfaces like disk controllers. Memory expansion. Communication ports. And VGA® level graphics up to 1024 x 768 resolution. Plus, two AT®-compatible, 16-bit expansion slots.

It runs DOS™ 4.0, UNIX,® OS/2™ and Microsoft® Windows 3.0. What's more, you can choose from four configurations, including a diskless network node and a full-featured model with 1.44MB floppy and the option of 40, 100 or 200 MB hard drive.



The only thing we left out is the noise. The Infinity Desktop runs so quietly, you'll hardly know it's on.

Whether you work in close quarters or spacious surroundings, the Falco Infinity Desktop covers all your needs. Without covering your desk. And that's about the size of it. To get one for your desk, call us today.

1-800-FALCO4U

FALCO

440 Potrero Avenue, Sunnyvale, CA 94086-4117

Circle 107 on Inquiry Card.

to do if you are installing a DIP system, with an eye toward expansion, is to make sure that the software you use stores images in a format that other packages can deal with. For the present time, this would seem to be the compression and file structure offered by CCITT Group 3 and Group 4 standards.

Equally important is identifying the documents that are most suited to digitization. At the outset, the most likely targets are those documents that are relatively static and occupy the greatest physical and temporal space in a particular organization. Examples might include processed orders, personnel files, medical records, and the like.

Once these categories are determined, you can then develop a plan to digitize the paper and train staff to use the new technology. As familiarity and comfort with the DIP system increase, the system can grow to incorporate incoming documents (e.g., faxes, correspondence, and orders) and to manage documents from the time of their inception through some sort of "active-document" technology.

Regardless of what approach you take, it is clear that DIP is a working and usable technology. In the coming year, expect to see more and more paper converted to machine-readable formats. The DIP revolution, when it finally arrives, will not be an overnight coup. Rather, it will emerge gradually as test installations turn into full-fledged systems and as more paper-bound sites begin to use the technology.

The emergence of DIP systems, combined with the push by Microsoft and others toward a "document-centric" approach in which data is treated as objects and the document at hand becomes the context in which people work, will greatly change the way in which computers are used. *Information at Your Fingertips* may be a vision now, but it certainly provides a direction toward which the industry can work.

The office of the future may not be entirely paperless, but the advantages of having instant and integrated access to information, combined with the enormous cost savings associated with digitizing paper, make the move to eliminating those trillion sheets per year extremely practical. All in all, the elements are present to really make DIP stick. ■

David A. Harvey is a computer journalist in Houston, Texas, who specializes in the technology and implementation of optical devices. You can reach him on BIX as "daharvey."

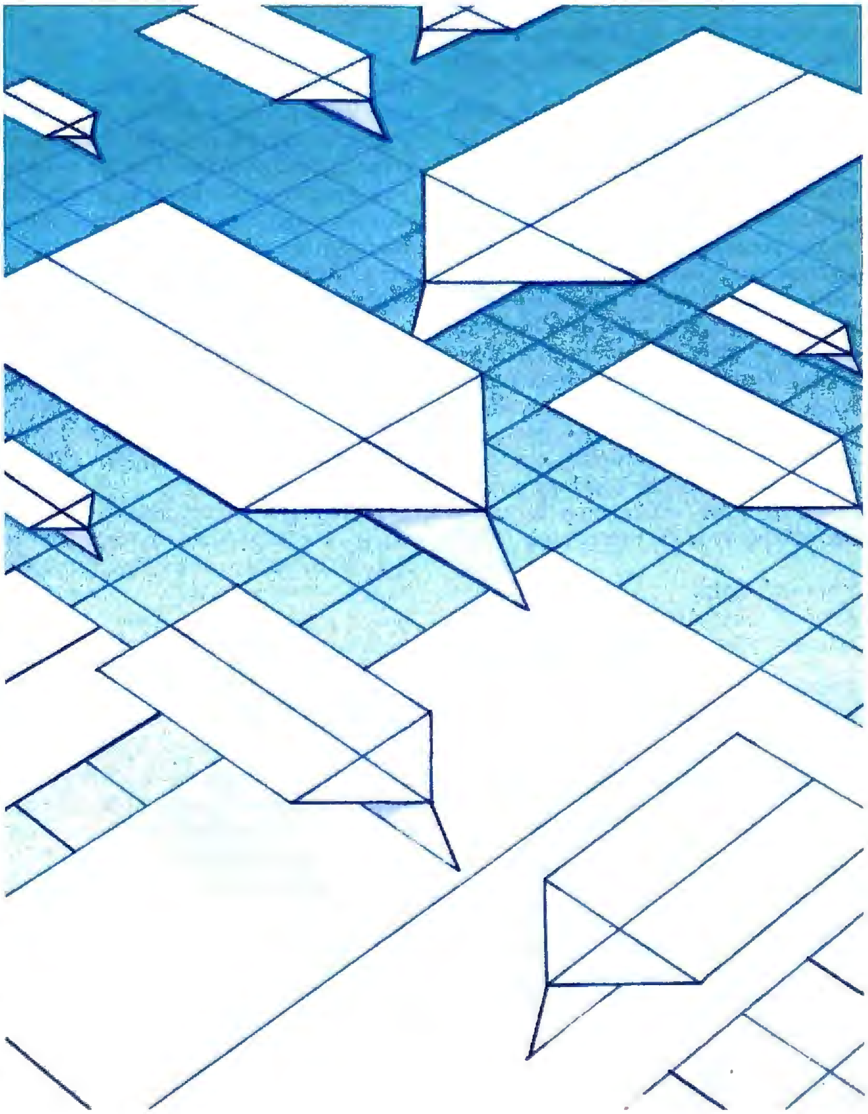
PRACTICALLY PAPERLESS

Document image processing is more than a neat idea. For many companies, it's a lifesaver.

DAVID A. HARVEY AND BOB RYAN

One of the biggest attractions at the 1939 New York World's Fair was "The House of the Future," which attempted to show the future direction of automation in the home. Today, the newsreels that trumpeted the House of the Future seem like quaint reminders of a much simpler time. Similarly, the phrase "paperless office" is viewed by many as an embarrassing reminder of a time not long ago when faith in computers and their capabilities was unbounded. As quaint—or even disreputable—as the phrase has become, however, document image processing (DIP) is making the paperless office a reality for many businesses with well-defined document-handling needs.

DIP systems run the gamut from relatively inexpensive stand-alone software systems to sophisticated, network-based minicomputer and mainframe systems. The degree to which you invest in the technology depends on the volume of documents you deal with and your need to access them quickly. Here we'll look at how DIP has met the needs of a number of different organizations.



Paper Airplanes

Alitalia was an airline faced with a paper crisis. Each of its 30,000 yearly purchase and repair orders required 10 supporting documents. As required by Italian law, all these documents had to be stored for two years before being transferred to microfilm in the company's general archives. The 750,000 documents were stored in three 16-shelf automated filing cabinets and nine other paper-storage devices. On an average day, 65 documents had to be located and retrieved, resulting

ILLUSTRATION: BARTON E. STABLER © 1991

in the loss of many hours of employee time—not to mention the time that was required to update and maintain the filing system.

Management was growing frustrated with its inability to integrate electronically stored information with the paperwork and with the fact that the paper documents were accessible by only one person at a time. What management wanted was a system to store, access, and archive all those documents, provide multiuser access, and integrate the paper-based information with the information in the company's on-line databases.

DIP on Trial

As they began looking for options, members of Alitalia management came upon the LaserView Document Image Management System from LaserData. According to Tonino Luciani of Alitalia's technical materials planning and purchasing department, they decided to test the system for a three-month period. Software, says Luciani, was the most important consideration.

Working closely with Society Per Software (a LaserData vendor) of Rome, Alitalia installed a DIP system consisting of two scanning and retrieval workstations connected to a local laser printer, a DIP server connected to a 20-disk optical jukebox and a laser printer, and two remote-retrieval workstations equipped with laser printers. The first phase—installing an electronic archival system—has satisfied the company's initial desire to get a handle on its paper-based documents and get rid of paper files. The second phase will involve linking the imaging system with the company's mainframe to allow information to be exchanged between the two systems.

Nuts and Bolts

Each document in the Alitalia system is scanned in by an operator who then enters the appropriate index information for document type, purchase order number, item number, and box number (used if a paper copy of the document needs to be stored). Additionally, the software automatically date-stamps the documents and assigns a supplier code.

To improve performance, the system uses two databases. The first, a daily database, holds the information from each day's scanning activity. The other, a general database, holds information about all the documents in the system. This was done, says Luciani, to separate scanning and retrieval activity. After scanning, the images are compressed using CCITT Group 2 and Group 4 standards and sent to the jukebox.

The legal profession brings a new set of needs to a DIP system.

The retrieval front end enables you to perform keyword searches, display up to nine different documents on-screen, scale or rotate the image (useful if the document was scanned in upside-down), zoom in on particular sections, and output the document.

The Alitalia implementation is an example of a DIP system that is primarily archival in nature. The future for Alitalia holds both a linkup to its mainframe and expansion of the system to cover other departments. Due to the modularity of the LaserView system, expansion should be much less painful than the initial installation.

Connecting the system with the mainframe will eliminate the duplicate imaging of electronically created documents. Currently, for example, when the company sends a telex to a supplier, the telex must then be scanned into the system. This type of situation results in about a 45 percent duplication between imaged and electronically stored documents, a redundancy that the company would like to eliminate.

Overall, Luciani has been extremely pleased with the results of the system. Not only has the system eliminated the time, expense, and wasted space associated with traditional files, but it has allowed Alitalia to search more thoroughly for needed information. To Luciani, the system provides the best compromise between a document file and a database.

Keeping Them Flying

Alitalia isn't the only airline making use of DIP. At the Minneapolis/St. Paul International Airport, Northwest Airlines has replaced a microfiche-based document-retrieval system with one based on Metaview, a DIP system from Metafile. Moving from microfilm or microfiche to DIP is not an unusual development (see the text box "The Evolution of DIP" on page 188).

Northwest's problem was with maintenance manuals. For example, the manuals and parts catalog for a Boeing 727 total about 50,000 pages. Having highly skilled—and highly paid—maintenance workers searching for the proper document on a microfiche system was neither fast nor cost-effective.

In cooperation with Metafile, Northwest created a LAN-based DIP system that stores the maintenance documents on optical disks. Metafile's Metaview is an object-oriented language built from the ground up to support imaging applications as well as cooperative processing between workstations on a LAN and between LANs and larger systems. In addition to significantly cutting the time required to retrieve a maintenance document, the Metaview system provides better indexing and output quality than the microfiche system it replaced and makes it easier to keep the information on the system up to date.

DIP and the Law

While the above examples deal with the need to store and manipulate information and images to fulfill archival and record-keeping tasks, the requirements of the legal profession bring a new set of needs to a DIP system.

The day-to-day work in the business of law is intellectual in nature. Thus, a lawyer needs the ability to locate information based on content and context. For example, a lawyer preparing to defend against a look-and-feel lawsuit not only needs to verify that the necessary briefs and pleadings have been filed, but also needs access to information that will help to prepare and substantiate the case. This means full text-searching abilities and the ability to group information by the content rather than the context of a document.

The legal department at Executive

BYTE ACTION SUMMARY

DIP Case Studies

A number of companies have adopted document image processing. They serve as models of situations where this technology can address a real need.

FAX FROM WINDOWS WITH WINFAX

Announcing WINFAX from Delrina Technology — the easiest way to fax! WINFAX installs under Microsoft Windows 3.0 as though it were a printer. When you're using any Windows application, select the print menu and choose WINFAX instead of your printer. It's that easy!

Not only is WINFAX easy to use, it produces the best looking faxes around. WINFAX sends any image created within Windows **directly** – without being printed or scanned first – so your fax output looks almost like laser printing. Transmissions are completely programmable for unattended operation.

For as little as $149 (+ shipping) you get:

- ▲ WINFAX fax software for Windows 3.0
- ▲ Your choice of ZOOM PC Sendfax board. Choose internal or external, 4800 baud or 9600 baud Group III broadcast fax
- ▲ A built-in 2400-baud Hayes-compatible modem

These ZOOM Telephonics fax/modems come complete with a **7-year warranty**. Full documentation and telephone technical support are also included.

PC MAGAZINE "WINFAX is one of those small software miracles ... fax transmissions are finally as easy as they should have been all along."

ALFRED POOR
FEBRUARY 26, 1991

No-risk 60-day money back guarantee

If you're not completely satisfied, return your WINFAX kit to us within 60 days for a full refund. This offer valid only in Canada & USA

TO ORDER CALL TOLL-FREE
1-800-879-4450

AMERICA'S MOST POPULAR GRAPHICS FORMS SOFTWARE NOW AT A NEW LOW PRICE

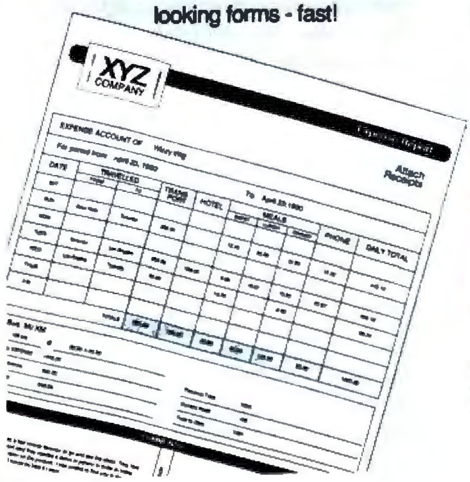
For a limited time only, we're cutting the price of PerFORM 2.1 in half - $149* ($175* in Canada). PerFORM 2.1 Designer & Filler saves you time, money and effort in managing business forms.

TAKE THE DRUDGE OUT OF ROUTINE BUSINESS FORMS

PerFORM 2.1 leads the pack in PC forms processing. Design your own forms quickly and easily on your PC instead of sending out. Fill in your forms on-screen instead of by hand. Save filled data in your database. Print only what you need instead of ordering thousands at a time.

WYSIWYG vs. GOBBLEDEGOOK

Some PC forms packages sell for peanuts. And that's exactly what they give you: a gobbledegook screen display that can drive you nutty. With PerFORM, what you see is what you get: great looking forms - fast!



Unlike low-end forms utilities that only give you WYSIWYG *preview*, PerFORM 2.1 is *completely* WYSIWYG, so what you see is what you print. Clear, crisp graphics. Your form appears on your screen the same as the final printed version - eye-catching and easy-to-read. Bitstream fonts and over 100 ready-to-use forms templates are included to get you going right away.

PerFORMANCE AND PRICE

New version 2.1 of PerFORM has the power and features of more expensive forms packages, yet costs only $149* during this limited-time promotion. Whether you use an old IBM-XT compatible, a brand new '486 or anything in between, PerFORM 2.1 makes the most of your hardware to give you high quality forms. And your forms are fully compatible if you move to PerFORM PRO in the future.

THE CRITICS' CHOICE

In just two years, PerFORM has won the accolades of the editors and the loyalty of thousands of users worldwide. The winner of the major media awards, PerFORM Designer & Filler is recognized as the industry leader in PC forms processing.

FORM YOUR OWN OPINION

Why just believe the critics? Form your own opinion. You can now own the leading PC forms software at a bargain utility price. What's more, new PerFORM 2.1 comes with a **no-risk 60-day money back guarantee**. Hurry! This low price offer won't last long!

CALL TODAY FOR A DEALER NEAR YOU!
1-800-268-6082

PerFORM

Circle 93 on Inquiry Card.

The Evolution of DIP

David Silver

Companies are always trying to reduce the amount of space and time required for filing and retrieving original documents. Paper documents have traditionally been stored and managed with file cabinets and a variety of indexing schemes. Retrieving these documents often mirrored the type of procedure associated with retrieving books from libraries.

New technologies have risen, however, to meet the need for compact storage and easy retrieval of documents. Document image management (DIM), which began with microfilm technology in the 1970s, is now a rapidly growing application for the PC environment.

The number of paper documents that need to be managed is astounding. According to the Association for Information & Image Management, American businesses generate more than 1 trillion pages of paper documents a year, and 2.7 billion new sheets of paper are put into file folders every day.

Paper and Microfilm

Microfilm was the first DIM technology developed to address the needs of paper-intensive businesses. During the 1970s and the early 1980s, advances in computer technology substantially increased the output of paper associated with most applications, greatly increasing the demands on manual paper-storage methods.

Microfilm offered companies numerous benefits over paper-filing systems: lower space requirements, easier and faster access to documents, improved file integrity, increased security, longer document life, and lower costs through productivity gains and space savings.

But while microfilm offered significant improvements, it fell far short of what was necessary to efficiently process and retrieve documents. Storing the documents required that they be sent off-site to be filmed, a process that typically took up to two weeks and consequently left companies without access to these documents during that time. Retrieving documents was a mechanical process that was often as time-consuming as retrieving paper documents from a file cabinet.

The Computerized Alternative

In the early 1980s, advances in computer and computer-peripheral technologies combined to bring about the first computerized document storage and retrieval systems. These first document image processing (DIP) systems featured proprietary minicomputers combined with new optical disk drives, paper scanners, and laser printers.

DIP systems revolutionized document management. For the first time, you had immediate on-line access to document images from your computer. Laser printers provided clear, near-perfect output of document images while database programs provided document-tracking functions for fast retrieval. In addition, these systems improved company work flow and productivity by taking advantage of LAN technology to electronically route document images throughout an organization. And DIP systems surpassed microfilm by further improving space savings, document security, file integrity, and document longevity.

The use of new technologies is always expensive, and minicomputer-based DIP systems were no exception. The cost of an average installation often exceeded $300,000. While financial institutions and government agencies embraced this new technology and its many benefits, the cost of these systems, coupled with their proprietary architectures, kept DIP technology from becoming widely used.

Let's Get Small

By the late 1980s, it was clear that if DIP was to become a force in document management, significant changes had to be made. Fortunately, improvements in DBMS software, scanners, laser printers, and display technology were under way simultaneously, and the price for optical storage was decreasing rapidly. At the same time, advances in personal computer technology (particularly the 386 processor) and the development of affordable, off-the-shelf PC add-in boards to control specialized DIP functions combined to bring about a new generation of PC-based DIP systems.

These PC-based systems have made DIP available to nearly everyone. By offering compatibility with standard hardware platforms, operating systems, LANs, DBMS packages, and graphical user interfaces, PC-based DIP can be easily integrated into existing equipment and applications. Through this level of integration, PC-based DIP systems have become open, cost-effective alternatives to expensive, proprietary minicomputer-based systems.

Today, PC-based DIP is a mainstream application; insurance companies, financial institutions, legal firms, government agencies, and hospitals are among the many types of businesses using it. Starting at as little as $15,000, PC-based DIP offers not only significant cost advantages but also performance benefits. DIP can now be easily integrated with other applications such as faxes, forms, and desktop publishing to help manage information distribution and output.

PC-based DIP also takes advantage of

Life (Los Angeles, CA) has such a system. Using LaserFiche LAN (developed on the Kofax platform) from CompuLink, the department has installed a system consisting of a NetWare LAN and LaserFiche LAN document-imaging software with image folders.

The basic hardware consists of eight Everex Step 386/20s, an Everex Step 386/25 server, and two Hewlett-Packard LaserJet II printers. The DIP hardware consists of three high-resolution Moniterm monitors, four Genius monitors, six Panasonic optical drives, a Fujitsu 3909 scanner, and a Calera TrueScan optical character recognition board. The OCR and optical drives are located on the server, while the scanner is attached to a dedicated workstation.

According to Jim Veach, vice president and assistant general counsel at Executive Life, the primary attraction of the DIP system comes from its ability to retrieve documents by folder and perform word searches. What Veach likes about the system is that CompuLink worked very hard to design and implement it to fit how a lawyer thinks and works. The LaserFiche LAN system allows the creation of virtual folders, both at the time of the initial scan and anytime thereafter. This lets lawyers superimpose an organizational system that is connetwork technology. Configured in a network environment, it fosters information-sharing throughout an organization. Document images can be routed throughout a company in the order in which they need to be processed, enabling you to have immediate, on-line access to thousands of documents without leaving your PC. In fact, networks allow multiple users to simultaneously view a single document image. With networking also comes the ability to automatically transmit fax images over phone lines, thereby permitting image-sharing among remote company offices.

Today and Tomorrow

Imaging has already become an integral application for a variety of industries. Further developments in DIP applications software, both vertical and horizontal, combined with the diminishing prices of PCs and peripherals, will encourage the number and types of industries using DIP to grow.

The 1990s will bring further improvements that will make PC-based DIP systems an essential and affordable technology for document management. Speed improvements in image compression and expansion; scanning, printing, and image retrieval; and a new generation of high-performance, advanced DIP applications will combine to bring about better DIP systems.

These improvements will make DIP attractive to more companies and industries. In the future, DIP will evolve beyond the task of document management to work in concert with other technologies to further foster information sharing and ultimately improve overall corporate productivity.

David Silver is president of Kofax Image Products (Irvine, CA). You can reach him on BIX c/o "editors."

textually familiar, with attendant increases in productivity.

"If you can get your day working so that you can complete a task, instead of having to stop halfway through because you're unable to get a document, your efficiency increases tremendously," says Veach. He adds, "In a paper world, you get a concept in your mind—you start thinking about it—and then you have to stop thinking, get the document, and try to start up again."

Currently, the DIP system at Executive Life is fairly small, with less than half the department (three attorneys, two paralegals, and three secretaries) on-line. Two of the attorneys are steadfastly putting every incoming document into the system. After this trial run, Veach sees the system expanding. He thinks that the Windows version will be a significant factor in this. Another boost to the system, he says, will be when the attorneys begin to draft their documents electronically. At the moment, Veach scans in every incoming document and puts file-bound documents into the system as they are used. He plans to gradually move all the paper in their 17 horizontal file cabinets onto disk.

Going Paperless

What started in 1969 as Brigadier General Robert F. McDermott's "impossible dream" of a truly paperless company has become a reality for USAA, the San Antonio, Texas, based insurance company he heads. Possessing the largest DIP system in the world, USAA has a virtually paperless environment in the areas that the imaging system serves. The system, which was the prototype for IBM's ImagePlus MVS/EVA system, drives some 1400 high-resolution imaging terminals that serve over 2000 users, both local and remote.

According to Charles A. Plesums, USAA's senior director of image technology, "We made a 90-degree change in the company by taking the paper that was lying flat and making it vertical. Other than that, the work flow remained the same."

To get a clearer picture of how this works, take a look at a day in the life of a typical document in the property and casualty policy service and underwriting system at USAA. When it first arrives in the mailroom, a letter is opened by a machine, and its pages are removed and arranged by a clerk. The pages are then transferred to a mail analyst.

The analyst reads the mail to determine the applicable customer and the routing of the document and enters that information into the computer. Indexing is largely automated. All the analyst needs to do is enter an IMS index transaction (a descriptive code, often the form number) and the customer name. The computer then supplies the routing and indexing data, although the analyst can add additional categories if necessary. Once the index is stored, a temporary key number is generated and written on the document. Total time elapsed? Only 11 seconds per document.

USAA's system is unique in that the indexing information is entered prior to scanning. According to Plesums, this speeds up processing by allowing the analyst to deal with exceptional situations, such as payments that should be refused and returned, original documents that need to be returned, and forms that need to be filled out. Because the analyst makes critical decisions before scanning, the operation is more efficient than if every document were scanned first before exceptions were dealt with.

The last phase of the input process involves checking the quality of the scan and entering the temporary document ID number to link it with the already-generated index. The paper trail stops there. As soon as the document number is entered, the document becomes available to all users of the system—including those at remote sites.

USAA's user interface is essentially a "virtual paper" interface, both in terms of how a document is manipulated and the time it takes to manipulate it. A document is stored in the form of a folder with virtual tabs and subtabs that provide access to specific pieces of customer information.

To retrieve a document, you issue an IMS transaction called Sendwork. The system then checks your qualifications, supervisor assignments, and priorities of work in the queue and selects the best document for you to process. The document is then displayed on an imaging terminal that consists of a high-resolution display and a dedicated cursor keypad that enables you to turn pages, zoom, rearrange pages, enter a specific page number, and perform other paper-handling functions. Interestingly, when windowing and mice were given a trial on the system, users did not respond favorably to them, opting instead for the cursor keypad.

Actual document processing involves the use of the graphics terminal, which is shared between two users, and a separate terminal for standard data entry. The document display shows the document, and the data terminal displays the history log and notes on the file. When finished with a particular document, you can then forward it (along with comments) to someone else for additional processing, save it to the archive, or suspend it until further information is available.

Peak Performance

Retrieval time depends on the age of the document. Those processed within the past year are retrieved within 15 or 20 seconds. Requests for older documents, which require the operator to manually mount an archived disk, take a couple of minutes.

To store and retrieve documents that are created on-site, USAA uses an approach called "presentation text," which links textual data to pregenerated forms in a forms library and then archives the text. The result is that each customer's image file contains not only incoming paper, but WYSIWYG copies of all outgoing correspondence, policies, and any other electronically gathered data.

In order not to compromise performance on its host mainframes, USAA opted to have separate CPUs within its IBM image system. The need for separate CPUs for the image-processing system becomes apparent when you consider that about 150,000 index items linked to about 1 million images are processed every day. The image system is served by two IBM 4381s, which use transaction processing to link to the information in USAA's IBM 3090s.

Smart indexing strategies are also important to maintain system efficiency. The upper limit is 300 pages on a document, and the optimized document size is 20 to 30 pages.

The storage subsystem is made up of five optical jukeboxes and 30 stand-alone optical drives that use 12-inch WORM (write once, read many times) media. By 1995, when the company can legally begin to discard images that are stored in the system, it will contain 250 million documents with over 1.5 billion pages and consume over 2 terabytes of disk space.

For the future, USAA is working on an image system that will support property and casualty claims processing, in addition to underwriting and policy servicing. This expansion effort will result in the addition of 2500 to 4000 terminals. The challenges the company faces in claims processing involve being able to store and retrieve the 1 million color photographs and approximately 400,000 tape recordings it receives each year.

According to USAA, its DIP system has saved 39,000 square feet of office space and freed up 120 employees from file maintenance. The net savings is approximately $5 million per year.

Because much of the customer service work in the insurance business is done over the phone, the ability to nearly instantly recall documents has also resulted in an estimated 2 percent to 10 percent time savings. Each percentage point of improved productivity provides an additional $1 million per year in savings.

Range of Opportunities

The above examples, ranging from small workgroup-size installations to mammoth enterprisewide systems, illustrate the range of problems you can address using a DIP system. In considering such a system, however, you should be thorough in assessing your needs before responding to a problem by throwing technology at it.

While not the solution to all document management problems, DIP is a viable solution to many of them. In such instances, DIP can actually provide the closest thing to a paperless office that you are likely to see in this century. ■

David A. Harvey is a Houston-based computer journalist specializing in the technology and implementation of optical devices. Bob Ryan is a BYTE technical editor. They can be reached on BIX as "daharvey" and "b.ryan," respectively.

THE DARK SIDE OF DIP

Do you know where your documents are? Do you know what's in them?

CHRISTOPHER LOCKE

"Mirror, mirror on the wall, who's the fairest of them all?"
—The Wicked Queen from *Snow White*

The moral of many folk tales is that the image—the seemingly accurate representation of reality—often deceives, usually with dire consequences for those who put their trust in such alluring reflections. In the case of document-imaging systems, this ancient warning is still well worth heeding.

Since imaging produces picture-perfect digital facsimiles of document pages, how can these images lie? When only a few dozen pages are involved, they don't; each screen image is a faithful replica of the paper document from which it was taken.

However, when an imaging system contains thousands or millions of pages, it rarely reveals the whole truth. The issue here is not accuracy but the retrieval of only those pages that are relevant to your immediate needs. If the system holds back crucial information, then, in effect, it lies.

Information systems don't lie intentionally, but all information-retrieval systems tend to lie by omission: They simply have little way of knowing what they contain relative to your queries. In document-imaging systems, this deceit by omission is an inherent attribute of the technology that can cost organizations millions of dollars after all the glamour wears off.

This fatal flaw involves the definition of the contents of document images so that relevant information can be recalled

ILLUSTRATION: BARTON E. STABLER © 1991

CATALOGING-IN-PUBLICATION DATA

Dreyfus, Hubert L.
Mind Over Machine.
Includes index.
1. Artificial intelligence. 2. Computers. 3. Expert Systems (Computer science).
I. Dreyfus, Stuart E. II. Athanasiou, Tom III. Title
Q335.D73 1986 006.3 85-20421
ISBN 0-02-908060-6

Library of Congress Cataloging-in-Publication Data. The items numbered 1 to 3 are topic descriptors defined by the Library of Congress.

on demand. The technical term for this challenge is *indexing*, and it applies to any form of computerized information retrieval. This seemingly straightforward concept is also employed in the back pages of any respectable reference book.

While it may seem tangential to note that works of fiction don't have indexes, this fact is very much to the point. Rightly or wrongly, publishers assume that novels will be read linearly; that is, users (readers) will become familiar with the contents of a novel by processing (reading) its pages from front to back.

This assumption doesn't hold for nonfiction; potential readers may simply want to check a single fact in a 600-page book or scan several relevant pages in search of some highly specific information. Few people have the time or the dedication to wade through an entire text for so little return. A table of contents helps, but usually not enough. Thus, the index was conceived.

BYTE ACTION SUMMARY

Indexing Documents

The dark side of document-image processing is the question of retrieval. Indexing documents properly and consistently for later retrieval isn't a low-order clerical task but a complex exercise requiring knowledge engineering skills. DIP tends to underestimate, or underemphasize, the complexity of this task. Let the buyer beware.

Why Index?

Although such an index represents a simple concept, creating one is no laughing matter. Take, for example, a 600-page tome that deals in part with AI. Give it to 10 different indexers to see what they come up with, and the first thing you'll notice is that no two indexes will be substantially alike. Because the process requires selectivity, and because of differing background knowledge, different indexers notice and emphasize different key words, phrases, concepts, and relationships.

In addition, it is unlikely that all indexers will decide to standardize on the same indexing terms. For example, *artificial intelligence*, *expert systems*, *intelligent machines*, *knowledge-based programming*, and *automated reasoning* may or may not refer to the very same thing. Without a careful consideration of context and a good deal of specific knowledge of the field, it would be hard to say. Although there are only five terms in this example, there could easily be a dozen that were fundamentally synonymous. The 10 indexers aren't likely to settle on a single term. Some would use one term, some another.

An individual might not decide to use just one term—grouping all related references under, say, *artificial intelligence*—but rather list each term in separate locations in the book's index, with differing page references for each.

Understanding that such an approach would needlessly confuse readers, an experienced indexer would choose a single term under which to supply page references to all related concepts—say, again, *artificial intelligence*—but would then list the other synonyms in their alphabetical index locations along with a pointer to this primary term—for instance, "Expert Systems. *See* Artificial Intelligence." Indexers must accommodate large, heterogeneous readerships whose members may be inclined to look for any one of many possible phrases when using an index to locate material about a specific concept.

Indexing Vocabularies

If you substitute an imaged document for a book, the real problem will begin to emerge: How will this document be retrieved? While few, if any, documents will be 600 pages long, there will be many thousands of shorter ones to search through. Even this simplified example should suggest that indexing is not a low-level task, and it becomes more complex as larger volumes of text are involved.

Choosing the right primary indexing term is not especially difficult at the level of a single book. The choice can be somewhat arbitrary as long as it is consistently applied. But the choice is tougher when many books are involved—for example, at the Library of Congress. This national document repository faces a challenge different from that of back-of-book indexing. However, the problems are related, and both are intimately connected to document imaging.

The Library of Congress does not (yet) attempt to provide as detailed a description of its holdings as a book's index does of its contents, but it does try to roughly characterize the subject of each book. Library of Congress subject indexers attach several topic descriptors to every nonfiction work published in America. You can find an example on the copyright page of any modern nonfiction book under the somewhat odd rubric Library of Congress Cataloging-in-Publication Data (see the figure).

The terms *artificial intelligence*, *computers*, and *expert systems (computer science)* in the figure are Library of Congress topic descriptors. The complete Library of Congress Subject Headings are available in three large volumes at most libraries. Or you can consult the CDMARC Subjects CD-ROM—MARC being an acronym for machine-readable cataloging (see the text box "Investigating Indexing" on page 198). This CD-ROM is a terrific bargain, especially for anyone considering document imaging. You might as well get an early taste of the indexing demands you're really going to be up against.

Two fundamental ideas underlie the Library of Congress Subject Headings. The first is to guarantee (or at least encourage) consistency in the selection of indexing terms. The problem here is often called *vocabulary control*, and, logically, the solution is called *controlled vocabularies*. Such agreed-upon lists of valid terms guide subject indexers in classifying a book's subject matter consistently, so multiple indexers will not apply multiple synonyms at random (see the table).

continued

TimeWands - The Obvious Choice

You have specific bar coding requirements.
That's why we give you a choice!

The **TimeWand II** is a **ruggedized** bar code reader ready for heavy-duty use. Its programmability allows your custom applications to be pre-set with prompts and cross-reference files. The large internal memory sizes of 32, 64, and 128K easily hold a day's worth of transactions along with the date and time of each entry.

If your data collection needs are simpler, the original **TimeWand** offers a cost effective alternative. The TimeWand date and time stamps each bar code scan, like the TimeWand II, but is contained in a smaller and lighter package. Even though it is compact, the TimeWand can still gather an impressive 2000 scans.

Both TimeWands transfer their data through the host computer's serial port where the data is stored in an ASCII text file. This allows the data to be easily combined with a wide variety of software packages.

Choosing either the original TimeWand or TimeWand II provides you with a quality bar code reader at an affordable price. **Call Videx at 503-758-0521 and ask for your free information kit.**

TimeWand (8K)....................$248.00
TimeWand II (32K)..............$698.00

Videx®

1105 NE Circle Blvd.
Corvallis, OR 97330-4285
503-758-0521 * FAX 503-752-5285

See us at ID Expo, May 14-16, Chicago, Booth #350
See us at Comdex Spring, May 20-23, Atlanta, Booth #4934
See us at PC Expo, June 25-27, New York, Booth #2430

Circle 288 on Inquiry Card (RESELLERS: 289).

CDMARC SUBJECTS FOR AI

A file dump from CDMARC Subjects for AI. This CD-ROM was developed from the eleventh edition of the Library of Congress Subject Headings. UF (use for) is the reciprocal of a USE pointer (equivalent to a SEE pointer in the previous edition). BT= broader terms; RT = related terms; NT = narrower terms.

Artificial intelligence
- UF AI (Artificial intelligence)
  - Artificial thinking
  - Electronic brains
  - Intellectronics
  - Intelligence, artificial
  - Intelligent machines
  - Machine intelligence
  - Thinking, artificial
- BT Bionics
  - Digital computer simulation
  - Electronic data processing
  - Logic machines
  - Machine theory
  - Self-organizing systems
  - Simulation methods
- RT Fifth-generation computers
  - Neural computers
- NT Adaptive control systems
  - Automatic hypothesis formation
  - Automatic theorem proving
  - Computer vision
  - Error-correcting codes (Information theory)
  - Expert systems (Computer science)
  - GPS (Computer program)
  - Heuristic programming
  - Machine learning
  - Machine translating
  - Perceptrons
  - PURR-PUSS (Computer program)
  - Question-answering systems
  - VL1 system
  - VL21 system

Since such synonyms do exist, controlled vocabularies must also provide "See" pointers from terms that are discouraged for indexing use to those that are approved (e.g., "Computer Control. *See* Automation" or "Computer insurance. *See* Insurance, computer"). In addition, "See also" pointers are provided to suggest related keywords (e.g., "Computer input/output equipment. *See also* Automatic speech recognition").

The second fundamental idea behind the Subject Headings is to establish not just terms but categories of terms, and relationships among these categories. "See also" references point to what are technically called *related terms* (RT). In addition, the Subject Headings classification includes pointers to *broader terms* (BT), which indicate more inclusive subject categories, as well as to *narrower terms* (NT), which name more specific subcategories (see the table).

What begins to emerge here is a quasi-hierarchical representation of a field of knowledge. Although it differs radically from a synonym list, this sort of extended conceptual taxonomy is often called a *thesaurus*.

While "See" pointers and the approved terms they indicate may be the product of arbitrary decisions, "See also" pointers entail some knowledge of the domain under consideration. In fact, the subject analysis that librarians perform to create these categories and relationships is strongly akin to what the AI literature calls *knowledge engineering*.

What You See and What You Get

These and related library techniques have evolved over untold thousands of worker-years of deep experience in document-collection management. Chances are good, however, that you would really rather not wade into all this. Here is where document-imaging systems come in, right on cue. High technology promises to solve all your problems while at the same time enabling you to bypass such complexity.

But think for a minute. Did librarians come up with such schemes because they enjoy complication? More likely, these techniques exist because they—or something very much like them—are crucial to doing the job. The job, in this case, is to serve the information needs of communities very much like your own.

If you're seriously considering document imaging, your organization has probably already encountered just such indexing and retrieval hurdles—they apply as much to paper-based filing systems as to computerized databases—possibly without much clue as to how deep such problems can quickly become. Don't expect imaging vendors to point them out, either, because their technology offers no substantial relief.

Most product literature, and even trade-press reporting, makes little mention of indexing as it relates to document imaging, except to acknowledge that the process requires "manual" effort. But it's not referring to the kind of manual effort required to type 80 words per minute. Rather than a task that can be handed off to low-cost temporary help, indexing of this sort requires knowledge-engineering skills.

Part of the problem—but only part—is that after a document has been captured in an imaging system you don't actually have the real document anymore; what you have is pictures of pages. (If you have ever wanted to cut a long but particularly relevant passage from a document image and paste it into a report, you know that a picture really is worth a thousand words—of typing.) Apart from optical character recognition (OCR), manual indexing is the only way to tie these pictures to meaningful concepts by which they might be retrieved.

In fact, document-imaging technology suggests many surprising parallels with the old on-line database systems once used almost exclusively to search bibliographic records of periodical literature. In those days, storage was too expensive to allow keeping the full text of documents on-line. As with imaging systems today, the documents themselves weren't

Mitsubishi Monitors Open More Windows Of Opportunity.

Windows™ 3.0 enables you to push your PC to new levels of performance and productivity. To take full advantage of its application versatility and powerful features, upgrade your monitor to the Diamond Scan 16L from Mitsubishi Electronics.

With a 16" CRT, the Diamond Scan 16L provides 42% more display area than conventional 14" monitors but without taking up additional desktop space. This larger screen size enables you to see more of the Windows™ graphical environment and work more easily with a variety of on-screen applications at the same time. With the Diamond Scan 16L and Windows 3.0, opportunities are unlimited!

In addition, the Diamond Scan 16L supports today's high resolution graphic standards. From VGA™ through 1024 x 768, this microprocessor-enhanced monitor is compatible with any Windows 3.0 application resolution.

Bring Out The Best In Windows 3.0.

The Diamond Scan 16L—and Diamond Scan 20L (the larger 20" model)—are both engineered with the latest technology and manufactured using only the finest materials and components available. It's the reason why Mitsubishi® continues to be the proven leader in monitor quality, performance and value.

Call or write Mitsubishi Electronics today and we'll show you how our high performance 16" and 20" color display monitors can help you open more windows of opportunity. For more information on these or other models in Mitsubishi's comprehensive monitor product line, call 1-800-843-2515.

MITSUBISHI

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

Circle 178 on Inquiry Card (RESELLERS: 179).

Investigating Indexing

There is no better way to understand the real challenges and opportunities involved in text management than to get your hands dirty in the problem. The following is an eclectic mix of software tools, R&D efforts, and professional associations that should provide plenty of insight into the wide range of options that full text affords.

TEXT MANAGEMENT SYSTEMS

Concordance Professional Edition $995
A hybrid text/database that allows a combination of fixed fields and fully indexed free text. Includes a full programming language for building applications.
Dataflight Software
10573 West Pico Blvd., Suite 68
Los Angeles, CA 90064
(213) 785-0623

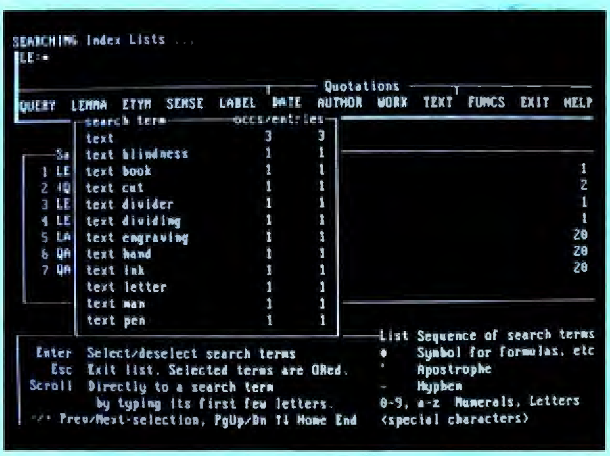
Folio Views $495
An information storage and retrieval system that enables full-text indexing and search as well as hypertext navigation. Topical/structural segmentation of text bases is a strong feature.
Folio Corp.
2155 North Freedom Blvd., Suite 1500
Provo, UT 84604
(801) 375-3700

Hyperties $349
An information system whose primary method of retrieval is the navigation of hypertext networks. Significantly, this is an *authoring* tool in addition to its presentation capabilities.
Cognetics Corp.
55 Princeton-Hightstown Rd.
Princeton Junction, NJ 08550
(609) 799-5005

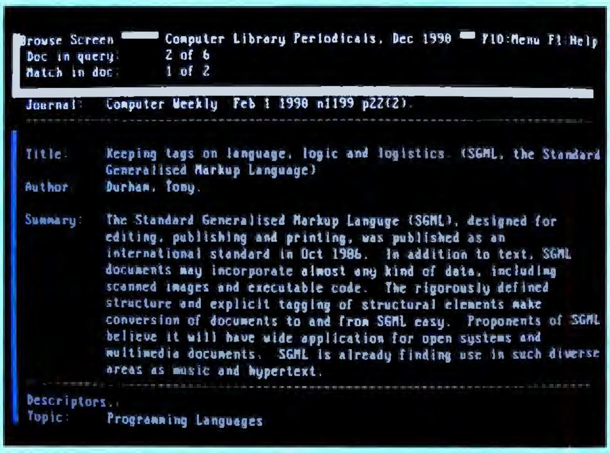
DOCUMENT STRUCTURE: TAGGING AND RECOGNITION

Author/Editor
for Mac $495
for DOS $695
for Unix ....$1100–$2500
An editor for Standard Generalized Markup Language. If you keep hearing about SGML but don't know what it's all about, here's a good place to begin learning about a powerful and growing document management/interchange methodology.
Softquad
720 Spadina Ave.
Toronto, Ontario,
Canada M5S 2T9
(416) 963-8337

FastTag
for DOS $2400
for Unix..........................$3100
While OCR recognizes characters, FastTag's pattern-matching capabilities



Screen A: *A screen capture from the Oxford English Dictionary on CD-ROM. The OED text data has been specially tagged for each of the categories shown: LEMMA (headword), ETYM (etymology), SENSE (definition), and so on. This enables the creation and display of an inverted file for each of these categories. Here, the inverted file of main dictionary entries or headwords pops up to facilitate selection. You can make multiple selections from this list, as well as from the inverted files for other categories (e.g., ETYM and SENSE) to produce a complex Boolean query. (Screen shot provided by Christopher Locke)*



Screen B: *A screen capture of a record from the December 1990 edition of the Computer Library CD-ROM. Note especially that the descriptors listed under Topic are subject headings. In the new incarnation of this product, Computer Select, you can now browse these descriptors in an inverted file that enables point-and-shoot selection of multiple subject headings to retrieve associated documents (i.e., similar to screen A). (Screen shot provided by Christopher Locke)*

recognize document *structure* and convert it into various machine-readable markup formats, SGML among them.
Avalanche Development
947 Walnut St.
Boulder, CO 80302
(303) 449-5032

CD-ROM: TOOLS AND APPLICATIONS

CDMARC Subjects .... $315 per year (updated quarterly)
This CD-ROM contains all the subject descriptors used by the Library of Congress (and many information vendors) to describe document content. Function keys enable a sort of hypertext navigation through the thesaurus structure (see the table in the main article).
Library of Congress
Customer Services Section
Cataloging Distribution Service
Washington, DC 20541
(202) 707-1312

The Original Oxford English Dictionary on CD-ROM $950
The OED is the operating-system manual set for the English language. The tagged structure and full-text indexing used here enable searches never possible with the massive 13-volume hard copy original (see screen A).
Oxford University Press
Electronic Publishing Division
200 Madison Ave.
New York, NY 10016
(212) 679-7300 ext. 7370

Computer Select .... $995 per year (updated monthly)
A highly practical collection of full-text and abstracted articles from hundreds of computer-oriented publications. This new incarnation of the older Computer Library CD-ROM makes far better use of the subject indexing descriptors attached to each document record (see screen B).
Computer Library
One Park Ave.
New York, NY 10016
(212) 503-3523

TOOLS AND LANGUAGES
Word processors are inadequate for much of the preprocessing required for serious text management applications. The products listed here are programming tools that may require some effort to master but will repay that effort in greatly increased control of textual information.

MKS Toolkit ....$249 for DOS
The regular-expression-based pattern-matching capabilities of Unix tools like ed, sed, grep, and awk constitute a sort of Swiss Army knife for text processing. The MKS Toolkit provides these and many other extremely useful text manipulation capabilities in a DOS environment.
Mortice Kern Systems
35 King St. North
Waterloo, Ontario,
Canada N2J 2W9
(519) 884-2251

PolyAwk...................$195 for DOS
Sage Professional Editor......................$295 for DOS
Sage offers awk either by itself or as a built-in language for modifying and extending the Sage Professional Editor text-editing environment: tools within tools within tools.
Sage Software
1700 Northwest 167th Place
Beaverton, OR 97006
(503) 645-1150

Snobol $95
Spitbol......................... from $195
Icon...................................$295
These three programming languages employ powerful pattern-matching techniques designed specifically for processing text. They are available in various PC, Macintosh, and Unix implementations.
Catspaw, Inc.
P.O. Box 1123
Salida, CO 81201
(719) 539-3884

THE HIGH END

Topic .... $15,000–$150,000
This document-retrieval system uses "concept retrieval," a shared-knowledge-base approach that captures information about subject matter of interest to users and stores it as reusable objects called topics.
Verity, Inc.
1550 Plymouth St.
Mountain View, CA 94043
(415) 960-7630

Text Categorization Shell............................$124,000 (includes installation and training)
TCS automatically categorizes text by semantic content rather than simple lexical string occurrences. It has been used by Reuters for subject indexing its online text databases.
Carnegie Group, Inc.
5 PPG Place
Pittsburgh, PA 15222
(412) 642-6900

IntelliText ... (inquire about licensing)
Although a commercial product has not been released, this thesaurus-based text management technology incorporates many of the concepts referred to in this article and is currently licensable.
Intelligent Technology Group
115 Evergreen Heights Dr.
Pittsburgh, PA 15229
(412) 931-7600

The CLARIT Project (inquire about sponsorship arrangements)
CLARIT stands for Computational Linguistic Approaches to Retrieval and Indexing of Text. This research project has obtained encouraging results and is open to corporate sponsors seriously exploring text management solutions.
Laboratory for Computational Linguistics
Carnegie Mellon University
Pittsburgh, PA 15213
(412) 268-8574

DOCUMENT MANAGEMENT EXPERTISE
The following are excellent sources for publications on library science as well as of people who know how to apply the principles discussed here.

American Library Association
50 East Huron St.
Chicago, IL 60611
(312) 944-6780

Special Library Association
1700 18th St., NW
Washington, DC 20009
(202) 234-4700

really there. Instead, the physical page-pictures were kept on library shelves, and the database was an automated assistant for paper-based filing and retrieval.

To index records in these on-line bibliographic systems, some types of consistent information were placed into structured database fields: author, title, journal, publication date, and so on. For books, such information might include Dewey decimal classification, Library of Congress call number and card number, and ISBN (several of these more arcane data items are shown in the sample Cataloging-in-Publication Data record in the figure).

However, providing only this type of standard information puts a tremendous burden on searchers: It assumes that you know exactly what you're looking for, which is seldom the case. More often, you want to know about something and are not even sure what that something should be called. It might have 50 possible expressions or perhaps only one that is so new or technical you've never heard the term used before. Only rarely will you know the titles of articles or books in which the concept appears or the name of an author who has written on the subject.

Needles and Haystacks

Two remedies were developed to deal with these inherent shortcomings of fixed-field database retrieval. The first was simply to add a new field: Subject. Subject indexing implies both the existence and skilled use of a structured thesaurus of related concept categories into which the elements of a controlled vocabulary have been appropriately placed.

From such a thesaurus, an indexer selects keywords that accurately describe a particular document and attaches them to that document's database record to assist retrieval. It is crucial that the indexer selecting these subject headings have sufficient understanding of the document itself, the field of knowledge that forms its context, and the methodology for applying subject headings. This level of indexing is a fundamental requirement for retrieving the pictures of pages from a document-image base. Unless you have already developed a comprehensive controlled vocabulary, a domain-specific thesaurus, and a pool of competent indexers, you are either leaving a big hole in your imaging budget or designing an information system that will stonewall everyone who uses it.

The second remedy for inadequate fixed-field database descriptors is to develop document abstracts. In an abstract, each document is summarized in a succinct and cogent paragraph, and the full text of these abstracts is then automatically indexed so that almost every word serves as a retrieval hook. Applied to good abstracts, this software-driven inverted-file indexing technique greatly increases the likelihood of a user finding relevant material.

However, succinctness and cogency are not inexpensive. Their cost is a function of knowledge—abstracters are relatively high-level knowledge workers in the true sense. Some people believe that

Effective retrieval is the only rational reason to build text/image systems.

AI will eventually master the natural-language understanding problem, thus enabling the automatic generation of abstracts. While such wishful thinking is not supported by the current state of the art, interesting document classification and indexing results have been obtained using certain AI techniques (see the descriptions of the Text Categorization Shell and the CLARIT Project in the text box).

Semantically Speaking

As the cost of storage continues to drop dramatically, on-line information services—and especially CD-ROM applications developers—are moving away from providing rudimentary fixed-field bibliographic citations (with or without subject keywords and searchable abstracts) and toward delivering full text. That is, search-it, dump-it, cut-it, paste-it ASCII. At first, such systems may seem to be technological marvels: Every word is a keyword.

While the value of full-text databases is hardly to be denigrated, the initial enthusiasm they inspire can give way to massive frustration for all the reasons given so far: no controlled vocabulary, no thesaurus, no clues. The problems that give rise to this frustration are technically termed *recall* and *precision*. These can be roughly translated as: "How am I supposed to read 300 documents before 5:00 p.m.?" and "That's not what I meant!"

What documents are about simply can't be captured by casually jotting a few words in a database header or even by dumping all the discrete words the documents contain into an inverted-file index. Even for full-text document databases, higher-level tools are required to perform the type of sophisticated semantic analysis prerequisite to the construction and maintenance of an adequate thesaurus. More important, such tools must be put into the hands of intelligent and knowledgeable people who are not adverse to long hours of difficult intellectual work. The American Library Association and Special Library Association are good sources for locating such people.

But serious consideration of full-text databases is not the focus here; picture bases are. To overcome this rigid dichotomy, there are hybrid possibilities worth exploring. If you can afford even more storage than images require—and that's a lot—it may be feasible to create full-text indexes for certain types (or portions) of imaged documents. This involves using OCR to convert page images into ASCII (where such conversion is possible).

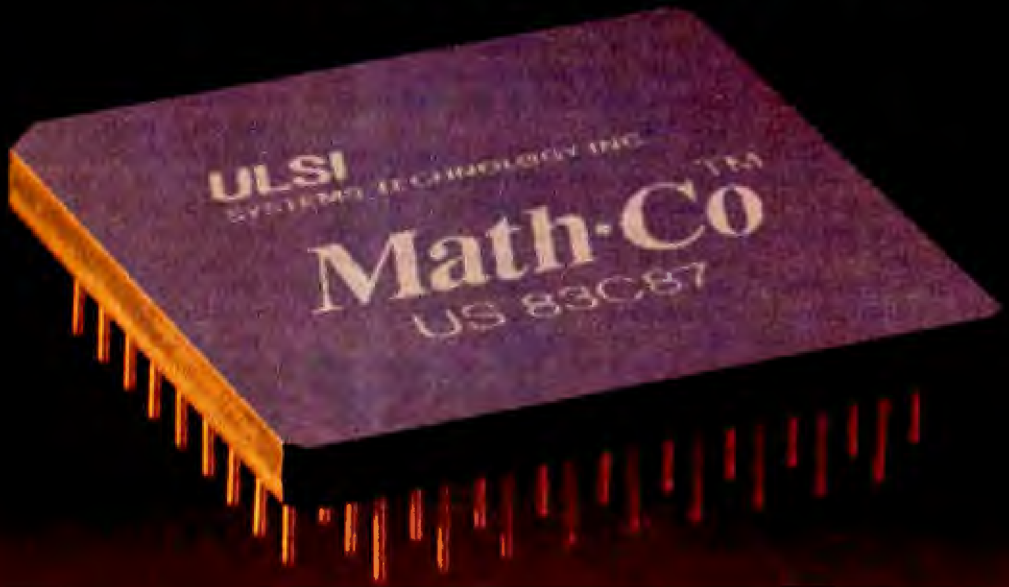
The ASCII will be "dirty" unless you correct the inevitable OCR errors, but while clean text is certainly preferable, it isn't necessary for certain indexing applications. You can use automatic file-inversion techniques to create an index in which every word that the OCR process captures correctly is linked by a pointer to its corresponding page image. The rest you just throw away.

While this approach is more involved and costly than straight imaging, it remarkably improves retrieval. The cost comes into perspective if you consider that effective retrieval is the only rational reason to build information systems of this type in the first place. However, after putting such a hybrid text/image system together, you will still have the same challenge that accompanies any full-text retrieval effort: the knowledge engineering that goes into constructing a first-class thesaurus of relevant concepts.

In this regard, a product called Topic is an education in itself, and it will work just as well with dirty OCR-image results as it will with plain text. However, whatever the tools used, information managers would be ill-advised to view this essential knowledge-engineering process as an optional step in creating usable document-retrieval systems. The

The New Generation

MATH COPROCESSOR



Lifetime Warranty • 30-Day Money-Back No-Risk Guarantee • Over 20% Lower List Price

Industrial Strength

The ULSI MathCo™ US83C87 from Specialty Development Corporation is a high performance CMOS math coprocessor that is software compatible with applications designed to operate with all 386 computers. The MathCo™ is available in speeds up to 33 MHz.

Fewer Clock Cycles Required

As the chart to the right illustrates, the MathCo™ is able to perform floating point instructions in far fewer clock cycles than the Intel® 80387. The superior design of the MathCo™ enables you to achieve maximum performance from your system.

Comparison Of Clock Cycles Required

Instruction	MathCo™	Intel®
Add	3	18
MPY	12	22
DIV	40	80
SQRT	37-41	125
REM	68-72	155

Lifetime Warranty • 30-Day Money-Back Guarantee

If at any time during the first 30 days of purchase, you are not satisfied with the MathCo™, you may return it, along with your purchase receipt to Specialty Development Corporation for a full refund of purchase price. This Money-Back Guarantee along with our industry-first Lifetime Warranty represent our confidence in this new generation math coprocessor.

Lower Prices

The suggested list price for the MathCo™ is over 20% lower than Intel's® math coprocessors' suggested retail prices.

Complete Compatibility

The MathCo™ is completely compatible with industry standards, used world-wide by not only scientists and programmers, but the general business community – individuals who want to speed up applications like spreadsheets, graphics, font generation, desktop publishing, databases and statistics.

Experience the New Generation of Math Coprocessors

Plug in the MathCo™ from ULSI and sit back for a fast ride through your most cumbersome applications. No more long waits while your data is processing. With our 30-Day Money Back Guarantee and Lifetime Warranty, now is the time to plug in the MathCo™. Call SDC today, 1-800-284-7732, for the name of the dealer nearest you.

Toll Free Support • Made in the USA

SPECIALTY DEVELOPMENT CORPORATION
1001 Capital of Texas Highway South, Bldg. I • Austin, TX 78746 • 512/327-8608 • FAX 512/327-5233

Circle 313 on Inquiry Card.

real problem for unalloyed imaging systems is that it's not optional, it's impossible.

Knowing About Knowing

So far, I have not admitted that there are situations in which there is no alternative to document-image management. OK, I admit it. If you have zillions of forms filled out in handwriting, imaging is better than paper, yes. If you have lots of critical graphical material, ditto. There are probably many other cases, but just because there may seem to be no practical alternative, the indexing problems described here don't go away.

For this reason, handwritten forms will sooner or later be converted into machine-readable ASCII. If the information they contain is valuable enough to justify imaging in the first place, the indexing currently applied to these images will so degrade retrieval that the costs directly resulting from lost business opportunities will make even manual conversion seem cheap by comparison. The more critical such information is to an organization's health and longevity, the sooner the crunch will be felt.

The core issues here are epistemological: How do we know something? What constitutes knowledge? Although raising such questions has always been seen as unbusinesslike, if not downright flaky, look for this to change. Despite the glut of verbiage about the information age—information society, information economy, information anxiety, and so forth—something has definitely changed from the time when the focus of business was almost exclusively on product.

Now we speak less of production and more of productivity, less of quantity and more about quality. These are significant reflections of a new concern for how new things can be done, how old things can be done better, and the human understanding required to do either. Rather than a set of objective facts that can be known in advance, knowledge is the result of such understanding.

In contrast, document-image processing presupposes that what is important in a document is already known. You type "This document is about *x*" into the index field. But that's today. What about tomorrow? You may want to turn to your information resources to mine a completely different type of ore.

It's interesting how many times you hear the phrase "for as long as records have been kept" and then notice that the data doesn't go back very far. This does not necessarily mean that record keeping began on the date given or that records before that date contain no relevant data. Often, it means that the records contain information that has only recently been perceived as worth knowing about and, therefore, was not previously indexed. As a result, this information is not currently retrievable. In fact, it's extremely misleading to refer to such data as information if no one can get at it. By any meaningful definition, information must *inform* someone.

For example, not long ago, there was no name for the disease now known as acquired immune deficiency syndrome. Although it was as deadly then as it is today, medical diagnosticians didn't know what to call it, or even what it was. Today we know a lot about AIDS, but it took longer than it might have to arrive at this knowledge. Meanwhile, an unnamed contagion spread through unsuspected vectors.

Granted, the history of AIDS so far has had deep social, political, and legal ramifications. Might it also have had a significant technological component? Could the medical records maintained in databases—as images or otherwise—have been better used to correlate the emergence of an as-yet undiagnosed constellation of symptoms with the histories of patients in which these symptoms were being observed?

Such records may very well have contained vital information that was not readily accessible because of inherent shortcomings—not in the ability of medical researchers, but in their information systems. If there is no name, there will be no explicit field or index term. If there is no retrieval hook, responses to queries will not return any documents. If searchers asking intelligent questions are not informed, events will follow their own course with no one the wiser.

Shuffling the Deck

Although somewhat hypothetical, this example is relevant if it makes you ask, "What am I missing in my own work?" In fact, epidemiology forms a good analogy to what many organizations would like to do better today: track potential yet unidentified problems and opportunities, and either head them off before they

become critical or take advantage of them before the competition catches on.

Accomplishing this task involves pattern recognition of such a high caliber that it is often referred to as intuition and considered a near mystical skill. Yet people do this sort of thing all the time, and more could do it more often if they were given software tools that enabled and encouraged deeper exploration of documentary evidence.

For example, say you have 10 fields in a customer-service database in which to type notes on the last bug-report call or 10 keywords to attach to the image of a letter from an irate consumer—or make it 20, 50, or 500. This sort of structured data about characteristics you have already identified as significant will never be adequate. You will always be caught short if you can't quickly restructure or reindex information in light of more recent intelligence. (Think of the CIA here; this type of intelligence may often involve no new data, but rather a new way of perceiving and interpreting existing information.)

Information resources, and especially document collections, are not just mountains of facts you already know but research bases to explore for clues about what you don't yet understand. More than that, they are the foundation on which new knowledge will be built by accretion. Detailed annotations and even off-the-cuff comments by knowledgeable people can add enormous value to documents if, and only if, they are also retrievable.

Hypertext linkages created between related texts can likewise be high-value-added contributions to greater comprehension, the nonnegotiable prerequisite to effective action. But all this requires text, not pictures of words. In fact, it requires more than text. It calls for sophisticated conceptual maps that you can continually debug and incrementally extend to make sense of the words, which are themselves simply tokens of some presumably real territory beyond the document.

Eye of the Beholder

Since I opened this article with a quote from the Wicked Queen, I'll close with one from Raymond Chandler and Robert B. Parker's *Poodle Springs*, something a little less fabulous and more contemporary. Listen to legendary private eye Philip Marlowe in the process of searching a dead woman's apartment. You can almost hear Bogart's sibilant inflection:

"The cops would have seen all this. They'd have looked at everything like they do, and anything that mattered would be down in a box in property storage with a case tag on it. Still, they didn't know all the things I knew, and I was hoping I might see something that wouldn't have meant anything to them."

If you look at document-image databases as the modern equivalent of property storage, the analog of the case tag would have to be an index-field entry. Instead of putting potential proof into plastic baggies with little labels, the police can now just snap a picture and scribble a few notes on the back. Me, I'm more like Marlowe, I guess. I'd rather get closer to the hard evidence and decide for myself who's the fairest of them all. ■

Christopher Locke is director of industrial relations at the Robotics Institute, Carnegie Mellon University. You can reach him on BIX c/o "editors."

EEF
ELEX ELECTRONIC FILING

The ELEX Electronic Filing System (EEF) is a hardware/software system designed to reduce the frightening volumes of paperwork that burden businesses on a daily basis. As paper is eliminated, transactions are made in a fraction of the time required by traditional means, costly storage facilities are reduced, data security and integrity is enhanced, and work quality and quantity is increased. These factors all give companies and individuals the competitive advantage they need to excel in the business environment of the 90's.

Filing vs. Archiving

Document image processing is a new technology which has just begun to evolve. The myriad of hardware devices on the market, and the lack of an industry standard protocol for communicating between them, make the integration of an electronic filing system a formidable task. And without intelligent software to control all aspects of the storage, management, and retrieval of documents, the filing system will be nothing more than a micro-fiche machine in disguise.

With these considerations in mind, EEF was designed as a turn-key solution which relieves the clients of all the intricacies involved in integrating a truly functional electronic filing system. Yet its flexible design allows continuous and smooth upgrade as the users needs grow and change.

Open Architecture

EEF is designed as a totally open architecture system. Rather than being a closed package, EEF is composed of individual building blocks defined by their area of electronic filing functionality. These blocks are not bound to specific hardware/software limitations. As such, they can be combined in a variety of forms on each of the following operating platforms, to achieve optimal satisfaction of an application's specific demands:

- A single user workstation under the **DOS** or the **OS/2** operating system.
- A local area network - **Novell NetWare** 286 and higher or any DOS 3.1 compatible **network**.
- A **host computer** under the **UNIX, VAX/VMS** or **IBM AS/400** system with a PC connection.

Input
Scanner, Fax, Word Processing, Host Computer, Etc.
Processing
Document Manager, Retrieval Engine, Hyper-Media, Database Application Generator, Turn-key Solution.
Output
Printer, Plotter, High Res. Display, Fax, Host Computer

EEF Applications

The EEF system opens a vast new world of opportunities for you. The possible applications are limitless, and to name a few:

Management Systems

Any application which requires original documents and forms (e.g. verification of signatures and L/C in the banking area).

Scientific and Engineering Data

Any application in these fields that requires maps, charts, logs, sketches, etc.

Medical Uses

The kind of visual information which is so essential for medical applications is handled by EEF in a natural, straightforward manner.

Art Catalogs

Making multi/media presentations of art works, for example at auctions, can provide an exciting new display method.

Real Estate / Travel Agency

EEF can be used to take the customers on an on-site electronic tour without ever leaving the office, thus shortening the process of selection.

EEF Pilot System

For prospective clients wishing to enter the field, we have prepared a pilot system, enclosing in one package the full range of functions necessary for electronic filing. The system components are:

Hardware

386 base micro-computer at 33MHz with 64K cache, 8 MB RAM, 1.2GB with access time of 0.8MS (disk caching), proprietary scanner and printer interfaces, high resolution (1660 x 1200) CRT display, laser printer 300 dpi at 8 ppm, scanner 300 dpi with 100 page feeder.

Software

The EEF software package, including the document manager, the retrieval engine, the hypermedia interface, and 20 hours of customization services.

Total cost for the pilot system is 30,000 US$.

For further details and literature, please contact:

EUROPE: ELEX INFORMATION SYSTEMS SA

65, Rue de Lausanne 1202 Geneva Switzerland Tel. + 41 22 738 11 88 Fax. + 41 22 738 11 90

USA: ELEX INFORMATION SYSTEMS INC.

125-127 North 4th Street Philadelphia, PA 19106 USA Tel. + 1 215 627 7202 Fax. = 1 215 627 2342.

Trademarks: DOS, OS/2, Microsoft Corp; NetWare, Novell, Inc.; UNIX, SCO Corp; AS/400, IBM Corp; VAX/VMS, Digital Equip. Corp.

DIVIDE AND CONQUER

Neural networks take a novel approach to the problem of automatic handwriting recognition

DAVID P. WRIGHT AND CHRISTOPHER L. SCOFIELD

For over 30 years, people have been touting the paperless office. Clearly it's not here yet. One obstacle has been the inability to find a way to mechanically read human handwriting and convert it into a computer-digestible form such as ASCII text. A second difficulty has involved the task of entering scanned information from forms into a computer database.

Nestor (Providence, RI) has developed products that can overcome these difficulties using its proprietary neural network technology. It has developed software that can be trained, in real time, to read unconstrained handprinted characters in English, as well as the thousands of Japanese kanji characters. (For information on a company with a product that reads script today, see the text box "Recognizing Script" on page 210.)

An Ocean of Forms

Our society is dependent on forms. Try to apply for almost anything—insurance, credit cards, motor vehicle registration, employment—and you'll have to fill out a form. Filing taxes, medical claims, sales orders, census information, and subscriptions also requires filling out forms.

What happens to those forms? Usually, someone reads them and then keys the information into a database. Manual data entry remains widespread. For example, over 50 billion checks are cleared yearly in the U.S.; most of these transactions are entered manually. The IRS estimates that there are over 194 million tax receipts per year, and most of these transactions are handled manually as well. But keyboard entry is slow, inaccurate, and expensive.

continued

There are several ways to automate forms entry. For $60,000 and up, page scanners are available that will perform quite well on forms with machine print and neatly hand-printed block characters. Most of these systems read forms specifically designed for optical character recognition (OCR), with special inks that are invisible to the scanner and with separated character boxes for hand-printed characters. The IRS 1040EZ is the most common example of this type of form. However, high cost and limited flexibility restrict the use of these expensive machines to specialized markets.

At the other end of the spectrum, for about $500 you can buy an OCR software package and get excellent results with machine-printed text in almost all modern font styles. However, these packages are not well suited for forms recognition because output data must be formatted, machine print must be of high quality, and hand-printed characters cannot be recognized at all.

Character recognition from forms presents many problems that are not encountered with machine-printed text. The form itself and the location of the data must be correctly identified. Each character's position, as well as its value, must be determined. Background information must be removed so that characters are separated from the form. Hand-printed information, or machine print that is degraded, must be accurately separated and recognized. These issues have yet to be resolved with off-the-shelf OCR software.

Nestor's newest product, NestorReader, attacks the problem of recognizing handwritten characters. The company is working to add the ability to identify which form an image represents (e.g., Is it a 1040EZ?) and which regions of the image correspond to data fields (e.g., Where is the Total Deductions field?). Nestor believes that the technique used to recognize characters will extend readily to the recognition of fields and forms.

BYTE ACTION SUMMARY

Real-Life Neural Networks

Automating the processing of business forms remains a major challenge. Current OCR technology can't handle human handwriting. But new techniques based on neural networks show great promise. We may live to see the paperless office after all.

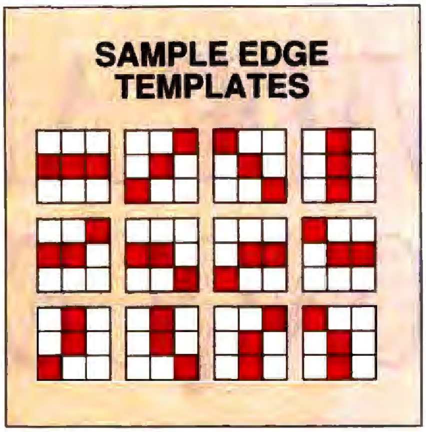


Figure 1: *Edge templates, or kernels, are like cells in the visual cortex that react to horizontal, vertical, or angled lines.*

Recognizing Handwriting

Traditional OCR systems seek to match a character image with a template stored in memory. Since every person writes differently, that technique won't work for hand-printed characters. Nestor's transputer-based system solves the problem with a two-phase approach. First, the system extracts a data set, or *feature vector*, from each character. A feature vector describes the distribution of primitive edges—vertical, horizontal, and angled lines—throughout the image of the character. Then a neural network discovers which character the feature vector most closely matches.

What defines characters in the first place? That's the key advantage of a neural network: You train it by example. By presenting a network with many examples of a handwritten number 2, for instance, you can teach it that a 2 occupies a certain complex region in a multidimensional feature space.

NestorReader's first task is to identify primitive edges. Various representations of the image can serve as input to the edge-detection phase. There is the raw bit map, of course, but the system also uses other representations derived from the bit map, including a single-pixel-wide *medial axis*, or skeleton, and a complementary outline that traces the character's outer boundary.

The system processes these input representations using a collection of 3- by 3-pixel edge templates, or *kernels*, like those shown in figure 1. You can think of the kernels as cells tuned to detect different kinds of edges, like the cells in the visual cortex of a cat that react to horizontal or vertical shapes. The system centers a 3-by-3 window on each pixel of the image, compares the bits found there to each of the edge templates, and assigns the image pixel a value corresponding to the best-matching template. If the character's bit map is a 50- by 60-pixel rectangle, the result is a list of 3000 edge orientations.

Organizing the Edges

The next step is to lay a grid over the pixel array. The 50-by-60 bit map might yield a 5-by-6 grid of 10-pixel-wide subwindows. But it's the number of subwindows—not their size in pixels—that matters. A smaller character occupying a 25-by-30 cell would also yield a 5-by-6 grid, although the subwindows in that case would be only 5 pixels square.

For each subwindow, the system counts up the number of edges of each type associated with each pixel in the subwindow. A grid of 5-by-6 windows yields 30 histograms, or tables, describing the frequency of edge occurrences in each window. In this way, the system spatially organizes the edge frequencies with respect to the image. These 30 tables, when concatenated, form the feature vector that supplies input to the neural network. Suppose there are 12 edge templates, as shown in figure 1 (in practice, there can be more). The feature vector comprises 360 values—30 tables by 12 templates. Each value represents the frequency of edge occurrence at some location in the image.

Building Models of Clouds

The neural network's job is to match each of these feature vectors to a character. It performs this task by modeling feature vectors in a many-dimensional feature space—for instance, a 360-dimensional space in the case of feature vectors with 360 values. The feature vector for an instance of 2 appears as a point in this space. Additional instances of 2 appear as neighboring points, and the class of all 2s composes a "cloud" of points. Now you can see why it's crucial to normalize the number of dimensions: All comparison must take place in the same feature space.

The class of all 3s makes up another cloud in the feature space. Objects like the 2 and 3 clouds have complex boundaries. To model these boundaries, the network uses basic building blocks called *radius-limited perceptrons*. These are n-dimensional hyperspheres, where n is the number of dimensions in the feature space—in our example, 360. During its training phase, the network builds up models of clouds corresponding to 2s and 3s by a process of accretion. Let a data point (e.g., a 360-element feature vector) representing 2 enter the network. If an existing sphere encloses it, and that sphere belongs to the 2 cloud, then there is no action required. The network correctly recognizes that pattern.

What if no sphere encloses the point? The network adds a new sphere to the collection of spheres that model the 2 cloud. The new sphere's center is the given point; its radius is the distance to the nearest sphere belonging to a non-2 cloud. The network thus refines its model of the 2 cloud.

Now a new point enters the network. It represents an instance of 2, and there is an existing sphere that encloses it, but that sphere belongs to the 3 cloud. That's an error. The network then responds by shrinking the enclosing sphere's size, thus adjusting the 3 cloud's boundary.

Over time, by means of both positive and negative reinforcement, the network's model of cloud boundaries grows more accurate. It learns when to identify a pattern as an instance of 2 and, just as important, when not to. Although the modeling occurs in a multidimensional feature space, it's conceptually similar to what happens in 3-D CAD. Instead of modeling the surface of an object by means of polygons, here we're modeling the volume of an abstract cloud using abstract spheres.

Running the Neural Network

Figure 2 illustrates the flow of information through the network. The first layer buffers the input. It accepts feature vectors one at a time; in our example, the input layer will require 360 cells.

The second layer of cells corresponds to the hyperspheres used to model the clouds. The relationship between the first and second layers is many-to-many. Weights that are assigned to the second-layer cells correspond to points in feature space at the origin of spheres. Thresholds of cell response correspond to the radii of the spheres. The number of cells in this layer may be quite large. Activation of a cell in this layer corresponds to finding an enclosing sphere for a point; adjustment of cell-response thresholds corresponds to adjusting the influence of a sphere in response to negative feedback.

The third, or output, layer contains one cell for each recognizable class of character. If our system recognized just the digits 0 through 9, there would be 10 cells in the third layer. The relationship of the second layer to the output layer is many-to-one. Each second-layer cell belongs to a class: 2, for example. Each cell in the output layer performs what is in effect a logical OR for a set of second-layer cells. There will be many second-layer cells for class 2; if any of these fires, so does the output cell for class 2.

The system runs several networks simultaneously.

Can more than one output-layer cell fire? Yes. Given a 2, the network might think it recognizes both a 2 and a 3. In that case, the network is said to be confused, and a higher level of arbitration comes into play. The system typically runs several networks simultaneously. Each starts with a different basic representation: One may begin with the raw bit map, another with the medial axis, and a third with the contour. If the networks arrive at different opinions, they vote, and the system abides by the majority decision. If, during training, the opinion derived from a particular representation seems consistently more valid than others, the system can increase the weight given to that opinion.

Tools of the Trade

Feature extraction and neural network processing are well suited to parallel processing. There are several ways in which parallelism might be exploited. Since the recognition of each character involves running several neural networks at once, one approach would be to dedicate a processor to each network. However, Nestor has achieved the best results by assigning all processing for each character—both feature extraction and the execution of multiple neural networks—to individual processors in a multiprocessor system.

The NestorReader takes advantage of the flexibility and excellent price/performance characteristics of transputers, which are high-speed, independent microprocessors designed and manufactured by Inmos, a subsidiary of SGS-Thomson Microelectronics. Multiple transputer modules (TRAMs), each with its own memory and communications links, plug into add-in boards that are available for AT, VME, Micro Channel, and other buses. NestorReader, hosted on a PC, recognizes about 10 characters

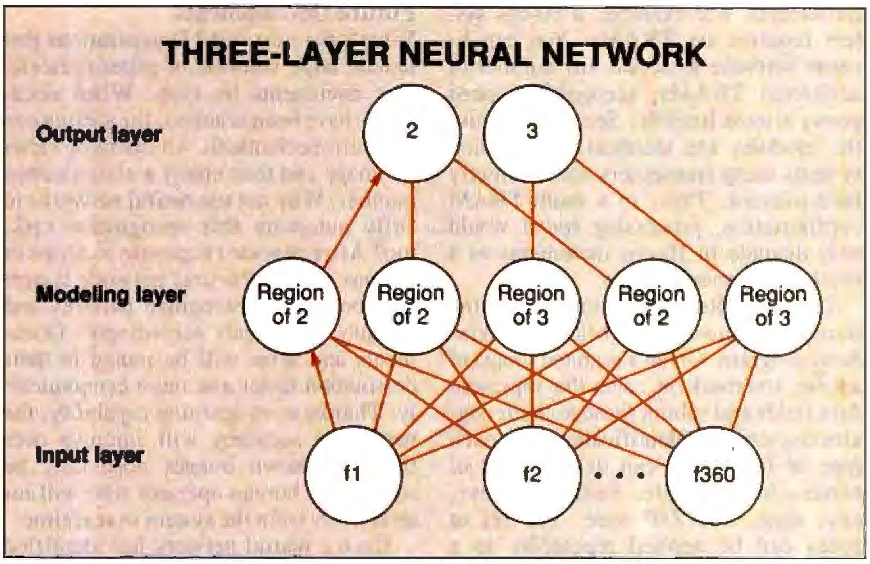


Figure 2: *A feature vector enters the network at layer 1. Many-to-many connections between layers 1 and 2, governed by weights that correspond to spheres of influence in feature space, enable the network to model character-class boundaries during training and to classify feature vectors during execution. Many-to-one connections between layers 2 and 3 map cell activations to character classes.*

Recognizing Script

Jane Morrill Tazelaar

Script recognition is still a long way off, right? Wrong! But handwriting recognition today just means reading hand-printed block letters, doesn't it? This may be true of most U.S. entries in the handwriting-recognition arena, but a small company in the U.S.S.R.—that's right, Russia—has a program that is reading script now. The program works; I have seen it, and it read *my* script, not just the company's test case.

The Moscow-based company is ParaGraph, and the product is CalliGraph, a graphics-tablet-based handwriting-recognition program. CalliGraph works by dissecting your handwriting into component parts: the loops and curves, their angles and sequence. It's really quite ingenious. I saw examples of the angular arcs and lines, and they don't look like letters, or anything else for that matter. They're just bits and pieces.

These bits and pieces of letters, as well as the overall appearance of the whole letters, are then compared to many different variations of similarly dissected letters to determine the letters you have written. Then the combined letters are looked up in a word list to see if they make up a valid word. As long as the word list is inclusive enough, the odds are good that CalliGraph will recognize what you wrote.

Admittedly, on the particular graphics tablet that I used, I had to write a bit larger than my normal script, but the program had no problem recognizing the first word I wrote, and it did so pretty quickly. The second word was more of a problem, but it turned out that the word just wasn't in the particular word list that ParaGraph was using at the demonstration.

Pen-based computing has become a buzzword of late in the computer industry. With it come visions of taking notes in raw script and automatically entering them into your computer. The reality in most cases is that pen-based computing is working, but primitively, with block letters and fill-in boxes. ParaGraph has come up with a new twist: handwriting recognition that actually recognizes your *writing*—a glimpse of things to come.

You can contact ParaGraph on BIX through its general director, Stepan Pachikov, as "spachikov."

Jane Morrill Tazelaar is BYTE's senior editor for the State of the Art section. You can reach her on BIX as "janetaz."

per second per TRAM.

The transputer-based architecture offers two distinct benefits. First, it provides you with modular, incremental performance options to meet specific requirements. For example, a 60-cps system requires six TRAMs. You can license software to access any number of additional TRAMs; recognition speed grows almost linearly. Second, because the modules are identical, recognition systems using transputers are inherently fault-tolerant. Thus, in a multi-TRAM configuration, processing speed would only degrade in 10-cps increments as a result of processor failure.

The NestorReader user interface to the transputer network is a Microsoft Windows program. Given a scanned image of a form, you mark the zones that represent data fields and submit these to the recognition system for identification. For each type of form, you can define a set of zones—for example, name, address, city, state, and ZIP code. The set of zones can be applied repeatedly to a batch of stored images as long as all the images represent the same type of form. The transputer network separates the contents of each zone into images of characters and then identifies the characters by means of the neural network technique described earlier. To assist post-process editing, the system can report confidence levels and alternate choices in order of confidence.

Future Developments

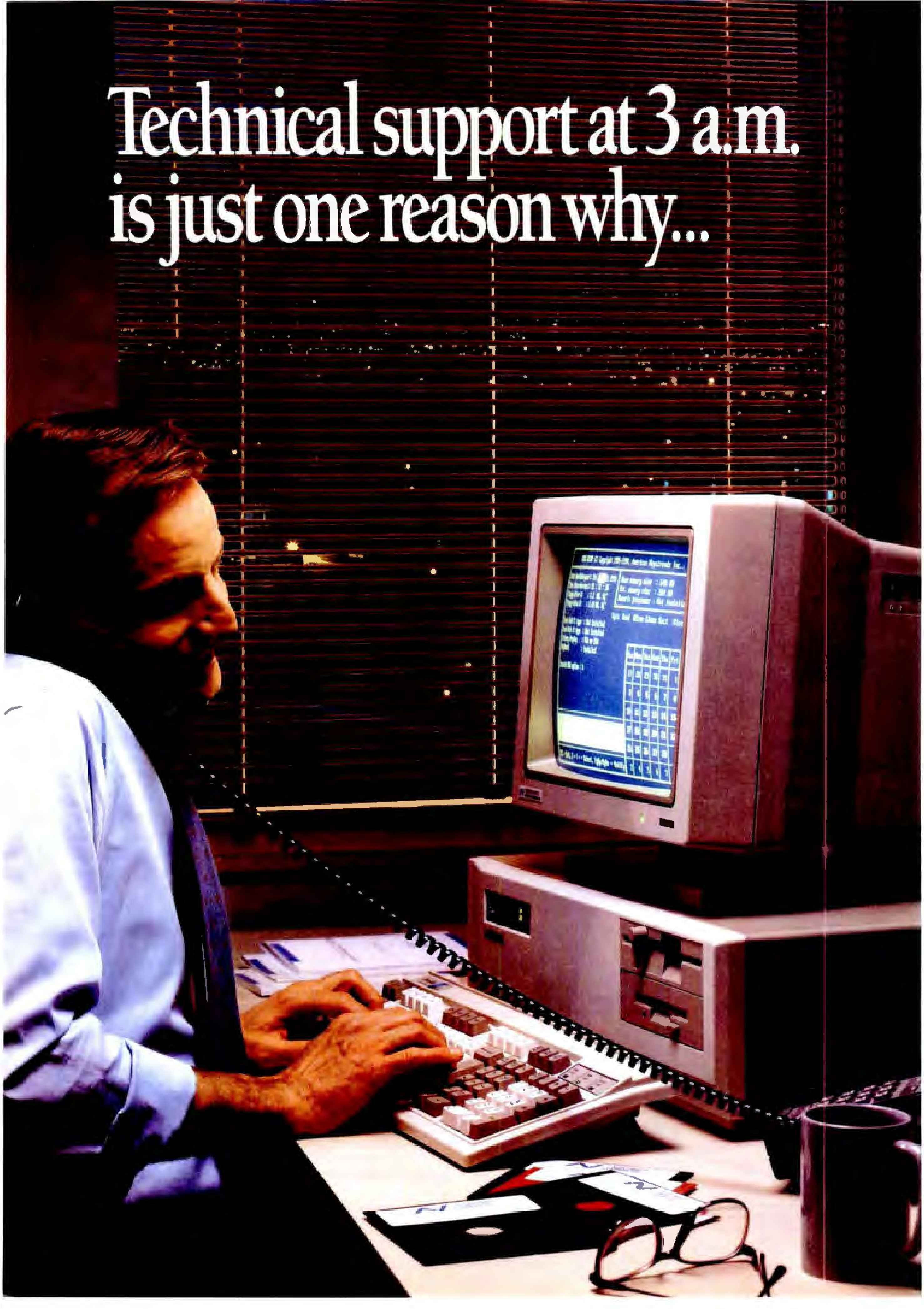
What's the next step? Organizations that handle large volumes of paper typically sort documents by type. When documents have been scanned, the sorting can be semi-mechanical: An operator views an image and then enters a classification number. Why not use neural networks to fully automate this recognition task, too? After repeated exposure to forms of various types, a neural network system will be able to recognize patterns and classify documents accordingly. Documents and faxes will be routed to their destination faster and more economically. Thanks to its learning capability, the network's accuracy will improve over time. Unknown images need only be routed to a human operator who will interactively train the system in real time.

Once a neural network has identified an image, the main task becomes finding the information on the document. Content must be separated from background, a process called *forms subtraction*. In addition to making the characters available for recognition, forms subtraction reduces the image size for subsequent storage. For instance, it would be inefficient for the IRS to store millions of tax forms on optical disk when only the content of the forms matters.

Form backgrounds (templates) can be stored once and merged with content upon retrieval. However, you can't just subtract an image of a blank form from an image of a document. Much of the form's content might be lost in cases where characters overlap background elements. Furthermore, forms are often printed with slight variations. To determine what is data and what is background (so that the correct character images will be used for recognition), you need an intelligent system.

Nestor is now developing neural network tools to solve these field- and form-level recognition problems. In concert with the character-level recognition system described here, Nestor hopes to show that neural networks can help bring the long-anticipated paperless office closer to practical reality. ■

David P. Wright is director of sales and marketing for, and Christopher L. Scofield is vice president of, Nestor Applied Systems. They can be contacted on BIX c/o "editors."


Technical support at 3 a.m.
is just one reason why...

Northgate® makes it safe to buy business computers direct.

A 24-hour business hotline service for your 24-hour business. Many companies don't realize the importance of 'round the clock technical support ... until they need it. But, chances are, you or someone you know has had questions about computing after normal office hours. If you purchased your systems from one of our competitors, you probably had to wait to get help. Time-wasting. Inefficient. Costly.

Northgate treats you right! Across town or around the world, Northgate's business customers have a special hotline that gives immediate 24-hour access to Northgate's team of technical experts. Compare this with our competitors. Many have limited hours (like 9 a.m. to 2 p.m. on Saturdays; closed Sundays), some won't answer the phone during lunch hour and close up shop at night. While others offer little or no support at all.

Northgate's commitment to customer service and support caught the attention of the 1990 Microcomputer Marketing Council who selected Northgate as the first winner of the Association's Service and Support Award. When you buy from Northgate, rest assured we're here to serve you—in person—all day, every day. And the call's always on us.

From our spectacular SlimLine 386SX to our our powerful Elegance 486™ file servers, Northgate backs them all with quality in every respect.

Industry's highest performing systems. In an industry overflowing with companies all claiming top performance, only one company is consistently ahead of the pack: Northgate. Since January of 1989 when our first *PC Magazine* Editor's choice was awarded, our name has become synonymous with pace setting performance. Seven Editors' Choice awards, eight *Computer Shopper* "Best Buy" Awards and three *InfoWorld* recognitions are proof.

Quality systems through manufacturing and testing. As a manufacturer, Northgate does not subscribe to the industry trend of taking shortcuts in technology to boost performance gains and keep prices down. Rather, we thoroughly test components for compatibility, performance and value. In fact, if you were to order a hundred of our machines with the same configuration, every one would have the exact same performance. From hard drives all the way to our ALPS keyboard switches. And every stop in between. No "parts of the month" surprises or compatibility problems. We stake our reputation on it.

Unparalleled compatibility with your current industry standard systems and software. One of our competitors recently announced they set up an "FCC Testing Lab." At Northgate, this is nothing new. For years, Northgate has gone the extra step to ensure that our systems are FCC Class B certified. And, we've invested hundreds of thousands of dollars to make sure our systems are compatible with MS-DOS, OS/2, Novell® Banyan, UNIX, SCO and other software. It's no wonder why many major software developers use Northgate to design, develop and "debug" their new software.

Dollar for dollar, Northgate is your smartest business decision. No doubt you can pay less for computers. And you can certainly pay more. But you won't get the product, performance, service and support that has positioned Northgate as the new industry leader. No matter what the price, you just can't buy better than Northgate.

Free pre-purchase consultation. Nobody spends thousands of dollars on systems during the first phone call. You know it, we know it. Instead, we offer a no-obligation pre-purchase consultation with one of our highly-trained Technical Consultants. You won't get high-pressure tactics or commission-hungry salespeople. Just friendly assistance in matching your business needs with the appropriate Northgate solution.

CALL TOLL-FREE

800-345-8709

IN U.S.A. AND CANADA

Major corporations, volume purchasers and government agencies call National Business Accounts: **800-548-3510**

Notice to the hearing impaired:
Northgate has TDD capability. Dial 800-535-0602.

NORTHGATE COMPUTER SYSTEMS, INC.

"Smart Tools For Business"™

7075 Flying Cloud Drive,
Eden Prairie, Minnesota 55344

Circle 197 on Inquiry Card.

PC Magazine said it best...
"Northgate stops at nothing to please its customers!"*

Call Northgate® Now.

Award-winning performance, unequaled service and incredible support for a price IBM®, Compaq® and Dell® can't hope to match.

The power of 386™ computing is the lifeblood of business today. And more and more, Northgate is the vendor of choice. Why? Northgate is the only company who consistently earns top ratings for performance, service, support and bottom-line value. Industry experts and users worldwide agree.

Northgate 386 ... computing's most decorated line. Northgate's rise to the pinnacle of 386 technology started in 1988 when *Computer Shopper* readers voted Northgate's 386 Power System both a "Best Buy" and Overall Best Buy. A few months later, *PC Magazine* named Northgate 386/20 and 386/25 "Editors' Choice." Later that year, our 386/33 received the same honor. Along the way, our 386 systems won several *InfoWorld* recognitions as well.

Revolutionary systems of the 90's: Northgate SlimLine.™

Often copied, never duplicated! It seems like everyone has jumped on the SlimLine bandwagon these days. Truth is, Northgate pioneered this incredible technology. We were the first to introduce full power 386 systems in a case measuring only 4.25" high.

Architecture that stunned the industry! SlimLine's fully-integrated motherboard features built-in IDE hard drive and floppy drive controllers, one parallel and two serial ports plus a 16-bit VGA controller. And we didn't scrimp on expansion capabilities. Our unique expansion tree has three full-length 16-bit and two half-length 8-bit slots for all your add-ons and peripherals.

Perfect single-user workstation or network terminal. SlimLine is ideal for use where you need full-size 386 power, but space is a premium.

For comprehensive system features and popular configurations, see next page.

Northgate Elegance™: Full-size 386 power and expandability.

The business systems of choice. Elegance's award-winning reputation has made them the choice of Fortune 1000 corporations, government agencies and universities around the world. And with good reason.

Elegance full-size systems are designed to allow you to easily expand your system as your business needs increase. You only pay for the components you need now.

Power for every application. From "simple" tasks like word processing and desktop publishing to advanced CAD/CAE and database management applications, Elegance delivers. To find out what systems are right for you, see next page for system configurations and upgrade options.

Northgate wins 1990 Microcomputer Marketing Council's Service and Support Award!

- 30-day no-risk trial period
- Full one year warranty on systems, 5 years on *OmniKey* keyboards.
- Northgate responds to your needs with overnight shipment of parts—at our expense!
- Free on-site service to most locations for one year if we can't solve your needs over the phone.
- Unique 24-hour toll-free technical support—the industry's best!
- We accept VISA, MasterCard, Discover and Northgate's Big 'N' card. We offer leasing and financing options, too!

Free pre-purchase consultation. Nobody spends thousands of dollars on systems during the first phone call. You know it, we know it. Instead, we offer a no-obligation pre-purchase consultation with one of our highly-trained Technical Consultants. You won't get high-pressure tactics or commission-hungry salespeople. Just friendly assistance in matching your business needs with the appropriate Northgate solution.

CALL TOLL-FREE **800-345-8709**
IN USA AND CANADA

Fortune 1000 corporations, government agencies and education institutions, call National Business Accounts: **800-548-3510**

Notice to the hearing impaired: Northgate has TDD capability. Dial 800-535-0602.

NORTHGATE COMPUTER SYSTEMS, INC.
"Smart Tools For Business"™
7075 Flying Cloud Drive,
Eden Prairie, Minnesota 55344

*PC Magazine, September 25, 1990

Circle 198 on Inquiry Card.

Only Northgate® offers a full range of 386™ systems in SlimLine, desktop, and vertical power cases!

SlimLine...a Northgate original!

SlimLine Features:

- Small footprint (16.5" square x 4.25" high) SlimLine case with room for two exposed and one internal half-height devices
- Intel and Weitek math coprocessor support
- 150 watt power supply
- Clock calendar chip rated at 5 years
- Front mounted reset and high/low speed controls
- MS-DOS 4.01 and GW-BASIC installed
- On-line user's guide to MS-DOS 4.01
- QA Plus Diagnostic and utility software
- FCC Class B certified

Editors Choice–all Elegance systems

Elegance Features:

- Desktop case features 5-bays with room for 3 exposed and 2 internal half-height devices with 200 watt power supply.
- For greater expansion, choose a vertical 7-bay powerhouse with a 220 watt power supply.
- American-made motherboard
- RAM expansion up to 8Mb on motherboard (16Mb total RAM with 32-bit memory card)
- 16-bit VGA video adaptor
- One parallel and two serial ports
- MS-DOS 4.01 and GW-BASIC installed
- Microsoft Windows 3.0 and mouse
- FCC Class B certified

If one of these popular models doesn't meet your needs, CALL! We'll custom build one just for you!

SlimLine 386SX/16 and 20 MHz with 64K Cache

- Intel 80386SX/16 or 20 MHz processor
- 2Mb of RAM on motherboard
- 40Mb hard drive
- 64K SRAM read/write-back cache
- 1.2Mb and 1.44Mb floppy drives
- 14" SVGA color monitor
- *OmniKey* keyboard
- Microsoft Windows and mouse

\$2399.00/\$2599.00

Or as low as \$75.00/\$80.00 per month*

SlimLine 386/25 MHz with 64K Cache

- Intel 80386/25 MHz processor
- 4Mb of RAM on motherboard
- 100Mb hard drive
- 64K SRAM read/write-back cache
- 1.2Mb and 1.44Mb floppy drives
- 14" SVGA color monitor
- *OmniKey* keyboard
- Microsoft Windows and mouse

\$3399.00 Or as low as \$105.00 per month*

SlimLine 386/33 MHz with 64K Cache

- Intel 80386/33 MHz processor
- 4Mb of RAM on motherboard
- 200Mb hard drive
- 64K SRAM read/write-back cache
- 1.2Mb and 1.44Mb floppy drives
- 14" SVGA color monitor
- *OmniKey* keyboard
- Microsoft Windows and mouse

\$3899.00 Or as low as \$120.00 per month*

Popular Northgate Elegance 386 systems:

Northgate Elegance 386/25

- Intel® 80386/25 MHz processor
- 4Mb of RAM
- 100Mb hard drive
- 64K SRAM read/write-back cache
- 1.44Mb and 1.2Mb floppy drives
- 16-bit VGA adaptor
- Desktop case
- 14" SVGA color monitor
- *OmniKey*® keyboard
- Novell certified

\$3699.00 Or as low as \$115.00 per month*

Northgate Elegance 386/33

- Intel® 80386/33 MHz processor
- 4Mb of RAM
- 200Mb hard drive
- 64K SRAM read/write-back cache
- 1.44Mb and 1.2Mb floppy drives
- 16-bit VGA adaptor
- Vertical power case
- 14" SVGA color monitor
- *OmniKey*® keyboard
- Novell certified

\$4449.00 Or as low as \$140.00 per month*

Call for complete custom configuration information.

Notice to the hearing impaired: Northgate has TDD capability. Dial 800-535-0602.

CALL TOLL-FREE

800-345-8709

IN U.S.A. AND CANADA

Major corporations, volume purchasers and government agencies call National Business Accounts: 800-548-3510

NORTHGATE COMPUTER SYSTEMS, INC.

"Smart Tools For Business"™

7075 Flying Cloud Drive,
Eden Prairie, Minnesota 55344

Circle 199 on Inquiry Card.

Document Imaging Systems

Systems that let you digitize, store, and retrieve documents come in all shapes and sizes. Some include specialized imaging hardware, while others are software-only products that work on standard platforms. Below is a list of companies that provide document imaging solutions.

Bell & Howell Document Imaging Products Co.
(ImageSearch Plus 5000)
6800 McCormick Rd.
Chicago, IL 60645
(708) 675-7600
Circle 1075 on Inquiry Card.

Blueridge Technologies, Inc.
(Optix Desktop Imaging System)
P.O. Box 430
Flint Hill, VA 22627
(703) 675-3015
Circle 1076 on Inquiry Card.

Bull HN Information Systems, Inc.
(ImageWorks)
Technology Park
Billerica, MA 01821
(508) 671-6000
Circle 1077 on Inquiry Card.

Compulink Management Center, Inc.
(LaserFiche LAN)
370 South Crenshaw Blvd., Suite E-106
Torrance, CA 90503
(213) 212-6820
Circle 1078 on Inquiry Card.

FileNet Corp.
(FileNet System)
3565 Harbor Blvd.
Costa Mesa, CA 92626
(714) 966-3400
fax: (714) 966-3490
Circle 1079 on Inquiry Card.

Flagstaff Engineering
(PaperTamer)
830 South Main St., Suite 211
Cottonwood, AZ 86326
(602) 634-5100
fax: (602) 634-0100
Circle 1080 on Inquiry Card.

IBM Corp.
(ImagePlus)
44 South Broadway
White Plains, NY 10601
(914) 288-3000
Circle 1081 on Inquiry Card.

Imara Research Corp.
(Imara)
111 Peter St., Suite 804
Toronto, Ontario, Canada M5V 2H1
(416) 581-1740
Circle 1082 on Inquiry Card.

Kofax Image Products
(KIPP)
3 Jenner St.
Irvine, CA 92718
(714) 727-1733
Circle 1083 on Inquiry Card.

LaserData, Inc.
(LaserView)
300 Vesper Park
Tyngsboro, MA 01879
(508) 649-4600
fax: (508) 649-4436
Circle 1084 on Inquiry Card.

Metafile Information Systems, Inc.
(Metaview)
421 First Ave. SW
Rochester, MN 55902
(800) 638-2445
(507) 286-9232
Circle 1085 on Inquiry Card.

Micro Dynamics, Ltd.
(MARS)
8555 16th St., Suite 701
Silver Spring, MD 20910
(301) 589-6300
Circle 1086 on Inquiry Card.

Newport Canyon Associates
(Fileflo)
2082 Business Center Dr., Suite 130
Irvine, CA 92715
(714) 833-0333
Circle 1087 on Inquiry Card.

Odesta Corp.
(ODMS)
4084 Commercial Ave.
Northbrook, IL 60062
(708) 498-5615
fax: (708) 498-9917
Circle 1088 on Inquiry Card.

Optigraphics
(Curator)
9339 Carroll Park Dr.
San Diego, CA 92121
(619) 292-6060
fax: (619) 546-7671
Circle 1089 on Inquiry Card.

Plexus Software
(XDP)
5200 Great America Pkwy., Suite 200
Santa Clara, CA 95054
(408) 980-8190
Circle 1090 on Inquiry Card.

Sigma Imaging Systems, Inc.
(OmniDesk)
622 Third Ave., 30th Floor
New York, NY 10017
(212) 808-4800
fax: (212) 986-0175
Circle 1091 on Inquiry Card.

Summit Software Corp.
(Laser Base)
430 10th St. NW, Suite N-202
Atlanta, GA 30318
(404) 888-0700
fax: (404) 888-0502
Circle 1092 on Inquiry Card.

TMS, Inc.
(TMSFax)
110 West Third St.
P.O. Box 1358
Stillwater, OK 74076
(405) 377-0880
fax: (405) 377-0452
Circle 1093 on Inquiry Card.

ViewStar Corp.
(ViewStar)
5820 Shellmound St.
Emeryville, CA 94608
(415) 841-8565
fax: (415) 653-9926
Circle 1094 on Inquiry Card.

Wang Laboratories, Inc.
(Open/image)
One Industrial Ave.
Lowell, MA 01851
(508) 459-5000
Circle 1095 on Inquiry Card.

Xerox Corp.
(GlobalView)
P.O. Box 1600
Stamford, CT 06904
(203) 968-3000
Circle 1096 on Inquiry Card.

Xionics, Inc.
(Image Service Environment)
765 The City Dr., Suite 340
Orange, CA 92668
(714) 971-4717
fax: (714) 971-5048
Circle 1097 on Inquiry Card.

Inclusion in the resource guide should not be taken as a BYTE endorsement or recommendation. Likewise, omission from the guide should not be taken negatively. The information here was believed to be accurate at the time of writing, but BYTE cannot be responsible for omissions, errors, or changes that occur after compilation of the guide.

Northgate® 486™/25 & 33 MHz

486 ISA...486 EISA.

Only Northgate gives you a choice!

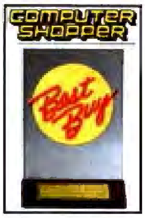
"Editors' Choice" Elegance™ 486/25 & 33 MHz ISA

Elegance 486i sets the pace! Northgate established a lead in the 486 race when our 486i outscored all competitors in *InfoWorld*'s 1990 reviews. Elegance "leads the pack by a comfortable margin," they said ... "tops in support and value."†

PC MAGAZINE EDITORS' CHOICE

Elegance 486/25i, Sept. 11, 1990
Elegance 486/33i, Feb 12, 1991

PC Magazine then reviewed 486/25 ISA systems. "Only one machine stands out," they said, "you could pay less for a 486 system, but not get the bonuses that are offered with the Elegance."††



Computer Shopper readers agree! Elegance 486/25i breezed past the competition and captured a 1990 "Best Buy" award. This makes three years in a row a Northgate Elegance system was voted tops by *Computer Shopper* readers.

Elegance 486/33 ISA makes it a clean sweep! The February 12, 1991 issue of *PC Magazine* declared Elegance 486/33 Editors' Choice saying the system was "a sure winner in its class." They made special note of Northgate's "clear documentation, excellent service policies, top name components and fine performance."

ISA 486 System Features:

- Intel 486/25 or 33 MHz processor
- 4Mb RAM; expandable to 8Mb on motherboard
- 200Mb IDE hard drive
- 1.2Mb and 1.44Mb floppy drives
- 64K SRAM read/write-back cache
- ISA bus
- One 32-bit, six 16-bit and one 8-bit slots
- One parallel and two serial ports
- Vertical "Power" case (desktop available)
- 16-bit VGA graphics adaptor with 512K video RAM (expandable to 1Mb)
- 14" SVGA color monitor
- *OmniKey*®/ULTRA keyboard
- MS-DOS 4.01 or 3.3 and GW-BASIC software installed
- Microsoft® Windows™ 3.0 and mouse
- FCC Class B Certified

$5399.00 25 MHz / **$6299.00** 33 MHz

486 EISA gives you full 32-bit performance!

Performance that rivals RISC-based minicomputers costing thousands more! New 32-bit EISA bus gives you the power to transfer data along your network at burst mode speeds up to 33 megabytes per second. That's a 15-fold improvement over 16-bit AT buses serving medium-to-large networks.

Complete compatibility! Elegance 486e is 100% compatible with UNIX, Novell® and DOS. Plus, Elegance is compatible with existing 8-bit and 16-bit ISA adapters, so you benefit from downward compatibility.

Compare Elegance 486e performance and Northgate service and support with any other vendor's in the industry. You'll find you can't buy better than Northgate! Call now ... let Northgate build your system today!

True EISA 486 System Features:

- Intel 486/25 or 33 MHz processor
- 4Mb RAM; expandable to 32Mb on motherboard
- 1Mb EISA caching SCSI controller
- 200Mb SCSI hard disk
- 1.2Mb and 1.44Mb floppy drives
- 128K SRAM read/write-back cache
- EISA bus
- Eight 32-bit EISA slots; six bus master and two slave
- One parallel and two serial ports
- 16-bit VGA graphics adaptor with 512K video RAM (expandable to 1Mb)
- 14" SVGA monochrome monitor
- Vertical "Power" case
- 300 watt power supply
- *OmniKey*®/ULTRA keyboard
- MS-DOS 4.01 or 3.3 and GW-BASIC software installed
- Microsoft mouse
- 25 MHz FCC Class B Certified (33 MHz FCC Class A)

$8199.00 25 MHz / **$9199.00** 33 MHz

Northgate wins 1990 Microcomputer Marketing Council's Service and Support Award!

- **30 Day No-Risk Trial.** To assure your complete satisfaction, Northgate gives you a 30-day No-Risk Trial.
- **Full parts and labor warranties:** 1 year on systems; 5 years on *OmniKey* keyboards.
- **Overnight shipment of replacement parts when needed** — at our expense.
- **Northgate's unique 24-hour toll-free technical support** leads the industry — most needs are met with just one call!
- **Free on-site service** to most locations if we can't meet your technical needs over the phone.
- **Easy financing:** Use your Northgate Big 'N', VISA, MasterCard or Discover Card. Leasing terms up to five years also available.

Free pre-purchase consultation. Nobody spends thousands of dollars on systems during the first phone call. You know it, we know it. Instead, we offer a no-obligation pre-purchase consultation with one of our highly-trained Technical Consultants. You'll receive friendly assistance in matching your business needs with the appropriate Northgate solution.

CALL TOLL-FREE
800-345-8709
IN U.S.A. AND CANADA

Fortune 1000 corporations, government agencies and education institutions call National Business Accounts: **800-548-3510**

Notice to the hearing impaired: Northgate has TDD capability. Dial 800-535-0602.

NORTHGATE COMPUTER SYSTEMS, INC.
"Smart Tools For Business"™
7075 Flying Cloud Drive, Eden Prairie, Minnesota 55344

Circle 200 on Inquiry Card.

TAME THE PAPER TIGER

With OCR, you can enter text into your PC or Mac faster than is humanly possible. The BYTE Lab stress-tests 14 contenders

STANFORD DIEHL AND HOWARD EGLOWSTEIN

The paperless office? Check out almost any desktop, file cabinet, or office trash can: We're still a long way from that elusive dream. Paper remains a primary means of communication in the business world. As a result, there's a treasure trove of information to be found in printed documents. Down in the basement of your building, there are are probably piles of reports that you could use if you had a way of quickly accessing the information. At the same time, the electronic exchange of information continues to grow and, with it, the problem of converting printed text into electronic form. Optical character recognition tools do exactly that. OCR software running on your desktop PC or Mac scans an image of a page, reads the characters that form the text, and translates them into a data file. Most OCR software can generate output directly into word processor formats, often preserving attributes such as font changes and boldfacing.

What OCR may not do is save you time. Even the best OCR packages fall short of perfect recognition. A really good package can achieve better than 99 percent accuracy. But think about it: That means you'll have to fix one out of every 100 characters—that's 20 characters in a single-spaced typewritten page of 2000 characters. The top packages have added spelling checkers to the recognition software to catch the most common errors. A few even use lexical word analysis to make sure the spellings follow common rules of the language.

To do a good job, OCR software needs a lot of processing power. Most of the packages we reviewed use your PC's processor to do the work. We'd suggest a minimum of a 386-based machine, running at 20 MHz or higher, or a Mac II.

PAPER SCU [illegible] ROM [illegible] 1991

BYTE ACTION SUMMARY

- **OCR**
- **WHAT YOU'LL LIKE**
  OCR translates hard-copy text into a data file. Most OCR software can generate output directly in word processor formats, often preserving attributes such as font changes and boldfacing.
- **WHAT YOU'LL DISLIKE**
  OCR may not save you time. Even the best packages fall short of perfect recognition.
- **WHAT WE RECOMMEND**
  If your workload justifies a dedicated system, we recommend the Kurzweil K5200. It comes closest to what OCR should be, although it costs a bundle. If your needs are less demanding, choose Calera's WordScan Plus for PCs. It's fast, accurate, and dependable. For Macintosh users, our pick is OmniPage Mac (until the Professional version ships, we suggest you purchase OmniTrain to add trainability to the product).

Mac- and Windows-based software needs scads of RAM—4 or 5 megabytes is a practical minimum. As for scanners, a flatbed scanner with an automatic document feeder (ADF) is highly recommended for serious work.

As an alternative to software-only OCR, consider the hardware-assisted packages. Calera's CDP 9000 is a stand-alone box with a sheet-fed scanner and SCSI, RS-232, and Ethernet ports. The Kurzweil K5200 is a sheet-fed (or single-sheet) scanner and RISC-based processing box. Caere's hardware solution, the Parallel Reader, uses one of three standard scanners driven by a multiprocessor PC. By optimizing the processing power for OCR, these units achieve the fastest recognition with a high degree of accuracy. The downside is price: Hardware solutions typically run $10,000 or more, enough to discourage casual users.

Beyond Training

All the OCR programs in this Product Focus claim to be *omnifont*. This means that they can recognize most nonstylized fonts without having to maintain huge dictionaries of specific font information. We chose to focus on omnifont products because of their flexibility in automatically recognizing a variety of fonts. However, a number of trainable packages

OCR FEATURES SUMMARY

Prices, platforms, and proofing tools distinguish OCR hardware and software (● = yes; ○ = no).

Product	Caere OmniPage 386 3.0	Caere OmniPage Professional 1.0	Caere OmniPage Mac 2.12	Caere Parallel Reader 1.0	Calera CDP 9000	Calera WordScan Plus 1.0
Platform	PC	PC	Mac	PC	PC, Mac	PC
Price	$695	$995	$695	$10,995	$21,950; $31,950	$995
Minimum configuration						
RAM	4 MB	4 MB	4 MB	Hardware and software supplied (except for mouse, VGA display, and keyboard)	2 MB	2 MB
Hard disk space	8 MB	8 MB	4 MB		5 MB	6 MB
Other software	Windows 3.0	Windows 3.0	System 4.2-6.0.4 Finder 5.0-6.1.4		Windows 3.0 Mac or Sun Unix	Windows 3.0
Other hardware	386, mouse	386, mouse	Mac II or Mac SE with accelerator card		286 or 386, mouse Mac II	286 386 recommended with mouse
Trainable	○	●	○	●	●	○
Omnifont	●	●	●	●	●	●
Lexical recognition	○	○	○	○	●	●
Smallest readable point size (300 dpi)	6	6	6	6	6	6
Largest readable point size (300 dpi)	72	72	72	72	28	28
Graphic preview	●	●	●	●	●	●
Landscape	●	●	●	●	●	●
Foreign language dictionaries	●	●	●	●	●	●
Deferred processing	○	●	○	●	●	●
Multiple jobs with automatic data feeder	●	●	●	●	●	●
Templates	●	●	○	○	●	●
Automatically parse text and graphics	●	●	●	●	●	●
Reorder text blocks	●	●	●	●	●	●
Decolumnize text	●	●	●	●	●	●
Numeric recognition	●	●	●	●	●	●
Learn ligatures	○	●	○	○	●	○
Dot-matrix support	○[3]	●	○[3]	●	●	●
Support for fax files	●	●	○	○	●	●
Retain format						
Type style (bold, italic, etc.)	●	●	●	●	●	●
Indents	●	●	●	●	●	●
Justification	●	●	●	●	●	●
Centering	●	●	●	●	●	●
Columns	●	●	●	●	●	●
Tables	●	●	●	●	●	●
Output formats						
WordPerfect	●	●	●	●	●	●
Microsoft Word	●	●	●	●	●	●
Rich Text Format (RTF)	●	●	●	●	●	●
XyWrite	●	●	○	●	●	●
WordStar	●	●	○	●	●	●
dBASE (.DBF)	●	●	○	○	○	○
Lotus 1-2-3 (.wk1)	●	●	○	○	●	●
Excel	●	●	●	○	●	●
Proofing tools						
Built-in editor	●	●	●	●	●	●
Search and replace	●	●	●	●	●	●
Spelling checking	○[4]	○	○[4]	●	●	●
Query on questionable characters	●	●	●	●	●	●

[1] AccuScan requires Scanning Gallery Plus 5.0, which costs $595. [2] Requires Image-In Scan/Paint ($149). [3] Yes with OmniDraft. [4] Yes with OmniSpell.

are available, often at lower prices than their omnifont counterparts.

The earliest OCR packages were strictly trainable. Before trainable packages can recognize text, you must teach them each character of a particular font. You have to scan a document, preview the scanned bit map of each character, and identify the character for the program. The program builds a database that assigns each image to its corresponding ASCII character. On the next pass, the program compares the scanned image of every character with the stored images in its database. If the program finds a reasonable match, it returns the ASCII character assigned to the matched image. This process can be very tedious and time-consuming. It also requires gobs of disk space to hold the font dictionaries that are created.

Omnifont technology changes all that. It uses *feature extraction* to recognize fonts regardless of their size as long as an *A* looks remotely like an *A*. An omnifont product contains a database of shapes (e.g., lines and circles). The OCR package breaks a character down into its component parts and does not have to contain information on many different fonts. It can recognize a letter by its unique combination of shapes. Theoretically, an omnifont package can understand any char-

OCR FEATURES SUMMARY

Hewlett-Packard Scanning Gallery Plus 5.0 with AccuScan	Image-In, Inc. Image-Read 2.0	OCR Systems ReadRight 2.01	Ocron Perceive 1.0.5	Recognita Recognita Plus 1.1	Xerox Imaging Systems AccuText 2.0	Xerox Imaging Systems Discover 386 5.0	Xerox Imaging Systems Kurzweil K5200
Platform PC	PC	PC	PC	PC	Mac	PC, PS/2	PC
$595[1]	$349[2]	$495	$595	$495	$799	$599	Windows: $21,950 DOS: $19,950
2 MB (3 MB req.) 7 MB Windows 3.0	640K (1 MB req.) Hard disk required Windows 3.0	640K Hard disk required DOS 3.0 or higher	2.64 MB 4 MB Windows 3.0	640K 3 MB	4 MB System 6.0.2 Finder 6.1 or higher	2 MB	640K 10 MB
286 (10-MHz and up), mouse	286 and up, mouse	XT and up, mouse recommended	286 or 386, mouse	XT and up, mouse	Mac II series	386	AT and up
○	●	○	●	●	●	○	●
●	●	●	●	●	●	●	●
○	○	○	○	○	●	●	●
6	8	6	8	6	8	8	6
72	24	16	36	24	24	24	24
●	●	●	●	●	●	○	○
●	●	●	●	●	●	●	●
○	●	○	○	○	●	●	●
○	●	●	○	○	●	●	●
●	○	○	●	●	●	●	●
●	●	●	●	○	●	○	○
●	○	○	○	●	●	●	●
●	○	○	○	○	●	○	○
●	●	●	●	●	●	●	●
○	○	○	●	●	●	●	●
○	●	●	○	●	●	●	●
●	○	●	●	●	●	○	●
●	●	●	●	●	●	●	●
●	●	●	○	●	●	○	●
●	●	●	●	●	●	●	●
●	●	●	●	●	●	●	●
●	●	●	●	●	●	●	●
●	●	●	●	●	●	●	●
●	●	●	●	●	●	●	●
●	○	●	●	●	●	●	●
●	○	●	●	●	●	●	●
●	○	●	●	●	●	○	●
●	○	●	○	●	○	●	●
●	○	●	●	●	○	●	●
○	○	●	○	○	○	○	○
●	○	●	○	○	○	●	●
●	○	●	○	○	●	○	○
○	○	○	●	●	○	○	○
○	○	○	●	○	○	○	○
○	○	○	○	○	○	○	○
○	●	○	●	●	●	○	○

acter without training. However, *omnifont* is a general term. Different vendors use different omnifont algorithms, and the effectiveness of these algorithms can vary widely. Some algorithms do an outstanding job of feature extraction while others are barely functional. And even the best omnifont algorithms are not perfect. Therefore, to enhance recognition, many OCR packages use omnifont algorithms and a learning facility.

More advanced OCR packages also use *lexical context* to improve accuracy. As part of the recognition process, the software compares its best guess to a stored dictionary. By comparing the scanned words to known good ones, the program can avoid nonsensical words.

Some Handy Features

Deferred processing can save you a lot of time and effort. Instead of scanning and recognizing one document after another, you can scan in a batch of documents, queue them up, and instruct the program to recognize them all at a later time, perhaps at the end of the day. Some packages can process multiple jobs with an ADF attached to the scanner, and some let you demark jobs with a blank page between each job in the ADF. When the program encounters the blank, it creates a new text file and loads subsequent pages to it.

continued

Figure 1: *As this chart shows, the high-end, hardware-assisted OCR products dominated our word-per-minute speed tests. We used five different types of test documents, and to ensure a fair sampling, we made each document at least nine pages long. (See the text box "How to Recognize a Good OCR Package" for an explanation of the test.)*

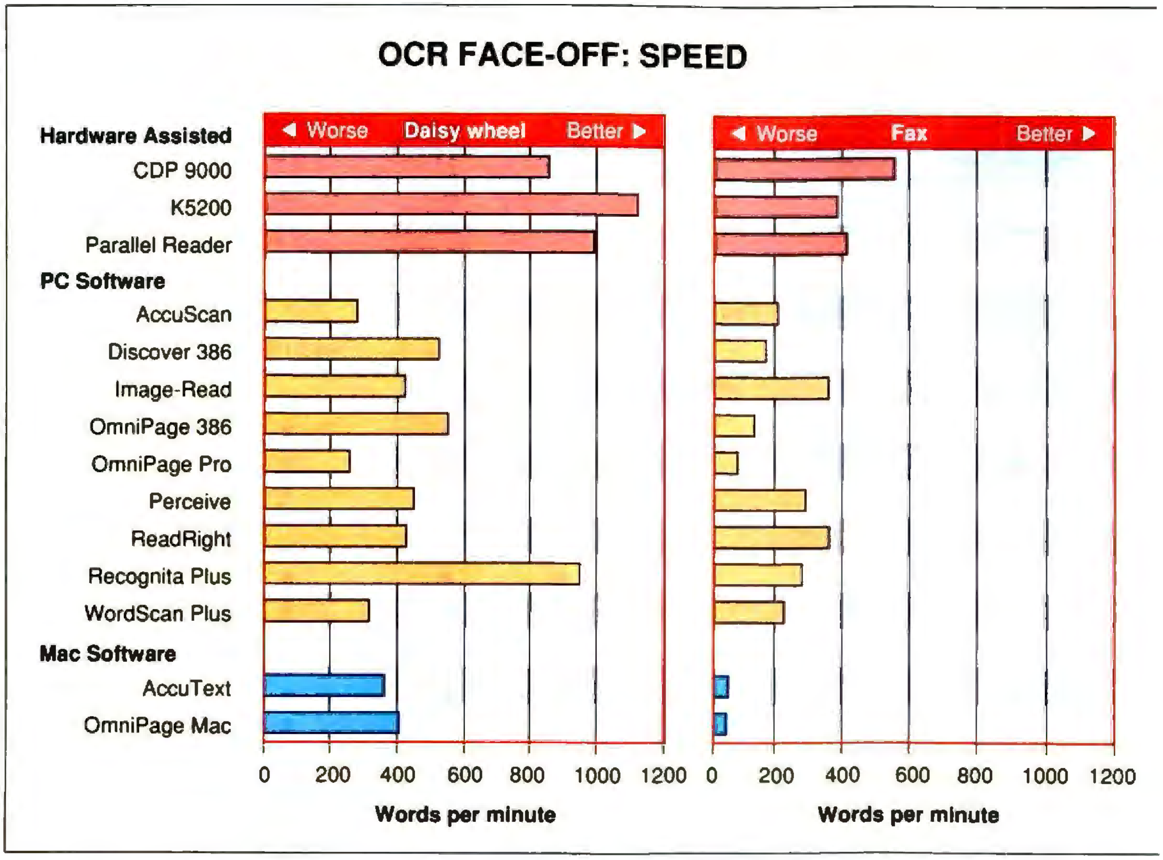
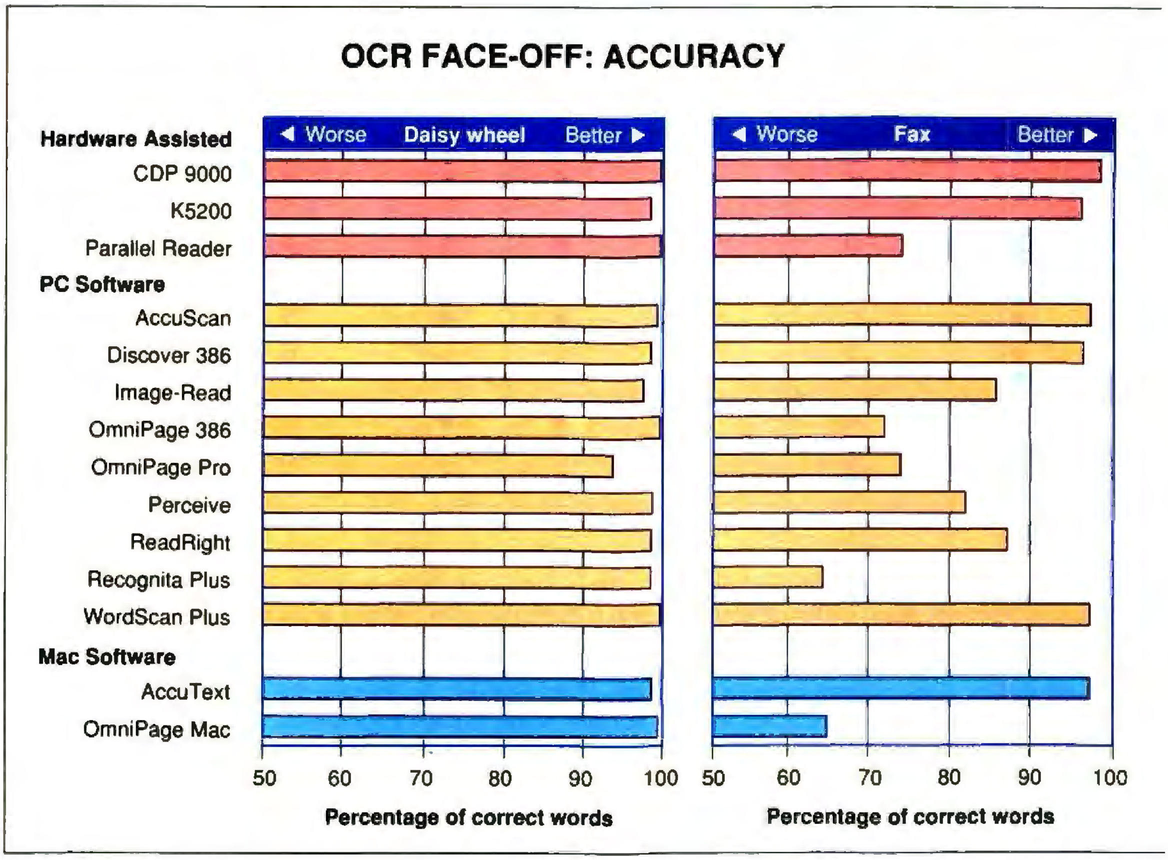
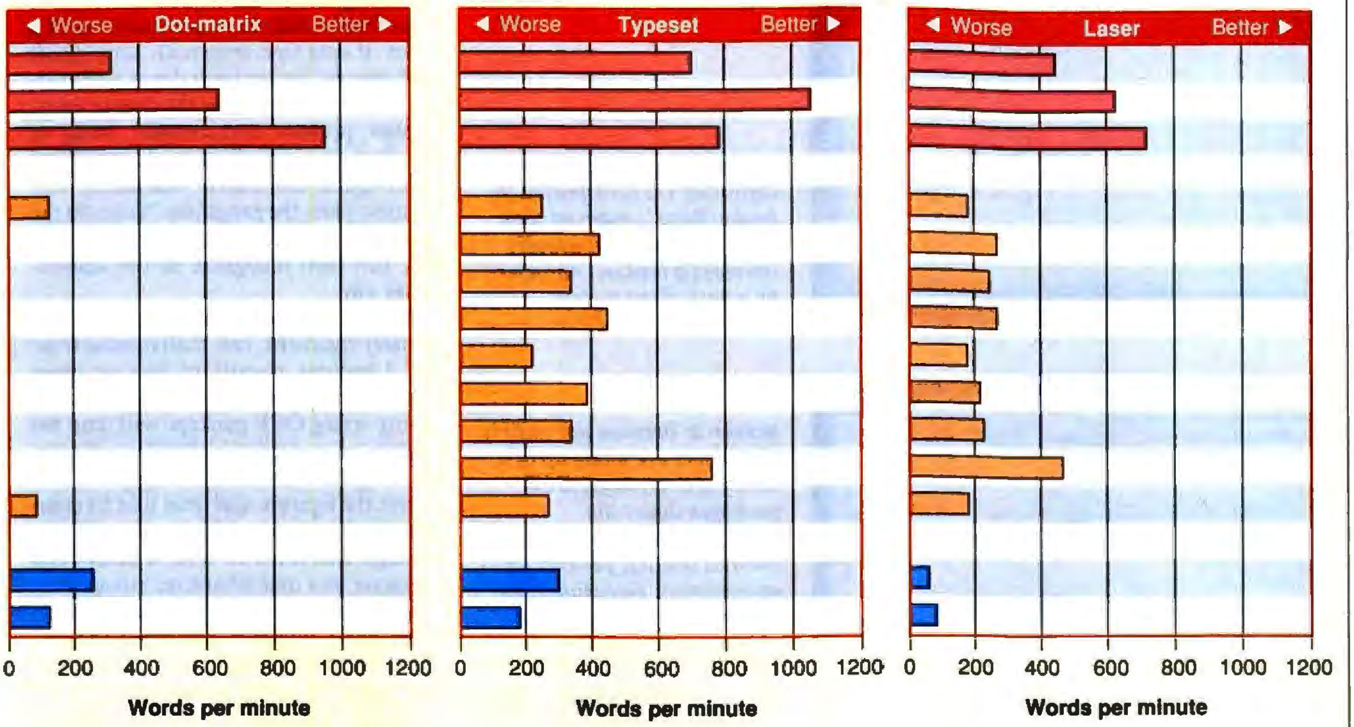
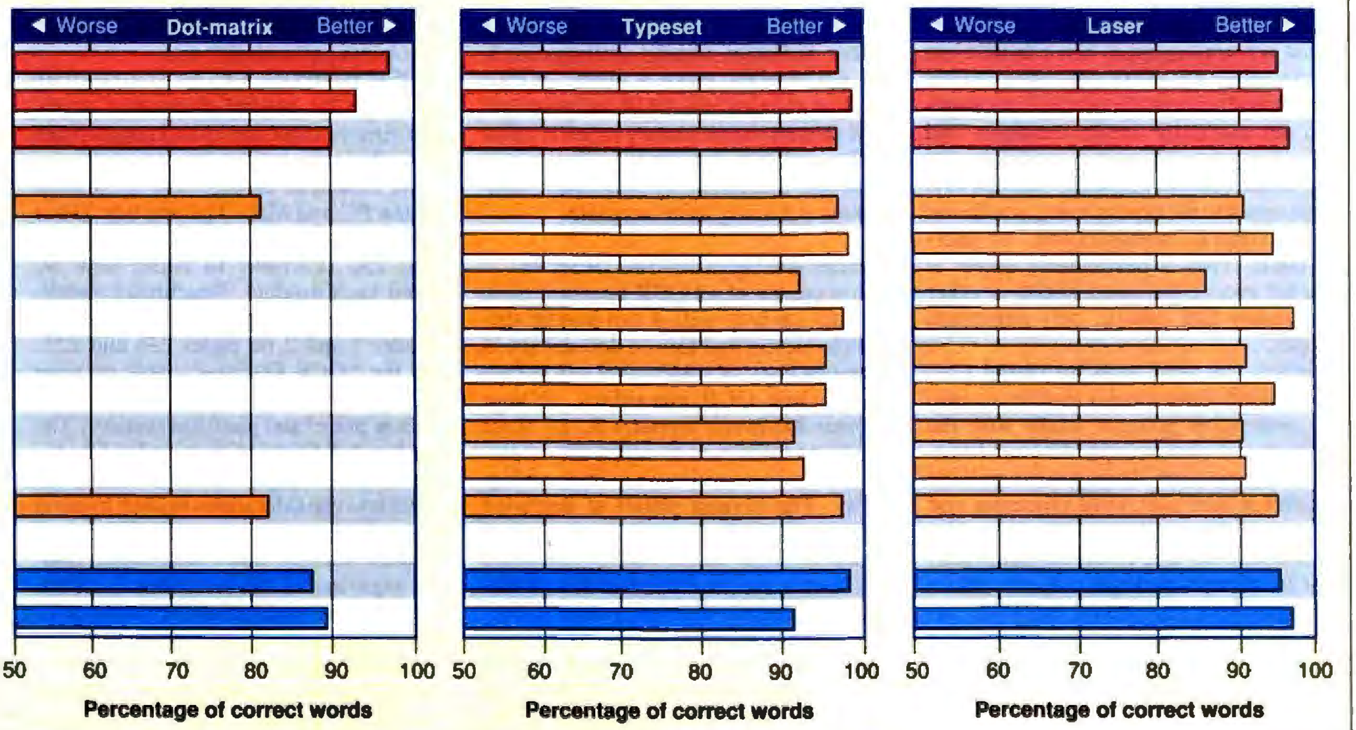
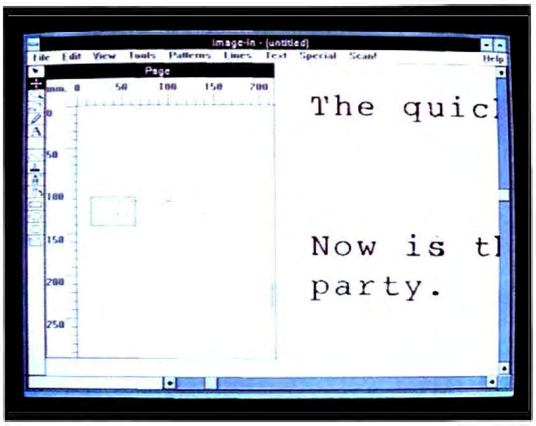


Figure 2: *Based on data derived from a custom software program developed by the BYTE Lab, this graph shows how accurately each OCR tool recognized our five test documents. If a program failed to sufficiently recognize a document, it received no score for that test. (See the text box "How to Recognize a Good OCR Package" for test details.)*




◀ Worse Dot-matrix Better ▶
◀ Worse Typeset Better ▶
◀ Worse Laser Better ▶
0 200 400 600 800 1000 1200
Words per minute


◀ Worse Dot-matrix Better ▶
◀ Worse Typeset Better ▶
◀ Worse Laser Better ▶
50 60 70 80 90 100
Percentage of correct words



Screen 1: *A typical broken character (T) is displayed in Image-Read's zoom window. OCR packages will usually interpret a broken character as a pair of characters.*

Screen 2: *Because dot-matrix characters are made up of a series of dots, many OCR packages detect the individual dots and interpret them as dashes, periods, or apostrophes. Sometimes, as shown here, only part of a character is read. Perceive's learning facility includes a Character Box, which you can adjust to account for misreads.*

Again, this can remove much of the tedium and baby-sitting from the process.

Templates can simplify the OCR process by letting you specify particular areas to be recognized. You can then use the template for every page that follows the same structure. Good OCR packages can automatically create templates and even recognize which zones contain text and which contain graphics. You can also limit zones to the type of entry you desire (i.e., numeric, alphanumeric, or user-defined). This is particularly useful if you are processing spreadsheets or other documents that contain only numerical entries.

When you deal with formatted text, you'll need some special features to ease the conversion process. Make sure the package you choose supports your favorite word processor. Then you can pull the document into your word processor and retain any formatting information. You should also be able to *decolumnize* text, that is, convert multiple columns into a single-column file. You'll need this capability if you want to load documents into a text-retrieval package. You should also be able to reorder text zones in any way you specify.

In the context of OCR, *spelling checking* enables the software to use a dictionary during the recognition process. The software may run across a letter that could be recognized as either one of two letters. Software without spelling checking will simply make a guess. With a spelling checker, the OCR software will first consult the dictionary to see if either of the spellings constitutes a real word. With the dictionary as tiebreaker, conversion is usually more accurate.

Get the Recognition You Deserve

The accuracy of an OCR program often depends on how well it can handle special characters and flawed documents. A degraded copy of a document can befuddle the best OCR algorithms. If your scanner hardware supports it, all these programs allow you to adjust the brightness of the scanned image to improve legibility. The biggest pitfall of degraded documents is broken characters (see screen 1). Many times, an OCR program will read a broken character as two distinct characters. Ocron's Perceive handles the problem creatively by placing ambiguous characters within a box. You can then expand this box right or left to cover more of a character's image. By boxing an entire broken character, you can teach the program to recognize it as a single character.

OCR programs might also have trouble recognizing dot-matrix characters. Since these characters are made up of a series of dots (see screen 2), some OCR packages recognize each dot as a character, usually interpreting the dots as apostrophes, periods, and commas. Many of the programs include special algorithms to recognize dot-matrix characters. For the most part, the programs "connect the dots" to create distinct characters that they can then recognize in the conventional way.

A font's distinctive characteristics, especially *ligatures*, can really cause trouble. Ligatures consist of two or more characters that are joined together. An unsuspecting OCR package will scan the ligature as a single, unfamiliar character. A good omnifont package will recognize the ligature and treat it as its component characters. Most any trainable package can learn to treat a compound character as a multicharacter string.

Other stylistic pitfalls include underlined, italic, boldface, and outlined type. We found that underlines caused the biggest problem. Many of the packages interpreted an underlined word as a single character. On the other hand, a good omnifont algorithm can distinguish boldface, italic, and even outlined characters. Since omnifont capability breaks these specialized characters into component parts, style changes are less of a problem. OmniPage handled stylized characters particularly well.

OCR programs also let you clean up an image by erasing designated areas. You remove stray marks and handwritten notes that can confuse the program.

We looked at 14 omnifont OCR tools for the PC and Mac. The text box "How to Recognize a Good OCR Package" on page 230 describes in detail how we tested each product. Benchmark results charting speed and accuracy appear in figures 1 and 2 on pages 224 and 225. See the "OCR Features" table on page 222 for a summary of specifications, including prices and platform support. The text box "A Simple Equation for Choosing OCR" on page 236 summarizes the important considerations to keep in mind as you begin your own evaluations. And because nothing beats long-term, real-life experience, we interviewed executives directly responsible for implementing OCR in a variety of companies, large and small. Their problems, solutions, and advice to OCR newcomers appear in "Voices of Experience," beginning on page 239.

continued

A Day In The Life Of

LaserStor®
Erasable Optical.

The day starts early for LaserStor Erasable Optical. It runs long. And it runs fast, at near-Winchester speed, actually. This is one dynamic storage system with a voracious and versatile appetite for work.

Here's what you get: • easy movement of an infinite amount of cartridge-resident data from near-line to on-line, without using valuable hard disk space • the most reliable and convenient data backup and archiving solution available • primary storage performance, for everyday or emergency use • lock-it-away data security or carry-it-away portability.

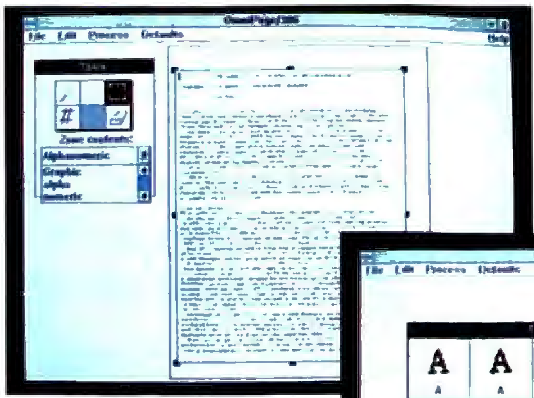
Now check the credentials. Seek times as fast as 35 ms. Bootability. Random and instant access to files. The industry's most comprehensive set of utilities software, including ARCserve* for backup. And your choice of 650 megabyte or one gigabyte cartridges, with certified data life of up to 25 years. Little wonder the *PC Digest* Ratings Report awarded us the highest rating for "capacity and overall performance unmatched by the other systems."

Day or night, as a tool for productivity or a device for data protection, LaserStor Erasable Optical is a timely choice. So call now. (408) 879-0300. Storage Dimensions, 2145 Hamilton Avenue, San Jose, CA 95125.

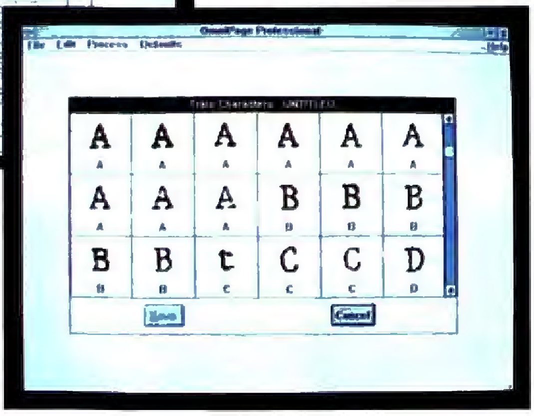
STORAGE DIMENSIONS

Sony-based products now available!

Circle 256 on Inquiry Card (RESELLERS: 257).



Screen 3: *OmniPage 386 makes it easy to restrict a zone's contents. After designating the zone, you simply choose the zone's type to restrict its contents.*



Screen 4: *OmniPage Professional includes the OmniTrain module, which can store many representations of the same character. This can help you process degraded documents.*

OmniPage

The three versions of Caere's OmniPage we looked at share the same basic interface and functionality. OmniPage 386 3.0, which runs under Windows 3.0, and OmniPage Mac 2.12 both perform basic OCR chores and sell for $695 each. To beef up either program, you can add enhancement modules: OmniSpell for spelling checking, OmniDraft for dot-matrix recognition, OmniProof for comparing two versions of the same file, and OmniTrain for teaching specialized fonts and symbols. The modules fit seamlessly into the OmniPage interface. OmniPage Professional 1.0 (also Windows 3.0–based) delivers all these goodies in one package for $995. We found that OmniPage Professional performs considerably slower than unenhanced OmniPage, but this is because the full package is doing more work, including a full spelling-checking session once the document has been read.

Using OmniPage is about as easy as OCR gets. For most documents, you only need to load your scanner's ADF, select "Scan" from a pull-down menu, and watch OmniPage go to work. Caere's omnifont algorithms effectively discern most text without the need for training or, for that matter, any manual intervention. If you do have special needs, OmniPage also offers impressive flexibility. You can manually define zones and easily restrict a zone's output to numeric characters or to any group of characters you specify (see screen 3). You can also reorder scanned zones, but we found that this was rarely necessary after automatic recognition.

If that's not enough, OmniPage Professional (or OmniPage with the OmniTrain module installed) combines omnifont capability with manual training, so you can maintain dictionaries of specialized characters (see screen 4). For most documents, you need not bother with training sessions. For example, while the other packages we tested couldn't handle underlining, OmniPage had no trouble.

We were disappointed with OmniDraft. Even with this add-on installed, OmniPage could not effectively read our dot-matrix document. Admittedly, nine-pin dot-matrix output is a real challenge, but other packages could do the job when OmniPage/OmniDraft could not. Similarly, OmniPage did not handle our fax document very well. Apart from these shortcomings, OmniPage Professional delivers the basic tools necessary for most professional OCR applications.

Photo 1: *The Parallel Reader, which packs four 68020 processors working in parallel, supports the Hewlett-Packard ScanJet Plus (shown at left with optional document feeder), the Microtek MS-II (right), and the Fujitsu 3093 (not shown).*

Parallel Reader 1.0

Caere's Parallel Reader is based on the same recognition technology as OmniPage, but it doesn't rely on your computer's processor for muscle (see photo 1). Rather, Caere put four 16-MHz 68020 processors into a standard 386SX clone. The 386SX runs the user interface and drives the scanner; the 68020s take turns recognizing pages. On start-up, the Parallel Reader software downloads the recognition code into each 68020. From that point on, the 68020s function as independent OCR coprocessors, taking scanned pages as input and returning final text as output. You have to pay for this extra power, however; the Parallel Reader sells for $10,995.

Before installing the Parallel Reader software (PREAD.EXE), you need to install your scanner. The Parallel Reader supports three scanners: the Hewlett-Packard ScanJet Plus with ADF, the Microtek MS-II, and the Fujitsu 3093. You install the scanner interface and software and then choose the correct driver from PREAD's menu. From that point, all three scanners work similarly. We tried both the ScanJet Plus and the MS-II but had better luck with the ScanJet. The MS-II's sheet feeder didn't like the variety of standard copier and typing paper we used. The rough surface on some of the paper caused sheets to stick together, jamming the scanner. The ScanJet Plus worked flawlessly even with fax paper.

PREAD runs under Windows 2.x. We ran it successfully under Windows 2.11,

Input Copy And Graphics Into Your Computer—Instantly—Without Using The Keyboard. Then Use Your Computer As A Full-Featured FAX To Transmit Documents Instantly.

All For Under $1,000!

PC MAGAZINE
EDITOR'S CHOICE
Chinon DS-3000
March 28, 1989

Chinon's new scanners could change forever the way computers are used. With OCR software you can input text without retyping it. With a simple add-in card, turn your computer into a full-featured fax. And DS-2000 and 3000 will scan almost any type of graphic image, so they're perfect for desktop publishing.

DS-2000 and 3000 offer different resolution levels so there's a scanner that's right for your applications—and your budget. Both scanners come bundled with exciting software so it's easy for you to get started. Call TOLL-FREE for the dealer nearest you.

Toll-Free (800) 441-0222 • In CA (213) 533-0274 • Fax: (213) 533-1727

Chinon America, Inc.
660 Maple Avenue
Torrance, CA 90503

CHINON

DS-2000 And 3000:
The Affordable Scanners From Chinon

Circle 63 on Inquiry Card.

How to Recognize a Good OCR Package

Recognizing a good OCR package is fairly easy once you get it running. It should do a good job of scanning different types of documents (at least the types you're likely to bump into) and do the job as quickly as possible. With that in mind, we challenged the products in this review to a fairly robust series of tests.

We took a 10-page ASCII document and printed it out both on a daisy-wheel printer at 10 characters per inch and on an IBM Proprinter (nine-pin dot-matrix) at 10 cpi. Next we faxed ourselves a copy of the daisy-wheel printed document at 200 dots per inch (i.e., fine resolution) to get a fax sample.

Our next test document was a series of internal BYTE memos that were printed at 300 dpi on an Apple LaserWriter. This document used a variety of typefaces and sizes: Times Roman and Helvetica in sizes ranging from 6 to 24 points. Just for fun we threw in some underlining, boldface text, and outline text. This gave us nine pages for our mixed-font laser output test.

Finally, we went to the Peterborough Town Library and checked out a book printed in a neatly typeset font. The text was formatted in a single column with a heading at the top of each page and page numbers and footnotes. Ten pages of this became our Typeset test.

If you have been keeping score, that gives us 49 pages of text for each of the 14 products tested. Rather than reading through 686 pages of text for errors, we got the computer to do it for us. We wrote a custom program that compares the original ASCII file to the scanned version, skipping over any stray characters, blank lines, and formatting errors. The software is smart enough to understand when a line of text is missing and resynchronize itself as needed. As it checks the files, the program creates a log file showing each error as it occurred, the error count, and the overall accuracy.

To count errors, we treated a text line as a single unit and compared each word in that line to the original. For each word in the original file that did not appear in the scanned copy, we added one error. At the end of the document, we subtracted the number of errors from the total word count and then divided by the total word count to get the accuracy: accuracy = 100 × (word count − errors) / word count.

The time it took to scan each group of pages gave us the throughput in words per minute. Because we used the "accurate" word count here, we automatically penalized any product for scanning errors in the process. The graph in figure 1 shows our results in wpm (words per minute); figure 2 charts overall accuracy. Our approach varies a bit from that of most vendors who define accuracy as the number of *characters* correct, not words. Most people will use spelling checkers to correct the misscans, and because spelling checkers correct *words*, we thought that word errors would be more meaningful. The average word is about six characters long, so that would mean that one of our errors is about the same as six of theirs. For that reason, our numbers won't exactly match those in the vendors' ads.

When interpreting the graphs, keep in mind that accuracy is probably more important than speed. The purpose of OCR is to enter text accurately. While one product may be faster than another, if you have to spend a great deal of time correcting mistakes, the process could be slower than if you typed the text.

---

but it wasn't happy under Windows 3.0 in real mode. The screen updates scattered all over the screen. After the program loads, you simply fill the ADF with printed sheets, select the type of document (i.e., standard or dot-matrix, single- or multiple-column), and let 'er rip.

The 386SX scans in a full page and passes it off to the first available 68020. As soon as the 68020 starts, the 386SX grabs the next page for another processor. The display tracks each processor's progress, and with most text, the pages move through the scanner as fast as it can handle them. Our only problem with the Parallel Reader is that it requires the ADF. It would have been nice to lay a book on the flatbed directly, but PREAD doesn't allow it. Still, it performs OCR well and does it fast (see figure 1).

CDP 9000 and TopScan Professional 1.1

Calera has been into OCR for quite some time. That fact was apparent when we took a close look at the CDP 9000: Most of the hardware is dated 1986. The unit itself just says "heavy duty" (see photo 2). The case is heavy-

Photo 2: *The Calera CDP 9000 contains both a scanning unit and a boatload of processors. Standard interfaces include SCSI, RS-232, and Ethernet. It's not pretty, but when it comes to recognizing text, this beast is a real beauty.*

On accurate scanning we see i to eye for less than a G.

From optical character recognition (OCR) to graphics scanning, you want accuracy. Good reason to look into the new Pentax IQ Scan. Another good reason is price. Because this one breaks the $1000 price barrier.

The key to high quality and low price is a unique folded optical path and Pentax optics. It's the basis for accurate duplication of the documents you scan into your computer.

But that's not all. Our optional packaged solutions give you an optimized match of hardware and software for your application and budget. That means OCR with accuracy as high as 99.9%. Plus accurate image scanning for the most popular desktop publishing and imaging software packages...in Windows,™ DOS and Macintosh® environments.

Whatever your application, you want accuracy. And a good price. On that we see i to eye. Pentax Technologies, 100 Technology Drive, Broomfield, CO 80021. Phone 303-460-1600. FAX 303-460-1628.

PENTAX®
TECHNOLOGIES

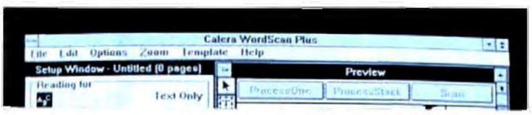
Circle 209 on Inquiry Card.

gauge steel, and the sheet feeder looks indestructible. In performance, the CDP 9000 is no lightweight either. It easily kept pace with the other top performers, particularly on faxed output.

The CDP 9000 connects to a Mac or any PC running Windows 2.x via a Western Digital SCSI card. TopScan Professional, Calera's Windows interface software, controls all operations of the unit through the SCSI connection. Instructions are also included for connecting the CDP 9000 to a Sun workstation through the SCSI port and for communicating through Ethernet and TCP/IP. We tested the CDP 9000 on a 25-MHz 386 DOS machine.

Whoosh! That's the only way to describe the scanner on this unit. It is sheet-fed only and scarfs up 11-inch pages in about 3 seconds. From there, the unit's internal processors take over. A casual count gave us four 16-MHz 68020s, one 10-MHz 68000, several dedicated support processors, and megabytes of RAM and ROM. After the processors do their job, the finished page and graphic scan move to the host and the next page feeds into the scanner. The Windows software definitely feels like something out of the 1980s. You use it only to set up the page scans and monitor the OCR progress, but it would be nice to see it running under Windows 3.0.

The CDP 9000 ($21,950 for the PC; $31,950 for the Mac) is faster than the software-only products and faster than the Kurzweil and Caere hardware on faxed pages. For large-volume OCR applications, the CDP 9000 seems almost ideal and left us wishing only that it could scan books.



the mouse, you select regions of the page in the order you want them recognized. WordScan scans the page and then brings up its Progress Monitor to show you how

AccuScan

AccuScan is a $595 add-in to Scanning Gallery Plus 5.0, Hewlett-Packard's Windows 3.0 image-handling software for the ScanJet and ScanJet Plus. After you install AccuScan, running Scanning Gallery gives you the choice between text and image processing. We found it easy to run AccuScan without ever cracking open the manual. All the buttons are self-explanatory, and there is context-sensitive help—if you get confused, select the help function and click on the button you don't understand. AccuScan brings up a clear explanation of the function.

When you're scanning, you have the option of manually selecting text blocks, having the computer select text automatically, or using interactive mode, which lets the system select the text and then pause for you to adjust the regions. AccuScan also has an interesting notching tool that lets you bite the corner off a text region.

What AccuScan isn't is fast. It placed near the low-middle of our DOS pack, with the exception of faxed output. When it comes to accuracy, however, AccuScan is appropriately named. It placed among the best packages, often achieving an accuracy rate of 96 percent or better. Besides recognizing scanned pages, AccuScan can also read TIF or PCX files scanned from Scanning Gallery Plus. The one shortcoming we found was its inability to scan images and text on the same page.

ReadRight 2.01

As we evaluated these OCR products, we noted a disturbing trend. While the good packages have made impressive leaps in bringing true OCR capabilities to PC-class machines, the poor packages bordered on useless. Unfortunately, the good packages not only carry steep price tags but also require a substantial hardware investment. OCR Systems' ReadRight came closest to bucking this trend.

ReadRight has a lot going for it, not the least of which is its $495 list price. It can run on an XT-class machine and requires only 640K bytes of memory. At first glance, these "advantages" looked like the kiss of death, but we were pleasantly surprised. ReadRight is capable of handling most OCR jobs.

ReadRight does not yet run under the popular Windows 3.0 interface (the company announced Windows 3.0 support while we were writing this review but wasn't able to send us a shipping version in time for testing). Still, the existing product is very easy to use. You control options by function keys. The options and associated function keys are clearly listed on the main screen. To select the type of document you'll be scanning, simply press the F5 function key. You can then choose Proportional, Monospaced, or Dot Matrix from a pop-up list. A separate Frame Menu brings up a graphical display of your document. You define a frame with the arrow keys. This process would be easier if ReadRight supported a mouse. From the main menu, you simply press Enter to initiate a full scan-and-read session.

If you choose this package, you'll have to do without some useful perks. Although you can watch text scroll by as ReadRight goes about its work, there is no way you can interactively teach or even correct characters. In fact, ReadRight doesn't even have a basic text editor, but it addresses this shortcoming by letting you access your own editor directly from the ReadRight menu. ReadRight has an option for reading dot-matrix input, but it couldn't handle our nine-pin test document. We think that OCR Systems has made the right trade-offs to keep ReadRight's price low. You give up perks, not functionality.

Perceive 1.0.5

Omnifont technology leaves you with precious few options if it cannot understand a particular font. Ocron's Perceive combines acceptable omnifont features with a powerful learning facility. On the other hand, the $595 package lacks other important features.

Perceive runs under the Windows 3.0 interface. As a page is scanned, the program opens two windows, one displaying the scanned image and the other scrolling the text as it is read. This makes it easy to see characters in context. You can disable one or both windows to speed the OCR process.

With the learning feature enabled, an ambiguous character will appear in a dialog box along with a number of possible options. You can type in up to 10 characters to define the unknown character or choose to skip over it. But Perceive goes further. You can move the box surrounding the character right or left to enclose more of the image. Most OCR packages will pick up only a portion of a broken character, get confused, and choke. Adjusting the image enables you to tell Perceive to look at the whole character before saving its definition. This takes care of the tricky problem posed by broken characters. You can also call an extended ASCII table and define an entry by selecting from among this set of unusual characters.

While Perceive's learning features exceed those of the other reviewed products, it falls short in other areas. Even after a complete learning session, Perceive could not handle our nine-pin dot-matrix document. It doesn't do deferred processing, a feature that can make OCR jobs less trying. You can't load more than one font file for a recognition pass, although you can add to an existing font file. You may have trouble if your font files become too bloated. This is a good package, and Ocron has reduced the cost from $795 to $595. The new price makes Perceive an attractive low-end offering.

Recognita Plus 1.1

We looked at the DOS version of Recognita Plus from Recognita Corp. of America. Although we received a Windows 3.0 version of the program, we couldn't get it to work reliably with our ScanJet or ScanJet Plus. The Windows version addresses some of the problems in the DOS version by offering additional features, including a text editor and a search-and-replace mechanism.

Recognita Plus includes a sufficient omnifont capability and some interesting learning features. When the program runs into an ambiguous character, it brings up a window containing the character's bit map. It also displays the character in context. It dims surrounding characters while the unrecognized character is highlighted. In many cases, the program also offers its best guess for the unknown character. You can then tell Recognita Plus to learn the proposed character or skip over it. You can also enter the correct character from the keyboard. The program builds a user tree (i.e., a font file) as you teach it new characters.

You edit an ambiguous character's bit


OmniTel Solutions For Today And Tomorrow
The Ultimate Systems Machine
"Although it features extremely fast cache, OmniTel's focus is on quality and reliability rather than speed. Their very clean board has eight layers instead of the six often found on PC clones, and a full 32MB of SIMMS can fit on the board."
Bernie Zilbergeld
Computer Currents
MADE IN U.S.A.
386-33MHz Motherboard
64K Cache
486-25/33MHz Motherboards
128K External Cache
USMACH SYSTEMS
Available in Desktop and Tower Configurations.
FCC Class B approved with OmniTel Motherboards
386SX-20MHz
with 64K Cache
VGA
1024 x 768
256 colors
with 1MB
"What impressed me the most about USM was the people, the service, and the support. With that, USM was able to satisfy all my needs with high quality products at competitive prices."
Giles Johnson
Oakland, California
Credit Card Size
Custom Designed FAX/
Data Modems for OEMs
Pocket Modem
Send & Receive
FAX/Data
MNP5/V.22 bis/V.42
Modems
Internal/External
Send & Receive FAX/Data
V.32/V.22 bis/MNP5/V.42
To Order OmniTel Products Call USM Today!
In CA: 415/623-9040
415/952-5885
408/980-0602
714/255-0113
Outside CA: 1-800-245-1USM
FAX: 415/623-7592
415/266-9134
408/980-0604
714/255-0115
386, 486 & SX are trademarks of Intel Corporation
OmniTel 386-33, 64K Cache System $2,495
OmniTel 486-25, 128K Cache System $3,295
OmniTel 386SX-20, 64K Cache System $1,995
Standard Configuration:
• 4MB RAM,70ns
• 1.2MB Floppy Drive
• 1.44MB Floppy Drive
• 100MB, 22ms Hard Disk (Toshiba/Conner)
• VGA-1MB, 1024 x 768, 256 Colors
• 101 Enhanced Keyboard
• Elegant Desktop Case
• 2 Year Motherboard Warranty
Monitor Options Additional
USM
USMACH
USM Distributors
43104 Christy Street
Fremont, CA 94538
U.S.A.
OmniTel Inc.
3500 West Warren Avenue
Fremont, CA 94538 U.S.A.
(415) 490-2202
Circle 203 on Inquiry Card.

A Simple Equation for Choosing OCR

The process of choosing an OCR package is fairly straightforward. Ideally, you should take a sampling of documents to your dealer and run them through the packages you are considering. If that's not possible, you are better off sticking with high-end products. Make sure that what comes out closely resembles what goes in. Otherwise, you will be headed for frustration and failure. We can't emphasize one point enough: Nothing can take the place of accuracy.

Unless you have reams of documents that share a similar font, you should choose an omnifont package. The problem is that omnifont algorithms vary widely. Omnifont capability can save a tremendous amount of time and effort if it works as advertised. For jobs featuring stylized fonts or unusual characters, go with a package that combines omnifont with a learning facility.

Proofing tools can be valuable if you are working with unusual fonts. An integrated editor, search-and-replace capability, and a spelling checker make it easier to handle OCR errors. A good proofer will also save a lot of time, especially if the alternative is human proofing by eye.

As always, carefully assess your needs. High-volume jobs may require a dedicated OCR system. The dedicated systems are expensive, but if your workload justifies it, it's the only way to go.

map by clicking bits on or off. This means that you can clean up a character or separate a ligature into two characters. As you improve the character, the program keeps trying to recognize it. Once the correct letter is offered, you can click on the Learn button. Many learning packages let you assign several different bit maps to a single character. In this way, a program can learn to recognize different representations of a character to account for printing anomalies. This is not the case with Recognita Plus. You can correct an imperfect character in your text file, but you cannot store it for later reference because Recognita Plus retains only one bit map for each unique ASCII character. Therefore, the manufacturer suggests that you teach the program only correct character patterns. Otherwise, you will assign an imperfect character to the font table, and the program may not recognize the correctly printed character later on. This potential for disaster dampens the effectiveness of an otherwise powerful learning facility.

Recognita Plus uses a hardware device for copy protection. The device attaches to the parallel port, in series with your printer. With the device attached, we had trouble printing reliably to our HP LaserJet III.

Recognita Plus carries an attractive price tag ($495), but if you're willing to make sacrifices to save some money, we recommend ReadRight.

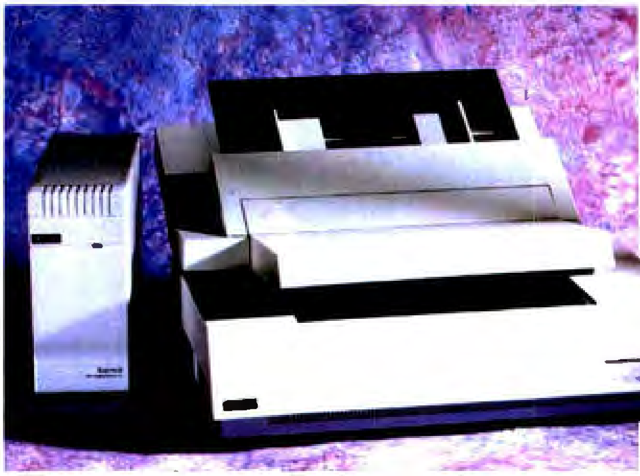


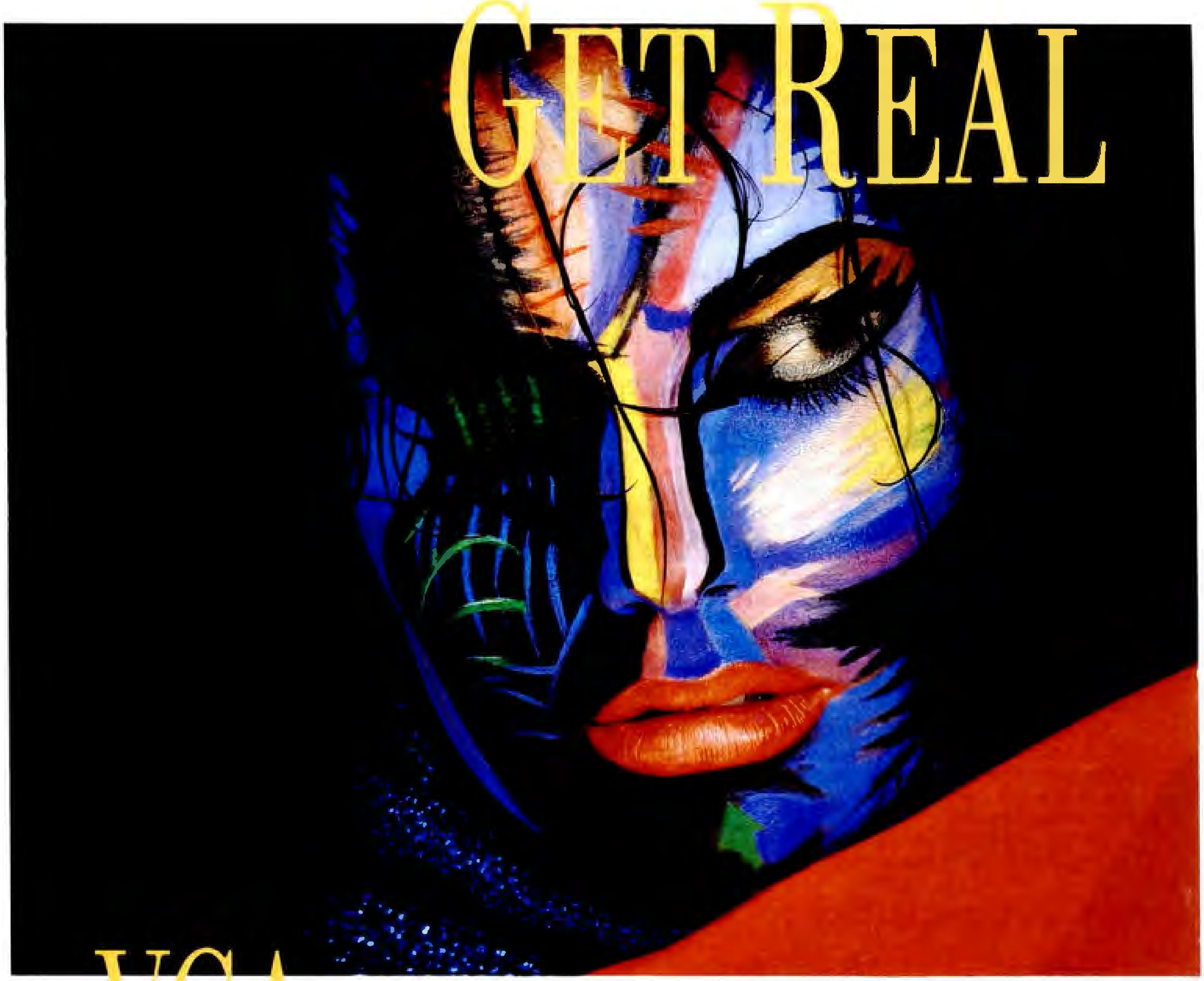
Photo 3: *The Kurzweil K5200, aided by its own processing unit (shown at left), proves that the professional OCR has arrived. If you have demanding documents and can justify the cost, the K5200 can do the job.*

Discover 386 5.0 and the Kurzweil K5200

Xerox Imaging Systems' Discover 386 and the Kurzweil K5200 Intelligent Scanning System are two birds of a feather: Like eagles, they're swift and sure; like ostriches, they're ugly as can be. The software for both is PC-based character mode with a difficult interface. We found it easy to get buried under piles of obscure menus. The upside is that the software does what it's supposed to do—faster and more accurately than almost any other tool in this review.

The big difference between the two isn't software, it's hardware. Discover 386 ($599) runs on your PC and uses your scanner and the PC's processor. The $19,950 K5200 (see photo 3) connects to the PC through a Western Digital SCSI card and is run by a dedicated AMD 29000 RISC processor running at 25 MHz. Our test unit came with 8 MB of RAM installed. Dressed up in Xerox pink and beige, the scanner has a flatbed base with an ADF. You can use the K5200 as an image scanner to scan TIFF files. Because the K5200 comes with its own processor, you don't need a very fast host to support it. We used a 25-MHz 386, but if you're going to dedicate a machine to driving the K5200, this might be a good way to use one of your old ATs.

To scan pages, you just put them in the scanner's document feeder, select the appropriate options, and press Go. There's no preview mode, and you can't see what's happening until the scan is complete. To select from the many options, you press letter keys to move from menu to menu. Once you get the hang of it, it's not too bad, and most documents can be scanned using the default settings. If you find yourself using a special group of



VGA
IMPACT SERIES

Introducing Trident's IMPACT''' Board.™ A super VGA card with real performance differences.

Like the power to produce stunning graphics with superb detail.* Or a palette of 256 different on-screen colors for presentations that scream.

And real upgradability. The IMPACT''' Board allows you to easily add low cost memory. Upgrade from 256k to 512k, or even 1MB. Then watch your color options expand, display flicker disappear, and software selection grow.

Speaking of software, the IMPACT''' offers drivers for Windows 3.0, SCO and Interactive X-Windows, 8514/A emulation, the new VESA BIOS, and many, many more.

Plus, the IMPACT''' Board comes with a package clone boards can't touch. Two year warranty. Driver updates. Easy set-up. And expert support.

All this and a real low price too.

So get the real thing—a Trident IMPACT''' VGA Board—and get noticed. Call 800.348.8808 for information and a dealer near you.

Trident
Super Graphics. Superior Products.

*1024 x 780 non-interlaced © Trident Microsystems, Inc. 321 Soquel Way • Sunnyvale, CA 94086 • 408.738.3194

Circle 280 on Inquiry Card.

settings, you can save these and recall them from a file later.

"Impressive" doesn't adequately describe this software. It's incredibly fast and extremely accurate. The purpose of OCR is to convert printed material into text, and that's clearly where Xerox put its efforts. The only two things we'd like to see fixed are Discover 386's inability to handle dot-matrix text (the K5200 can do it), and the K5200's flatbed scanner. The manual cover for the scanner opens from one side, not the end, like most scanners. If you're scanning books, you can insert only one side of the page. To scan the other side, you would need to turn the book over, but the K5200 software can't handle upside-down pages.

AccuText 2.0

AccuText ($799) is Xerox's OCR offering on the Mac platform. AccuText uses the same Intelligent Character Recognition system as the Kurzweil K5200 and the Discover 386 (described above). ICR combines an omnifont algorithm with lexical context. Using almost any Macintosh text editor, you can build a user dictionary of special terms to help when you are dealing with documents containing esoteric terminology. However, AccuText does not have a learning facility. OmniPage on the Mac took advantage of its learning features to significantly outperform AccuText on the nine-pin dot-matrix test.

AccuText includes a nice utility for deferred processing. You can load your image files into a TIFF queue, order the jobs in any way you choose, and batch them up for processing.

The program also includes a utility for loading AccuText documents directly into HyperCard stacks. You can put an entire file on a single card, store each page on a separate card, or house each block of text on separate cards. AccuText supports all the major Macintosh file formats.

Tiger Taming

It's a hard call, but if your OCR workload justifies a dedicated system, we recommend the Kurzweil K5200. It comes closest to what OCR should be. You simply place pages in a feeder, press a key, and watch it go. It's fast, accurate, and—for the most part—hassle-free. Although it costs a bundle, you'll recover a good bit of that expense by avoiding many worker-hours of proofing, rescanning, and troubleshooting. The Calera CDP 9000 and Caere Parallel Reader are also excellent, but the K5200's speed and accuracy gave it the edge.

If your needs are less demanding and don't warrant expensive hardware, you can choose from a number of good software products. On the PC side, we really like Calera's WordScan Plus. It's fast, accurate, and dependable. When our coworkers needed an OCR job done fast, we often turned to Calera. For $995, you get highly accurate omnifont capability and all the amenities you expect from an OCR package.

If you're on a Macintosh platform, we recommend OmniPage for the Mac. At press time, a version of OmniPage Professional was not yet available for the Mac, but it is forthcoming. In lieu of the full package, we suggest that you purchase OmniTrain to add trainability to the product.

OCR has finally arrived, as long as you catch the right bus. A bad package will drive you mad, while a good package will tame the paper tiger. ■

Stanford Diehl and Howard Eglowstein are BYTE Lab testing editors. They can be contacted on BIX as "sdiehl" and "heglowstein," respectively.

COMPANIES MENTIONED

Caere Corp.
(OmniPage 386 3.0,
OmniPage Professional 1.0,
OmniPage Mac 2.12,
Parallel Reader 1.0)
100 Cooper Court
Los Gatos, CA 95030
(408) 395-7000
fax: 408-354-2743
Circle 1401 on Inquiry Card.

Calera Recognition Systems, Inc.
(CDP 9000, WordScan Plus 1.0)
2500 Augustine Dr.
Santa Clara, CA 95054
(408) 986-8006
fax: (408) 986-1440
Circle 1402 on Inquiry Card.

Hewlett-Packard Co.
(Scanning Gallery Plus 5.0 with AccuScan)
Customer Inquiries
19310 Pruneridge Ave.
Cupertino, CA 95014
(800) 752-0900
fax: (208) 344-4809
Circle 1403 on Inquiry Card.

Image-In, Inc.
(Image-Read 2.0)
406 East 79th St.
Minneapolis, MN 55420
(800) 345-3540
fax: (612) 888-3665
Circle 1404 on Inquiry Card.

OCR Systems, Inc.
(ReadRight 2.01)
1800 Byberry Rd.
Huntingdon Valley, PA 19006
(800) 233-4627
fax: (215) 938-7465
Circle 1405 on Inquiry Card.

Ocron, Inc.
(Perceive 1.0.5)
3350 Scott Blvd.
Santa Clara, CA 95054
(408) 980-8900
fax: (408) 980-5100
Circle 1406 on Inquiry Card.

Recognita Corp. of America
(Recognita Plus 1.1)
1250 Oakmead Pkwy.
Sunnyvale, CA 94088
(408) 749-9935
fax: (408) 730-1180
Circle 1407 on Inquiry Card.

Xerox Imaging Systems Datacopy Kurzweil
(AccuText 2.0, Discover 386 5.0, Kurzweil K5200)
185 Albany St.
Cambridge, MA 02139
(800) 248-6550
fax: (617) 864-4186
Circle 1408 on Inquiry Card.

Manufacturers of other products used in this review:

Hewlett-Packard Co.
(ScanJet Plus)
Customer Inquiries
19310 Pruneridge Ave.
Cupertino, CA 95014
(800) 752-0900
Circle 1409 on Inquiry Card.

Microtek Lab, Inc.
(MS-II, MSF-400G)
680 Knox St.
Torrance, CA 90502
(213) 321-2121
fax: (213) 538-1193
Circle 1410 on Inquiry Card.

PRODUCT FOCUS

Voices of Experience

Alan Joch and Rick Grehan

Optical character recognition can be a time- and money-saving alternative to rekeying hard-copy documents or electronic files formatted by an archaic word processing system. It can also be a frustrating technology riddled with its own time traps, especially if you don't understand its limitations, according to some companies that have used OCR for years.

Their advice: Be sure you are clear about what you want OCR to do, and don't expect magic.

"Many employees thought that the OCR system would allow them to place any document in the scanner and instantly receive a usable file ready for the word processor," notes Sunny Anderson, who is manager of the OCR operation at the Denver law offices of Berenbaum & Weinshienk, P.C. "They weren't prepared for the fact that they'd have to perform some cleanup work depending on the condition of the incoming document."

But those who understand OCR's limitations can be rewarded with fewer manually keyed documents, a partial taming of the paper tiger, and possibly, like the State of Delaware, the front end to a document management system. Evan Wilner, public advocate for the State of Delaware, represents the rate and service interests of the state's 650,000 citizens with regard to public utilities. Headquartered in Wilmington, he and his staff often work on cases stretching across several weeks and sometimes generating 2000 pages of text. Wilner's OCR and document management system allow for a central database with full text searching capabilities, so the staff can browse through previous testimony. If, for example, an expert witness recalls only a portion of some crucial evidence, Wilner can instantly retrieve the full text of earlier testimony, refresh the witness's memory, and plan that day's briefs and arguments.

A Growing Market

A recent survey conducted among BYTE readers tracked interest in OCR used in document storage and retrieval systems (where documents exist as editable text files, not solely as archival images) and in the more traditional hard-copy and electronic-file conversion systems.

Twenty-two percent of respondents said they currently used OCR in their operations, tied primarily to PC-based systems. Macintosh and PS/2 platforms accounted for 23 percent and 20 percent of the systems, respectively. Half of those who already ran OCR said they planned to expand their systems in the coming year. PCs remained the dominant platform, but PS/2-based products outpaced Macs (21 percent versus 17 percent) for those looking toward the future.

Those using OCR ranked document storage, data entry, desktop publishing, and general business correspondence as the primary applications for their systems. Only 5 percent said they currently used OCR as part of a networked document management system, although 15 percent said they planned to install such a system in the next year.

BIS/CAP International, a market researcher based in Norwell, Massachusetts, also identifies potential growth in such systems. According to Jane Stanhope, associate director of the Image Management Systems Service, new installations of all document management systems (archival and editable) in 1990 totaled 1357, with revenues of $910 million, for an installed base of 2841. New installations in 1995 are expected to rise to 22,786, with revenues of $12.6 billion, for an installed base of 51,557. BIS/CAP expects workgroups ranging in size from 3 to 15 workstations to account for a significant portion of those gains. Installations of that size rose by 446 in 1990, on revenues of $229 million, for an installed base of 995 systems. But by 1995, the numbers could rise to 6819 new installations, with revenues of $2.9 billion, for 15,871 systems.

A Publishing Tool

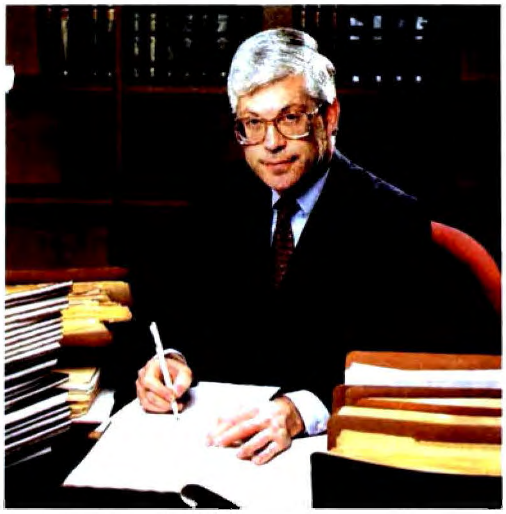
Reader's Digest Association (Pleasantville, NY) is in the process of implementing a Unix-based accounting system that eventually may depend on OCR, according to Vane Lashua, applications development manager for PC applications. In the meantime, the publishing house uses Calera's WordScan Plus to convert into ASCII files mailing lists and book or magazine manuscripts that lack electronic files.

"The editor will just put the manuscript into the hopper [the automatic document feeder on a Hewlett-Packard ScanJet], and in no time, 20 to 30 pages will be scanned in," says Lashua. "We can scan both sides of a stack of paper and collate the pages. Also, if the manuscript is in a two-column format, the scanned file will come out as a single-column galley with the type in logical order."

But over time, Lashua has learned the limitations of OCR as much as its capabilities. "Typically, if we have massive amounts of information to capture, we'll just give someone a manuscript and let them crank it out by keying the information in on a computer. It's much more accurate and much quicker than scanning because we have less cleanup to do with the files."

The company recently completed a glossary culled from 500 pages of typewritten material in a variety of column formats and typefaces. "We made the decision to rekey the job on a word processor rather than using OCR and then going back to clean and sort everything," says Lashua. "Human typists will make accommodations if a column is not aligned properly. If the OCR system sees a column isn't aligned with the others, it will make a new column."

Power to the Public Advocate



Evan Wilner, State of Delaware

The Delaware Public Advocate's office runs "garden-variety" 12-MHz 286 and 16-MHz 386SX machines with Calera's WordScan Plus in both hardware-assisted and software-only versions. The hardware-assisted version—WordScan Plus AT—sits in the slower 286, while the software-only WordScan Plus runs on the 386SX. Evan Wilner also uses Xerox DataCopy internal fax boards to feed information directly to his OCR system.

Wilner evaluated OCR systems based on the time and effort required to convert a document from its original state to being in the word processor "ready to drive the laser printer." Wilner is particularly happy with WordScan's integration with Microsoft Word for Windows. A new macro capability lets him drive the OCR system via a pull-down menu in the word processor.

Today, the considerable enthusiasm for the OCR system in Wilner's office is spilling over into other departments. Wilner was called into the Delaware Court of Chancery to provide a demonstration of the system.

Defense Support

Rockwell International's North American Aircraft Division (El Segundo, CA) used OCR to help create technical specifications and manuals for Department of Defense contracts for the B1-B bomber project, according to Sandra Alcorn, computer systems analyst. Each of the approximately 100 engineers in the project engineering group used a Macintosh to produce documentation and correspondence. The individual workstations were connected to a central Oracle database, which Rockwell customized to provide for automatic updates whenever one of the engineers made a change to a drawing.

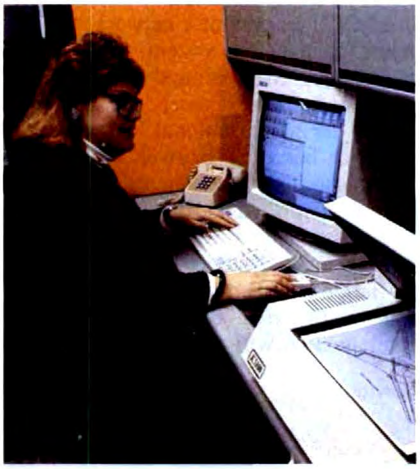
The divison ran a networked imaging system that cuts down on the volume of paper generated and speeds access to files. Some documents, however, needed to be altered, and in those cases, the group used a Kurzweil K5200 scanner to convert documents into ASCII or other formats.

"We run Interleaf on four Sun 386is. If we need to make a change on a proposal, I scan it in, convert it to Interleaf format, and enter the changes using Interleaf publishing software," Alcorn says.

The Kurzweil scanner is connected to an AST 386, which holds the OCR software, as do the four Sun Microsystems workstations.

Alcorn says most of the OCR problems she's encountered result from poor orignals or text type smaller than 9 points. "I recently tried to OCR 6-point type in a two-column format. Some of it scanned really well, other parts not very well at all. This document happened to be in a serif typeface. The system has a little more trouble with serif than sans serif."

Sandra Alcorn, Rockwell International



Before choosing an OCR system, Alcorn advises buyers to analyze their specific needs carefully. "What's more important for you: text or images? What about formatting? Do you have a large amount of information that's tied to hard copy with no electronic files? Then pay attention to text verification and how well the scanner scans text."

Directory Assistance

TravelSouth USA (Atlanta, GA) uses Xerox's AccuText 1.1 software running on a Mac IIcx to produce a 500-page directory for an annual trade show of southern travel agents and tour operators. Tricia Sheldon, special projects coordinator, gleans directory information from questionnaire responses she receives from 700 convention delegates. In the past, the company hand-entered all the responses, which included company names and addresses and answers to business questions. "That was a big waste of time," she concedes.

A second element of the mailing is the recording of bingo numbers used by delegates to set up appointments with show exhibitors. That information also had been entered and proofread by the four-person office.

In total, the two phases required about three weeks of staff time. "We spent 15 full days calling numbers back and forth to each other," Sheldon recalls.

After the first run-through using OCR equipment to produce the latest directory, Sheldon says the results were mixed but generally positive. "OCR did some things we wanted and didn't do some other things we had hoped it would do."

Although she designed her questionnaire so that it could be easily scanned using the company's HP ScanJet Plus, the OCR software labored over the inconsistencies that were among the responses. "Some replies were typed in all caps, some were upper- and lowercase." Because of these vagaries, the staff still devoted more time than anticipated to proofing files. Phase two, the entering of bingo numbers, proved more efficient, Sheldon says.

Sheldon evaluated several varieties of software by taking samples to a local dealer and spending about two days testing for accuracy and speed. "AccuText let me select fields. I could tell it to scan this block of information and that block of information. That worked well with our forms," she notes.

OCR Law

Sunny Anderson,
Berenbaum & Weinshienk, P.C.

Sunny Anderson, of Berenbaum & Weinshienk, P.C., credits OCR with taming the compatibility problems the office faced when documents arrived from various sources. Anderson says the law firm was continually sending documents out to be scanned or put to disk before it decided it might be quicker and easier to do the work in-house.

The firm uses Caere's OmniPage 386 running on a Morse 386SX with 4 megabytes of RAM and two 32-MB hard disk drives, and a Hewlett-Packard scanner. Occasionally, Anderson also uses HP's Scanning Gallery software for capturing graphics. She says that speed and price were the main selection criteria for choosing the system.

Anderson reports that passing documents through a spelling checker has significantly shortened the cleanup time. She has also built a set of WordPerfect macros that strip out unwanted formatting characters and ready the file for a final pass through the word processor. But the system occasionally misreads some characters—an *S* for an *8*, for example.

Anderson's advice to anyone considering OCR is to determine the volume of documents that will be fed to the system, as well as their overall quality. "And make sure you have someone on staff who is competent and is willing to be trained for the system," she cautions, "because you will become dependent on that person." ■

Alan Joch is a technical editor for the BYTE Lab. Rick Grehan is the director of the BYTE Lab. You can contact them on BIX as "ajoch" and "rick_g," respectively.

"RUNS RINGS 'ROUND dBASE" PC Computing

"BEST BUY" PC WORLD

After I struck out with dBASE, Paradox, and nobody, but nobody believ our customer tracking and

...but when I came back that afternoon with a complete, customized Alpha FOUR® application, even Marge was impressed.

At our Monday morning staff meeting, I announced I was going to automate our sales tracking and invoicing system later that day.

Skepticism ran high. "Paul, you promised me an application like that two years ago," said Marge. "You couldn't do it, and neither could that dBASE programmer you hired. It'll never happen!"

On the other side of the room, Tim, a new hire whispered to Richard, "I didn't know the boss was a programmer, too."

"He's not," said Richard. "Couldn't write code to save his life. But he keeps trying because he thinks it's critical to the business."

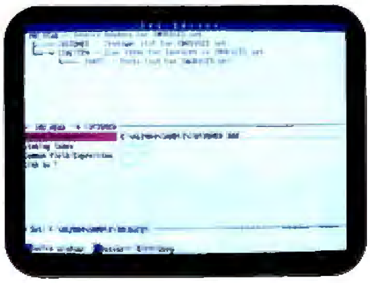
I'd already tried three times before to program a database: first with dBASE (much too complicated). Then I tried Q&A (not powerful enough). Then I bought Paradox (just like dBASE). All were either too complicated, or not capable enough for our needs.

This time, I was confident. Why? Because I just bought Alpha Four, the relational database for non-programmers like me. I spent 45 minutes over the weekend with Alpha Four's audiocassette tour. So I knew how easy application design with Alpha Four would be, even the first time.

I knew within hours, I'd be able to build a fully relational customer tracking and billing system, complete with custom menus, beautiful screens and extensive help messages for error-free data entry.

And that's exactly what I did. You should have seen Marge's face when the first, perfectly formatted invoice came off the printer.

I DEVELOPED MY APPLICATION IN MINUTES!



I designed my application with Alpha Four's unique "application outliner." It automatically set up a system of menus, sub-menus, and procedures based on the outline I laid out.

MY REPORTS LOOK GREAT

Alpha Four's report writer was even more impressive. I "painted" reports and invoices on-screen. They look exactly like I wanted them to—much better than our old paper forms.

I'LL NEVER KEY IN DATA TWICE AGAIN

I always ran out of power with other simple-to-use databases; they weren't relational. With Alpha Four, I created different databases for customers, invoices and inventory and then related them into a "set," just by drawing on-screen, a diagram of the links between the databases.

Now, we never have to enter the same information more than once. New invoices can be generated for existing customers without having to re-enter their information—we just "look it up" in our customer database.

TOTAL COMPATIBILITY WITH dBASE FILES

And I was delighted that Alpha Four is totally compatible with dBASE .dbf files. Our mailing list went right into the new application without even having to convert the files!

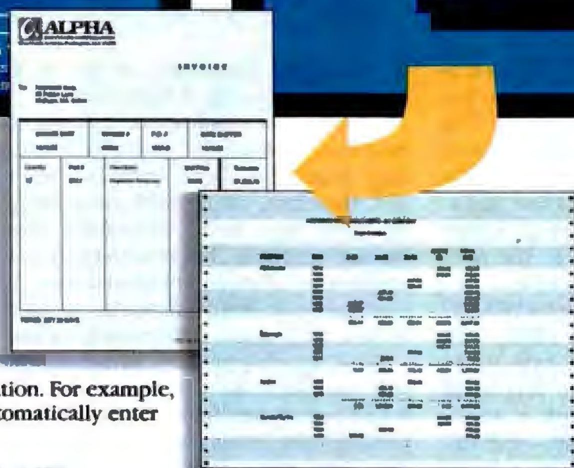
FASTER, MORE ACCURATE DATA ENTRY

Alpha Four has all the features of an advanced database, but they're all simple enough for me to use. When you enter data, you can automatically change the case of letters from lower to upper. You can display data entry templates for formatted fields like phone numbers, or skip over fields when

"EXCELLENT VALUE"
INFO WORLD

"RATED # 1"
PC WEEK

Q&A,
ed I could automate billing process myself...



certain conditions are met. Of course, all calculations are performed automatically.

Look-ups are super flexible. Display information from a look-up database in a multi-column window anywhere on the screen. Select from the window and Alpha Four automatically fills in the related information. For example, enter a part number, and have Alpha Four automatically enter the correct description and price.

SAVE $450 WITH THIS AD!

SPECIAL OFFER: $99 UPGRADE FROM YOUR EXISTING DATA MANAGER*

If you already have any database software, integrated package or mail list manager, or if you are currently using your spreadsheet to manage data, you can upgrade to Alpha Four for just $99.

NO RISK OFFER!

And it's fully guaranteed. If you're dissatisfied, return Alpha Four within 60 days for a full refund. This is a limited-time, one-copy-per-organization offer, available from Alpha Software, or through your local dealer.

*Qualifying packages include: programming databases (dBASE® II, III, and IV, Paradox, Clipper® Foxbase® Fox Pro® Revelation, etc.), flat-file databases (Q&A® PFS:Professional File® Rapid File® etc.), integrated packages (Microsoft Works® PFS:First Choice® Lotus Works® etc.), and mailing list managers (Fastpack Mail, etc.) or spreadsheets with databases (Lotus 1-2-3® Quattro Pro®).

All trademarks are registered with the appropriate companies.

ALPHA SOFTWARE CORPORATION
One North Avenue, Burlington, MA 01803

Circle 317 on Inquiry Card.

HOW TO ORDER

Mail the coupon below to Alpha Software or take it to your local dealer to pick up your Alpha Four Upgrade Kit. Remember to bring proof you have an existing qualifying product.*

For **Fastest Service** Call: **1-800-852-5750**, Ext. 117 Orders Only Hotline: **1-800-336-6644** Or Fax the order form to: **1-617-272-4876**

In **Canada** Call: **1-800-451-1018**, Ext. **117** Or fax your order to: **1-416-365-1024** Or mail coupon to: Alpha Software Corp., 626 King Street, Suite 301, Toronto, Ontario M5V 1M7

Alpha FOUR $99 Upgrade Offer (SUGGESTED RETAIL $549)

ALPHA SOFTWARE CORPORATION
One North Avenue, Burlington, MA 01803
1-800-852-5750, Ext. 117

YES! Please send me Alpha Four relational database for non-programmers for just $99 (SRP: $549), plus $8.50 shipping and handling. I understand it is fully guaranteed and I may return it within 60 days for a full refund. I have enclosed the cover page of my existing qualifying product* manual (or original diskette).

Method of Payment: ☐ Check Enclosed Diskette Size: ☐ 3½" ☐ 5¼"
☐ Charge my credit card: ☐ VISA ☐ MasterCard ☐ Amer. Express

Card # ______________________ Exp. ______

Name ______________________

Address ______________________

City, State, Zip ______________________

Daytime Phone ( ) ________ (in case we have questions about your order)

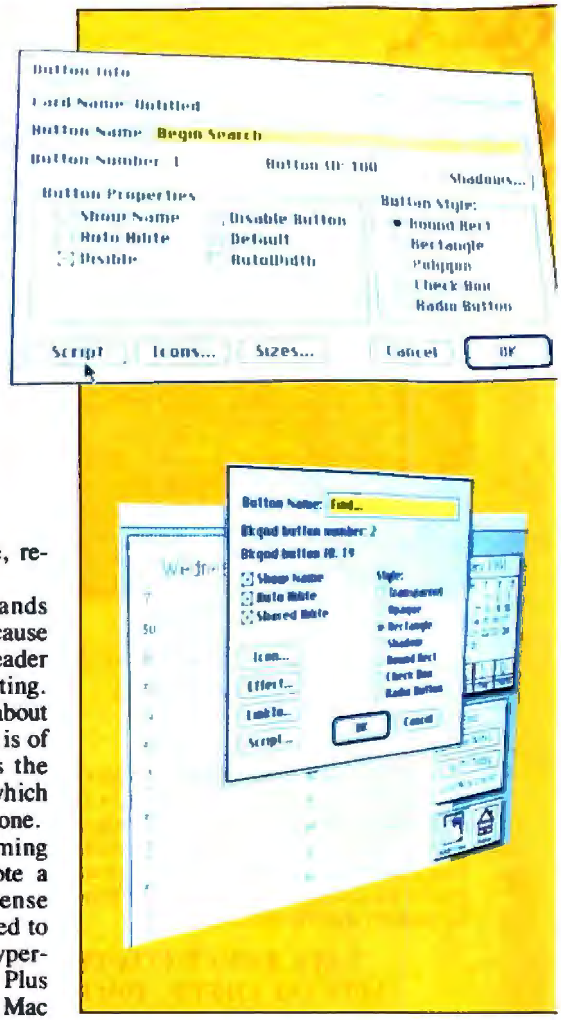
Offer to change without notification. TAE

BYTE REVIEWS

SOFTWARE

Script Languages: The BASIC of the 1990s?

LAMONT WOOD



You have data. And you want to make some sense out of it. You want to write a program that will probe, sort, or otherwise arrange all the information. In other words, you need to do some quick-and-dirty end-user programming. Forget elegance. Forget maintenance. You want answers. And you want them now.

Since the late 1970s, we've had BASIC in various incarnations. In 1978, with some excitement and an 8K-byte RAM board, I fired up a 4K-byte version of BASIC and flipped through a dozen pages of stapled instructions—and decided I didn't need to read them. A list of the three dozen command words was enough. Sound familiar?

The rest was then up to you. You slapped on GOTOs and GOSUBs to patch the holes you discovered in your original conception until you had something that worked—although after a point, even *you* couldn't say how.

Tight, cryptic code was in vogue, as restricted RAM meant that you were constantly looking over your shoulder with the free-memory statement (FRE). You'd even overhear schoolkids arguing about how many parenthetical brackets they needed in a particularly monstrous function statement they were hacking out, as if they were conjuring up a spell.

But this is the 1990s. Now we have object-oriented programming (OOP)—some say "hyper-programming"—for the masses. Data, which you probably always thought of as numbers and text, has become *objects* that include graphics and reside in *containers*. GOTO and GOSUB have been banished, and programming languages use a prolix "self-commenting" syntax that reads like the English of strangely dictatorial kindergartners; writing those statements, of course, requires the following of tight rules.

Even most conditional commands have fallen from favor, probably because they require analysis from the reader and, therefore, are not self-commenting. You still have to be concerned about memory capacity, but now the talk is of megabytes. Documentation takes the form of book-length manuals, of which there usually needs to be more than one.

So is quick-and-dirty programming still possible? To find out, I wrote a BASIC program for a phone expense problem (see below), and then I tried to solve the same problem using HyperCard, SuperCard, and Spinnaker Plus for the Mac (using a Mac SE and a Mac IIcx) and using ToolBook, Spinnaker Plus, and HyperPad for the PC (using a 16-MHz 386 with a Hercules display). Without going into every feature of these packages, I've tried to provide a comparative perspective of them by using each to create a real-world application.

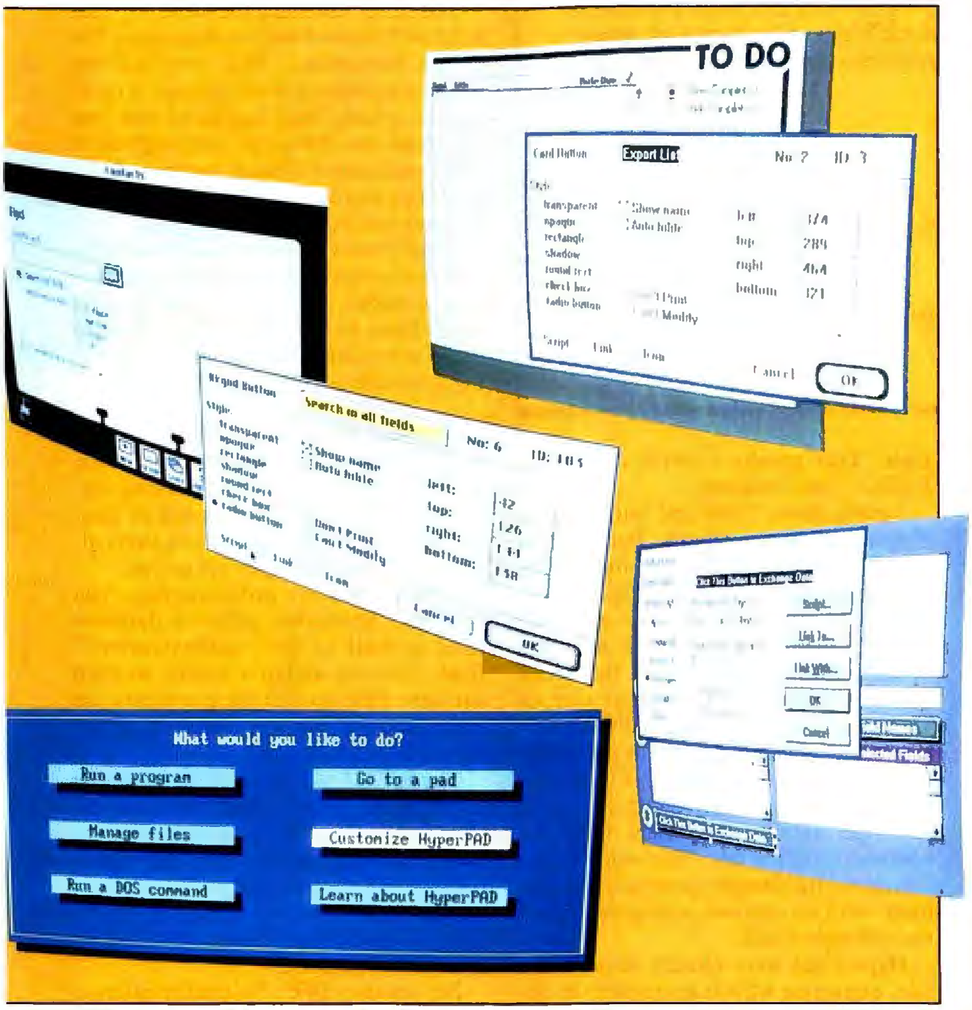
I used each package to read through a comma-delimited ASCII data file that contained 1944 items (approximately 120K bytes). Each record, which was a line ending with a carriage return, had six fields—internal number, date, numeric amount, code number, comment, and null (which you were to ignore)—detailing expense transactions from 1985 through 1990. The programs analyzed yearly phone expenses by searching through the file for every record that contained the word *phone* or *Phone* in the comment field and adding its amount to the total for that year.

And the answer, of course, is yes, quick-and-dirty programming is still possible. However, it's like working in the presence of your mother, who won't let you get dirty. As for "quick"—well, that word may have to be dropped from common usage.

Our Old Friend BASIC

The GWBASIC version of my program consists of 15 lines that take up about 450 bytes on disk. It runs in 15 seconds. The program listing (see listing 1) looks fairly cryptic, but the main thing to notice is that FOR...NEXT causes the program to loop 1944 times between that statement and the following NEXT statement. INSTR checks for the word *phone* or *Phone* in the comment field—the CM$ string. The MID$ function extracts the year (5 to 0) from the date field, and VAL changes the year and the amount from text style (as they are represented in the data file) to numeric values. The array (dimensioned in line 40) allows you to refer to data by its position on a list. In this case, although array *A* has values from 0 to 90, I use only 85 to 90.

If INSTR finds *phone* or *Phone*, the



BYTE ACTION SUMMARY

- **OBJECT-ORIENTED SCRIPT LANGUAGES**
- **WHAT THEY DO**
  Most script languages provide lavish displays that let you program graphically, using "buttons" and other objects to represent actions defined by "scripts." They offer an alternative to BASIC for building small applications.
- **WHAT YOU'LL DISLIKE**
  Although programming may become easier, an application written in one of the reviewed object-oriented script languages will run many times slower than the same application written in BASIC. In the test application, the BASIC version ran 16 to 40 times faster than any of the script versions.
- **WHAT WE RECOMMEND**
  For the Mac, HyperCard is tuned for running applications rather than writing, while SuperCard offers more authoring tools and features. For the PC, ToolBook is likely to become the de facto standard for Windows. And if you need to develop for both the Mac and the PC, consider Spinnaker Plus, which is available in Mac and PC versions.

year value D is extracted, the amount value (AMT$ converted to the numeric value A) is added to the amount in item D of list A, and then item D and the comment field are printed on the screen.

The OOP Approach

With OOP, you don't just start writing code. First, you construct a screen, placing *objects* on it by clicking on the software's tool icons. Objects are generally *fields* or *buttons*. A field and a button can each contain a program written in a *script language*, which runs when you click on it with a mouse or when it receives a "message" from another object. (While the script languages don't offer GOTO or GOSUB, you can accomplish major vectoring by sending a message to the script in another object, telling it to take over.) A field also can contain data. Fields come in varieties—for example, for painted or drawn graphics, for formatted data, and for screen labels.

Thus, you have objects, you can assign data and programs to them, and you can change the data and invoke the programs at will. You can also move them around on the screen (but this is not illustrated by this example).

A further embellishment of the object-oriented script languages I examined is that they have not one but many screens stacked on top of one another. The *background* is the screen page whose contents show on all the layers (or pages or cards—nomenclature varies) stacked above it. Since you can selectively display or turn off the contents of each layer, you have enormous control over what you see. You can even do animation. But for the quick-and-dirty programmer, the multilayer approach can be a nuisance. You probably take no notice of whether you are pasting your fields on the background or on some other layer, which leads to headaches later on when you try to refer to those fields from a script.

That being the case, the first step I took for each package was to lay down five fields to contain the input data and another six fields to display the results. After I created, placed, and sized the fields, I gave each a mnemonic name that had meaning within the program's context (e.g., "itemdate" and "amount").

The next step was to create a button and write a script for it that would input the date, total the desired numbers, and display them in the results fields. The packages offer syntax checkers or debuggers with error messages. As a program went through the file, the inputs were displayed to reassure me that something was happening and that it was consistent with the BASIC program. If the inputs were not displayed, the run times were about one-third faster.

I found that I could spend an infinite amount of time fiddling with the appearance of a screen; the packages generally

Listing 1: *A BASIC test application. This program analyzes phone expenses by year. It reads through a comma-delimited ASCII data file where each record has six fields. The data details expense transactions from 1985 through 1990.*

```
10 KEY OFF: CLS
20 LOCATE 2, 27: PRINT "VERSION FOR GWBASIC"
30 OPEN "I", #1, "D:DATACMA.ASC"
40 DIM A(90)
50 FOR N=1 TO 1944
60 INPUT#1, N$, D$, AMT$, CD$, CM$, NUL1$
70 X=INSTR(CM$, "phone"): Y=INSTR(CM$, "Phone")
80 IF X=0 AND Y=0 THEN GOTO 150
90 A=VAL(AMT$)
100 D=VAL(MID$(D$, 7, 2))
110 A(D)=A(D)+A
120 LOCATE (D-80), 30: PRINT USING "####.##";A(D)
130 LOCATE 15, 15: PRINT SPC(50)
140 LOCATE 15, 15: PRINT CM$
150 NEXT N
```

included optional field borders, button icons, clip art, and elementary drawing and painting tools to spruce things up. It's best to be philosophical about all this: It is said that the majority of effort that goes into any program is put into the display of the information and the intangibles involved, rather than into simple data processing where there are no intangibles. With OOP packages, you just get more results for your tinkering.

The interface screens of each package offer an optional "message box" where you can type in commands for immediate execution to test something in the script language or to adjust the screen. Aside from being self-commenting, the script languages have an interesting concept in common called *chunking*. With chunking, you can say something like "put the first word of it after the third word in the second line of field *A*," and the computer will understand. This does much the same thing as the BASIC MID$ statement but can be understood at a glance. The packages can determine if a data item is supposed to be a number or a text string, and you can use *it* as a pronoun to replace the last-used variable name.

HyperCard 2.0

HyperCard from Claris, a subsidiary of Apple, comes bundled with Mac systems. For an extra $199, you can get 1400 more pages of documentation suitable for software developers. As the "first OOP tool for the masses," it seems to have become the archetype. Scripts written in HyperCard, SuperCard, and the Mac version of Spinnaker Plus can be cut and pasted to each other and run with minimal editing. You can even use the script language documentation of one package with that of another.

They all ran the test program at the same speed, presumably because they all use the same underlying file access routines. That speed—a world away from BASIC—was 5 minutes.

Laying down fields and buttons with HyperCard was a breeze. But when it came to writing the script, there were only minimal file handling capabilities. You can only open a text file and read from it—there is no automatic handling of data files. You can have the script READ UNTIL a particular character, or UNTIL a carriage return, or FOR a certain number of characters. The only solution was to have it READ UNTIL a comma and assume that by doing so, it had just read another data field from the comma-delimited file. This worked, but it involved the dangerous assumption that there were no commas within the text of the comment fields.

HyperCard went blindly through the file, extracting what it assumed to be sequential data records and putting them into fields. It seemed to work, but each record was bracketed by quotation marks and a comma. I removed these from the amount field using chunked delete commands so that the software would recognize the contents as numeric values. I similarly chunked the year value out of the date field to let the script know where to add the new amount.

HyperCard 2.0 has numerous improvements over version 1.2, including resizable windows and the capability of importing color graphics. For quick-and-dirty purposes, however, these features are not put to use.

SuperCard 1.5

SuperCard is a $299 package from Silicon Beach Software, a subsidiary of Aldus. For the quick-and-dirty programmer, its functionality seems to be little different from that of HyperCard. The main outward difference is that the tool icons are kept on the screen at all times, so you don't have to wade through menus to get what you want.

The script ran much the same way that it did with HyperCard, with the same file access limitations. The script-editing window includes pop-up displays of commands, words, and functions that you can paste into the script, although there is no explanation of their purpose. Alas, the script language's written documentation was not much more in-depth.

SuperCard's main advantage over HyperCard is that it can create its own run-time versions. This process adds about 300K bytes to the file, and no extra license is required to distribute the resulting applications.

Spinnaker Plus 2.0

Spinnaker Plus is a $495 package for the Mac that I also tested in a Windows version. It is noteworthy for having its message box and a selection of tool icons always present at the top of the screen.

When you start programming, you find that Spinnaker offers a database field as well as the "garden-variety" field. You can assign a format to each database field so that their contents are treated as, for instance, currency, dates, signed integers, or text.

The READ command again is limited to text input, which forces the use of the READ UNTIL "," formulation. Also, the script-editing facility has, like SuperCard, a list of commands and keywords you can call up and paste into the script. But it seems no more useful than flipping through the manual.

For another $495, Spinnaker offers a developer's kit with unlimited distribution of the run-time package. The company stresses that its nearly identical version for Windows allows you to use Mac scripts on a PC and thus avoid programming duplication.

Spinnaker for Windows

The Windows 3.0 version of Spinnaker Plus does not show the polish that's evident in the Mac version. For instance, the installation procedure in the manual is corrected in the addendum, and that procedure is corrected in the user notes. The user notes suggest that developers must occasionally exit Spinnaker and go back to Windows so that Windows can clean up the memory.

Indeed, Spinnaker occasionally produces inexplicable "out of memory" messages. It often took me two attempts to load the program—the first try would produce an "unrecoverable error" message followed by a soft abort, but an immediate retry would be successful. Simply placing the cursor on the file menu

ITEMS DISCUSSED

HyperCard 2.0 .... (bundled with Mac)
Claris Corp.
5201 Patrick Henry Dr.
Santa Clara, CA 95052
(408) 987-7000
Requirements: Mac or Mac II, 1 MB of RAM, and System 6.0.5.
Circle 1105 on Inquiry Card.

HyperPad 2.0 .... $149.99
Brightbill-Roberts & Co., Ltd.
120 East Washington St., Suite 421
Syracuse, NY 13202
(315) 474-3400
Requirements: IBM PC, XT, AT, PS/2, or compatible with two floppy disk drives, 448K bytes of available RAM, and DOS 2.0 or higher.
Circle 1106 on Inquiry Card.

Spinnaker Plus 2.0 .... $495
Spinnaker Software
201 Broadway
Cambridge, MA 02139
(617) 494-1200
Requirements:
Macintosh version: Mac Plus, SE, SE/30, II, IIx, IIcx, or IIci with 2 MB of RAM, a hard disk drive, and System and Finder 6.01 or higher.

Windows version: IBM AT or PS/2 with 2 MB of RAM, a hard disk drive, Windows-compatible graphics and a pointing device, and Microsoft Windows 3.0.
Circle 1107 on Inquiry Card.

SuperCard 1.5 .... $299
Silicon Beach Software
9770 Carroll Center Rd.
San Diego, CA 92126
(619) 695-6956
Requirements: Mac Plus, SE, SE/30, II, or IIx with 1 MB of RAM (2 MB to run color), System 6.0.2 or higher, and Finder 6.1 or higher.
Circle 1108 on Inquiry Card.

ToolBook 1.0 .... $395
Asymetrix Corp.
P.O. Box 40419
Bellevue, WA 98004
(206) 637-1600
Requirements: IBM AT with 640K bytes of RAM plus at least 256K bytes of extended memory, a hard disk drive, Windows-compatible graphics and a mouse, and Windows 3.0.
Circle 1109 on Inquiry Card.

sometimes generated continuous hard disk thrashing—something I haven't seen since Windows/386's overworked applications. The company says all this will be addressed in "the next version."

Important nuggets of information are scattered throughout the manual, and I found it not only possible but advisable to consult the HyperCard manual for questions on the script language. Even that was not always profitable, though, since the on-screen error messages are, for reasons not explained, shown in a tiny, cursive typeface that is nearly impossible to read on a Hercules display.

The phone expense program ran in 10 minutes, 50 seconds. Still, that's probably better than doing it by hand.

ToolBook 1.0

This $395 Windows 3.0 programming environment shows none of the awkwardness with Windows that Spinnaker Plus shows. ToolBook's maker, Asymetrix, is headed by a Microsoft board member, so you can assume that ToolBook's programmers got the best guidance available concerning Windows. Nevertheless, the fact that it isn't very fast—even its demo programs clunk along—must say something about the basic nature of Windows.

For the purposes of this review, what sets ToolBook apart from the other packages is its powerful "import" command. While with the other programs *import* means to place a graphic or text file into a particular field for display, ToolBook's importer can handle data files. Each record in the file becomes a page, and each record field from the file becomes a "recordfield" on that page. Importing took 3 minutes, and ToolBook thereupon created a program file more than 700K bytes long, since it incorporated the data with the program.

However, the import function did half my work. All I had to do was size and arrange the resulting fields on the background and then create a button and write a script for it. Well, OK, I also had to assign new font sizes to the text. ToolBook created the field with the largest typefaces available in my system, so that the original screen looked like a string of billboards that each contained a corner of a huge word.

The script used ToolBook's SEARCH RECORDS command to tell ToolBook to start at the bottom of the book and search for a field with the *phone* string. On a page where it struck pay dirt, it added the amount into the appropriate results field. I had to set the contents of the results fields to 0 at the start of the script so that ToolBook would treat their contents as numbers.

The most notable thing about the ToolBook script language (called OpenScript) is that the syntax is more demanding than those of the other script languages. You can't get away with saying "put it into field p90." You would have to say "put it into the text of field p90" to show that you want to manipulate the contents of the field rather than the field itself. Actually, you can't even get away with that; you would *really* have to say "put it into the text of field p85 of this background." (Discovering these little wrinkles can give you gray hair.)

ToolBook offers considerable advantages over the other packages I looked at in that it has more file-handling power. It can import data files directly into a book. It has facilities for using and manipulating dBASE files and for employing dynamic link libraries (DLLs). It also has provisions for using Dynamic Data Exchange (DDE), the Windows protocol that lets one Windows application control another.

Had the data resided in another Windows application that uses DDE, such as the Excel spreadsheet or the IBM Current flat-file database, I could have loaded, say, Excel in the background and used ToolBook's DDE commands to tell Excel to extract and send the data. However, that requires knowing the background program's command structure and data hierarchy, and that's probably beyond the realm of quick-and-dirty programming.

The program ran in 5 minutes, 9 seconds. That's about the same as HyperCard and SuperCard on the Mac IIcx and about twice as fast as the Windows version of Spinnaker Plus.

The original versions of Windows 3.0 come with a run-time "reader" version of ToolBook. Asymetrix now sells an

author's resource kit for $450, with unlimited distribution rights to the run-time ToolBook and its associated DLLs.

HyperPad 2.0

HyperPad, a $149.99 PC program from Brightbill-Roberts, has a menu structure that looks similar to that of HyperCard (right down to the inclusion of "Save a copy" under the file menu), but there are no graphics. It's entirely character based. Not only do you not run in Windows, you only need 450K bytes of available RAM to run. Thus, older PCs are no longer excluded from the world of OOP.

Despite its lack of graphics, HyperPad still has fields and buttons in boxes, but they are drawn from character cell to character cell with the PC's set of alphanumeric symbols. I found that you can position fields on the screen without using a mouse, but you cannot size them. For sizing, you have to use the "rectangle" command from the message box and give the coordinates of the corners. Rather than going to the trouble of doing this for six results fields, I made one results field and had the totals for the individual years posted on separate lines in the field. (The script languages of the other packages also allow you to address individual lines of a field.)

The script language's READ statement allows an ITEM option, which causes it to automatically separate fields from a comma-delimited ASCII file—no more "read until comma." However, you have to refer to fields by their original identification numbers. Also, each command must end with a semicolon. If it does not, it means that it is part of a loop or conditional structure (such as an IF...THEN...ELSE statement), and HyperPad looks for the end of the structure and gives you an odd error message if it finds none. It ran the phone expense program in 3 minutes, 55 seconds—not bad, but still 15 times slower than BASIC.

For professionals, Brightbill-Roberts offers two run-time packages with unlimited development rights—one for $99 and one for $5000. The second package doesn't produce credits for Brightbill-Roberts, so no one needs to know you didn't do the whole thing from scratch.

Wave *of* the Future? Or Wave *at* the Future?

The old BASIC way of programming was dominated by loops, arrays, and all-too-clever improvisations to prop up other improvisations, as users struggled to bring a handful of programming tools to bear on the problem. The new object-oriented script-language packages, on the other hand, demand preliminary, thorough analysis of the problem, leading to scripts dominated by dull but comprehendible lists of practically identical IF...THEN statements. Cleverness is less important than a lawyerly knowledge of the script syntax and the hundreds of commands and functions it embodies. Sloppy programming habits are made nearly impossible. Spontaneity, though, *is* a sloppy thing.

In other words, civilization has arrived, and with it a dull conformity. All the packages I examined offer the same basic approach of fields, buttons, pages, and scripts. But just as people have written tomes differentiating the various dialects of BASIC, there are differences to be found in the object-oriented script-language world.

HyperCard is part of any Mac's basic software, but it is tuned to running applications rather than writing them, and the necessary documentation is an extra-cost option. SuperCard and Spinnaker Plus offer more authoring tools and features. Spinnaker's advantage is that it offers a Windows twin, although that twin is having growing pains.

On the PC side, ToolBook seems fated to be for Windows what HyperCard has been for the Mac—the first and foremost object-oriented script language. It offers refreshing file-handling advantages, although its script language is more complicated. HyperPad, meanwhile, seems to be neither fish nor fowl. Its lack of on-screen graphics means you cannot have the advantage of easy pictorial representation of your data. True, it runs on older machines that Windows won't run on. But then, so does BASIC. ■

Editor's note: *Listings of the application written with the script languages are available in electronic format. See page 5 for details.*

Lamont Wood has evaluated personal computers and software for 13 years, authoring more than 200 articles on the subject. He currently writes a computer column for the San Antonio Business Journal. *You can reach him on BIX as "lwood."*

NOW SHIPPING

The Old Standard For Debugging Just Retired

The new standard for debugging Windows, DOS and OS/2 has arrived.

A selection of unique features includes:

- 100% CodeView™ -information compatible
- Windows and PM user interface
- Character-mode user interface
- Easy to learn and use
- Automatic display of global and local data
- Advanced graphical data structure display
- Advanced data browsing
- Run-Time debugging for stepping through your program
- Post-Mortem debugging after a crash
- Conditional breakpoints
- Unique "VCR-style" remote control interface
- 15 views of the program
- Serial and Network remote debugging
- Dual monitor support

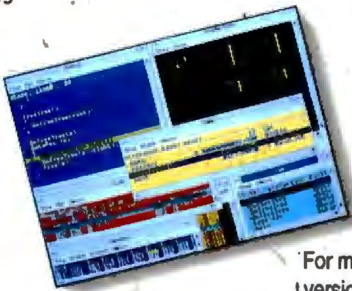
Windows highlights:

- Single monitor support ("Windows-Windows" debugging)
- Debugs Windows Enhanced 386, Standard, and Real mode
- Advanced window message spying capability
- 386™/486™ watchpoint support

DOS highlights:

- Debugs *ANY SIZE* DOS application - takes only 12KB
- Loads drivers and TSRs in high memory for maximizing application's memory space
- EMS 4.0 emulation, as well as VCPI services 386™/486™ watchpoint support

MultiScope Debuggers for DOS run under DOS or Windows, and debug DOS applications	**(SRP $179)**
MultiScope Debuggers for Windows and DOS run under DOS or Windows, and debug Windows real mode, Windows protected mode, and DOS applications	**(SRP $379)**
MultiScope Debuggers for OS/2 run under OS/2 full screen or Presentation Manager, and debug OS/2 full screen and PM applications	**(SRP $449)**



MultiScope Debuggers have easy to use Windows, PM and character mode user interfaces

For more information and a free trial version, please call (800) 999-8846, (415) 968-4892, or FAX (415) 968-4622. For European pricing call ++46-13-63189.

PC Magazine Technical Excellence Award, InfoWorld Product of the Year, BYTE Award of Distinction.

*C51 and C60 support
All trademarks are property of their respective owners

MULTISCOPE

LOGITECH

Circle 185 on Inquiry Card.

See the Future.

The ideal 16-inch ergonomic monitor for professional graphics and business applications.

Maximum performance for CAD/CAM, spreadsheets, databases, WYSIWYG word processors and desktop publishing. Designed for PCs and Macintosh II.

1024 × 768 resolutions. Supporting the new, higher refresh rate of 70Hz and above for a flicker-free display. No distortion. Sharply focused. Bright images across the entire screen.

An anti-static, non-glare screen. Low magnetic radiation. No interference between two monitors separated by a mere six inches, for dual-display applications.

Microprocessor-controlled configuration for your applications, memorizing size and position of the screen settings you prefer.

NANAO®

NANAO USA CORP.
23510 Telo Ave., Suite 5
Torrance, CA 90505 USA
Phone (213)325-5202
Fax (213)530-1679

Circle 186 on Inquiry Card (RESELLERS: 187).

Other monitors compete against the standards.
FLEXSCAN® sets them.

FLEXSCAN 9080i
16" (15V), 0.28mm dot pitch CRT
1024 × 768 Super high resolution with 70Hz high refresh rate
Scan Frequency Automatic Adjustment
H: 30-64kHz V: 50-90Hz
VGA, 8514/A and Mac II Compatible

SOFTWARE

Atlantix, Altos Fill DOS-to-Unix Connectivity Gaps

JON UDELL AND TOM YAGER

Two views of an Axcess server from Windows. File Manager browses files shared by the Unix SMB server, while a Unix session proceeds in another window. You can achieve the same result—by different means—with a Portable NetWare server.

Today, network administrators have more options for interconnecting DOS and Unix LANs, and the products take vastly different approaches to that connectivity. Atlantix Axcess and NetWare for Altos Unix turn the Unix host into a PC LAN server to provide file and print sharing and terminal emulation for access to Unix applications.

Axcess forges these links by bringing the Server Message Block (SMB) protocol and NetBIOS interface to the Unix host. Altos's product is an implementation of Portable NetWare that puts NetWare Core Protocol (NCP) and IPX on the Unix host. The host then acts as a NetWare file server.

Atlantix Axcess 1.0

Atlantix's maiden product, CocoNet, delivered Xenix connectivity to the NetWare LAN (see Reviewer's Notebook, February 1990 BYTE). The company's latest offering, Axcess, brings Unix into the fold. First out of the gate is a version of Axcess for SCO's Unix V.3.2 and Open Desktop. Axcess complies with the LAN Manager 1.0 protocol. Atlantix is not, however, a licensee of Microsoft's LAN Manager for Unix; the Axcess server was developed independently.

Unix servers for DOS LANs are multiplying like rabbits. The basic architecture—Portable NetWare excepted—is usually the same. Run SMB and NetBIOS on a Unix machine, so DOS clients can see it as a file and print server. Then give DOS users a terminal emulator that talks to Unix over the network, so they can tap into Unix applications and worldwide internetworking.

Given an SMB/NetBIOS foundation, how do you support NetWare clients? Several variations on the basic theme have emerged. Axcess switches between two transport protocols—NetWare's IPX and its own NetBEUI (NetBIOS Extended User Interface)—using a packet driver. Performance Technology's Powerfusion (see "Powerfusion Provides the Glue for Networking DOS and Unix" in the March BYTE), by contrast, uses a single transport—IPX—and NetWare's optional NetBIOS interface. Portable NetWare, of course, requires only IPX.

Thanks to the SMB/NetBIOS architecture of Axcess (and CocoNet and Powerfusion), DOS clients can connect not only to a Unix SMB server but also, for example, to OS/2 LAN Manager servers. Does that matter? You be the judge, but LAN Manager 2.0 has turned a number of heads in recent months. If environments with a mix of Unix and OS/2 servers become more common, Axcess will fit right in. For NetWare LANs, though, that flexibility comes at a price. A DOS workstation communicating with both SMB and NCP servers has to work harder and give up some RAM.

Axcess comes with packet drivers for 3Com, Racal-InterLan, Western Digital, and Novell Ethernet adapters. The packet driver insulates the adapter from the transport protocols that use it and enables several protocols to run concurrently. Atlantix supplies two: its own NetBEUI and a version of IPX configured for the packet-driver interface.

With early versions of CocoNet, you had to use Novell's ECONFIG utility to change the packet type of the NetWare server and all IPX shells. That's fixed now. Axcess doesn't require ECONFIG: The packet drivers will promiscuously accept either generic 802.3 or vendor-specific Ethernet packets.

In fact, we tried it both ways. With IPX set for 802.3-style packets, the DOS workstation we used was able to see the Axcess Open Desktop server and a standard NetWare server. Using Novell (type 8137) packets, we could connect to the Axcess server and to the Portable NetWare server. (Ironically, the "real" NetWare server defaults to generic 802.3 packets, but the Portable NetWare server uses Novell packets.) If we had switched the standard server to 8137, all three servers would have been accessible.

The Axcess client software requires about 60K bytes of RAM—in addition to the 55K bytes used by the NetWare shell. The protocol stack uses 30K bytes, and the redirector uses another 30K bytes. You must load both to use either terminal or file services on the host. We did succeed in loading them high using QEMM-386, but we had to sacrifice the high-loading of other things on a machine that's normally stuffed to the gills.

Once loaded, Axcess behaves like any MS-Net-like client. The `net use` command works in the familiar way. Bear in mind that the Axcess server treats each drive connection as a Unix user. If that user's account carries a password, you'll have to supply it to `net use`.

Atlantix bundles two terminal emulators: `vtp` (virtual terminal) for DOS, and `xnterm` for Windows. The `vtp` emulator works nicely but depends to some extent on a `terminfo` database entry not commonly found on (but transportable to) non-SCO systems. As a result, we were able to run the `vi` editor in full-screen mode on the Open Desktop machine but lost the full-screen capability when we hopped through `telnet` to a machine running Interactive Systems' Unix.

By the time you read this review, Atlantix should be separately selling a new Windows emulator called WindowView. That is important for two reasons: `xterm` is a Windows 2.x application that won't run under Windows 3.0, and `vtp`'s behavior under Windows is a bit erratic. In theory, you should also be able to use any Windows emulator that can speak NetBIOS, such as Future Soft Engineering's DynaComm. We tried that, but couldn't get DynaComm to link up with the Open Desktop host. Atlantix was still investigating this as we went to press.

On the Server Side

We installed the Axcess server software on the BYTE Unix Lab's 8-megabyte Everex 386/33, which currently runs Open Desktop 1.0. Things could have gone a bit more smoothly. First, we had to swap out the Everex's Western Digital adapter for a Tiara board supplied by Atlantix. (Support for more adapters, including Western Digital's, is forthcoming, the company says.) Installation then seemed to proceed normally, but when we booted the relinked kernel, its TCP/IP connectivity was missing. The fix was simple enough, once we discovered it. We needed to run the Unix `mkdev` command to register SCO's TCP/IP stack as a client of the Tiara board, alongside the NetBEUI stack that Atlantix had installed.

Server administration is done Unix-style and exploits Unix's user-oriented security. Although you'll likely want to create new accounts for use by Axcess clients, it's not strictly required. A client can map a drive to an existing account and will enjoy the per-file permissions associated with that account. An administrator can use the file `.profile.smb`, located in each user's home directory, to control the client's environment—for example, by specifying a Unix "mount point" for the mapped drive.

While working with Axcess, we experienced a real-life crisis with BYTE's everyday NetWare server. Casting about for a place to dump 200 MB of storage in a hurry, we realized Axcess could help. There wasn't enough room on the Open Desktop machine's own hard disk. But with the help of the Unix Lab crew, we were able to NFS-mount part of another Unix machine's disk and then connect an Axcess client to the extra storage. As the Unix/DOS cold war continues to thaw—thanks to products like Axcess—we look forward to many more peace dividends.

NetWare for Altos Unix 1.0

NetWare has long been considered the standard in PC networking. It is fitting, then, that one of the most exciting developments in PC-to-Unix connectivity should come (indirectly) from Novell.

Portable NetWare, strictly speaking, is NetWare 386 for PC Unix systems (see "NetWare 386: Less Pain, Great Gain," March 1990 BYTE). Novell doesn't sell it directly but licenses it to other companies. Altos, one of the pioneers in the microcomputer Unix field, was among the first to bring Portable NetWare to market (it may be available from Interactive Systems by the time you read this). The Altos version of NetWare is called, simply, NetWare for Altos Unix. That's no play on words; this is the real thing.

Unlike traditional NetWare, the Altos Unix version is not an operating system

BYTE ACTION SUMMARY

- **ATLANTIX AXCESS 1.0**
- **WHAT IT DOES**
  Unix host runs SMB and NetBIOS to provide file and print services to DOS clients. Also includes terminal emulator for access to Unix applications and services.
- **WHAT WE RECOMMEND**
  Good solution if you're already standardized on SMB/NetBIOS connectivity, since the Axcess client can communicate with OS/2 and DOS servers as well as the Axcess Unix server. Acceptable for NetWare users, but some extra overhead is unavoidable.
- **SYSTEM REQUIREMENTS**
  386 or 486 PC running SCO Unix V 3.2.2 or SCO Open Desktop 1.0; Atlantix-approved LAN adapter card.
- **WHAT YOU'LL PAY**
  $4595 for 32-user license
- **FOR MORE INFORMATION**
  Atlantix Corp.
  4800 North Federal Hwy., Suite 301B
  Boca Raton, FL 33431
  (800) 262-6526
  (407) 362-9700
  fax: (407) 362-9772

  Circle 1234 on Inquiry Card.

unto itself. Instead, this implementation makes full use of the resources and structure provided by Unix. It stores NetWare files and directories in ordinary Unix format, so they're accessible to Unix users according to Unix file access rules. NetWare uses the same Altos Ethernet adapter that Unix uses to support TCP/IP networking. In fact, the two protocols can share the same cable simultaneously. This bodes well for installations that have a mix of Unix and DOS systems. With Altos NetWare, you can make both DOS and Unix file services available from a single system.

All this versatility brings with it some responsibilities that go beyond ordinary Unix or NetWare. To use NetWare for Altos, you must understand at least the basics of both NetWare and Unix. NetWare not only uses Unix resources, it depends on them. Adding devices to the system, making backups, starting and stopping the system, and many other administrative tasks must be done from Unix. Those unfamiliar with Unix who are looking to NetWare for Altos only to provide DOS file services must be prepared to dive into some thick manuals.

It Lives to Serve

We tested NetWare for Altos Unix on an i486-based Altos System 5000 with 16 MB of memory and an 800-MB hard disk drive. NetWare for Altos runs on other members of the Altos line, but the 5000 is best suited for file serving. It supports multiple independent SCSI channels in its server configuration, and Altos's innovative drivers implement mirroring, drive spanning, and striping. These features are Altos's enhancements to SCO Unix System V. They boost Unix file I/O significantly, and that has a direct impact on NetWare performance. This, along with Altos's long history and experience with Unix, makes Altos hardware a better choice for a demanding application (e.g., file serving) than a brand-X clone with Unix installed on it.

Installation is nearly automatic. The software comes on a quarter-inch tape cartridge. The software is, like other versions of NetWare, sublimely tunable without reinstallation, so the installation process asks very few questions. It takes well under an hour to go from sealed box to running NetWare.

The Altos NetWare server software is partly administered through a simple menu-driven program called `sconsole`. The familiar Novell FCONSOLE lets you perform certain administrative tasks from workstations. Mostly, though, you must use `sconsole` for the nuts-and-bolts adjustments. From the Unix side, Altos provides a handful of utilities to list users and servers and perform certain emergency administrative tasks without trotting to a DOS client system.

Note that Altos NetWare is a server-only implementation; DOS clients running under Unix (services provided by either VP/ix or DOS Merge) cannot attach to NetWare servers, Altos or otherwise. Similarly, Unix users won't have access to files on other NetWare servers.

Making the Connection

Once you've installed and enabled the software, connecting DOS clients is exactly the same as with any other version of NetWare. You run one TSR program (IPX) that supports the Novell protocol, and another (NET3 or NET4) that makes file services available to DOS programs. After that, you can mount preconfigured subdirectories on the Altos Unix host directly as DOS letter drives.

Altos NetWare also includes NVT, a terminal emulator that allows any DOS client to start a Unix remote-terminal session on any Altos NetWare host. NVT is a TSR; pressing a hot key brings up a

BYTE ACTION SUMMARY

- **NETWARE FOR ALTOS UNIX 1.0**
- **WHAT IT DOES**
  Implementation of Portable NetWare runs atop Altos Unix to provide file, print, and Unix terminal services to DOS NetWare clients.
- **WHAT YOU'LL LIKE**
  An excellent choice for mixed Unix/NetWare installations.
- **SYSTEM REQUIREMENTS**
  Altos Series 5000, System 400, or System 700 computer running Altos Unix System V.
- **WHAT YOU'LL PAY**
  $3150 for 16-user license
  $4075 for 32-user license
  (prices vary by reseller)
- **FOR MORE INFORMATION**
  Altos Computer Systems
  2641 Orchard Pkwy.
  San Jose, CA 95134
  (408) 922-0333
  fax: (408) 433-9335
  Circle 1233 on Inquiry Card.

menu of active Altos NetWare servers. NVT hooks into DOS interrupt 14, so you need to run a DOS communications program that performs serial communications through this interrupt. The one drawback of this approach is that it can be slow. A stand-alone terminal emulator that makes more direct connections should have been provided as well.

The NetWare IPX software is compatible with the public-domain packet-driver standard; however, you can make faster terminal (and other) services available through DOS TCP/IP packages like that from FTP Software. At one point in the tests, we had one DOS client wired up to use NetWare, NFS, and TCP/IP simultaneously. The software played together perfectly, making even more options available to administrators.

NetWare for Altos Unix supports the full range of NetWare 386 commands and utilities. Any Novell-familiar administrator or user should feel right at home. In tests, connections to the server seemed responsive and reliable—exactly what you'd expect from NetWare.

NetWare-loadable modules *won't* work with NetWare for Altos. That's not too much of a problem, since you can add many of the services that NLMs offer (e.g., tape backup and heterogeneous networking) to Unix.

A NetWare for Altos system can share a network with other traditional NetWare servers, but not without some effort. Altos NetWare uses a network packet type that differs from that of regular NetWare; if you want all your servers to be visible to DOS clients simultaneously, you will need to use the ECONFIG utility to change your NetWare servers and DOS IPX software to use a matching packet type. This operation is quick, but it's an inconvenience for networks with more than a handful of nodes. Altos reports that a future version of its NetWare will have a changeable packet type.

From the moment we installed NetWare for Altos Unix and switched it on, both the Altos hardware and software ran constantly without failure or complaint. Future releases will blend in more functionality, including better support for programming client/server applications. As it stands today, however, Altos NetWare is Novell solid, and it's one of the most hassle-free ways to connect DOS and Unix networks.

Worlds Apart

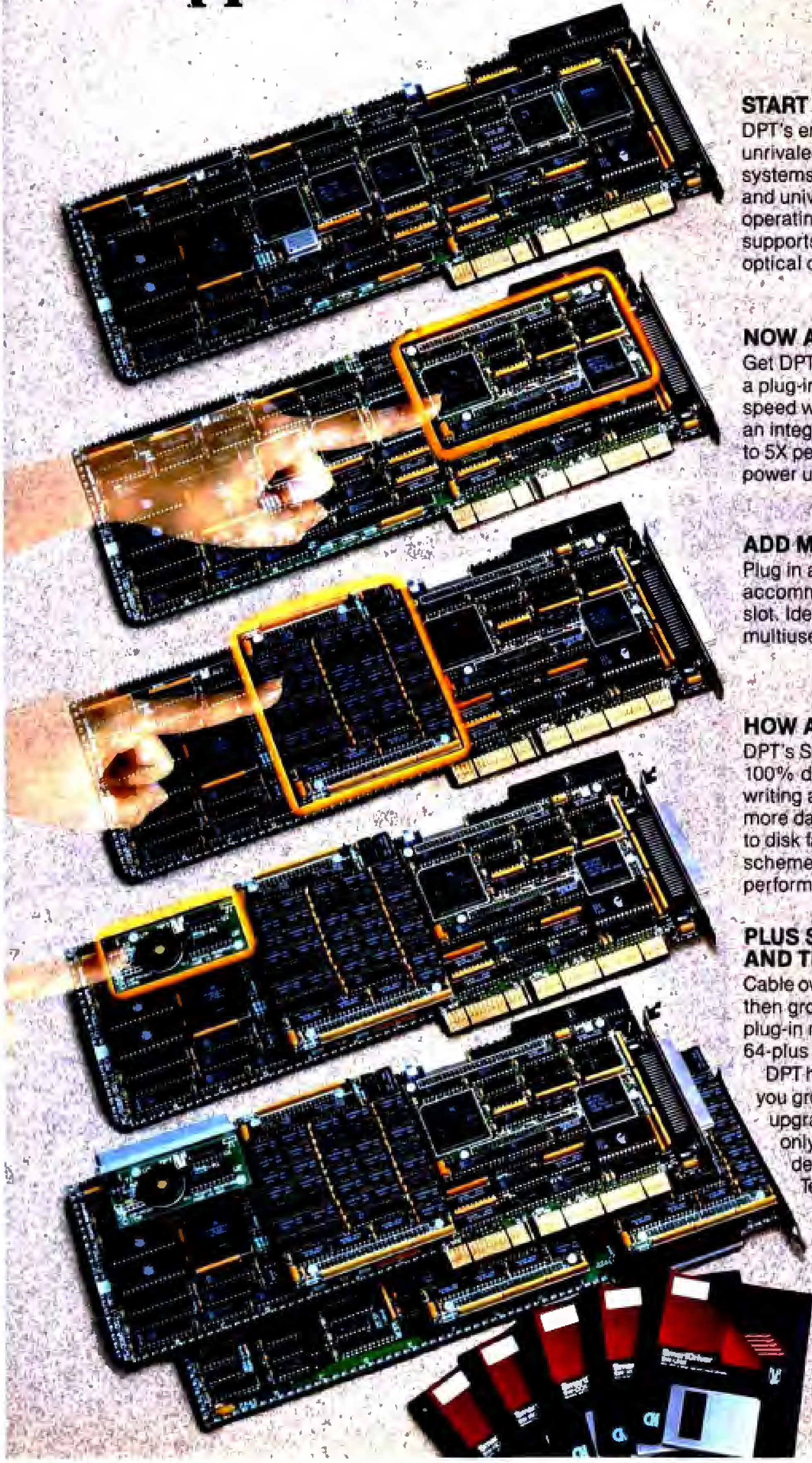
Atlantix Axcess and NetWare for Altos Unix deal with the problem of DOS-to-Unix connectivity in different ways. Axcess makes the Unix host an SMB/NetBIOS server. For DOS clients who are already on an SMB/NetBIOS LAN (e.g., Lan Manager), Axcess is a free ride. DOS/NetWare users have to give up a chunk of RAM to use Axcess, but they gain the ability to use NetWare and SMB servers (of all types) concurrently.

NetWare for Altos Unix, a Portable NetWare implementation, is a natural fit for pure NetWare installations. It doesn't provide NetWare/LAN Manager interoperability, but it's a true NetWare server that's instantly available—at no extra cost—to NetWare clients.

Together, these two products demonstrate that network administrators have a choice in how they interconnect DOS and Unix LANs. ■

Jon Udell, a BYTE senior editor at large, administrates BYTE's editorial LAN. Tom Yager is a BYTE technical editor and manages the Unix Lab. You can reach them on BIX as "judell" and "tyager."

SmartCache™ Plus: the grow-as-you-go approach to SCSI controllers



START WITH THE BEST...
DPT's entry level SmartCache Plus board offers unrivaled price/performance for single-user systems. It features ISA or EISA bus mastering, and universal SCSI disk compatibility for all PC operating systems. SmartDriver software supports SCSI-2 peripherals like tape and optical drives.

NOW ADD CACHING!
Get DPT's award-winning caching technology in a plug-in module! Move up to disk caching speed without investing in a new controller. With an integral 512K cache, the module provides up to 5X performance gains for workstations, power users, and small multiuser systems.

ADD MORE USERS, ADD MORE CACHE!
Plug in a 2 MB or 4 MB memory module and accommodate up to 18 users from a single card slot. Ideal for medium-sized networks or multiuser systems.

HOW ABOUT DISK MIRRORING?
DPT's SmartCache mirroring module provides 100% disk fault tolerance by simultaneously writing all data to a second "mirrored" drive. No more data loss or costly system down-time due to disk failures. And unlike software mirroring schemes, fault tolerance is achieved with no performance penalties.

PLUS STILL MORE CACHE, AND THEN SOME...
Cable over to DPT's 4 MB Cache Expansion Card, then grow your system to 16 MB by adding more plug-in memory modules—enough power for 64-plus users!

DPT has your solution—no matter how you grow. Performance, compatibility and upgradability make SmartCache Plus the only SCSI controller you'll ever need. For details, contact Distributed Processing Technology, 140 Candace Drive, Maitland, FL 32751. Phone (407) 830-5522; FAX (407) 260-5366. In Europe (UK) phone 44 04 884 718 FAX 44 04 884 8892.

DPT

Circle 97 on Inquiry Card (RESELLERS: 98).

APPLICATION

Low-Cost 3-D Animation Materializes for PC Users

GREG LOVERIA

A finished 24-bit render. Note the completed phone handset object. The human figure wire frame was provided by an early release of a HumanCAD ((516) 752-3568) library of human body models. The photo and screens were produced by Greg Loveria with disk-to-slide conversions handled by Image Center ((800) 433-8829).

I first heard rumblings last July that the CAD software giant, Autodesk, was developing a full-featured, professional, three-dimensional animation package to be priced under $3000. As a die-hard zealot for AT&T's Topas, a 3-D modeling and animation software package, my first reaction was a cynical "Impossible!". After working with Autodesk's new 3D Studio, however, I've had to get used to the taste of crow.

Retailing for $2995 through certified Autodesk multimedia dealers, 3D Studio is a complete, professional 3-D modeling and animation package for the PC. This package promises to appeal not only to animation and imaging professionals but also to those involved with CAD, design, presentation, and multimedia applications.

Unlocking the Studio

My evaluation copy of 3D Studio arrived in one of the most unique packages I've ever seen; it has a handle on the large three-ring documentation binder. This foreshadows other atypical design and application concepts displayed throughout the documentation and the program itself. Developed by Autodesk over the course of two years, 3D Studio runs on 386/486 systems with DOS 3.3 or higher, and it implements Phar Lap's 386|DOS-Extender standard. A 386 virtual memory manager pages code and data larger than available system RAM space. Hard disk space can be allocated as additional memory; however, 3D Studio requires a minimum of 3 megabytes of *real* memory.

Because the software runs in protected mode, a capable 386 BIOS is required; thus, 386SX machines with incompatible ROM BIOSes, older 16-MHz 386 machines, and 386SX add-in cards may not work with it. In addition, a math coprocessor is required. According to Autodesk, a Weitek WTL3067 (for the 386) or WTL4167 (for the i486) improves rendering speeds by as much as 50 percent. I tested 3D Studio on Zeos International's 486/25 EISA tower with 8 MB of memory and a 344-MB SCSI drive.

The program's main screen defaults to standard VGA (640 by 480 pixels in 16 colors), but internally, 3D Studio performs all image renders with full 32-bit color. Autodesk's Display Interface drivers are used to determine the output device type and resolution in both one- and two-monitor display configurations. You can generate single-frame renders and Autodesk Animator .FLI files in a variety of display resolutions and color depths.

As shipped, 3D Studio has several display hardware drivers: standard and Video Seven video RAM VGA, Truevision's ATVista or TARGA, Everex's Vision 16, and a NULL driver for disk renders. A Hewlett-Packard PaintJet/XL driver is included for color hard copy. For recording animations to tape, Diaquest's single-frame animation video recorder controllers are supported (see the text box "Testing 3D Studio" on page 262).

Installation of the software is effortless and requires at least 10 MB of free disk space; 20 MB is recommended for optimal performance. I simply typed INSTALL and swapped the seven 5¼-inch 1.2-MB floppy disks when prompted. You start up the program by typing in its acronym, 3DS.

Modular Modeling

3D Studio encompasses five integrated program modules. The 2-D shaper allows the creation and Bézier spline manipulation of 2-D polygon shapes (including text). The 3-D lofter manages the extruding of 2-D shapes into 3-D mesh objects. The 3-D editor controls scene illumination and camera and object placement. The materials editor regulates object surface textures and attributes, and the keyframer creates object/camera motion scripts for animation. Each module interacts with the others through user-requested data transfers.

You select commands with a mouse or digitizing tablet from pull-down and side menus, which is reminiscent of AutoCAD. 3D Studio directly imports and exports both 2-D and 3-D DXF wire-frame models into the 2-D shaper, 3-D lofter, and 3-D editor modules. You can save all working data in the five modules at once as an entire project. As in AutoCAD, commands are organized into trees, with branches for specific options. Each program module also has a subset of icon buttons grouped into an icon panel that controls screen views and module-specific functions (see screen 1).

The 2-D shaper is where most objects are born. Creation of simple 2-D shapes, such as circles and rectangles, is handled directly from the menu. You can create more complex object cross sections using point-to-point line segments. Once shapes are created, you can easily curve or deform them using Bézier spline adjustments. For precision control, you can enter coordinates with the keyboard for point placement or rotation; there is also real-time feedback of the current cursor position or rotation angle. A grid overlay and grid and angle-snap modes make the process even more manageable.

You can create 2-D text in over 20 fonts, ranging from Swiss and Serif to Times Roman. You can determine text size and aspect ratio by sizing a rubber-banded box as desired. The fonts are all ordinary objects, and you can modify them with the spline and point tools.

BYTE ACTION SUMMARY

- **3D STUDIO**
- **WHAT IT DOES**
  3D Studio is a versatile, fascinating tool for producing realistic 3-D scenes and professional-quality animations.
- **WHAT YOU'LL LIKE**
  3D Studio is compatible with a broad range of popular display cards, and it is currently the least expensive way to do professional 3-D rendering and animation on a PC. You can create animations in Autodesk Animator .FLI format for playback on any VGA-equipped PC.
- **WHAT YOU'LL DISLIKE**
  Many properties (e.g., object surface characteristics) can't be animated. 3D Studio's renderer lacks some important properties, including environment mapping.
- **WHAT WE RECOMMEND**
  If you'd like to see your CAD drawings, presentations, and product simulations come to life, 3D Studio is the most versatile and cost-effective way to do it.
- **SYSTEM REQUIREMENTS**
  386- or i486-based PC with DOS, a math coprocessor (Intel or Weitek), 3 MB of RAM, a hard disk drive with 20 MB of free space, a VGA or Super VGA display adapter and monitor, and a mouse or digitizing tablet; additional equipment and software required in most cases.
- **WHAT YOU'LL PAY**
  $2995
- **FOR MORE INFORMATION**
  Autodesk
  2320 Marinship Way
  Sausalito, CA 94965
  (800) 879-4233
  fax: (415) 491-8304

  Circle 980 on Inquiry Card.

Making the Leap to 3-D

After creating polygons and text in the 2-D shaper, you can pass assigned shapes to the 3-D lofter module for extrusion into 3-D mesh objects. Mesh objects are collections of interconnected vertices and object faces in 3-D space. By default, *lofting* an object amounts to extruding it along a straight path. The lofter supports paths of any shape, however, and it also allows separate paths for the *x* and *y* axes. As a result, even a moderately complex object (like the phone handset shown in screen 2) is a breeze to create.

The lofting process is fast—faster than I had expected—and you can preview an object in the lofter before it is created. Complex mesh objects can cause render times to escalate rapidly. The lofter offers a surprising level of control over the complexity of lofted objects. Many simplistic objects, such as cubes, do not need the cross-sectional geometry required for, say, the phone handset object, and the lofter lets you specify how much detail is needed.

The lofter builds 3-D objects one at a time. To place them in a scene or manipulate them in 3-D space, you pass them to the 3-D editor. As mentioned earlier, you can create simple 3-D mesh objects, such as spheres, toroids, and cubes, directly inside the 3-D editor. The 3-D editor also governs object, light, and camera positioning, along with scaling and rotation in a 3-D scene.

I found placing and adjusting lights and cameras within a 3-D scene uncomplicated and instinctive. 3D Studio lights are adjustable for color and brightness, and they come in three varieties: ambient, omni, and spot. Ambient light ensures a minimum visibility for the entire scene, while an omni light generates an effect similar to that of an uncovered lightbulb or sunlight.

I found the spotlight to be my favorite because its effect can be so dramatic. You can focus spotlights; that is you can adjust the size of the hotspot (brightest area) and falloff (the dimming of the light as it reaches the edge of its coverage). You can aim a spotlight by identifying a target for the light in the 3-D editor.

In addition to several fixed views, the 3-D editor also provides a movable camera view. Cameras have target positioning with a lens focal length that ranges from 15mm wide-angle to 200mm telephoto, and the cameras can be rotated or dollied from any viewport. After creating a camera (a scene can have several), you can make what the camera sees visible by clicking on a view and pressing the *C* key.

In a large scene with complex mesh objects, redraw time of all four viewports can get a bit sluggish. By pressing Alt-B, you can display 3-D mesh objects in an outlined box representation in any of the viewports, which makes redraws virtually instantaneous. This feature is particularly helpful when setting camera positions. Clicking and dragging a camera in any of the other three viewports also updates the camera viewport in real time. This made finding that perfect camera angle and position much better than hit-and-miss.

Colors, textures (like glass, chrome, or marble), and other surface type adjustments are made through a pop-up screen of the current materials library. Selecting a material permits its assignment to objects or groups of selected objects in the 3-D scene. 3D Studio includes a library of 105 different materials that is loaded by default. You can add new materials and modify existing ones through the materials editor.

The materials editor maintains user control of ambient, diffused, specular, reflectivity, transparency, and color at-

Screen 1: *The 2-D editor's interface screen shows 3D Studio's hierarchical menus and icon buttons. The drawing area shows the building blocks for some of the objects that appear in the rendered image in the photo.*

Screen 2: *The 3-D lofter shows the lofting of 2-D phone handset elements (shown in the photo) into a unified 3-D object.*

tributes via slider bars. Reflection, opacity, and bump and texture mapping of TARGA and GIF files can also be assigned to a material.

Both *Phong* and *Gouraud* object shading (as well as flat and wire-frame) are controlled in the materials editor through buttons. Of the two, Phong shading produces higher degrees of object realism, but rendering times are longer than they are for Gouraud shading.

I modified the glass, plastic, and chrome materials in the default library for application to objects in the review image (see the photo), and then I saved them under new material names. Changing back to the 3-D editor module, I assigned the new materials to various objects and rendered the camera viewport as seen in the rendered review image.

Exit to Toontown

You can generate a disk or videotape animation for any scene from within 3D Studio's keyframer. Moving and changing objects, cameras, or lights within the keyframer creates keyframes for those items. To generate a 60-frame animation, you just advance to frame 60 (with a slider) and make the changes you want reflected in the last frame; all movements and adjustments are incrementally interpolated through each frame, from the first frame to the current one. A low-resolution preview lets you see a shaded, real-time version of the animation on the VGA monitor.

After previewing the sequence, I generated an .FLI animation file and uploaded it to BIX. It can be found in the photo/listings conference as 3DSTUDIO.ZIP, and you can play it back on any VGA-equipped system.

3D Studio supports hierarchical object animation. For instance, a flock of birds can all be assigned to follow the motion path of a lead bird while moving in their individual motion paths. These hierarchies can be slaved to invisible dummy objects within the sequence for added realism. Lights and cameras can also be slaved to follow an object's motion path, and you can use any spline path created in the 2-D shaper/3-D lofter as a motion path. By executing the morph command in an animation sequence, I was able to transmutate cubes to spheres and fluidly bend columns so that they appeared to be

Testing 3D Studio

Like the Video Toaster that was reviewed last month, Autodesk's 3D Studio was tested in the BYTE Multimedia Lab. It performed flawlessly in all my test configurations. The Zeos International ((800) 423-5891) system's default display was served up by Diamond Computer's ((408) 736-2000) SpeedStar Plus, a Super VGA card, for 256-color renders. My renders were speeded by the addition of a Weitek ((800) 468-3167) WTL4167 math coprocessor chip.

I also used the Hercules ((415) 540-6000) Graphics Station Card with Hercules's new 3D Studio Autodesk Display Interface driver software. This adapter allowed me to design models at 1024 by 768 pixels in 16 colors and render them in 24-bit color, all on the same monitor.

Using the higher Texas Instruments Graphics Architecture resolutions requires a multiscan monitor; I tested two multiscan units in the one-monitor display configuration: a 15-inch Relisys ((408) 945-9000) RE-5120 and a 14-inch OptiQuest ((800) 843-6784) with an impressive 0.25-millimeter dot pitch. Both units performed flawlessly, and 24-bit color renders looked absolutely fantastic.

Since I wanted to eventually generate video-recordable animations, I tested both Truevision ((317) 841-0332) TARGA+ and ATVista+ adapters in two-monitor display configurations. Both generate directly recordable NTSC video (see the review "TARGA+ Lowers Cost of High-End Graphics," January BYTE). I used a Relisys RE-5155 RGB monitor when previewing images and then switched back to NTSC output when I was ready to record the final animation sequences to a Sony ((800) 523-7669) VO-5850, a U-Matic single-frame editing videotape recorder. The recorder was driven by a Diaquest ((415) 526-7167 DQ-50P parallel interface VTR controller board with Action Animator software.

The Diaquest board does all the work of controlling the VTR for animation. After each frame is rendered, 3D Studio tells the Action Animator software to place the frame on tape. The Diaquest board then signals the VTR to perform a one-frame insert edit. This insert edit records the rendered 1/30-second animation frame to tape, precisely on the frame following the previous one. After the edit, the VTR controller software instructs the VTR to rewind the tape to a specific park point and wait for the next rendered frame of animation to be recorded.

dancing. Adjustment of motion fluidity and looping are also provided via pop-up track and key information displays.

I found that a few techniques included in other animation software packages are not available or are cumbersome to use in 3D Studio. Fading objects from one color to another cannot be done directly. Also, true environmental mapping is not possible, so metallic objects can't display surface reflections of objects surrounding them.

Overall, each program module in 3D Studio is bursting with unique control and command parameters. Understanding object creation via the 3-D lofter is key to making realistic images. I spent many enlightening hours simply reading, experimenting, and lofting assorted 2-D shapes with strange path variations, and that was just with one module.

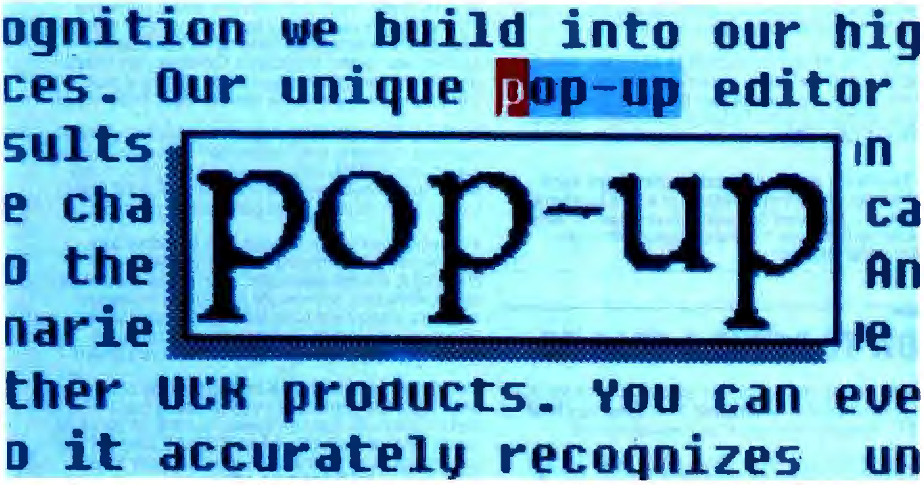
Simply listing 3D Studio's commands without benefit of descriptions would probably fill this entire review. However, 3D Studio's tutorial and massive reference manuals cover every step in profusion. This should make 3-D object modeling and animation a breeze for the first-time user, and I know the software will elicit exclamations of joy from its users at every turn.

At $2995, Autodesk's 3D Studio deserves a five-star rating. I'm happy that this review has afforded me the opportunity to be one of the first to publicly stand and applaud. ■

Greg Loveria is a computer graphics and desktop publishing consultant, animator, and technical writer in Binghamton, New York. He can be reached on BIX c/o "editors."

WordScan™ The Most Accurate OCR You Can Buy.

And We'll Prove It.



Our unique Pop-up Editor guarantees the most accurate results possible. Proof twice as fast without referring to the original document.

We started with the lowest error-rate OCR technology in the industry. Then we added exclusive features to make WordScan even more accurate. With WordScan you get the same state-of-the-art recognition we build into our high-end systems, at desktop prices.

Exclusive features make WordScan even more accurate.

Our unique *Pop-up Editor* guarantees the most accurate results possible. It pops up an enlarged image of any questionable character or word so you can proof without referring to the original document.

And because WordScan uses dictionaries during recognition, we don't make mistakes common to other OCR products. You can even add your own words so WordScan accurately recognizes unusual or specialized terms.

"WORDSCAN PLUS REDEFINES WHAT WE EXPECT FROM AN OCR PACKAGE. ITS EXCEPTIONAL ACCURACY, WEALTH OF FEATURES, AND HANDS-OFF DESIGN SET A NEW STANDARD." —PC MAGAZINE

Zap figures or text right from a fax card to your word processor or spreadsheet. No fuzzy print-outs. No retyping. No errors. And only WordScan has built-in dot-matrix support to read even draft quality dot-matrix documents *accurately.* Most OCR products can't do this at all or charge you extra.

Other unique WordScan features get the job done faster, better.

Clipping, another WordScan exclusive, lets you choose just what you want on the page. Text, image, or both. All in one pass.

Scan Now, Recognize Later lets you scan large documents now, but do OCR later so your PC is not tied up.

Make different documents look the same with our unique *Style Sheet* feature.

Process multiple documents into separate files automatically. Just put a blank page between documents and WordScan does the rest.

We'll send you the proof.

To see the results of head-to-head, real-world comparison tests with the leading competitive OCR software products, or to get the name of a dealer where you can make the comparisons yourself, just give us a call at 800-544-7051.

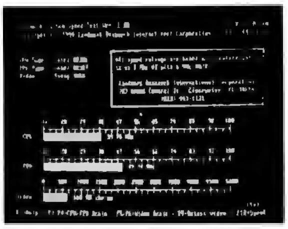
CALERA
RECOGNITION SYSTEMS

2500 Augustine Drive, Santa Clara, CA 95054 USA. 800-544-7051; outside USA, 408-986-8006; FAX 408-986-1440

Circle 58 on Inquiry Card.

PC DIAGNOSTICS • PREVENTATIVE MAINTENANCE • BENCHMARK TESTING • PERFORMANCE ENHANCEMENT

SPEED TEST YOUR PC



You've seen the *Landmark Speed Rating* advertised by many major PC manufacturers, now you can have your own copy of the **Landmark System Speed Test™**. Accurately measure CPU, math, and video speeds to *make an informed purchasing decision*, determine the best PC for the job or maybe just win some bets in the office on whose PC is *really* faster! Includes the Landmark AT CMOS RAM Setup program to update your system configuration *on-the-fly*. Regularly $29. **BYTE Special ONLY $19.**

THE 5 MINUTE SOLUTION TO FLOPPY DRIVE FAILURE

With **AlignIt™** you can *clean, diagnose, and align* your floppy drives in minutes *without* a scope. Patented technology requires only a screwdriver to perform ANSI-accurate alignments (.3 mil).

AlignIt is *ideal for corporate users* with 2 or more PCs because it includes a **"GOLD STANDARD"** feature so you can align all your PCs to the same in-house standard, *guaranteeing that all your floppies are perfectly interchangeable* between PCs.

80% of all floppy drive failures can be fixed with AlignIt so don't replace your drive, save time and money instead.

Includes dual size floppies, (both high and low density) and no-mess pre-lubricated cleaning diskettes (both sizes) good for 180 uses. Replacements and single drive size versions available. For all PCs and compatibles. Regularly $249 (single size $149). **BYTE Special, SAVE $$$ CALL NOW.**

HARD CORE TESTING FOR PROFESSIONALS

Landmark/SuperSoft **Service Diagnostics™** is ideal for professionals requiring the *most exhaustive diagnostic* test capabilities. Each module is CPU specific, including PC, XT, AT, 386/486, and PS/2. Since 1981 major manufacturers like Wang, Xerox, Prime, Sony, DEC, NEC, and NCR have relied on Service Diagnostics to tackle their toughest operating problems.

Intended for professional service and repair technicians, Service Diagnostics is also *easy to use* for the novice. Clear, concise on-line help and intuitive menus make finding system problems a breeze. Tests all CPUs, math chips, all memory, floppy, fixed and non-standard disk drives, standard/non-standard printers, system board, video, com ports and all keyboards. Utilities include low-level reformat, log bad sectors, edit bad sector table; the partition editor allows you to set up multiple partitions; *back-up program* transfers hard disk image on unformatted floppies and allows for *restore* after reformat.

Ideal for UNIX and other operating systems, the *self-booting version* doesn't require DOS. The manual offers troubleshooting tips to the component level. Also available in a complete Kit including: all CPU specific software, dual size floppy alignment software (see AlignIt), and PC/XT & AT ROM POSTs. ***Winner of the PC Magazine Editor's Choice Award in August 1990.***

PC WON'T BOOT? THEN JUST KICKSTART IT!

Don't replace your motherboard, don't call service, use **KickStart 2™**. When serious hardware problems occur, nothing gets you up and running as fast. KickStart 2 *measures power within 2.5%* on all four voltages, *shows Power-On Self-Test* (POST) failure codes, and features *on-board ROM-based diagnostics* allowing you to *determine and remedy the problem quickly, easily, and inexpensively!*

Built-in serial and parallel I/O *allows for testing via modem*, or simply logging results to a remote terminal, printer or laptop. You can configure your own test routines and store them in KickStart 2's battery backed-up CMOS RAM saving valuable setup time. Includes serial and parallel loopback plugs and Landmark JumpStart AT ROM BIOS for testing PCs that don't issue POST codes. KickStart 2 *tests your system regardless of O/S (even UNIX).*

On-board switches, LEDs, and digital displays allow complete control over testing in systems lacking video or disk (ideal for motherboard or system burn-in).

KickStart 2 is the *ultimate SECURITY CARD* too! With both supervisor and user levels of password protection, you can prevent unauthorized use of your PC and accidental running of destructive tests. Regularly $599. **BYTE Special, SAVE $$$ CALL NOW.**

> ***"KickStart 2 system diagnostics board helps users check out virtually every aspect of a PC's hardware system... the board is a worthy investment for computer maintenance." David Claiborne, PC Week - December 24, 1990.***

HOW TO DEBUG A DEAD PC

Need an *inexpensive solution* for dead or problematic PCs and motherboards? Try **KickStart 1™** or **JumpStart ROM POST™**, two quick and easy to use debugging tools.

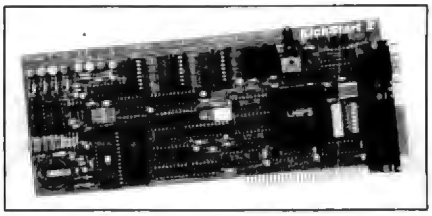
KickStart 1 test card shows power status on all four voltages and binary PORT 80 Power-On Self-Test codes. The manual translates error codes for easy failed circuit isolation. Regularly $99. **BYTE Special, SAVE $$$ CALL NOW.**

JumpStart ROM POST is a plug-in chip designed to replace your motherboard BIOS for testing purposes. Tests include CPU register and logic, 8087 math coprocessor, 8253 timer, 8237 DMA controller, 8259 interrupt controller, parity error and memory refresh logic, erroneous maskable/non-maskable interrupt detection, display adapter (MDA, CGA, EGA), keyboard, keyboard controller, floppy controller, drive A: read Base memory at normal & slow refresh rates, and POST checksum. Display of motherboard switch configuration. Regularly $199 (AT version) $99 (XT version). **BYTE Special, SAVE $$$ CALL NOW.**

> ***"SuperSoft's Service Diagnostics: The Kit is a technicians dream, with all the tools necessary to accurately analyze all phases of computer operations... It is well worth its performance potential." Bill O'Brien, PC Magazine - August, 1990.***

PC MAGAZINE EDITORS' CHOICE

- Service Diagnostics XT/AT Kit...Reg.$595, SAVE $$$ CALL NOW
- Service Diagnostics PS/2 Kit...Reg. $495, SAVE $$$ CALL NOW
- XT ROM POST... Regularly $99 SAVE $$$ CALL NOW
- AT ROM POST... Regularly $199 SAVE $$$ CALL NOW
- Individual pricing available on all kit components, please inquire



KickStart 2 is ideal for permanent installation. It eliminates the need for an I/O card, provides remote and on-site diagnostic capabilities for quick repair time and offers a solid hardware based solution to unauthorized access with impenetrable password protection.

SLASH DOWNTIME AND OPERATING PROBLEMS

With **PC Probe™** you'll save time and money when your PC starts acting up. In one easy-to-use package you get *Diagnostics, Benchmarks, Performance Enhancement Utilities, and System Information*. Combined, this arsenal of tools will keep your system up and running at peak performance and remove the mystery about what's inside.

PC Probe diagnostic testing quickly isolates the source of hardware problems, even locating bad RAM chips. It tests system board, RAM, video, keyboard, com ports, floppy drive, hard drive, Ethernet card and more. Run PC Probe tests in batch mode or single pass, *remote* or on-site.

PC Probe allows you to *increase your hard drive data transfer rate* by determining optimum interleave and changing it, *prevent catastrophic data loss* by performing data revitalization, *reformat* the hard drive, *run external programs*, display and edit CMOS RAM on-the-fly, *prevent accidental hard drive data destruction* with passwords, *diagnose problems with device drivers installed.*

The 200 page on-line manual has built-in table of contents, *topic/text search*, and troubleshooting tips. PC Probe comes with dual size floppies and 9 & 25 pin serial/parallel port loopback plugs. For PC XT, AT, 386, 486 and compatibles using DOS 2.0 or higher. Regularly $149. **BYTE Special SAVE $$$ CALL NOW.**

CONFUSED BY TECHNICAL COMPUTER JARGON?

Finally, with a single keystroke, you can define virtually every computer term known in a matter of seconds. This award-winning, easy-to-use utility, defines over 4200 computer terms and concepts for you without having to leave the program you're in.

The Computer Glossary™ (a software version of the best-selling book by Alan Freedman) installs as an application or hot-key accessed TSR. The definitions are written in concise, standard English. Plus, The Computer Glossary provides colorful industry "backgrounders" fascinating to the beginner and expert alike.

Get the most out of your software, manuals and computer magazines, buy The Computer Glossary and become a true **POWER USER**. Runs under DOS or MS-DOS 2.0, or later, with 32K of RAM and 1.4 MB of hard disk space on IBM PC, XT, AT PS/2 and compatible computers. Regularly $59. **BYTE Special, SAVE $$$ CALL NOW.**

CALL (800) 683-6866

International use FAX (813) 443-6603

Voice (813) 443-1331

Visa • MC • Amex • CODs Accepted • Dealer Inquiries Welcome

LANDMARK/SuperSoft.

First in PC Testing... Since 1981

703 Grand Central Street • Clearwater, Florida 34616

Circle 260 on Inquiry Card.

SYSTEM

The Fastest Portable: IBM's P75 Road Warrior

ROGER C. ALFORD

Photo 1:
The Model P75 486's gas-plasma screen displays VGA images with up to 16 shades of orange at 640 by 480 pixels. An integrated XGA controller supports 256 simultaneous colors at 1024 by 768 pixels on an external CRT.

Most of the new powerful 33-MHz 486 systems come in large desktop or tower cases, but faster doesn't have to be bigger. IBM's PS/2 Model P75 486 portable proves that point.

The P75 outperforms any other portable computer BYTE has tested. However, the machine is small only when compared to desktop machines: at 18 by 12 by 6 inches and 22 pounds, this is no laptop. Physically, its design resembles that of IBM's PS/2 Model P70. The keyboard detaches from the case to reveal the display and floppy disk drive, both of which tilt forward when in use.

The base system includes a 3½-inch high-density floppy disk drive, a 101-key IBM Enhanced PS/2 keyboard, an integrated 10-inch diagonal gas-plasma display, an integrated XGA controller, a SCSI hard disk drive controller, 8 megabytes of system RAM, a serial port, a parallel port, a mouse port, four Micro Channel expansion slots, and a 160-MB, 16-millisecond or 400-MB, 11.5-ms 3½-inch SCSI hard disk drive. IBM lists the system with a 160-MB drive for $15,990; the 400-MB system, which I tested, costs $18,890. IBM also tossed in a 2400-bps modem ($462) and IBM DOS 4.0 ($150), which brought the total system price to $19,502.

Rocket with a Handle

The P75 is an impressive example of how much computing power you can cram into a portable computer. The well-laid-out interior takes maximum advantage of all available space. IBM placed the power supply, hard disk drive, and whisper-quiet fan along the vented bottom of the unit. As you might expect, the system design makes extensive use of surface-mount technology and fine-line traces on multilayer circuit boards to achieve the highest possible integration.

Two half-size 16-bit Micro Channel slots and two full-size 32-bit Micro Channel slots are easily accessible, making it easy to add an internal modem, network controller, or other add-in board. By integrating the floppy disk drive controller, SCSI controller, XGA video controller, and serial and parallel I/O ports onto the system logic boards, the P75 486 has ensured that all four Micro Channel slots are available.

Four high-density (72-pin) single in-line memory module sockets hold the system RAM. The 36-bit-wide memory modules (32-bit memory plus 4 parity bits) that plug into these sockets have a notably wider data path than the 9-bit-wide modules that plug into the more conventional 30-pin SIMM sockets that are found in most of today's systems. Typical 386 and 486 systems have 30-pin SIMM sockets, so you must install DRAM modules in groups of four to support the 32-bit-wide processor data path. With the Model P75, you can install single modules.

Two 4-MB SIMMs of 70-nanosecond DRAMs make up the system's standard 8 MB of memory. IBM offers both 2-MB ($565) and 4-MB ($1095) memory upgrade modules to allow total system memory of 8, 10, 12, 14, or 16 MB. You can add more memory by way of a Micro Channel memory board.

Following the latest trend in high-end systems, the Model P75 positions the i486 processor on its own replaceable board. This, presumably, will allow an easy upgrade to a 50-MHz i486 when it becomes available. A heat sink sits atop the i486, secured by a hold-down screw and thermally conductive epoxy. The P75 includes no external cache, and it does not support Weitek's WTL4167 math coprocessor.

continued

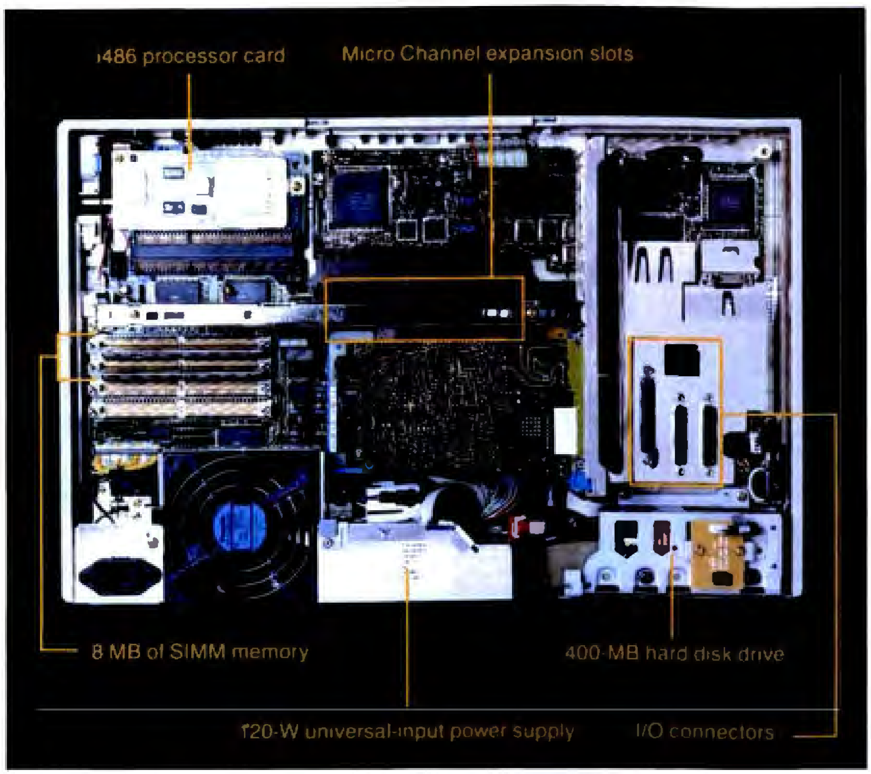


Photo 2: *The Model P75's interior makes effective use of limited space by using highly integrated surface-mount technology. The 400-MB hard disk drive and the universal-input power supply are tucked neatly away along the bottom of the unit. A removable i486 processor card (upper left) allows for future CPU upgrades. The I/O ports (right) sit behind a plastic access door.*

BYTE ACTION SUMMARY

- **IBM PS/2 MODEL P75 8573-401**
- **WHAT YOU'LL LIKE**
  IBM's new portable puts i486 power and top video performance in a 22-pound package.
- **WHAT YOU'LL DISLIKE**
  You'll pay a premium for the Model P75. It's not as fast as desktop i486-based systems in most performance categories, and the system's gas-plasma display doesn't take full advantage of the system's XGA graphics capability.
- **SYSTEM CONFIGURATION TESTED**
  33-MHz i486 CPU, 8 MB of SIMM RAM; 400-MB SCSI hard disk drive, 3½-inch high-density floppy disk drive; 10-inch gas-plasma display with 640- by 480-pixel VGA graphics and 16 gray scales; IBM Enhanced PS/2 101-key keyboard; four Micro Channel slots: two 16-bit half-size and two 32-bit full-length; ports for serial, parallel, mouse, and external floppy disk drive; 60-pin external SCSI port, external XGA; internal 2400-bps modem; PC-DOS 4.0
- **WHAT YOU'LL PAY**
  Base system starts at $15,990
  System as tested: $19,502
- **FOR MORE INFORMATION**
  IBM Corp.
  U.S. Marketing & Services
  Department ZW1
  1133 Westchester Ave.
  White Plains, NY 10604
  (800) 426-2468

  Circle 1221 on Inquiry Card.

Shades of Gray and XGA

The gas-plasma display is about what you might expect from a flat-panel display: It's merely adequate. The display has a wide viewing angle and is acceptably bright, but the orange-on-black or black-on-orange display options both lack contrast. The display converts colors into 16 shades of orange. This lets you run many graphics programs but compounds the contrast problem.

The gas-plasma display supports CGA, EGA, and VGA graphics, at up to 640 by 480 pixels. To extend display life, you can set the system to blank the screen automatically after an interval of inactivity ranging from 1 to 120 minutes. You restore the screen by pressing the Shift key or by moving the mouse or other pointing device.

The flat-panel display will serve in the field, but you'll want to hook up a real CRT when you're in your office. The P75's XGA video controller includes 1 MB of memory and generates images at up to 1024 by 768 pixels with 256 simultaneous colors, or 640 by 480 pixels with 64,000 colors. For an extra $82, you can get a 10-foot keyboard cable extension, which lets you put the system unit on the floor.

An access door at the left rear of the P75 provides access to the XGA video connector, as well as the serial, parallel, and pointing device ports, an external floppy disk drive connector, and a SCSI connector. You access the I/O connectors for Micro Channel boards through this door as well.

In addition to supporting the internal SCSI hard disk drive, the integrated SCSI controller can support up to six external devices, such as a CD-ROM drive, scanner, tape backup system, or additional hard disk drives.

The spring-loaded floppy disk drive automatically pops out to an accessible angle when you remove the keyboard from the front of the case, and the bottom of the gas-plasma display also pulls out to adjust the viewing angle. Three LEDs below the floppy disk drive indicate power on, floppy disk access, and hard disk access. The lightweight keyboard case is flimsy, but the keyboard itself has a good feel, with a soft keyclick feedback. The system also includes a speaker, but the sound is almost inaudible in a room with any background noise.

The Model P75's universal-input 120-watt power supply is easily adequate for a portable system. The power supply accepts 100 to 240 volts input at 50 to 60 Hz, making it usable worldwide. The power cord receptacle is located at the rear of the system behind a sliding access door.

For portability, IBM included a fold-down handle on the top of the P75. An optional molded plastic traveling case

Add HP NewWave to Windows and what do you get? Simply a breakthrough.

Windows 3.0 is a great step forward. It just doesn't go far enough. You still have to overcome barriers you thought you'd left behind. Such as DOS. The complexities of file management and application integration. And working in two environments.

The solution? Simply add HP NewWave. In this one simple step, you turn your PC into the most powerful, easiest-to-use information tool in business. To prove it, we've put an eye-opening, interactive demonstration on disk.

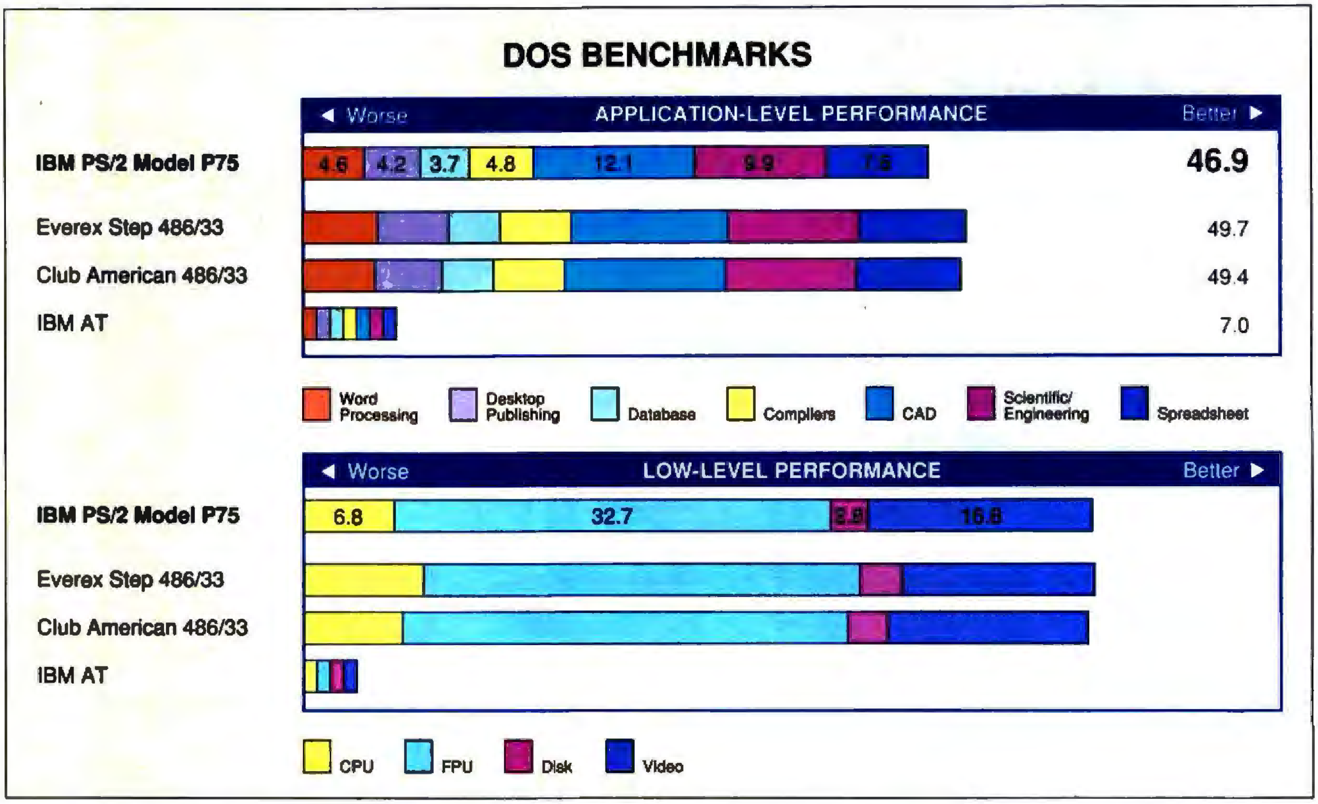
It shows how NewWave's simple object model lets you work on one desktop environment, instead of having to use both the Program and File Managers. You don't have to understand the DOS file system at all. And it works with the Windows applications you already have.

Integrating NewWave applications is astoundingly simple. Just drag and drop. "Drill down" editing lets you make changes in part of a document, such as a chart, without leaving it. And with "hot links," your data changes automatically in all connected files.

To evaluate NewWave, call (408) 376-2727 for your interactive demonstration disk. (Handling charge $3.95.) Then experience one of the most dramatic breakthroughs ever brought to your screen.

HEWLETT PACKARD

HP NewWave requires Windows 3.0 and an Intel 286 or 386 based PC with 640 Kb base and 2 Mb extended memory. Windows 3.0 is a product of Microsoft Corporation. © 1991 Hewlett-Packard Company NSS9016



CONVENTIONAL BENCHMARKS

	LINPACK (single) (MFLOPS)	Dhrystones (Dhry./sec.)
PS/2 Model P75	0.88440	25488.8
Everex Step 486/33	0.91120	26912.9
Club American 486/33	0.92630	27472.3
IBM AT	0.02105	2317.9

For application and low-level benchmarks, results are indexed and show relative performance, for each individual index, an 8-MHz IBM AT running MS-DOS 3.30 = 1. For all benchmarks, higher numbers indicate better performance.

The BYTE low-level benchmark suite identifies performance differences between machines at the hardware level, the application benchmarks evaluate real-world performance by running a standard test suite using commercially available applications. Application indexes include tests using the following programs: Word processing. WordPerfect 5.0, Desktop Publishing. Aldus PageMaker 3.0; Database. Borland Paradox 3.0 and Ashton-Tate dBASE IV; Compilers. Microsoft C 5.1 and Turbo Pascal 5.5; CAD. AutoCAD release 10 and Generic CADD level 3 1.1.5, Scientific/Engineering. Stata release 2, MathCAD 2.5, and PC-Matlab 3.5f; and Spreadsheet: Lotus 1-2-3 release 3.0 and Microsoft Excel 2.1

The BYTE Lab introduced version 2.0 of the DOS benchmarks in the August 1990 issue (see "BYTE's New Benchmarks: New Looks, New Numbers"). Benchmark results for machines reviewed under previous versions aren't directly comparable. To obtain a copy of the benchmarks, join the listings area of the byte.bmarks conference on BIX or contact BYTE directly

($299) includes a handle, wheels, and storage for cables and a mouse.

The system comes with drivers for its XGA interface, and a reference disk with several utilities, including system setup, disk cache, and diagnostics. IBM also includes an informative, well-illustrated quick reference manual.

As expected, the unit showed a high level of IBM compatibility. It ran everything I threw at it. I ran the system using IBM PC DOS 4.0. IBM is working on SCSI drivers for its upcoming release of AIX for the P75.

As Fast as You Wanna Be

The P75 is the fastest portable BYTE has tested. Most 33-MHz 486 desktop systems are faster, however. In fact, the system came in with the slowest overall performance of the 486/33s tested so far by the BYTE Lab, excelling only in the video tests. This isn't surprising, since the P75 is a revision of the older 386-based P70 design and lacks an external CPU cache. Still, the system will blow the case off any 386 portable around.

In the low-level system benchmarks, the P75 posted a 6.8 CPU index—well below the 7.2-to-9.0 ratings for the desktop systems BYTE has tested. FPU performance was closer but still brought up the rear. Similarly, the system's SCSI disk subsystem performance—even with IBM's 11.5-ms hard disk drive—is middling. The P75 makes up for its slower performance on those tests with its blinding video speed. Its video performance of 16.8 left the Club American 486/33, at 15.0, a distant second.

The application-level performance indexes follow the low-level indexes fairly closely, with the CAD index being the only one where the P75 is not the slowest (see the figure).

The Model P75 is a high-powered portable that gives you the most possible processing power and disk storage on the road. If you need the power and can pay its high-powered price, the P75 might be the right system for you. With the exception of the keyboard, it's well built. On the other hand, $16,000 will buy you a respectable 386 portable with enough money left over to buy a moderately equipped 486 desktop system. ■

Roger C. Alford is president of Programmable Designs, a Michigan-based consulting firm. He is the author of Programmable Logic Designer's Guide *(Howard W. Sams, 1989). You can reach him on BIX c/o "editors."*

The #1 Distributors In The World Now Sell The #1 Software Protection In The World.

Software developers creating the latest applications for IBM PC/XT/ATs or compatibles can now turn to local distributors for the *first-class* in *world-class* software protection.

Rainbow Technologies' Software Sentinel™ family of hardware keys is protecting over $1 *billion* in personal computer software. Right now. Worldwide. With virtually unbreakable security.

The hardware key concept is simple and effective. Developers incorporate unique codes in their software program which interact with the Sentinel key. The key is shipped with the program and must be connected to the PC in order for the software to run. It's that easy.

Choose Rainbow's SentinelPro™ for most applications or the Sentinel-C for custom configurations. Each model assures the developer that only *holders of the key* can run the software. Without adversely affecting the operation of protected or unprotected programs.

No matter where you sell your software worldwide, stay in control of your distribution and revenue by choosing the internationally accepted standard in protection. For additional information, contact Rainbow Technologies Ltd. in the U.K. or one of the #1 distributors listed below.

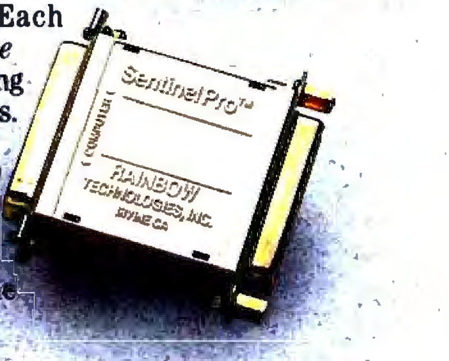
SentinelPro™

- Runs under DOS, OS/2 and Xenix, on IBM PC/XT, AT, PS/2 and compatibles, and Atari ST
- Algorithm technique (Never a fixed response)
- Parallel port version
- Minimal implementation effort
- Higher level language interfaces included
- 100 times faster than fixed-response devices (1 ms)
- ASIC design for reliability
- Evaluation kits are available

Call Today For More Information.
DISTRIBUTOR INQUIRIES WELCOME.

Sentinel-C

- Protects multiple packages with one device
- 128 bytes of non-volatile memory programmed before shipment of the software
- Rainbow supplies the developer a unique adapter for programming the unit
- Higher level language interfaces included
- Runs under DOS, OS/2 and Xenix, on IBM PC/XT/AT, PS/2 and compatibles
- Parallel port version
- Evaluation kits are available



- **FRANCE**
  Kontron Electronique
  Vélizy Villacoublay (Paris)
  tel: (33) 1 3946 9722
  fax: (33) 1 3946 0240
- **ITALY**
  BFI IBEXSA SPA
  Milan
  tel: (39) 2 331 00535
  fax: (39) 2 349 2344
- **INDIA**
  Threshold Technologies
  New Delhi
  tel: (91) 11 727 3820
  fax: (91) 11 941 111
- **BENELUX**
  IntroCom Electronica
  Hengelo, The Netherlands
  tel: (31) 74 430 105
  fax: (31) 74 429 895
- **SPAIN**
  MECCO
  Barcelona
  tel: (34) 3 422-7700
  fax: (34) 3 432 2847
- **TURKEY**
  BIMEKS
  Istanbul
  tel: (90) 1 346 9000
  fax: (90) 1 338 7210
- **GERMANY**
  Rainbow Technologies, GmbH
  Munich
  tel: 49 89 9613051-53
  fax: 49 89 9612617
- **SWITZERLAND**
  IBV AG
  Birmensdorf (Zurich)
  tel: (41) 1 737 0176
  fax: (41) 1 737 1832
- **SCANDINAVIA**
  PERICO A/S
  Oslo, Norway
  tel: (47) 2 491500
  fax: (47) 2 397064
- **GREECE**
  Byte Computer Applications
  Athens
  tel: (30) 1 9232335/9234918
  fax: (30) 1 325 3308
- **AUSTRALIA AND NEW ZEALAND**
  FMS Pty. Ltd.
  Melbourne
  tel: (61) 3 699 9899
  fax: (61) 3 699 7501
- **MEXICO**
  Impex Computacion
  Baja
  tel: (52) 66 28 0643
  fax: (52) 66 81 9567
- **ARGENTINA**
  Agri-Aid
  Buenos Aires
  tel: (54) 1 46-8364
  fax: (54) 1 322-3459
- **CHILE**
  HALCON S.A.
  Santiago
  tel: (56) 2 333 536
  fax: (56) 2 395 765
- **TAIWAN**
  Lehightek
  Taipei
  tel: (886) 2 312 2145
  fax: (886) 2 341 2137
- **JAPAN**
  Gilten Shoji Co., Ltd.
  Nagoya
  tel: (81) 52 251 4721
  fax: (81) 52 251 0229
- **CHINA**
  Beta Trading
  Hong Kong
  tel: (85) 2 5 448963
  fax: (85) 2 5 469179
- **THAILAND**
  BCS International
  Bangkok
  tel: (66) 2 319 4451-2
  fax: (66) 2 319 8443
- **KOREA**
  IMEX Trading Corp.
  Seoul
  tel: (82) 2 587 1475
  fax: (82) 2 549 9788

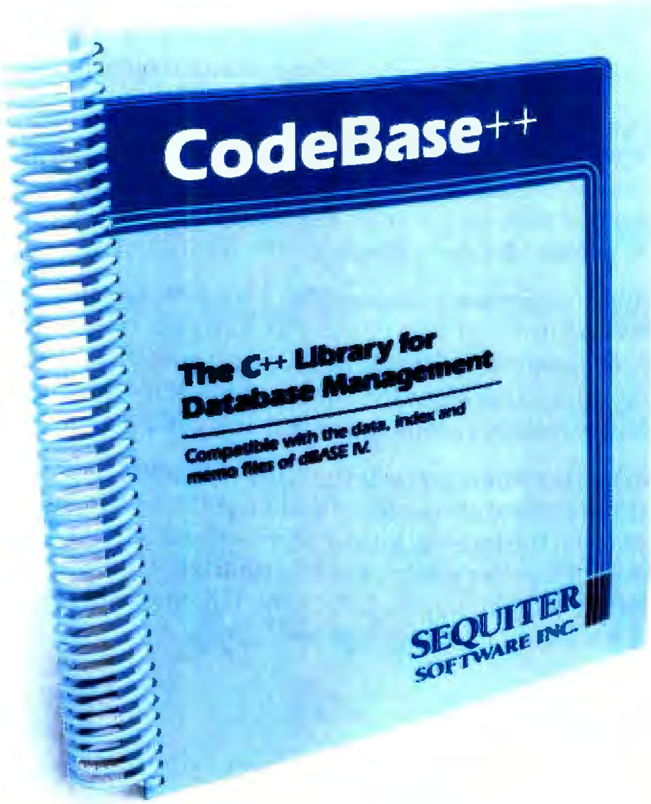
RAINBOW TECHNOLOGIES, LTD.

Shirley Lodge, 470 London Rd., Slough, Berkshire, SL3 8QY, U.K. Tel: 0753-41512 Fax: 0753-43610
USA: Rainbow Technologies, Inc., 9292 Jeronimo Rd., Irvine, CA 92718 • (714) 454-2100 • (800) 852-8569 • FAX: (714) 454-8557

Circle 226 on Inquiry Card (RESELLERS: 227).

Objective dBASE programmers try C++

Use CodeBase++ with C++ to build multi-user, dBASE compatible programs. Take advantage of object orientated programming to quickly create maintainable, readable software.



dBASE Compatible

Use CodeBase++ classes to access and change the data, index and memo files of dBASE IV and III. Use other classes to manipulate strings, sort at high speed, perform date arithmetic, evaluate dBASE expressions, manipulate linked lists and manage memory.

Portable

Port your programs between DOS, Microsoft Windows, and OS/2. Keep all the profits as you distribute your programs royalty free.

Fast

Watch as your C++ programs execute much faster than corresponding dBASE, Clipper or FoxPro programs. Be surprised at the small executables and low memory requirements. Examine the C++ source code, which is completely included, to learn good object orientated programming techniques.

Order Today

Order today at $295 and discover why Sequiter Software Inc. and most dealers offer a 60-day money back guarantee.

SEQUITER SOFTWARE INC.

Call (403) 448-0313

Fax (403) 448-0315

P.O. Box 5659, Station L, Edmonton, Alberta, Canada T6C 4G1

Circle 234 on Inquiry Card.

APPLICATION

Access Extended Edition and dBASE Data with InfoAlliance

JON UDELL

I don't want to know where you've stored it, or how. I just want to *use* the data." That complaint, which is heard throughout the corporate world, defines the problem that Software Publishing Corp.'s InfoAlliance aims to solve. SPC calls the product a "transparent data-source integrator."

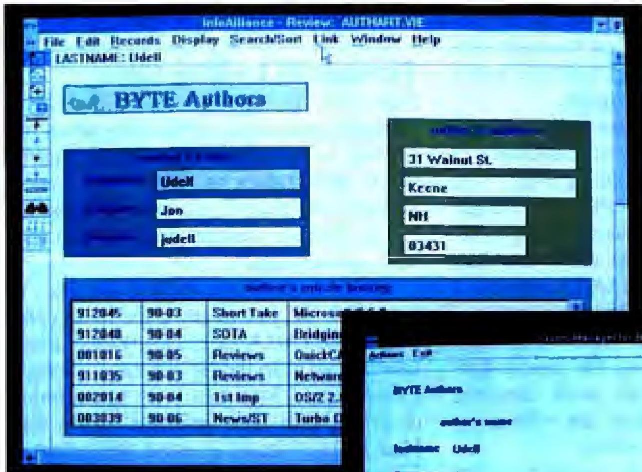
In its current form, that means you can use InfoAlliance to build OS/2 Presentation Manager (PM) applications that read and write IBM Extended Edition (EE) Database Manager tables, .DBF files created by dBASE, FoxPro, and Clipper, and database files owned by InfoAlliance's native DBMS. An InfoAlliance server, or "network data-source integrator," can export such data sources across a LAN to OS/2 clients running InfoAlliance. There's no Windows client yet, but SPC has announced that one will ship in mid-1991. At the same time, SPC expects to deliver support for two additional Structured Query Language engines: Microsoft's SQL Server and IBM's DB2.

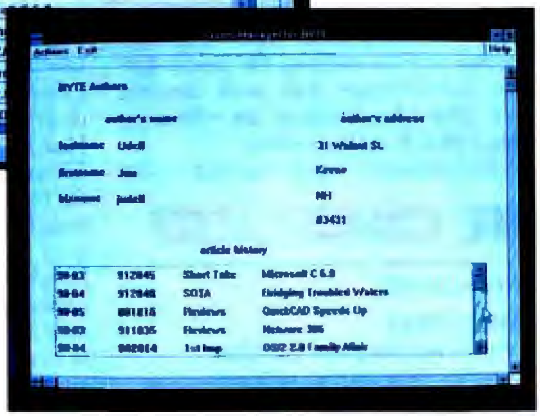
My test-bed was a pair of Compaq PCs: a 12-megabyte Systempro and an 8-MB Compaq 486/25 connected by way of Olicom 16/4 token-ring adapters. Since InfoAlliance currently runs only under PM, and since its sole SQL source is IBM's EE Database Manager, I installed OS/2 EE 1.2 on both machines. That, in turn, dictated that the network operating system had to be IBM's LAN Server.

Trials and Tribulations

In case you haven't worked with an EE LAN before, here's a quick overview. EE 1.2 comes with a LAN requester, a database server, a database requester, and a communications manager. LAN Server 1.2, which is a separate product, provides file and print services. That means that any EE workstation can provide database services to a LAN, can use the database services of any other EE workstation, and can use the file and print services of an EE machine running LAN Server.

The communications manager supports all these connections—and others,





These screens show how a related pair of databases might look using InfoAlliance (left) and Extended Edition's Query Manager (below).

notably sessions with IBM hosts—but does so in different ways. In particular, the file-server-to-client link uses NetBIOS, but the database-server-to-client link requires an advanced program-to-program communications (APPC) session.

My plan was to set up the Systempro as both file server and database server, and the Compaq 486/25 as both file requester and database requester. I wanted to explore IBM's own client/server database arrangement before delving into SPC's. The file server and requester part, mediated by NetBIOS, worked well. (Note, by the way, that neither IBM's nor SPC's client/server database requires a file server. I installed LAN Server only to create a normal network scenario.)

But, although I struggled mightily with IBM's communications manager, I was never able to get the EE database requester on the Compaq 486/25 to speak APPC to the EE database server on the Systempro. I mention this because InfoAlliance, which needs only NetBIOS, *did* manage to connect my database client workstation to EE SQL tables stored on the server. Lacking the APPC link, I still couldn't run EE's Query Manager on the client. Since InfoAlliance is not a complete substitute for Query Manager, the situation wasn't ideal. Still, I rate the simplicity of InfoAlliance's network substrate as a key virtue. The fewer moving parts, the better.

Forging the Alliance

The application in the photos above relates a pair of databases: One describes authors, the other articles. The screens shown exploit the one-to-many relationship of authors to articles, displaying for each author a scrollable list of articles. Separate screens enable the user to add to and update the authors and articles databases. I built the application three ways: first with EE data under EE's Query Manager (I'll call this the EE/EE version), then with InfoAlliance data under InfoAlliance (IA/IA), and finally with EE data under InfoAlliance (EE/IA). The top photo depicts both the IA/IA and the EE/IA versions; they're visually, but not functionally, identical. The bottom photo shows the EE/EE version.

With InfoAlliance, just as with Query Manager, you can build complete PM applications without writing a single line of code. InfoAlliance is clearly the superior screen designer. Query Manager can only build rudimentary screens with Systems Application Architecture-style menu controls. But InfoAlliance screens have menus, shaded or bit-mapped backgrounds, a variety of fonts, and an icon palette. In design mode, InfoAlliance's graphical editor draws lines, ovals, rectangles, and text, colors these objects, and aligns them with data fields. It lacks the grouping feature typical of drawing programs, but it's well suited to rapid construction of eye-catching screens, and it doubles as the report designer.

After I'd built the data-entry and update screens for the two databases, I filled them with data that I pulled from existing .DBF sources. For the EE/EE and EE/IA versions, that required a delimited-ASCII import to move the data into SQL tables. For the IA/IA version, I ran an import to move the data into native InfoAlliance (.FIL) files. Note that I did that only to exercise the native format. InfoAlliance will work directly with .DBF files (although not with associated dBASE-style indexes).

InfoAlliance's import function is a lot friendlier than Query Manager's. You can specify the order in which to take fields, and you can merge columns into existing records. When errors crop up, Query Manager points you to a log file and bows out. InfoAlliance, on the other hand, walks you through the erroneous records so you can correct them. It's a nice touch—the sort of added value that SPC's marketing people stress.

BYTE ACTION SUMMARY

- **INFOALLIANCE**
- **WHAT IT DOES**
  InfoAlliance integrates data from disparate data sources, such as IBM Extended Edition Database Manager and Ashton-Tate's dBASE.
- **WHAT YOU'LL DISLIKE**
  No access to Extended Edition's powerful query language.
- **WHAT WE RECOMMEND**
  If you're planning to move your dBASE (or Clipper or FoxPro) data to Extended Edition's SQL tables, InfoAlliance will ease the transition.
- **WHAT YOU'LL PAY**
  10 users/1 server: $8500
  35 users/3 servers: $23,500
  200 users/9 servers: $99,500
- **FOR MORE INFORMATION**
  Software Publishing Corp.
  1901 Landings Dr.
  P.O. Box 7210
  Mountain View, CA 94039
  (415) 962-8910

  Circle 1231 on Inquiry Card.

Through the Looking Glass

I'm sorry to say, however, that InfoAlliance processes errors only when importing to its native files. When importing to SQL tables or .DBF files, you're no better off than if you use the tools that EE or dBASE provide. In fact, you may be in worse shape.

In the case of my EE/EE version, as I've said, EE just pointed me to an error log. In the IA/IA case, I corrected errors interactively. In the EE/IA case, though, InfoAlliance reported only the number of errors and then referred me to EE. Had I not already learned the name of EE's error log, I would have had to repeat the import in EE. Of course, it's EE that does the import anyway, whether directly or under the programmatic control of InfoAlliance (through EE's SQL application programming interface). At a minimum, I would expect InfoAlliance to point me to the error log. But SPC's claims of transparent integration and ease of use led me to hope for more: that data importation to EE tables would work the friendly InfoAlliance way, not the obscure EE way.

At other times, the InfoAlliance/EE relationship was more transparent than I would have liked. In InfoAlliance, for example, you use the design editor to define new fields. In Query Manager, by contrast, the design editor only places fields that you've previously defined elsewhere. When I designed the EE/IA screen shown in the top photo, I planned to merge fields from the table I'd defined for my EE/EE version (see the bottom photo) with the graphical layout that I had created for my IA/IA version (not shown). So I opened the IA/IA design file, selected everything, copied to the clipboard, closed the file, opened the EE table through InfoAlliance (it came up as a fields-only IA design file), and pasted in the contents of the clipboard.

Then I set about replacing the IA fields with EE fields. But the "Cut" menu option was grayed; InfoAlliance wouldn't let me delete the IA fields. Why? InfoAlliance was only acting as proxy. EE's Database Manager can add columns to SQL tables but cannot delete columns. InfoAlliance, when using EE tables, naturally obeys the same restriction. When I pasted fields from the IA file into the EE table, I indirectly executed a bunch of irreversible "add column" operations. Here InfoAlliance did maintain transparency—in a literal sense—but the result wasn't what I'd wanted at all. I'd rather have been reminded that the current data source was EE and that the paste would be permanent.

One of the key advantages of my EE/IA version, as compared to the IA/IA version, is that the former—thanks to EE—enforces *referential integrity*. The "author name" column that links the authors and articles tables carries a constraint: An author named in the articles table (in a column defined as the foreign key) must appear in the authors table (in a column defined as the primary key).

When I built the IA/IA version, I tried to find a way to enforce the integrity of the link using InfoAlliance's DBMS, which relies heavily on "formulas" embedded in fields. In the end, I could not come up with the right field-validation formula, but so what? With EE at my disposal, I didn't need any procedural shenanigans to achieve referential integrity. It's a property of the tables themselves.

However, while you can add columns to an EE table through InfoAlliance, you can't define primary and foreign keys. That can be done only in Query Manager. In this case, "transparency" evidently means that table definition always works the same way, whether the source is EE, dBASE, or InfoAlliance. But should it? Why hide one of EE's finest features from the InfoAlliance user?

In the same vein, InfoAlliance doesn't encapsulate EE's interactive query tools. After I'd imported real data about BYTE articles into EE tables, I was once again struck by SQL's extraordinary power. Toying with Query Manager's "query-report-form" toolkit, I was able to ask and quickly answer a series of multidimensional questions about the cost of manuscripts. The reports weren't pretty—just formatted ASCII text—but they told a fascinating story.

InfoAlliance's forms-based approach is far more restrictive. Instead of working directly with SQL result sets, you spend a lot of time fiddling with forms through which to filter the data. To order and group data from one or more tables, you embed formulas in fields. That's a reasonable approach for .DBF or native InfoAlliance sources. And you can certainly make pretty reports—or mailing labels, for that matter. But it seems a tragic underutilization of a SQL engine.

continued

Networking the Data

One goal of a multiuser DBMS is to manage locks intelligently. What happens when two users try to edit the same record at the same time? Here again, unavoidably, InfoAlliance's behavior depends on the underlying engine. LAN versions of dBASE (and compatible programs) exhibit a very high degree of concurrency. They lock contested records automatically and only when necessary. InfoAlliance performs equally well when the data source is a .DBF or native .FIL file. It also reports the name of the user holding the lock.

With EE, though, it's a different story. Since SQL engines work with multitable result sets rather than simple records, it's tough to deliver the high level of concurrency that dBASE and FoxPro users have come to expect. EE's own default behavior isn't entirely satisfactory. When a Query Manager user tries to update a column of a row that another user has open

SPC believes in SQL and wants to help bring it to the corporate desktop.

with update access, things stall: Both users see the hourglass, and nothing else, until someone backs off. InfoAlliance, when using EE tables, works the same way. Although it clearly has to work within the capabilities of EE, a more informative message would go a long way toward making a naive user comfortable.

InfoAlliance always requires a data-source integrator. For stand-alone use, there is a local DSI that gives the program access to .DBF or .FIL data on local (or redirected) drives and to EE tables (which must reside on the same machine). The network DSI connects the machine on which it runs to everything that a local DSI can use, and then it exports those connections across the network. I ran the network DSI on the Systempro server; that's how I gave the Compaq 486/25 client access to the Systempro's EE tables.

Any InfoAlliance workstation can export local data by running a network DSI, and it can simultaneously connect to and use data exported by one or more remote network DSIs. It's a wonderfully flexible system. InfoAlliance maps remote servers into the local file system, so access to them seems familiar. A handy network monitor, which is included with the network DSI, enables administrators to monitor users, open files, and locks. An advanced feature, which I didn't test, allows administrators to roll back incomplete multiserver transactions.

The Eye of the Beholder

It's difficult to make sweeping generalizations about InfoAlliance. Everything depends on what sort of data you have, how you use it, and what your long-term plans are. The native DBMS is really quite sophisticated—good enough, probably, for many simple data systems with well-defined modes of access.

For those users who would prefer not to tackle relational database design in its full generality, InfoAlliance files support "multivalue" fields and groups that implement one-to-many relationships directly. With excellent network support and superb user-interface aesthetics and functionality, InfoAlliance alone—data-source integration notwithstanding—has a lot going for it. A Windows version would certainly broaden the appeal of this option.

However, SPC does not pretend that InfoAlliance is a serious database engine in its own right. Data-source integration is the real attraction. SPC believes in SQL and wants to help bring it to the corporate desktop—something that we all keep hearing about but few of us have seen. How will that noble and worthy ambition play out? One possibility is a .DBF-to-SQL migration scenario: You train users on an InfoAlliance system that connects to .DBF sources and then cut over transparently to a SQL engine. My own experiments showed me that this is a viable strategy. As a database administrator, I'd want users to run the EE/IA version of the articles-and-authors application to gain two key benefits: enforced referential integrity, and access to the powerful query language.

Today, though, InfoAlliance does not deliver both of these benefits. The referential integrity comes through to InfoAlliance clients, but the query language doesn't—not unless users are also set up to run Query Manager. In addition, the EE/IA version doesn't handle concurrency in the way users may have come to expect.

Despite its advantages, I might have a hard time selling the EE-based version to my users. If I could deliver the query language, too, and an enhanced SQL-oriented query toolkit, that might tip the scales. The paraphernalia that surrounds SQL engines can be pretty scary, but SQL itself really isn't. Access to the query language needn't conflict with the ease of use that is SPC's hallmark. And it would support one of SPC's stated goals: to empower users to work with data directly.

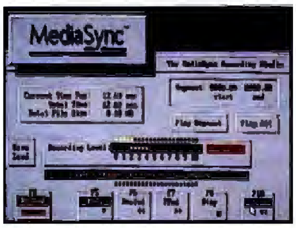
Harnessing engines like EE Database Manager, SQL Server, and DB2, and licensing ordinary users to drive them, is a daunting but essential task. If SPC is serious about this project—and I think the company is—there's much work yet to be done to leverage the full power of the engine without overwhelming the driver. I salute the valiant first effort and look forward to better things to come. ■

Jon Udell, a BYTE senior editor at large, administrates the BYTE editorial LAN. He can be reached on BIX as "judell."

Your Animations Never Sounded So Good!

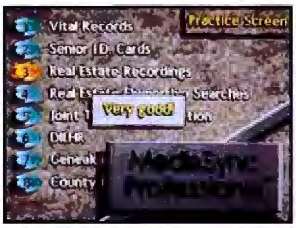
Announcing Advanced Multimedia Synchronization for Autodesk Animator® and Autodesk 3D Studio™ Users.

MediaSync.™
Real Multimedia Power.™



You've just finished some great animations. All you need now is a powerful soundtrack to tie them all together. But how will you do it? How will you ensure that your flics start exactly when you want them to? And where do you find the audio hardware capable of the quality you require?

Introducing MediaSync™ (formerly MediaEngine). Powerful, easy-to-use multimedia synchronization software that gives you the tools you need to produce stunning presentations that your audiences can hear as well as see. Tools like **Absolute Referencing™**, which lets you schedule flics to play and images to display at discrete times during your soundtrack. And tools like **Frame-Accurate Audio Scheduling™**, which allows you to fully synchronize audio effects with *exact frames* in your Autodesk Animator and Autodesk 3D Studio flics!



Audio Hardware Included.

For only $695, The MediaSync System™ includes the MediaSync Audio Processor™ card and the MediaSync Recording Studio™ software to handle high-fidelity digital audio. Or, get MediaSync:Sound Blaster™ Software for only $199. Or, go interactive with MediaSync Professional™ for just $895. The choice is yours.

MediaSync runs on any standard IBM PC AT® or compatible equipped with 640K RAM and a VGA display. Which means that you can use MediaSync today, right out of the box. Bouncing balls will impact with a *Boom*, flying logos will really *Swoosh*, and sales figures will materialize precisely on cue. And most important, your animations will never be the same again.

Contact your Autodesk Multimedia Reseller or call Genesis Multimedia Products at (414) 796-1005.

Genesis Multimedia Products Division, 15850 West Bluemound Rd., Suite 307, Brookfield WI 53005, ©1991, Genesis Multimedia Products.
MediaSync, MediaSync Professional, MediaSync Audio Processor, MediaLanguage and Absolute Referencing are trademarks of Genesis.

Circle 118 on Inquiry Card (RESELLERS: 119).

SOFTWARE

A Graphical Environment That Runs Where Windows Can't

OWEN LINDERHOLM

BYTE ACTION SUMMARY

- **GEOWORKS ENSEMBLE**
- **WHAT ENSEMBLE DOES**
  Ensemble is a multitasking graphical environment with bundled productivity applications.
- **WHAT YOU'LL LIKE**
  Ensemble runs well on even the smallest PC. The applications are robust enough to justify running Ensemble, and DOS programs are just a button-press away.
- **WHAT YOU'LL DISLIKE**
  There are not yet any programming tools available, and no third-party applications.
- **WHAT YOU'LL NEED**
  IBM PC, XT, AT, PS/1, PS/2, or compatible; 512K bytes of RAM; a hard disk drive; CGA or better display; DOS 2.0 or higher; and a mouse.
- **WHAT WE RECOMMEND**
  The Ensemble applications are perfect for inexperienced users, and the minimal hardware requirements may help you salvage older PCs and save money on future ones.
- **WHAT YOU'LL PAY**
  $199.95
- **FOR MORE INFORMATION**
  GeoWorks, Inc.
  2150 Shattuck Ave.
  Berkeley, CA 94704
  (415) 644-0883
  fax: (415) 644-0928
  Circle 1221 on Inquiry Card.

GeoWorks' multitasking and advanced graphics capabilities are exploited in the included GeoWrite application. Note the Motif-like appearance.

The personal computer revolution is fast leaving behind those users who can't afford to change. Many new blockbuster programs simply cannot run at a useful speed on anything less than a quick 286. Windows 3.0 finally brought a reasonable-quality graphical user interface (GUI) to the DOS masses, but at the cost of leaving all those users with IBM PC or XT compatibles unable to point and click. When GeoWorks brought out Ensemble, with its multitasking graphical environment for IBM compatibles, many hailed it as the savior of the XT, since it not only works on any IBM PC, it works quickly enough to be useful on those older and slower systems.

Ensemble is deliberately very similar to several other graphical environments available on a range of different systems. It most resembles Motif, a popular GUI on Unix workstations. But it includes a trashcan similar to the one on the Macintosh and a suite of user programs similar to those provided with Microsoft Windows. This latter inclusion makes it a little difficult to describe Ensemble as just a GUI, since it comes with several useful end-user applications. These applications are what makes Ensemble worthwhile, since there is currently no provision for end-user programming under Ensemble, and applications from other software companies may be a little slow appearing for an environment from as small a company as GeoWorks.

The Heart of the Matter

According to GeoWorks, churning beneath Ensemble is an operating-system engine that in some ways rivals OS/2, except that it has better graphics support and much lower hardware requirements. Hidden beneath Ensemble is an underlying operating-system layer, PC/GEOS, that features preemptive multitasking, dynamic memory and object management, and interprocess communications. However, no developer's tools are yet available to fully test those features. Ensemble is only the first of what will be—if third-party support can be rallied—the most powerful applications available for smaller PCs.

Installing Ensemble is a simple but lengthy process, with seven 360K-byte disks to copy. The instructions were clear, however, and the installation program made it easy to select and test all the appropriate drivers for the screen, mouse, and printer.

There are two basic ways to use Ensemble. The first is a novice user's, or "appliance," mode, where a small selection of programs is available. Even beginners will have to move on from this mode fairly rapidly, since the most useful Ensemble applications, such as the word processor, are only available in the more advanced "professional" mode. The appliances include a notepad, a calculator, an address book, a scheduler, a banner printer, and a simple version of solitaire. The appliance mode does not allow windowing; all the applications run full-screen.

The professional mode uses Motif-style windows and allows plenty of fun customization, including the ability to add your own background (a nice view of a full moon is included) and alter configurations on the fly. It also allows multitasking, including the ability to run communications in the background.

One of the best parts of the professional mode is the file manager application, which is one of the best programs of its kind I've seen. It is intuitive, easy-to-use, and fast. One added bonus of working with files under Ensemble is that all files created by Ensemble applications can have long filenames of up to 32 characters, and they can all have attached comments to explain what they are used for. Unfortunately, this does not apply to files created by other programs.

The other applications in the professional mode are also good. GeoWrite, the word processor, is a fairly basic graphical word processor offering good editing, formatting, and typographical features, but it has few added frills, such as a spelling checker. Its strength is that it is truly WYSIWYG, and it prints scalable fonts even on dot-matrix printers. Ensemble uses Nimbus Q scalable-font technology, and the results are excellent on laser printers and 24-pin dot-matrix printers, and still very good even on nine-pin dot-matrix printers.

GeoDraw is a basic drawing program that uses objects and is resolution-independent. It doesn't have bit-map painting capabilities, and no program that does is included. The two personal-information management programs included are also very good. GeoDex is a flexible Rolodex program that can dial numbers, search, and link with the planner program, GeoPlanner. The planner has clean, simple features and can put in repeating events with some flexibility. The other useful application is a scrapbook that is similar to that used by the Mac. It lets you save copies of frequently used text or graphics and paste them into the word processor or drawing program extremely easily.

GeoComm is a straightforward telecommunications program that can emulate several terminals. It uses scripts that are somewhat basic, but they are adequate for automating many on-line tasks and can download files using the XMODEM protocol. However, I experienced occasional problems when GeoComm attempted to dial or hang up the modem.

Besides providing a graphical environment and some pretty useful applications, Ensemble also provides a straightforward and easy-to-use DOS shell. This is available from the Ensemble welcome screen, where you also select between the appliance and professional modes. You can either exit from Ensemble to the DOS prompt and run programs from there, or you can install buttons in the DOS mode of the program that allow you to invoke DOS applications simply by pressing the correct button. This DOS shell sits atop MS-DOS, which Ensemble loads after saving an image of itself, so I experienced no compatibility problems on my 386SX-based clone.

The documentation is very good, particularly for beginners. A simple quick-start booklet not only makes it easy to get going with Ensemble but also provides several helpful hints for those not used to working with GUIs. The main manual is also excellent, although the index is a little inaccurate in parts.

An Attractive Ensemble

I had few problems with Ensemble apart from the occasional difficulties with dialing and hanging up the modem in GeoComm. Because of the way it uses color three-dimensional shading, Ensemble does not look very good running on a CGA display in monochrome and doesn't look wonderful on a Hercules display. It does, however, look good on almost any other display.

Another problem is that sometimes the GeoWrite word processor leaves small sections of letters behind when deleting characters, which is unsightly but only a display artifact that does not affect the text file. A bigger concern is the lack of more powerful applications for the environment. There is no database, spreadsheet, or powerful word processor, nor is there a way for end users to program for the interface. All these will be needed, plus a wide range of less commonly used applications, before Ensemble becomes a widely accepted interface.

Prospective users shouldn't let these problems scare them away. For a relatively low price, Ensemble offers a useful word processor, drawing program, Rolodex, planner, and communications program. They all work well together and are tied up in a friendly and easy-to-use GUI that is responsive and good to look at on almost any machine. Finally, the file manager and DOS shell are about the friendliest and prettiest ways you can find to avoid the DOS prompt. ■

Owen Linderholm is a BYTE senior news editor based in San Francisco. He can be contacted on BIX as "owenl."

SYSTEM

ALR's Multiprocessing Monster Uses Six i486 Processors

JOHN UNGER

The most obvious way to make a computer run faster is to speed up the CPU, but in a multitasking environment, you can also add processors and have each work simultaneously on a different task. The Advanced Logic Research (ALR) MultiAccess Series 3000 multiprocessor Unix machine uses both techniques. (See the text box "Multiprocessing Explained" on page 281.)

The MultiAccess system holds up to six Intel i486 CPUs running at 25 or 33 MHz. It also keeps a 33-MHz 386 CPU on the SCSI controller busy when that processor is not servicing file I/O requests. The system includes 13 combination Corollary C-Bus/ISA bus expansion slots. The Santa Cruz Operation's Unix/System V/386 release 3.2 and MPX multiprocessing kernel make the package work. (See photo 1.)

MPX lets existing multiuser, multitasking Unix applications run on the MultiAccess system's many processors. All the processors execute a single copy of the kernel and schedule themselves from a run list of processes. MPX is transparent to users and the applications that they run.

ALR offers the MultiAccess system in four configurations. The Models 10 and 20 include one 25-MHz i486 CPU in a tower PC-style chassis. The Models 30 and 40 come with two 25-MHz i486 CPUs and use a minicomputer-style enclosure that accommodates a large uninterruptible power supply, a Model 10-/20-type chassis, and additional room and power for up to seven full-height hard disk drives. The Models 10 and 30 include a 330-megabyte SCSI hard disk drive; the Models 20 and 40 use a 650-MB hard disk drive.

Serious computing power isn't cheap. A Model 10 with one 25-MHz i486 CPU, 8 MB of RAM, a 330-MB SCSI hard disk drive and controller, a VGA adapter, and a high-density 5½-inch floppy disk drive costs $15,999. My Model 20 review unit had four i486 CPUs, a SCSI controller card with an on-board 33-MHz 386 processor, SCO Unix, five copies of MPX (one for each processor), SCO TCP/IP, a 650-MB SCSI drive, a 150-MB cartridge tape system, an Ethernet card, and a single memory board with 16 MB of RAM and costs $50,064. This configuration can accommodate up to 96 users, however. Assuming that those users are running low-cost terminals, the total cost per user isn't unreasonable.

Photo 1: *The MultiAccess Series 3000 symmetric multiprocessing system holds up to six i486 processor boards. SCO Unix and the MPX multiprocessing kernel coordinate processor activity.*

Proprietary Bus Architecture

The heart of the MultiAccess system is Corollary's proprietary C-Bus. ALR is the first out of the gate with a multiprocessor machine, but other companies, including American Mitac and DEC, also have C-Bus multiprocessor computers in the works.

The C-Bus supports processor and shared-memory communications; it clocks in at 16 MHz and supports burst transfers of up to 64 MB per second. The MultiAccess system's backplane has 13 dual C-Bus/ISA expansion slots. Each i486 module sits on a board that plugs into the C-Bus/ISA bus connectors (see photo 2).

The base system comes with a pair of system/CPU boards that occupy two slots. One board includes a 25-MHz i486

BYTE ACTION SUMMARY

- **ALR MULTIACCESS SERIES 3000, MODEL 20**
- **WHAT IT DOES**
  This symmetric multiprocessing computer uses SCO Unix's MPX extensions with Corollary's C-Bus to process multiple tasks simultaneously.
- **WHAT YOU'LL LIKE**
  Up to 160 users can access the computing power of the system's six i486 processors.
- **WHAT YOU'LL DISLIKE**
  A fully configured system can cost well over $60,000, depending on your needs.
- **SHOULD YOU BUY?**
  The system is best suited to environments where many users are running compute-intensive tasks, or where administrators can spread the system's cost across many terminal users.
- **SYSTEM CONFIGURATION TESTED**
  Four 25-MHz i486 CPU modules; 33-MHz 386 on SCSI controller; 16-MB RAM; 256K-byte external cache on each i486 CPU module; high-density, 5½-inch floppy disk drive; 650-MB SCSI hard disk drive; 150-MB cartridge DC-600 tape drive; ALR FlexView 2X Super VGA color monitor; 800- by 600-pixel ALR VGA adapter; 101-key IBM Enhanced–style keyboard; two serial ports; 12 SIO ports; parallel port; external SCSI connector; one Western Digital thick/thin Ethernet port; SCO Unix/System V/386 release 3.2; SCO MPX; SCO Unix TCP/IP Ethernet communications.
- **WHAT YOU'LL PAY**
  Base system: $15,999
  System as tested: $50,064
- **FOR MORE INFORMATION**
  Advanced Logic Research, Inc.
  9401 Jeronimo
  Irvine, CA 92718
  (800) 444-4257
  fax: (714) 581-9240
  Circle 1232 on Inquiry Card.

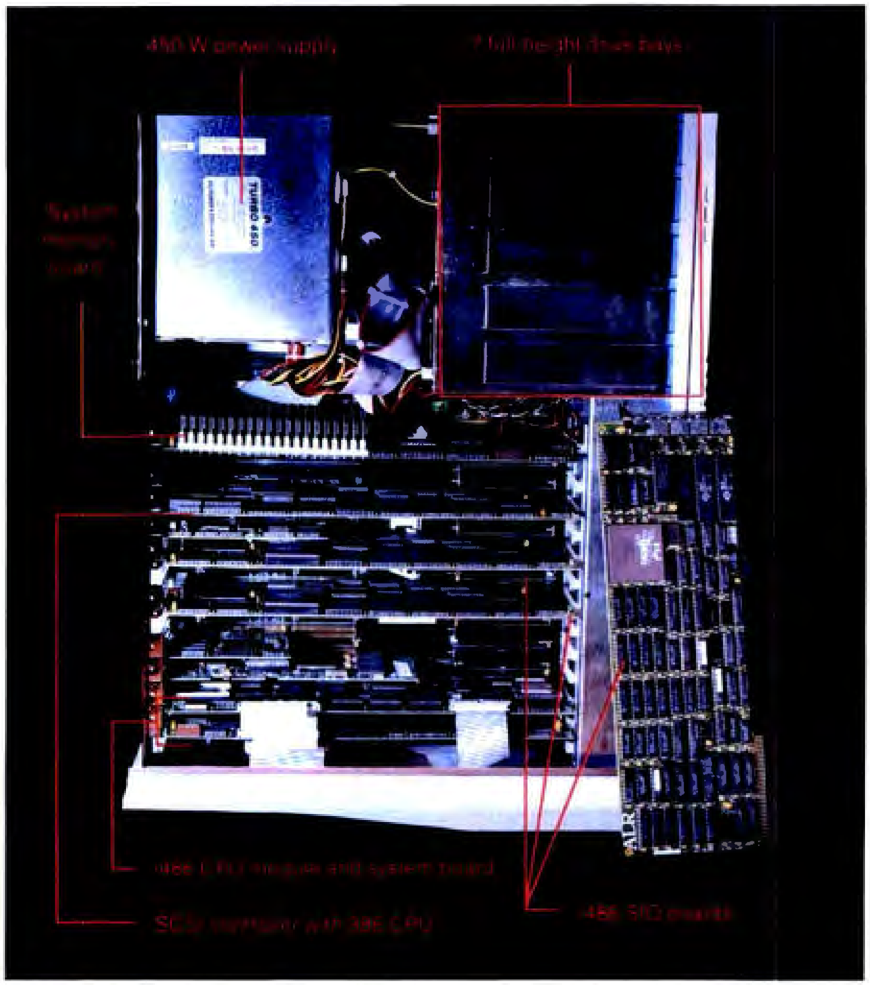


Photo 2: *Inside, the MultiAccess design includes combination ISA bus/C-Bus expansion slots. The C-Bus slots hold up to six i486 processor boards (see lower right), each with its own external 256K-byte cache.*

CPU with a 256K-byte external write-back cache. The other holds an AT interface board that contains computer-specific logic, such as DMA controllers, a real-time clock, a Phoenix ROM BIOS, a diagnostic CMOS ROM, a serial port, and the floppy disk drive interface. ALR also includes an Adaptec SCSI disk drive controller card, a VGA graphics adapter, a serial/parallel port card, and a memory card with 8 MB of RAM. These components occupy 6 of the 13 available slots. My heavily loaded review system had only one open slot.

Additional processors, which are called serial I/O (SIO) boards, include an i486, 256K bytes of cache RAM, a cache controller, and four I/O ports. Each I/O port plugs into a terminal concentrator box ($695) that supports up to 8 users, for up to 32 terminal users per processor board. Memory boards hold up to 16 MB of RAM using 1-MB single in-line memory modules; the MultiAccess system holds up to 64 MB of RAM on four boards.

The C-Bus uses shared memory, so it must preserve integrity between system RAM and each processor's cache. With ALR's write-back cache design, the most recent values for the data that one CPU needs could easily be located in another processor's cache, in which case the values in main memory would be out of date. The C-Bus controller detects this situation and tells the cache controller with the correct data to pass the values to the requesting processor.

Multiple Performances

Because the MultiAccess is a multiprocessor machine, its performance is not directly comparable to that of single-processor Unix workstations. BYTE's standard suite of Unix benchmark programs consists largely of single-threaded or serial applications that spawn only a few

Multiprocessing Explained

If you run power-hungry applications, you are probably already using multiple processors in your current machine. Numeric coprocessors, graphics coprocessors, and other coprocessors unload some processing tasks from the CPU, but the system can operate on only one task at a time. *Multiprocessor* architectures take the coprocessor concept a step further. These machines use the same serial, or "pipeline," processing model, but they allow you to run separate tasks simultaneously on each of the system's CPUs.

Multiprocessing architectures fall into two groups: *asymmetric* and *symmetric*. Each processor in the asymmetric design is task-specific. One processor might handle disk I/O while another runs application programs, for example, and system designers would optimize each processor for its specific task. Symmetric systems (e.g., MultiAccess) distribute tasks equally among the available processors: Any processor can service any task.

A single program doesn't execute any faster on a symmetric multiprocessor system than it would on a single-CPU computer. But five programs can run simultaneously on a five-processor system and get the same performance as if each were running on its own system.

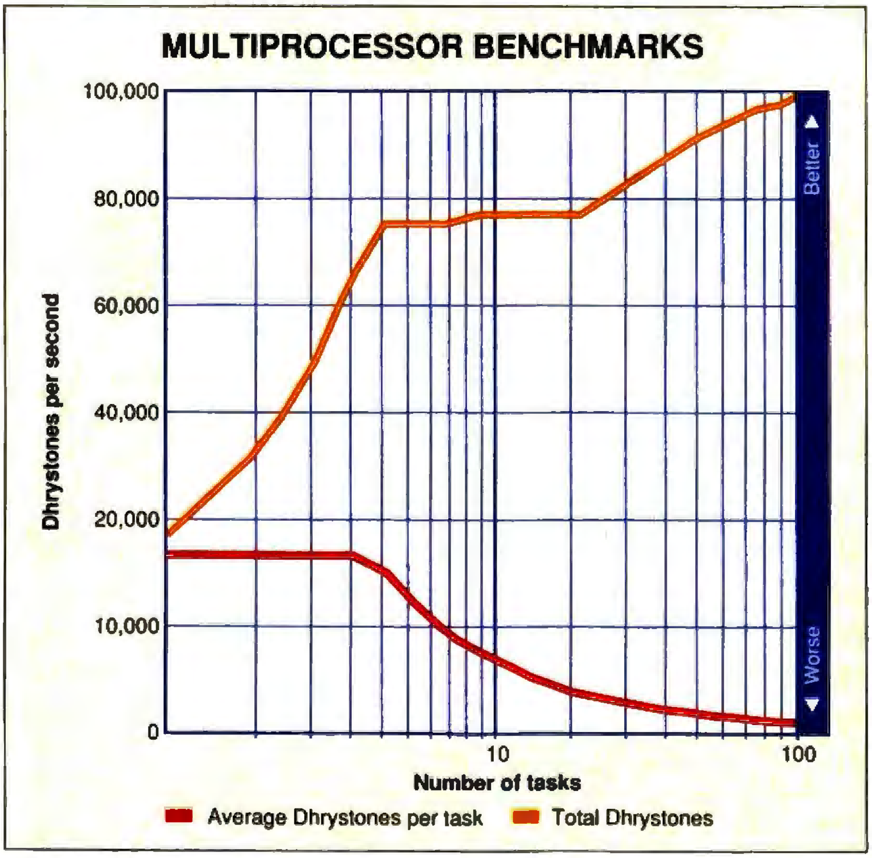
Don't confuse multiprocessing with its more sophisticated cousin, *parallel processing*. Computers that use parallel processing divide a task into many parts, run each part simultaneously on a different CPU, and then combine the results when the program finishes. This approach works well for a single, huge numerical simulation or for any problem that you can break down into separate sections and calculate independently.

processes. They don't take full advantage of this computer's multiprocessor power. When run on the MultiAccess system with the minimum of background multiprocessing administration, the standard benchmarks turn out results that are about the same as those produced on other single-processor 25-MHz i486 computers BYTE has tested.

As an alternative, the BYTE Unix Lab developed a simple multiprocessing benchmark that runs multiple, concurrent copies of the Dhrystone2 test used in BYTE's Unix benchmark suite. (Because of some program changes, the Dhrystone2 results in the Multiprocessor benchmark test aren't comparable to those in the Unix benchmark test.) I ran the test 13 times, increasing the number of concurrent tasks each time until I reached 100. Each test returned a separate Dhrystone result for each concurrent process.

The lower curve in the figure shows the average Dhrystones per task, which begin to drop after five concurrent processes. With five processes, it was clear which process was running on the 386 on the SCSI board. The processes running on the four i486 modules averaged 16,667 Dhrystones per second; the fifth process, running on the 386, generated just 8696 Dhrystones per second.

The higher curve in the figure adds the results for each test to illustrate the total amount of processing power available as a function of the number of processes running. Total CPU power increased linearly as I added up to five



BYTE's Multiprocessor test runs multiple copies of the Dhrystone2 test concurrently. I ran the test 13 times, adding more tasks on each pass. Each instance of the Dhrystone2 returns its own result. The lower curve expresses the results as average Dhrystones per task. The higher curve shows the aggregate Dhrystones for all tasks in a given test. While the average Dhrystones per task decline rapidly after five, the total number of Dhrystones increases until the number of tasks approaches 100.

processes, after which the total Dhrystones began to climb more slowly, finally leveling off as the number of processes approached 100.

Compute Server for the 1990s

The MultiAccess system is an impressive piece of hardware. With a full complement of 33-MHz i486 processors humming away, aggregate system performance should be capable of exceeding 150,000 Dhrystones per second. The system's outstanding performance and capabilities make it ideal for use as a compute server on a LAN, as well as for supporting many terminal users.

Fully configured, the MultiAccess system serves up to 160 users at an average cost of less than $500 per user.

The cost of adding a single processor board to the MultiAccess is about what you would pay for a stand-alone i486 computer: $5999 for a 25-MHz board and $7499 for the 33-MHz unit. A fully loaded Model 20 with six 25-MHz i486 CPUs costs roughly $60,000, depending on how much memory you add. Fully configured, the MultiAccess serves up to 160 users at an average cost of less than $500 per user, excluding the cost of terminals ($500 each).

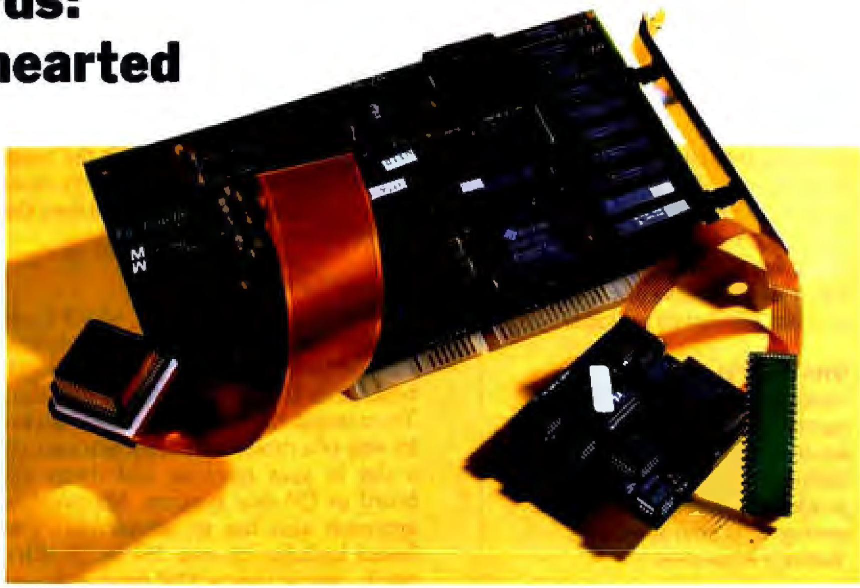
The MultiAccess system is well suited to environments where many users must access the same large data sets and then run CPU-intensive analyses of the data. Its centrally located multiprocessor CPUs and disk storage make it easy to manage such a system, and adding new users is as easy as stringing a new serial cable. ■

John Unger is a scientist who works for the U.S. government in the Washington, DC, area. He can be reached on BIX as "junger."

HARDWARE

SX Upgrade Boards: Not for the Fainthearted

STEVEN J. VAUGHAN-NICHOLS



The FastCache-SX upgrade board (left) fits into a 16-bit ISA slot and connects to an AT system's 286 socket by way of a special plug and cable. The Cumulus 386SX card (right) plugs directly into the 286 CPU socket. Both accept an 80387SX FPU.

On the face if it, 386SX upgrade boards seem like a great idea. The millions of perfectly good AT-class computers in use are the equal of any 386SX personal computer in graphics, mass-storage, and memory capacities. Their only shortcomings are lack of speed and their inability to run 32-bit applications. Despite this, the market has been quite slow to accept 386SX upgrade boards. Two products that attempt to buck this trend and revitalize the legion of older 286 machines are Cumulus's 386SX and MicroWay's FastCache-SX.

Both products have several strikes against them. Strike one: They're expensive. For the $495 minimum price of an SX upgrade board, you can buy a brand-name SX motherboard from direct-mail distributors. Strike two: There can be as many potential compatibility problems lurking for users of SX upgrade boards as there are for someone who decides to replace the entire motherboard. I tested both boards on several machines, including a Compaq Deskpro 286 and several IBM PC clones, and recommend that only experienced PC users work with them.

Cumulus 386SX

The Cumulus 386SX is a daughterboard that plugs into your system's CPU socket. It runs at the same clock speed as the original 286 CPU, so you're buying the advantages of a 32-bit processor and not a boost in speed.

The daughterboard itself is tiny—approximately the size of a 3½-inch floppy disk label—and it includes a socket for an 80387SX math coprocessor. It fits into AT systems that use either the pin-grid-array 286 processor socket or the plastic-leadless-chip-carrier (PLCC) socket. You can't use it in machines that use the three types of leadless-chip-carrier sockets. The daughterboard itself costs $495. If you want to add a math coprocessor, you'll have to ante up another $95 for a special cable kit. I tested the board with a math coprocessor installed.

Installation is a snap for old hands at hardware tinkering, but hardware novices should seek expert help rather than attempt the operation themselves. In some cases, clearance around the CPU socket may prevent you from installing the daughterboard. Assuming you have room to install the card, the first step is to set the 386SX's speed with a jumper. Then you remove the 286 chip (PLCC sockets require a special extraction tool that Cumulus sells for $50). Finally, you plug the daughterboard into the old socket. That's the basic procedure, but the exact method varies depending on your system's architecture. The installation guide covers these variations in painstaking detail.

That's the good news. The bad news is that merely installing the Cumulus board won't turn your AT into a 386SX-compatible clone. In fact, it may not work at all. Cumulus, like MicroWay, maintains a list of compatible machines. If your computer isn't on it, be ready for trouble. Fortunately, Cumulus will refund your money, plus return shipping, if you can't get the board to work.

Even in "compatible" machines, it's likely that your motherboard won't mesh perfectly with the new processor. This means that while some protected-mode software requires Cumulus software drivers to work properly, other software (notably Windows 3.0) won't work right with the drivers installed. To the company's credit, a separate sheet documents these and other, more minor compatibility problems.

Another potential drawback with the Cumulus board is that, except for the CPU, it runs at the motherboard's clock speed. The CPU itself runs at twice the speed of the system up to the limit of its inherent capacity. This creates a data I/O bottleneck that keeps you from realizing the full advantage of the higher-speed processor.

You do get some performance advantages, but users looking for a performance boost will be disappointed. As the BYTE benchmarks show (see the figure), a Cumulus-augmented system was sometimes slower than an unmodified Compaq Deskpro 286. Some software, like the PKzip data-compression utility, detects the 386SX chip and uses 386-specific instructions to boost performance, but few other programs do this.

While no one is likely to buy this board for its speed, it does have other advantages aside from enabling the use of 386-specific software. The board comes with drivers and programs that make extended memory emulate LIM 4.0 expanded memory and let you use high memory for memory-resident programs.

continued

BYTE ACTION SUMMARY

- **386SX UPGRADE BOARDS**
- **WHAT THEY DO**
  SX upgrade boards replace the 286 CPU in your AT system with a 386SX.
- **WHAT YOU'LL LIKE**
  Both products let you run 32-bit applications that require a 386-class CPU. The FastCache's on-board 16- or 20-MHz clock and 32K-byte CPU cache also make your old 286 system run faster.
- **WHAT YOU'LL DISLIKE**
  Installation can be a nightmare—particularly with the FastCache board—and you may encounter additional software compatibility problems after you get the system running. Both boards are also relatively expensive.
- **WHAT WE RECOMMEND**
  Buy only if the vendor has tested its board with your computer. The Cumulus board offers 386 compatibility but no performance gain; the FastCache offers both. Consider, however, that you can buy a comparable 386SX motherboard by mail order for less than the cost of either of these upgrade boards.
- **WHAT YOU'LL PAY**
  $590 for the Cumulus 386SX card with connector cable; $690 for the MicroWay FastCache-SX 20-MHz 386SX board with 32K bytes of SRAM cache and cable.
- **FOR MORE INFORMATION**

Cumulus Corp.
23500 Mercantile Rd.
Cleveland, OH 44122
(216) 464-2211
fax: (216) 464-2483

Circle 1229 on Inquiry Card.

MicroWay, Inc.
Research Park
P.O. Box 79
Kingston, MA 02364
(508) 746-7341
fax: (508) 746-4678

Circle 1230 on Inquiry Card

These procedures aren't as smooth as those of QEMM from QuarterDeck, but they do increase the board's utility.

Another plus for Cumulus is that the technical documentation, while brief, is complete and to the point. Cumulus technical support is provided by a toll telephone line. The knowledgeable and helpful technical staff quickly and promptly answered my questions. Given the array of possible compatibility problems from this type of upgrade, I can't overstate the importance of good support.

MicroWay FastCache-SX

Unlike the Cumulus 386SX, which plugs directly into the CPU slot, the MicroWay FastCache-SX is a three-quarter-length board that fits into any 16-bit ISA slot. You connect the board to the CPU socket by way of a cable. This approach uses up a slot in your machine and limits the board to ISA-bus systems. MicroWay's approach also has its advantages: The board includes its own 16- or 20-MHz clock, and it uses a 32K-byte on-board processor cache (problems with correctly monitoring DMA preclude on-board caching with the Cumulus design). The board also has a socket for an 80387SX math coprocessor.

The boards start at $495 and $595 for the 16- and 20-MHz versions, respectively. You'll also need the cable that connects the board to the CPU socket. MicroWay sells this separately for $95. My 20-MHz 386SX board included an additional 32K bytes of cache RAM ($70), which brought the total price for my upgrade to $760. As this went to press, MicroWay announced the FastCache Plus, a full-length board that holds a CPU and up to 8 megabytes of system RAM. MicroWay charges a $100 premium for the board, which should perform memory accesses faster.

It's not surprising that the FastCache is much faster than the Cumulus board. It zoomed by the Cumulus board on most tests. Part of the FastCache performance is due its 25-nanosecond static RAM cache, which maintains compatibility with the slower motherboard and bus. An Austek controller directs the cache and lets the SRAM function without wait states. You run a utility to enable the cache and determine what system functions to place in it. Once you have determined what options to use, you activate the cache with the appropriate flags in your AUTOEXEC.BAT file.

However, the instructions don't tell you how to determine the appropriate options. Despite an expert knowledge of computers and a careful reading of the manual, I could only pick up bits and pieces of the answer. Trial and error while running system benchmarks and supplied test programs was the best I could do.

Even with the cache on its best behavior, a FastCache system can run into compatibility problems. You might find interaction problems between extended memory and the board. For such problems, MicroWay supplies a utility that takes over the system services interrupt to improve performance. The problem with this approach is programs like Windows 3.0's SMARTDRV disk cache, which also use this interrupt.

But even these software aids may not be enough to get your system up and running with the FastCache. For example, your BIOS might not be able to cope with the faster processor speed. The most common symptom is intermittent problems with floppy disk drive access. The fix for this, as described in the manual, is to upgrade your BIOS (MicroWay sells a compatible Phoenix 386 ROM BIOS for $50).

Installation Blues

MicroWay claims that you can install the FastCache in any AT. I didn't find this to be the case—and I know my way around under the hood of a PC clone. And the testing engineers in the BYTE Lab are masters at installing recalcitrant hardware. Despite our combined efforts and extensive MicroWay technical assistance, we failed to get the board up and running on AT clones from Austin, Gateway, and Swan. In working to resolve these problems, MicroWay discovered a compatibility problem with 286 systems that use the Chips & Technologies Neat chip set. MicroWay was designing a fix at press time.

We did get the board to work on a Compaq Deskpro 286, but even that was a chore. One aspect of the installation involves inserting a plug into the 80287 socket. In the Deskpro 286, and only in this system, you must cut the connection between pins 25 and 26 on the plug. Another problem is access. In many cases, drive bays and other components block access to the CPU and/or FPU socket, which means pulling the motherboard to complete the installation.

I recommend that only the most grizzled hardware veterans try to install the MicroWay board. The manual won't be much help. It's poorly organized and lacks an index. Luckily, MicroWay has excellent technical support that's only a toll call away. Better yet, you can have TRW, a company specializing in on-site

Graphical User Interface CLEARING HOUSE

Specializing in products for Microsoft Windows and OS/2 Presentation Manager environments

G.U.I. CLEARING HOUSE - PM / Windows Catalog

File Edit Search Order!

WINDOWS APPLICATIONS

Development Tools

ACTOR 3.0	795
ADEPT Expert Application Builder	595
Bridge 2.0 Tool Kit	629
C-TRIEVE/Windows (Coromandel)	349
C_talk/Views	429
C++/Views	469
CASE:W 3.0 (CASEworks)	849
Graphics Server SDK	379
Guide 3	439
Icon Author (AimTech)	call
Knowledge Pro Windows	629
Lasertalk PC	309
Microsoft SDK for Windows 3.0	349
Multiscope for DOS/Windows 3	159
ObjectGraphics (WhiteWater)	409
Personal Case	179
PowerLibW	265
ProtoView	595
ProtoGen	409
Pubtech BatchWorks	89
SpeedEdit for Windows	255
ToolBox (Drover)	249
The Whitewater Resource Toolkit	189
WindowsMAKER (Candlelight)	695
WinTrieve	369
Zortech C++ Compiler	179

Database/Forms

Access SQL (SPI)	1279
Chart Builder for Superbase	169
dBFast/Windows	295
ERwin	729
FormWorx Forms Publisher	199
INTEGRA SQL (Coromandel)	609
JetForm	399
MARVIN Image Database	2395
Omnis 5/Windows	759
PerForm Pro	299
Q+E/Windows ver 2.5	139
Superbase 2 ver 1.2	249
Superbase 4 ver 1.2	469
Thinx	399

Engineering/Planning

ABC Flowcharter (Roykore)	249
CON-FLO, control valve analysis	179
Design/IDEF	2795
DesignView	749
DRAFIX Windows CAD	459
MathType	199
MetaDesign, diagramming tool	329
Milestones, Etc (Kidasa)	139
ORI-FLO, metering analysis	179
Project for Windows	469
PUMP-FLO, pump analysis	179
RFFlow, flowcharting	119
SPACETEK:Facility Planner	call
Topdown Project Planner (Ajida)	249

WPMA Member
The Windows & Presentation Manager Association

1-800-522-4624

International, call (203) 426-4624
Monday - Friday 9:00am to 8:00pm EST

*GUI Clearing House is the only national reseller **specializing exclusively** in Windows and OS/2 Presentation Manager environments. This specialization is necessary in order to properly serve you, our customer, in this rapidly evolving market. **Our goal is to provide you with the finest customer service in the industry and to ensure that the products you select are the correct ones for your application.***

When you call GUI Clearing House, you will be greeted by one of our friendly, knowledgeable sales staff who will take the time to talk with you to understand your specific requirements. To further assist you, we maintain a staff of technical consultants available to answer in-depth technical questions on products; and to help customers in identifying applications to meet their needs.

Please Note: The applications listed in this ad represent only a small sample of the Windows and OS/2 Presentation Manager products available through GUI Clearing House. Call us for pricing on any Windows or Presentation Manager application. We'll promptly get pricing and availability for you. CALL TODAY!

Connectivity

Business Session for Windows	269
DaVinci eMAIL for Windows	959
DynaComm (Windows)	259
DynaComm Elite	399
FaxIt! for Windows	179
MicroPhone II	259
Network Courier	CALL
TERM for Windows	179
Windows Workstation	559
WinComm	139
WinTerm	409

Tax Preparation

MacInTax 1040 Personal	69
It:X Personal Tax Analyst	69
MacInTax State Supplements (call)	69
TaxView Professional Series	call

General/Productivity/Utilities

Adobe Type Manager	59
Asymetrix Toolbook	309
BeckerTools 2.0	119
Distinct Back-up	119
hDC Icon Designer	49
IBM Current 1.1	259
Icon Pak II	89
PackRat 3.0	315
PackRat Network (3 User)	579
Personal Librarian	859
PLUS for Windows (Spinnaker)	279
Printer Control Panel (LaserTools)	139
Publisher's Powerpak	69
PubTech File Organizer	159
SmarText (Samna)	409
WideAngle/Windows	119
Windows/On The World	409
Windows Shopper's Guide	15
YourWay (Prisma)	call

Publishing/Graphics

Adonis Clip-Art Window Shopper	42
Aldus PageMaker	499
Archetype DESIGNER	795
Arts & Letters Graphics Editor	509
CA Cricket Graph v1.3	159
CA Cricket Presents	349
Corel DRAW! 2.0	399
DoDOT! (screen capture/convert)	139
Image-In Full Pak	679
Image-In Scan & Paint	139
Image Prep	269
Import for Windows	259
Instant ORGcharting	NEW
Micrografx Charisma	349
Micrografx Designer 3.01	469
Microsoft Office for Windows	call
Picture Publisher	489
PowerPoint for Windows	335
PubTech Multi-Tack	139
Scrapbook+ 2.1 (Eikon)	129
Ventura Gold Series for Windows	559
WordScan Plus (Calera)	795

Word Processing

Ami' ver 1.2	159
Ami' Professional ver 1.2	319
Gram-mat-ik for Windows	79
Language Master for Windows	89
NBI Legacy	359
Palantir Windows Spell 3.0	89
Word for Windows	329

Financial/Accounting

Accounting by Design	1059
Biz-Nix Accounting Partner	299
Bookkeeping by Design	559
CCA Enhanced Business Pkg	795
Evolve (ASI)	169
CCA Active Payroll	NEW
CCA Job Costing Module	NEW

PM APPLICATIONS

Active Life for PM	139
Aldus PageMaker for PM	579
Asymetrix ToolBook for OS/2	NEW
Brief for OS/2	229
CASE:PM for C or C++	1895
CASE:PM for MicroFocus Cobol	2369
ChipChat (Cawthon)	279
Collage PM	179
Corel Draw! for PM	call
DeScribe	529
Excel for PM	349
HyperACCESS/5 for OS/2	169
Lotus 1-2-3/G	579
Micrografx Designer	509
Multiscope for OS/2	349
Nexpert Object, PM Runtime	929
Object-1/PM (MDBS)	895
OS/2 PM Softset (Microsoft)	129
OS/2 PM Toolkit (Microsoft)	409
PackRat for PM	339
PackRat PM Network (3 User)	579
Perspective for OS/2	259
Q+E/PM ver 2.5	139
Relish	NEW
RT-Graphics (FSI)	959
RT-Graphics Toolkit w/source (FSI)	649
SmallTalk/V PM	339
SpeedEdit for OS/2	255
SpeedEdit for PM	255
Sytos Plus/PM (Sytron)	259
WideAngle for PM	119
Wingz (Informix)	359
Word for OS/2 PM (Microsoft)	call
WordPerfect 5.0 for OS/2	339
WinPRO/PM (Xian)	379
Zortech C++ OS/2 Compiler Option	139
Zortech C++ OS/2 Dev Edition	489

HARDWARE, etc.

Image Scanners

Logitech ScanMan 256/PC-AT	409
Logitech ScanMan 256/MCA	509
Microtek scanners	call

Boards

ATI 8514/Ultra	NEW
NEC Graphics Engine Brd 16 (AT)	689
NEC Graphics Engine Brd 256 (AT)	969
Paradise 8514A Plus (AT)	699
Paradise 8514A Plus (MCA)	759
Intel SatisFAXtion board	NEW

MultiMedia Products

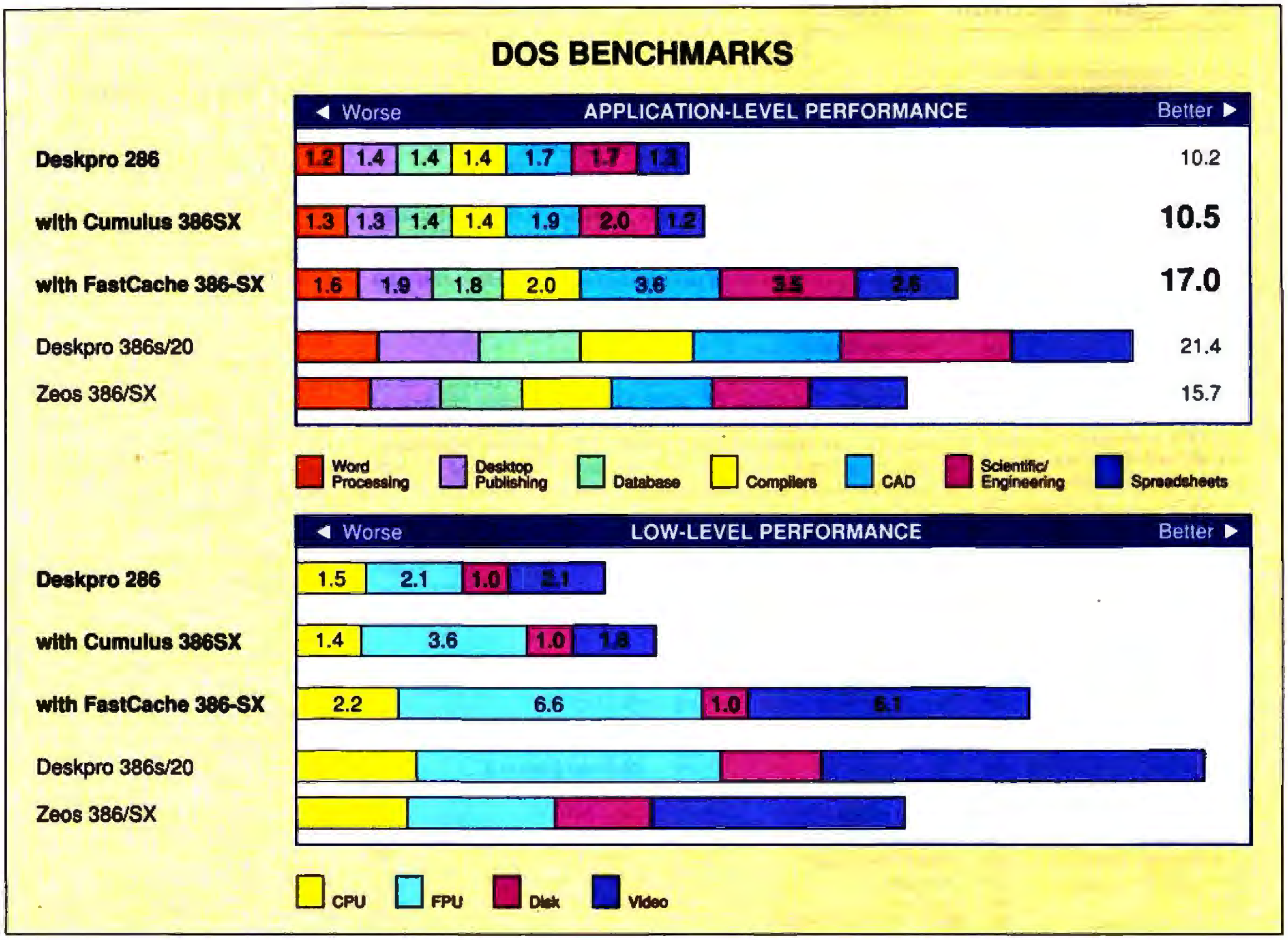
Super VideoWindows	NEW
VideoLinX:FRAMEBUFFER	NEW
XYXIS 600Mb Erasable Optical Drv	NEW

GUI Clearing House offers a full line of hardware items selected to augment the Windows, Presentation Manager, and MultiMedia based platforms. If you don't see a particular item, just ask.....we will promptly obtain pricing and availablity for you. Call us TODAY!

PAYMENT - Visa, MasterCard, Diners Club and Carte Blanche accepted. Personal and company checks accepted. Please allow 2 weeks for processing. Corporate and institutional purchase orders subject to credit approval and a minimum initial purchase $500, paid via C.O.D. or in advance. C.O.D minimum purchase is $100, maximum $1,000 payable by cash, cashier's check, or money order. CT residents add 8% sales tax.
SHIPPING - Shipping/handling charge is 3% or $8 minimum; 6% for C.O.D.. Larger shipments may require additional charges. Call for information for shipments to Alaska, Hawaii, and points outside the United States.
TERMS - All products carry manufacturer's warranties only. Product warranties, guarantees, rebates, trial period privileges, or other promotional programs are handled by the manufacturer. Defective items replaced or repaired at our discretion. All returned items must be accompanied by a return material authorization (RMA) number. There is a 15% restocking fee on non-defective merchandise. Shipping is non-refundable. Opened software and other consumables are non-refundable. We can not guarantee compatibility. Item availability, price, terms, and policies subject to change without notice. **Graphical User Interface CLEARING HOUSE** is not liable for damage due to omissions or typographical errors. Mailing address is **Graphical User Interface CLEARING HOUSE**: P.O. Box 10, Sandy Hook, CT 06482. (203) 426-4624

 190110

Circle 122 on Inquiry Card.



CONVENTIONAL BENCHMARKS

	LINPACK (single) (MFLOPS)	Dhrystones (Dhry./sec.)
Deskpro 286 with		
Cumulus 386SX	0.08	3344
FastCache-SX	0.15	6618
Deskpro 386s/20	0.16	7938
Zeos 386/SX	0.08	5760

For application and low-level benchmarks, results are indexed and show relative performance; for each individual index, an 8-MHz IBM AT running MS-DOS 3.30 = 1. For all benchmarks, higher numbers indicate better performance

The BYTE low-level benchmark suite identifies performance differences between machines at the hardware level; the application benchmarks evaluate real-world performance by running a standard test suite using commercially available applications. Application indexes include tests using the following programs. Word processing: WordPerfect 5.0; Desktop Publishing: Aldus PageMaker 3.0; Database: Borland Paradox 3.0 and Ashton-Tate dBASE IV; Compilers: Microsoft C 5.1 and Borland Turbo Pascal 5.5; CAD. AutoCAD release 10 and Generic CADD level 3 1.1.5; Scientific/Engineering: Stata release 2, MathCAD 2.5, and PC-Matlab 3.5f; and Spreadsheet. Lotus 1-2-3 release 3.0 and Microsoft Excel 2.1.

The BYTE Lab introduced version 2.0 of the DOS benchmarks in the August 1990 issue (see "BYTE's New Benchmarks: New Looks, New Numbers") Benchmark results for machines reviewed under previous versions aren't directly comparable. To obtain a copy of the benchmarks, join the listings area of the byte bmarks conference on BIX or contact BYTE directly.

computer repairs, install the board for you for an additional fee. But why bother? All the help in the world may not be enough. When the FastCache works, it works like a dream. But it doesn't always work.

As stated earlier, the company does maintain a list of systems that the board works with, and you'd be well advised to stick to that list. If you do venture into unexplored territory, MicroWay has a 30-day money-back guarantee and will pay for return shipping if the board does not work.

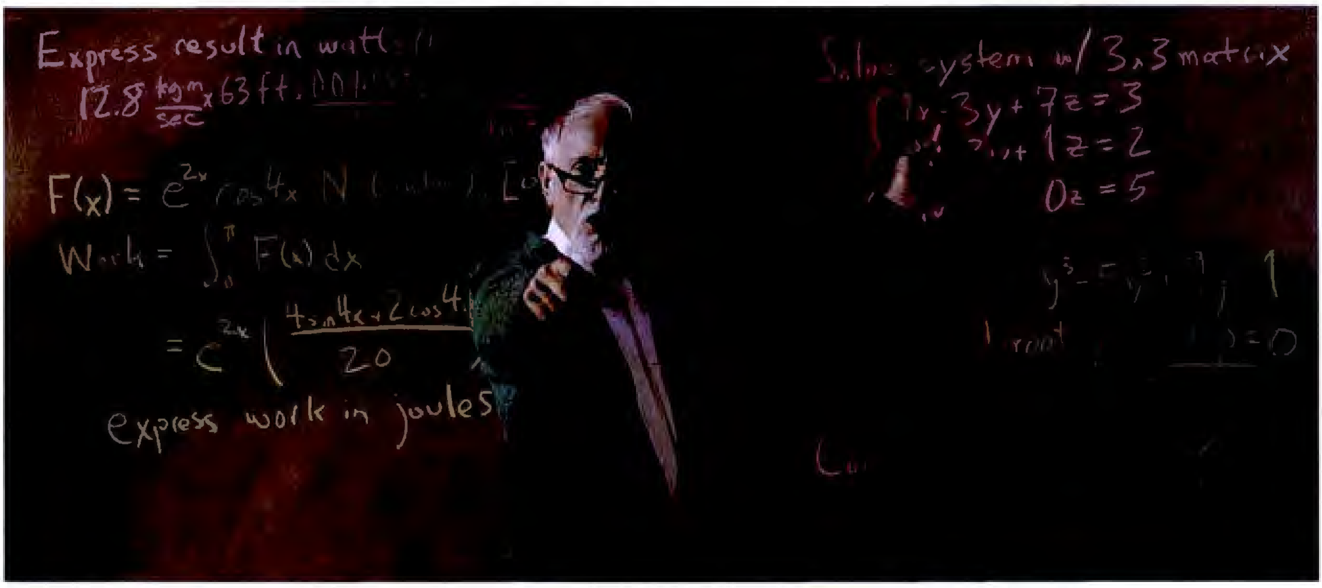
Three Strikes

You'll need technical expertise and patience to install either of these boards. Even when they work, you'll probably run into some software incompatibilities. And the prices are just too high for what you get.

However, if you're convinced that an upgrade board is the way to go, and you're not a hardware wizard, the Cumulus 386SX is the better choice. It won't, however, boost performance substantially. If you know the interrupt tables better than the multiplication tables and are willing to spend extra money for better performance, give the MicroWay FastCache a try. Better yet, invest in a new 386SX motherboard. You can buy a 16-MHz 386SX motherboard and 1 MB of RAM for less than $400 by mail order. Installing it takes a little bit more work, but you will probably be happier in the long run. ■

Steven J. Vaughan-Nichols is a freelance writer and a consultant in Lanham, Maryland. You can reach him on BIX as "sjvn."

In college, you would have killed for MathCAD. So why aren't you calculating with it now?



100,000 engineers and scientists already let MathCAD do their calculations for them.

Now that college is far behind you, perhaps it's time you graduated from spreadsheets, calculators and programming.

Because in today's working world of engineering and science, there's no time for anything less than MathCAD. The software that lets you perform engineering and scientific calculations in a way that's faster, more natural, and less error-prone than any calculator, spreadsheet, or program you could write yourself.

Thanks to MathCAD's live document interface,™ you can enter equations anywhere on the screen, add text to support your work, and graph the results.

PC MAGAZINE EDITOR'S CHOICE
March 14, 1989 issue.
Best of '88
Best of '87

It also comes complete with over 120 commonly used functions built right in. Perfect for creating complex equations and formulas, as well as exponentials, differentials, cubic splines, FFTs and matrices.

You get three-dimensional plotting, vivid graphing, and the ability to import HPGL files from most popular CAD programs, including AutoCAD.®

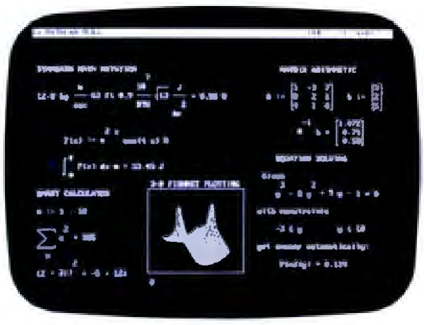
Done calculating? MathCAD prints *all* your analyses in presentation-quality documents, even on PostScript® compatible printers.

All of which has made MathCAD far and away the best-selling math software in the world. In fact, it's used by over 100,000 engineers and scientists – just like you.

There's MathCAD for the PC. MathCAD for the Mac, written to take full advantage of the Macintosh® interface. And a Unix® version that utilizes the speed and unlimited memory of your Unix workstation.

We also have Applications Packs for Advanced Math, Statistics, Mechanical, Chemical, and Electrical Engineering. Each is a collection of adaptable mathematical models, designed to let you start solving your real world problems right away.

For a free MathCAD demo disk, or upgrade information, dial 1-800-MATHCAD (in MA, 617-577-1017). Or see your software dealer.



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

Available for IBM® compatibles, Macintosh computers, and Unix workstations.

TM and ® signify manufacturer's trademark or registered trademark, respectively.

1-800-MATHCAD

MathCAD®

MathSoft, Inc., 201 Broadway, Cambridge, MA 02139

U.K.: Adept Scientific 0462-480055; France: ISECEGOS 1-46092768; Germany: Softline 07802-4036; Japan: CRC 03-665-9762; Finland: Zenex Oy 90-692-7677; Italy: Channel 02-4229441. *PSE #3*

Circle 170 on Inquiry Card.

the window box, but you won't see how it looks on the page until you exit the paragraph text window. In the display, you can selectively change kerning, fonts, spacing, and text rotation. Changing the paragraph box size changes margins, not the font size.

3-D Made Easy

A picture is worth a thousand words, so to test some of the enhancements in version 2.0, I recreated the 2-D soup can label from my version 1.1 review and turned it into a 3-D soup can (see photo 1). I tested Corel Draw on a Gateway 2000 386/33 with an ATI Wonder+ (800- by 600-pixel, 256-color) driver.

The conversion from 2-D to 3-D was easy. Highlights were simply a matter of blending two objects. Blends were so easy and fast that I kept trying variants, such as adding increments and changing colors. To curve the objects to a can shape and scrunch the sides, I grouped the objects, applied the envelope effect, and used snap-to guidelines to position envelope nodes precisely. Corel Draw did the rest of the work.

The can top started life as an ellipse, and then I reshaped it with a perspective tool and filled it with a 60-degree linear fountain for realistic shading (see photo 2). I tried several ellipses before I got it right. The hardest part was the can rim, which turned out to be trivial once I realized that I could add my own arrowheads to a line. I added a vertical vanishing-point perspective to the complete can so that it would look real, right down to the dent that the supermarket bagger gave it.

Photo 2: *The can top was created by first drawing an ellipse, which was then reshaped using a perspective tool and filled with graded shading.*

By the time I got to the rim, the drawing was complex, and the split-screen redraw was slow. As I mentioned earlier, rescaling with rulers set in points or picas caused Corel Draw to bomb, but the final results more than compensated for any problems.

2.0 Kudos

Compared to competitors like Micrografx's Designer 3.0 (see "New Adventures in Graphic Design," August 1990 BYTE), Corel Draw 2.0 is my choice for drawing software. With all its embellishments, it's still easy to use; its interface is still intuitive.

Also, the pictures look great. My boss, who knows the limits of my artistic ability, looked at a printout and asked, "You did that?" I couldn't have done it without this new version. I'm delighted with Corel Draw because it makes me look so talented. ■

—Sue Rosenberg

Reviewer's Notebook provides new information—including version updates, new test data, long-term usage reports, and reader feedback—on products previously reviewed in BYTE.

Even This Is More Confining Than Clipper.

Just as the vast expanse of the American West gave its settlers a new perspective on opportunity, Clipper's open architecture lends unprecedented freedom to application development.

Unlike fixed systems, Clipper never forces you to "make do". Its language is fully extensible with user-defined functions and new user-defined commands. You can extend the language with routines written in Clipper itself, or integrate code from other languages like C, Assembler, dBASE® and Pascal. Odds are, you already have knowledge you can use with Clipper!

But if a customizable language isn't enough, there's even more elbow room. Database and I/O drivers can be supplemented or replaced. Even Clipper's linker knocks down barriers by allowing you to develop applications larger than available memory, without defining overlays! And when you're done, Clipper's compiler generates stand-alone, executable files for cost-free, unrestricted distribution.

So, don't let the bounds of fixed systems fence you in. Unleash your imagination in the wide-open spaces of Clipper. To find out more, give us a call today.

Clipper® 5.0

The Application Development Standard

213/390-7923

Ask For Department-A

nantucket®

Circle 188 on Inquiry Card.

Perfectly

For Great Electronics and Computer Product Performance

Jameco's careful orchestration of product selection, quality control, customer support, and competitive pricing will make your next electronics purchase seem effortless. It will be done right, saving you time and money!

Over the past 16 years, Jameco has mastered the distribution of quality electronic components, computer products, and test and measurement equipment. That's why our market intelligence group tracks the very latest technology. Our purchasing groups buy globally for the best quality and value, thoroughly prequalifying each vendor and product against our high standards. And our in-house quality assurance group constantly tests products received into stock.

We offer the widest product selection. For example, choose from a full price/performance spectrum of computer systems, from starter to mid-range, to the most advanced computing tools available. Select from our catalog of over 4000 Jameco products.

Jameco conducts a full program of customer support: beginning with your plan to purchase and continuing

Jameco 16MHz 80386SX Motherboard

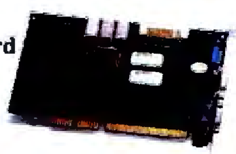
Jameco 16MHz 80386SX Computer Kit
- 2MB RAM (expandable to 8MB)
- 200 Watt power supply
- 101-key keyboard • Multi I/O Card
- Toshiba 1.44MB, 3.5" floppy drive
- DR DOS 5.0 and QAPlus diagnostic software

$1199.95/JE3816
monitor extra

Jameco 33MHz 32KB Cache 80386 Computer Kit
- 4MB RAM (expandable to 16MB)
- 300 Watt power supply
- 6 half-height drive bays
- 101-key keyboard • Multi I/O Card
- Toshiba 1.44MB, 3.5" floppy drive
- DR DOS 5.0 and QAPlus diagnostic software

$2599.95/JE3833
monitor extra

Microspeed PC Trackball



Jameco VGA Card

Conner IDE Hard Drive

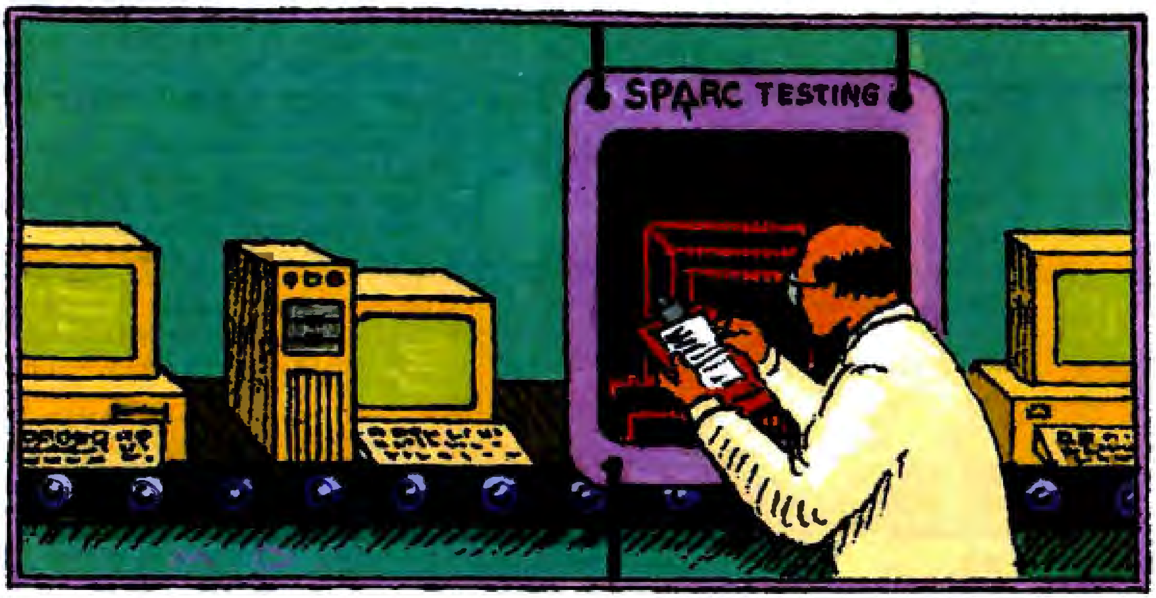
Please refer to Mail Key 1 when ordering

Terms: Prices are subject to change without notice. Items subject to availability and prior sale. Complete list of terms/warranties is available upon request.


Orchestrated
through the life of the product. We maintain telephone customer support; our technically expert staff will answer your questions and discuss your needs, before, during, or after purchase. And you can place an order 24 hours a day!
Consistent quality, wide selection, latest technology, solid customer support, and competitive prices have produced millions of satisfied Jameco customers. Most have requested an encore, joining our large family of repeat customers from big and small businesses, schools and universities, government, and individuals.
If an effortless electronic or system purchase experience sounds good to you, give us the chance to orchestrate it. Call Jameco for a complete product catalog, or visit our catalog-store/headquarters located in Belmont, CA, serving Silicon Valley and the Stanford Technology Park Area.
JAMECO
ELECTRONIC COMPONENTS
COMPUTER PRODUCTS
1355 Shoreway Rd.
Belmont, CA 94002
(415) 592-8097
FAX: (415) 592-2503
Jameco 20MHz 32KB Cache 80386SX Computer Kit
• AMI Motherboard with 32KB cache, 4MB RAM (expandable to 16MB)
• 200 Watt power supply
• 101-key keyboard • Multi I/O Card
• Toshiba 1.44MB, 3.5" floppy drive
• DR DOS 5.0 and QAPlus diagnostic software
$1899.95/JE3820
monitor extra
DB25 Connectors
Memory Modules
Jameco Breadboards and Metex Multimeters
LEDs
EPROMs
Axial and Radial Capacitors
All trade names are registered trademarks of their respective companies.
Circle 147 on Inquiry Card.
© 4/91 Jameco Electronic Components/Computer Products

BRETT GLASS

SPARC REVEALED



A close look at Sun's increasingly popular architecture for high-performance workstations

In 1987, Sun Microsystems announced the Sun-4, the first computer system based on a new CPU architecture called *SPARC* (Scalable Processor Architecture). Unlike the Motorola 68000 family of microprocessors in Sun's earlier workstations, SPARC was a RISC processor. The CPU was contained in a 20,000-gate Fujitsu array when most commercial microprocessors were five to 10 times more complex. Also unlike the others, which were second-sourced by few vendors, SPARC was positioned as an open architecture that was clonable by all. Sun hoped this would eliminate dependence on any one chip vendor.

Since that time, SPARC has become more than a CPU architecture. It's a family of standards; an array of chips from at least half a dozen vendors; a vehicle for standardized, shrink-wrapped Unix software; and the foundation upon which dozens of manufacturers are basing new workstation products.

Licensees with current or potential SPARC implementations include Fujitsu, Cypress Semiconductor, Bipolar Integrated Technology, LSI Logic, Texas Instruments, Solbourne/Matsushita, Philips, Harvest VLSI Design Center, and Systems and Processes Engineering. BIT is working on the first emitter-coupled logic SPARC implementation, while LSI Logic, TI, and Cypress are racing to develop next-generation superscalar SPARCs. Fujitsu's Sparclite chip set is designed to address the embedded market and includes two universal asynchronous receiver/transmitters, an interrupt controller, counter/timers, DRAM refresh, and 2K-byte on-chip instruction and data caches.

Workstation vendors include Solbourne, CompuAdd, Solarix, Mars Microsystems, Opus Systems, ICL, Meiko, Tatung, Toshiba, RDI, and others. Systems range from large file servers, such as ICL's symmetrical multiprocessing servers, to RDI's laptops. Some vendors buy their system boards from Sun or license a design created for LSI Logic by Opus Systems; others have designed unique implementations.

A Classic RISC

To understand SPARC, you must understand RISC. The RISC architectural philosophy evolved from research projects at the University of California at Berkeley and Stanford University in the early 1980s. Instead of following the trend toward larger and more complex CPU architectures, these research groups favored CPU speed and simplicity. They believed program memory consumption and ease of assembly language programming were justifiable trade-offs for improvements in optimizing compiler technology (which made assembly language coding less necessary) and decreases in the price of RAM (which made it less important to have a

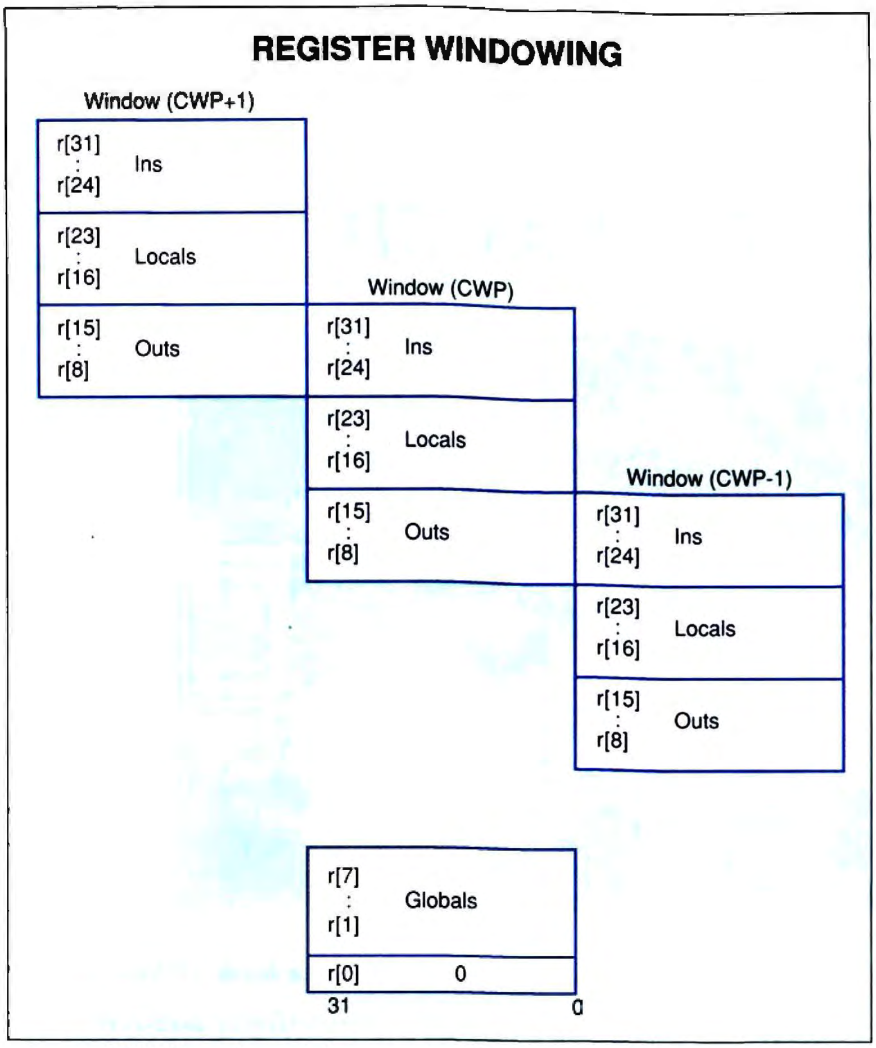


Figure 1: *SPARC's register windows consist of 24 32-bit registers each, with eight registers of overlap between successive windows. Because parameters can easily be passed in registers, the register file replaces the processor stack for many applications. (Courtesy of Sun Microsystems)*

tightly packed instruction set).

The products of RISC development efforts have many features in common, and all are part of the SPARC architecture (see the text box "RISC Basics" on page 298). SPARC borrows its basic instruction formats and register-windowing scheme from early influential RISCs. Most RISC chips use pipelining to allow concurrent execution, and SPARC is no exception. However, unlike the MIPS chips, which allow software to control the pipeline, SPARC implements pipelining in hardware to allow implementations to work in different ways.

A CPU with Windows

An important concept of SPARC architecture—borrowed from the Berkeley RISC chips, the TMS 9900, and other "workspace" machines—is *register windowing* (see figure 1). At any given moment, a program running on SPARC has access to 32 32-bit processor registers. These include eight global registers (g0–g7) plus 24 registers that belong to the current register window.

The first eight registers in the window are called the *in* registers (i0–i7). When a function, or main program, is invoked, these registers may contain arguments for that function to use. The next eight registers are the *local* registers; these are scratch registers that can be used for any purpose while the function executes. The last eight registers are the *out* registers; the function uses these to pass arguments to functions it calls.

When one function calls another, the callee can choose to execute a SAVE instruction. This instruction decrements an internal counter, called the *current workspace pointer*, shifting the register window downward. The caller's out registers then become the callee's in registers, and the callee gets a new set of local and out registers for its own use. Note that only a pointer has changed; the registers do not need to be saved on a stack. The return address also does not need to be put on a stack; the CALL instruction automatically saves its own address in o7 (output register 7), which becomes i7 (input register 7) if the CWP is decremented. Thus, the callee can access the return address whether or not it has decremented the CWP.

Despite their names, there is no hard-and-fast rule that says all the ins and outs must be used for arguments. If a function does not have eight arguments, it can use some ins as temporary storage if they're not already being used for other purposes. Similarly, unused outs can be used as temporaries; it's up to the compiler and the operating system to establish conventions.

Register windows are also used to save the processor context when traps, or interrupts, occur. SPARC operating systems ensure that there is always an unused register window below the current one. If a trap occurs, the CWP is decremented, and the new window saves the processor context. Traps on SPARC are vectored, making them fast compared with some other RISCs.

The original SPARC chip, as implemented by Sun, had seven overlapping windows, bringing the total number of registers to $7*16 + 7$ (not counting g0), or 119 registers. (Large numbers of registers are a hallmark of RISC chips.) But what happens if, due to recursive or deeply nested function calls, six levels are not enough? In this case, when the program attempts to decrement the CWP into the last unused window (which must be reserved for trap handling), it discovers that the window has been marked *invalid* in a register called the *window invalid mask* register. This causes a trap, and the processor has an opportunity to "spill" registers to make more room. That is, it writes the contents of some of them out to memory.

Similarly, a long series of subroutine returns can cause a window underflow, which causes the processor to call in a trap handler to fill registers from memory. Application programs don't know—and, in fact, cannot know unless the operating system is willing to tell them—how many register windows the CPU actually has. All spilling and filling of

Death Taxes Software Piracy

We can save you from one of them.

Sorry. Death we can't do anything about. As for taxes, when you use our product you'll probably wind up paying more. But software piracy: there we offer some help. Our family of software protection devices (dongles) have improved unit sales for over 2,000 companies around the world. Our products can be used in the MS-DOS, OS/2 and Macintosh environments.

Build Your Own Custom Protection Environment

Use our patented "dual-locking" ASIC chip as the basic building platform. Next, add options like: on-the-fly read/write memory, write-once or multiple-write locking codes, and encryption shells. Then add your own programming creativity to build a protection environment best suited to your product.

Users attach the device to their parallel port, and programs won't run without it. Back-up copies, hard disk and LAN operation are not interfered with.

Your Intellectual Property Belongs To You

And if you don't protect it, who will? Our products offer the most equitable way to protect your interests without sacrificing the rights of your customers. Call us today for information and demonstration units.

Software Security

1011 High Ridge Road
Stamford, CT 06905
203-329-8870

Fax 203-329-7428
BBS 203-329-7253
AppleLink™ D2379

1-800-333-0407 ext. 102

AUSTRALIA 619 316 2873 • EUROPE 44 932 821 230 • FINLAND 358 0 505 33 55
ITALY 39 2 21 30 450 • NETHERLANDS 31 34 026 77 77 • NORWAY 47 2 44 88 55
SWITZERLAND 41 1 341 9550 • UK 44 784 430 060 • USSR 71 70 50

Circle 238 on Inquiry Card.

RISC Basics

What distinguishes a RISC from other CPUs? While there are many variations on the theme, most RISC processors have the following attributes in common:

Fewer instructions. Studies in the early days of RISC showed that most compilers used only 30 percent of the instruction sets of some complex instruction-set computers (CISCs), such as DEC's VAX, and of those, they used 20 percent of the instructions more than 80 percent of the time. RISC processors attempt to implement only that 30 percent, allowing the chip to be smaller, cheaper, and (in theory) faster.

Fewer instruction formats. To maintain simplicity within the CPU design, RISCs generally have only a handful of possible instruction formats. Usually, all instructions are the same length: one word. Note that instructions and data words are the same size on most processors. This implies that it can take more than one instruction to load an arbitrary constant into a register. This is true on SPARC, where there's no load-constant instruction per se and room only for a 13-bit immediate operand in the arithmetic and logical instruction formats.

How, then, do you load a constant into a SPARC register? You can set the low 13 bits of register i0 and clear the rest with an instruction such as `add %g0, const, %i0`. (The register g0 always yields the value 0 when read.) Likewise, you can set the high bits of a register by executing an instruction called SETHI, which loads the upper 22 bits and zeroes out the rest. A SETHI and an add are sufficient to produce any 32-bit constant. However, because most constants used in computer programs are small positive and negative numbers, a single add or or instruction suffices in most cases.

Dummy registers. As shown above, most RISCs have a dummy register (g0 on SPARC) that yields the value 0 when read and discards any value written to it. Using such a register as a source operand provides a convenient way to turn an instruction with two sources into an instruction with a single source without complicating the instruction set. Using a dummy register as a destination allows an operation to be executed strictly to set the condition codes. On SPARC, the pseudo-instruction `cmp %i1, %i2` is assembled as the subtract instruction `subcc %i1, %i2, %g0`.

Load/store architecture. The only operations available to manipulate external memory are loads and stores; all other instructions affect only the on-chip registers. However, some processors, including SPARC, bend this rule and implement atomic load/store instructions. These instructions, which may include test-and-set or swap operations, facilitate the design of multitasking and multiprocessing systems.

Limited addressing modes. A processor that conforms strictly to the minimalist RISC philosophy does all address calculations in registers and has only one addressing mode: indirect through a register. However, most real-life chips, including SPARC, have register-plus-displacement modes. SPARC is unusual among RISCs in that it has a third addressing mode, which forms a memory address by adding the contents of two internal registers. Thus, in systems without memory management units, one register can hold the base address of a process's memory space, while another is used as an index into that space.

No microcode. Because one CISC instruction can perform many functions, CISC code takes up less memory space and bus bandwidth than equivalent RISC code. RISC proponents argue, however, that this is an artifact of the early days of computers when RAM was more expensive than it is now. The RISC philosophy states that better cost/performance can be gained by eliminating microcode and by hard-wiring instruction decoding and sequencing. Simple instruction formats make this approach practical.

Single-cycle execution. Most RISC instructions are simple enough to require only a single cycle to execute. Many, however, require multiple cycles for loads, stores, or complex operations such as multiplication and division.

Many on-chip registers. Most RISCs, including SPARC, have ample on-chip storage for intermediate results, which minimizes time-consuming memory operations. The first SPARC implementation had 119 32-bit registers.

Deferred jumps and calls. Instructions that transfer control from one portion of a program to another are difficult to execute in just a single cycle. Typically, loading the processor's instruction pointer takes one instruction time, while fetching the first instruction from the new routine takes another. To avoid wasted time, many RISCs allow an additional instruction to be inserted into the "delay slot" before the branch is actually taken. SPARC does this; what's more, it annuls (i.e., does not execute) the delay instruction if a conditional branch is not taken.

All these characteristics are typical of RISCs, but experts still differ on precisely what constitutes a RISC and what does not. Since RISC has come into vogue, the RISC-iness of different architectures has become a religious issue, and virtually every manufacturer touts the RISC-like aspects of its products. Even Intel, in its marketing pitch for the i486, claims that this CISC has a RISC at its core. ■

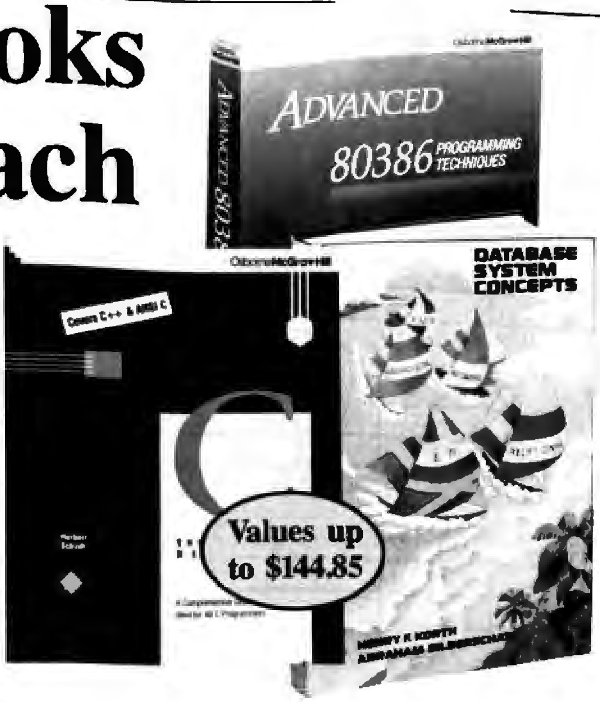
registers is invisible to an executing user program. The program's only responsibility is to allocate space, most often on a stack, to save its registers during a context switch.

Spilling and filling registers is an essential part of Unix multitasking on SPARC. During a context switch, most SPARC operating systems, including Sun's SunOS, spill the active register windows so that the entire CPU is available to the next process that runs. SPARC critics note that saving so much context incurs a great deal of overhead. However, the designers argue that since function calls are more common than context switches, more time, on average, is saved than lost by this architecture. SPARC proponents also claim that Unix context switches are so time-consuming that juggling registers consumes only a fraction of that time.

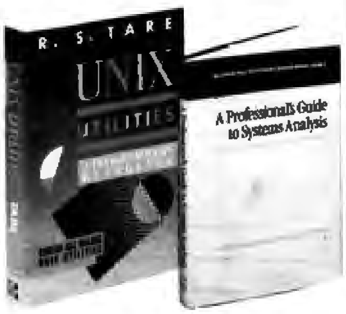
However, developers who want to have fast context switching can still have it:

Take any 3 books for only $1.00 each

when you join BYTE Book Club®



UNIX UTILITIES.
By R. S. Tare.
Written for programmers and serious hobbyists, this practical manual explains all the features of the most popular utilities in the UNIX environment. 352 pp., illus. Paperback
062884-X Pub. Pr., $29.95



A PROFESSIONAL'S GUIDE TO SYSTEM ANALYSIS.
By M.E. Modell.
Detailed coverage of how to conduct a cost-benefit analysis, how to document and validate your findings—to design the best systems for your user's needs. 307 pp., illus.
042632-5 Pub. Pr., $37.95

SOFTWARE DIAGRAMING: A New Design Paradigm.
By Drs. J.S. Murphy and K.G. Balke.
This important work lays the foundation for a model in which diagrams gradually replace textual programming language. 386 pp., illus.
044118-9 Pub. Pr., $49.95

DATA EXCHANGE: PC/MS-DOS.
By S. Ross.
Convert files quickly and painlessly with step-by-step instructions from word processing programs to spreadsheets to databases, then from databases to word processing programs. 426 pp., illus. Paperback
053923-5 Pub. Pr., $24.95

INTRODUCING PC-DOS & MS-DOS, Second Ed.
By T. Sheldon.
Covers all releases through 4.0, as well as Microsoft Windows and DOS-SHELL. Features a tutorial format, with expanded coverage of batch file techniques. 403 pp. illus. Paperback
056565-1 Pub. Pr., $27.95

WINDOWS PROGRAMMING: An Introduction.
By W.H. Murray III, and C.H. Pappas.
This down-to-earth guide unlocks all the power and versatility of Windows 3.0, enabling you to take advantage of a graphics-based multitasking environment. 651 pp., illus. Paperback
881536-3 Pub. Pr., $28.95

ARTIFICIAL INTELLIGENCE USING C: The C Programmer's Guide to AI Techniques.
By H. Schildt.
This hands-on guide shows you how to create your own AI applications and systems using C. 412 pp., 37 illus.
881255-0 Pub. Pr., $21.95

DATA PROCESSING IN UNIX.
By R. S. Tare.
The only guide you'll ever need to harness the full power of UNIX for database management. Examines such applications as INFORMIX, INGRES, and UNIFY. 438 pp., illus.
062885-8 Pub. Pr., $39.95

CLIST PROGRAMMING.
By K. Bosler.
This powerful reference tool gives you greater insight into CLIST's uses and applications and helps you program more effectively. 320 pp., illus.
006551-9 Pub. Pr., $47.95

DATABASE SYSTEM CONCEPTS.
By H.F. Korth and A. Silberschatz.
From fundamental concepts to advanced problem solving, this book provides a clear understanding of the design and use of database systems. 546 pp., illus.
044752-7 Pub. Pr., $46.95

All books are hardcover unless otherwise specified. A shipping/handling charge and sales tax will be added to all orders. If card is missing, use this address to join:

Your one source for computer books from over 100 different publishers

THE C PRIMER, Third Edition.
By L. Hancock, M. Krieger, and S. Zamir. 026001-X Pub. Pr., $29.95

1-2-3 RELEASE 3: The Complete Reference.
By M. Campbell. 881318-2 Pub. Pr., $28.95

ADVANCED 80386 PROGRAMMING TECHNIQUES.
By J.L. Turley. 881342-5 Pub. Pr., $22.95

C: The Complete Reference, 2nd Ed.
By H. Schildt. 881538-X Pub. Pr., $28.95

TURBO LANGUAGE ESSENTIALS: A Programmer's Reference. *By K. Weiskamp, N. Shammas, and R. Pronk.*
584905-4 Pub. Pr., $24.95

POWER GRAPHICS PROGRAMMING.
By M. Abrash. 585443-0 Pub. Pr., $24.95

IBM MICROCOMPUTERS: A Programmer's Handbook.
By J. Sanchez and M.P. Canton. 054594-4 Pub. Pr., $44.95

DATA-DIRECTED SYSTEMS DESIGN: A Programming Guide.
By A. Modell. 042633-3 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 to 4 weeks (12-15 times a year), members receive the Club Bulletin offering more than 30 books—the latest, 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 shipped automatically.

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 at any time thereafter. BYCA-035

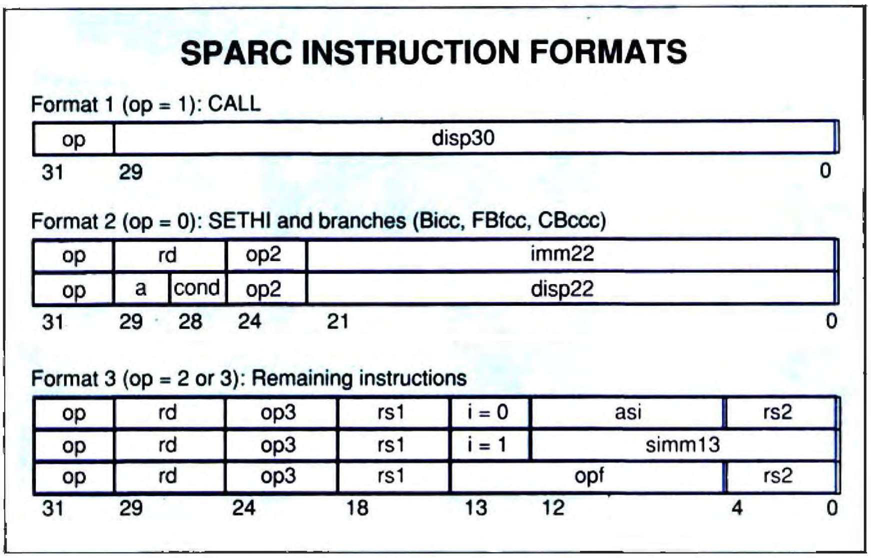


Figure 2: *SPARC has only three instruction formats. One is used exclusively for unconditional subprogram calls, while the others are used for SETHI, branches, and arithmetic and logical instructions. (Courtesy of Sun Microsystems)*

They can confine each of the processes in a multitasking system to a smaller group of register windows that are always in the processor and ready for use. This mode of operation is not the norm on Unix systems, but it is useful in compact real-time executives such as Ready Systems' VRTX.

Why *Scalable*?

Why did Sun pick the name *Scalable* Processor Architecture? The acronym can be interpreted in three ways—two technical, one anecdotal. First, the on-chip register file is scalable; it can easily be enlarged from eight windows (which is its size in most current implementations) to 32 windows. With a large register file, registers for multiple processes, or *coroutines*, could reside in the CPU concurrently.

Second, SPARC's proponents claim, as do all RISC enthusiasts, that because the architecture is relatively simple, it's easy to scale a particular chip design to use smaller signal paths and transistors, resulting in tinier, faster chips. This is somewhat misleading, since SPARC isn't the only architecture for which this argument is made. All RISC manufacturers claim a similar degree of scalability; even complex instruction-set computer proponents argue (with some justification) that a thoughtfully designed CISC is every bit as scalable as a RISC.

The third interpretation—an interesting historical footnote—is that the *S* in SPARC originally stood for *Sun*. Silicon Valley folklore says that Sun Microsystems changed the official expansion of the acronym when it decided to embark on its open architecture strategy.

A Simple Instruction Set with a Few Surprises

The SPARC instruction set is like that of the Berkeley RISC chips in that it has three possible instruction formats (see figure 2) and 74 possible instructions (see the table), including the floating-point operations. Because the architecture standard requires SPARC processors to look the same only to applications (not to the operating system), virtually any instruction can be emulated if hardware isn't present to perform it. For example, Fujitsu's Sparclite, an inexpensive implementation of SPARC designed for embedded applications, emulates floating-point operations in software.

The integer data types SPARC supports are signed and unsigned bytes, 16-bit halfwords, 32-bit words, and 64-bit doublewords. Also, there is a tagged word format in which the 2 least-significant bits serve as flags to indicate the type of the object. In SPARC SmallTalk and Lisp implementations, these bits are both 0 when the rest of the bits contain a 30-bit integer. Otherwise, they flag the uppermost 30 bits as a word-aligned pointer to an object of a different class.

SPARC floating-point numbers can be 32 (single), 64 (double), or 128 (quad) bits long; they conform to the IEEE 754 standard. The quad format—new in version 8 of SPARC and seldom before implemented in any architecture—uses a 112-bit mantissa for applications requiring incredible floating-point precision. The floating-point unit has 32 32-bit, nonwindowed registers, which must be saved on a per-context basis.

Like the 68000, SPARC is "big-endian"—it stores multiple-byte objects in memory with the most significant byte at the lowest address. This was a necessary choice for Sun, because it facilitates the implementation of Sun's "big-endian" protocols: remote procedure call (RPC), external data representation (XDR), and Network File System (NFS). These protocols can put "little-endian" chips, like the Intel 80x86 family, at a disadvantage when communicating—a penalty that was severe enough to motivate the addition of a new "byte swap" instruction to the i486. Floating-point operations are specified so that they can execute concurrently with integer instructions, but they must appear to the program as if everything was done in sequence.

Delayed Branches

Among the interesting characteristics of SPARC is the way it handles branching. Many RISC architectures have delayed branches—that is, the instruction following a branch instruction is executed while the processor prepares to transfer control to the destination. SPARC, however, implements a novel feature (seen also on the Hewlett-Packard Precision Architecture): an *annul* bit, which allows the processor to annul the effects of the delay instruction following a conditional branch if that branch isn't taken. On processors that implement delayed branches but cannot annul the delay instruction, the compiler must try to fill the delay slot with a useful instruction whether or not the branch is taken. If, however, the delay instruction can be annulled, the obvious candidate is the instruction that would otherwise reside at the destination of the branch. Thus, SPARC compilers are more likely than those for other RISCs to fill the delay slot with a useful instruction.

A useful feature for unconditional branches is a *branch always* instruction, which can be made to unconditionally annul the subsequent instruction. This is useful for debuggers, where it's desirable to replace a single instruction with a branch to a debugging routine.

The Architecture Evolves

The original SPARC architecture was remarkable for its omissions as well as its special features. Most glaring of the omissions was the lack of integer multiply, divide, and remainder instructions.

SPARC INSTRUCTION SET

Although true to the minimalist RISC philosophy, the SPARC instruction set exposes certain special features, such as register windowing, to program control (N/A = not applicable).

Loads	Stores	Object to be loaded/stored
LDSB/LDSBA	STSB/STSBA	Signed byte
LDSH/LDSHA	STSH/STSHA	Signed halfword
LDUB/LDUBA	STUB/STUBA	Unsigned byte
LDUH/LDUHA	STUH/STUHA	Unsigned halfword
LD/LDA	ST/STA	Word
LDD/LDDA	STD/STDA	Doubleword
LDF	STF	Floating point
LDDF	STDF	Double floating point
LDFSR	STFSR	Floating-point state register
N/A	STDFQ	Double (from floating-point-deferred trap queue)
LDC	STC	Coprocessor
LDDC	STDC	Double coprocessor
LDCSR	STCSR	Coprocessor state register
N/A	STDCQ	Double (from coprocessor-deferred trap queue)

A at end of instruction = alternate address space

Cosmic load/store and synchronization

LDSTUB/LDSTUBA	Atomic load/store unsigned byte
SWAP/SWAPA	Swap register with memory
STBAR	Store barrier
FLUSH	Flush instruction memory

Special register manipulation

RDASR/WRASR	Read/write ancillary-state register
RDY/WRY	Read/write *y*-register (used in integer multiply/divide)
RDPSR/WRPSR	Read/write processor-state register
RDWIM/WRWIM	Read/write window-invalid mask
RDTBR/WRTBR	Read/write trap-base register

Logical/arithmetic

AND/ANDcc	AND
ANDN/ANDNcc	AND NOT
OR/ORcc	OR
ORN/ORNcc	OR NOT
XOR/XORcc	XOR
XNOR/XNORcc	XOR NOT
ADD/ADDcc	ADD
ADDX/ADDXcc	ADD with carry
SUB/SUBcc	SUB
SUBX/SUBXcc	SUB with borrow
MULScc	Multiply step
UMUL/UMULcc	Unsigned multiply
SMUL/SMULcc	Signed multiply
UDIV/UDIVcc	Unsigned divide
SDIV/SDIVcc	Signed divide
TADDcc/TADDccTV	Tagged ADD
TSUBcc/TSUBccTV	Tagged SUB

cc = set condition code based on result

ccTV = modify condition codes and trap on overflow

Branches, calls, jumps

Bicc	Branch on integer condition code
FBicc	Branch on floating-point condition code
CBicc	Branch on coprocessor cc
CALL	Call and link (return address < o7)
JMPL	Jump and link (return address < o7)
RETT	Return from trap
Ticc	Trap on integer condition code

Register window management

SAVE	Save caller's window
RESTORE	Restore caller's window

Miscellaneous

SETHI	Set high bits of register
NOP	No operation
UNIMP	Unimplemented (causes trap)

Coprocessor

CPop (implementation dependent)

Floating point

F(i,s,d,q)TO(i,s,d,q)	Conversions between integer, single, double, quad
FMOVs,FNEGs,FABSs	Move between floating-point registers with absolute values or negatives
FSQRT(s,d,q)	Square root
FADD(s,d,q)	Add
FSUB(s,d,q)	Subtract
FMUL(s,d,q)	Multiply
FDIV(s,d,q)	Divide
FCMP(s,d,q)	Compare
FCMPE(s,d,q)	Compare with exception if unordered
FsMULd	Multiply single, result to double
FdMULq	Multiple double, result to quad

Multiplication was accomplished by a "multiply-step" instruction (executed several times to multiply two registers together) or by shifts and adds (when one operand was a constant). Division was done entirely in software.

Many of the trade-offs in the original SPARC architecture were based on statistical studies, which showed that certain features—such as hardware multiply—would not enhance performance on an average system. But as Michael Slater, publisher of the newsletter *Microprocessor Report*, points out, the results of such tactics might be similar to "a statistician drowning in a creek whose average depth is 3 feet." Some applications—particularly fixed-point graphics and digital signal processing—showed dramatic slowdowns on machines without hardware multiply and divide features, and some users reported that their new Sun-4 systems were slower than their old 68000-based Sun-3s.

Fortunately, there was room for the architecture to evolve, and the most recent release, version 8, includes multiply and divide instructions. (Fujitsu's Sparclite also implements a divide-step instruction, but this did not become part of the standard.) Programs need to be recompiled to take advantage of these new instructions, but there will be no need to keep two versions of the software around. As with floating point, the new instructions can be emulated on older hardware.

Also in the latest release is a synchronization instruction, called *Store Barrier*, which flushes out delayed writes in multiprocessor systems, and floating-point multiply instructions, which take two operands of one precision and produce results at the next higher precision. The SPARC-architecture manual now includes, as an appendix, a specification for a SPARC Reference memory management unit. While the MMU isn't actually part of the SPARC architecture, this document suggests an MMU architecture that many SPARC vendors have copied to facilitate operating-system ports.

A Compendium of Standards

For SPARC products to proliferate, the market requires a well-defined set of standards—preferably more solid, reliable, and verifiable than the de facto set that has grown up around the IBM PC. To this end, several corporations involved with the SPARC architecture have founded a nonprofit organization to serve as the custodian of the standard: SPARC

Figure 3: *SPARC licenses the name SPARC, with the trademarks shown, to its members. At top is the logo displayed by SPARC International members, and at the bottom is the logo certifying compliance with SPARC Compliance Definition 1.0. (There will be a similar logo for SCD 2.0.)*

International (SI), formed in 1989, owns and licenses the SPARC trademarks (see figure 3); tests hardware, software, and systems for conformance to the standards; provides tools that aid conformance testing; and administers joint marketing programs.

Among the key documents published by SI is the *SPARC Compliance Definition* (SCD) *2.0*, which describes (and incorporates by reference) several standards that SPARC systems must meet to be considered compliant. Among these are AT&T's System V Application Binary Interface, AT&T's SPARC supplement to the System V ABI, AT&T's System V Interface Definition, and the X Protocol reference manual.

The System V ABI, defined for each processor family by a special supplement, is AT&T's answer to the problem of producing shrink-wrapped Unix software. In theory, any software that conforms to the ABI will work on any system that supports it. SCD 2.0-compliant systems and software must also conform to standards for binary file formats, loading and linking, and installation. SCD 2.0 lists other features as well, like NFS, which are optional but required to run many shrink-wrapped SPARC software products.

Thou Shalt Conform

SI will, for a fee, test computer systems for conformance to SCD 2.0. What's more unusual, however, is SI's effort to certify applications software. For a small fee, SI provides applications developers with a package called the SPARC Application Conformance Toolkit, or SACT. This package contains the source-level test, the binary-level test, and the standards databases.

The source-level test consists of a program that parses the C code of an application, performing static validity checks on calls to the operating system. The binary-level test—like Discipline on the Macintosh—monitors system calls at run time, and it performs similar validity checks on the actual arguments passed to the system. The standards databases contain the criteria that the system calls must meet.

SACT can be used for more than SPARC compliance testing. You can also use it to test for conformance to POSIX 1003.1 (aka FIPS 151-1), the X/OPEN Portability Guide Release 3, and the System V Interface Definition. As such, it is an excellent tool for software verification.

Other Related Standards

Two other SPARC standards are important to makers of SPARC hardware: MBus, a vendor-independent CPU pinout standard, and SBus, a peripheral interface for SPARC-based systems. The MBus, or Module Bus, standard grew out of workstation vendor need for plug-compatible CPUs. Chips need to be interchangeable, or system makers will be locked into specific implementations as soon as they've finalized their motherboard designs. MBus, a 40-MHz CMOS interconnect standard, specifies the way CPU modules talk to memory and I/O modules via their I/O pins. Chip vendors have agreed on similar interfaces for EPROMs, ROMs, and RAMs, but MBus is the first industry-wide interconnect standard for CPUs.

SBus, Sun's I/O Interface Bus, is Sun's standard for peripheral boards that ride piggyback on the motherboard of a system such as the Sparcstation. Because signal-path lengths are short, SBus is able to achieve transfer rates of up to 100 megabytes per second, compared with 33 MBps for EISA running at full capacity.

Sun has actively encouraged the development of boards for this bus, since they enhance the functionality of Sun's products, and more than 100 vendors have developed products that work with it. Nearly all SPARC clone vendors have taken advantage of the availability of these peripherals by providing connectors for SBus cards.

A Good RISC

SPARC may prove to be more important as a strategy than as a CPU architecture. Many SPARC proponents I interviewed said that SPARC's architecture is not so different from that of other RISCs, and that other chips—including MIPS—currently offer better performance.

It is important to put this information in perspective, however. Most SPARC implementations are still in their first generation, but with the fierce competition among chip vendors, future generations of SPARCs will have the potential to offer truly impressive performance figures.

Because thorough conformance tests and tools are already in place, there will be few surprises when the next generation comes along; shrink-wrapped software bearing an appropriate seal is likely to work without modification on all SPARC platforms. For this reason, buying a SPARC-based system, or writing software for one, is probably a good RISC for the foreseeable future. ■

ACKNOWLEDGMENTS

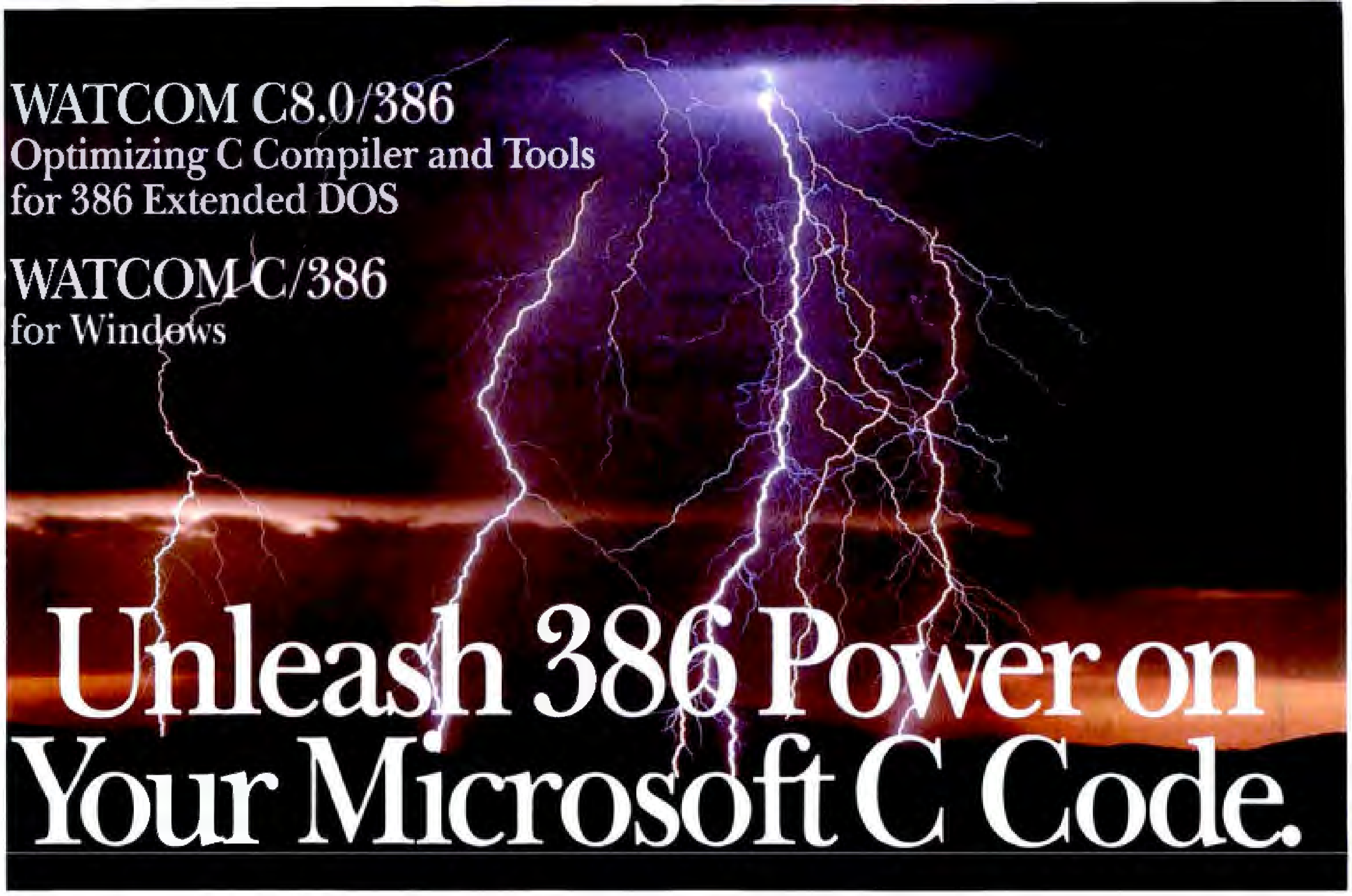
The following people provided invaluable assistance in the preparation of this article: Phil Huelson, Gayle LeDoux, and David Fickes of SPARC International; Marty Coleman and Dave Ditzel of Sun Microsystems; Michael Slater, publisher of Microprocessor Report*; and Brian Rosen of Mars Microsystems.*

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.

FOR MORE INFO

SPARC International
535 Middlefield Rd.
Menlo Park, CA 94025
(415) 321-8692
Internet: info@SPARC.COM



- Interactive source-level debugger
- Generates high-performance code for 32-bit protected mode
- Microsoft source and library compatible
- Fast, tight code
- Profiler
- Protected-mode version of compiler
- Graphics library
- 100% ANSI C and SAA compatible
- Run-time compatible with WATCOM FORTRAN 77/386

Experts Agree on WATCOM C:

"When Novell went looking for a 32-bit compiler for use with the NetWare 386 developer's kit, the company selected WATCOM's...It's clear that Novell chose wisely; this product is a winner."
Fred Hommel, BYTE, December 1989

"WATCOM C/386 is a fantastic new ANSI C compatible compiler for 386-based PC's...If you have written your application in Microsoft C, you will love this compiler."
J. Richard Hines, Electronic Test, December 1989

"Microsoft library- and source-compatibility makes WATCOM C7.0/386 ideal for porting DOS applications to 32-bit native mode. This compiler enables full 386 performance without 640K limitations."
Richard M. Smith, President, Phar Lap Software, Inc.

"WATCOM is definitely the leader in object-level optimizations...For flat-out executable speed... WATCOM C showed shining performance."
Computer Language, February 1989

WATCOM C8.0/386 Professional

• 100% ANSI C optimizing compiler • Protected-mode version of compiler • 386 run-time library object code • Windowed source level debugger • Profiler • Editor • 386 graphics library • MAKE • Linker • Object-code librarian • Object-code disassembler • Supports Phar Lap and ERGO DOS extenders

WATCOM C/386 for Windows

- Enables 32-bit Windows 3.0 GUI applications
- Interactive debugger for 32-bit Windows GUI applications
- Ideal for porting 32-bit Unix applications to Windows
- 32-bit flat model simplifies Windows memory management
- Royalty-free run-time license
- Requires Windows 3.0 SDK, does not require DOS extender

1-800-265-4555

WATCOM

415 Phillip Street, Waterloo, Ontario, Canada N2L 3X2
Tel. (519) 886-3700 Fax (519) 747-4971

SALE!SALE!SALE!

$3.00 each or 6 for $15.00 U.S. includes shipping and handling.
$4.00 each or 6 for $20.00 Foreign includes shipping and handling.

BYTE BACK ISSUES

Limited Quantities — Order Now!

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
January											
February											
March											
April											
May											
June											
July											
August											
September											
October											
November											
December											
Inside the IBM PCs											

☐ BYTE '83-'84 Index $2.00
☐ BYTE '85 Index $2.00
☐ BYTE '88 Index $2.00

Available Issues ☐

Special Bound Copies of BYTE

Volume III, Part 1— January 1978 through June 1978
Volume III, Part 2— July 1978 through December 1978

$7.95 U.S. includes shipping and handling
$9.95 foreign includes shipping and handling

Please indicate which issues you would like by checking (√) the boxes.

Send requests with payments to:

BYTE Back Issues
One Phoenix Mill Lane
Peterborough, NH 03458
(603) 924-9281

☐ Check enclosed. Payments from foreign countries must be made in U.S. funds payable at a U.S. bank.

Name ______________________

Address ______________________

City ______________ State __________ Zip __________

Postcode ______________ City ______________

Country ______________________

Charge: ☐ VISA ☐ MasterCard

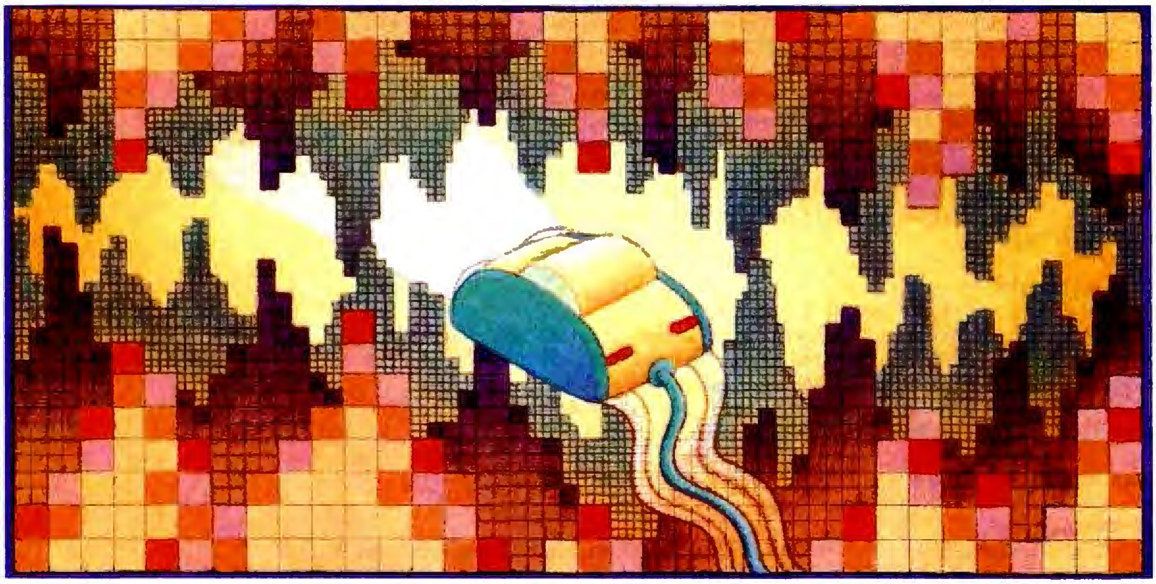
Card # ______________________

Exp. Date ______________________

Signature ______________________

TOM THOMPSON

MACINTOSH VIDEO REVEALED



A journey to the center of the Mac reveals an elegant design for device-independent graphics

You usually don't wonder how or why something works until it stops working. However, on some occasions, I get curious about how something operates on the Mac—not because it has stopped working, but because I want it to do something it normally doesn't do. All I wanted one day was an easy way to change the Mac's screen depth; that is, change how many bits "deep" each pixel is on the monitor's screen. (The more bits per pixel, the more colors you can have. One bit gives you black and white, 2 bits gives you 4 colors, 4 bits gives you 16 colors, and so on.) Along the way, I discovered a lot about how the Mac's video operates.

Here's the problem. One evening, I was checking out some new accelerated QuickDraw boards for the Mac. The tests involved running applications and seeing how they performed at various screen depths. I was using a Mac IIfx equipped with several monitors and timing how fast I could scroll through a PageMaker 4.0 document chock full of 24-bit color images. If a board enhanced the screen-drawing speeds, the scrolling should go faster. Pretty exciting stuff.

Occasionally I'd take a break and wander into the BYTE Lab to snag a can of chilled Diet Jolt from the environmental test chamber. When I returned to the test equipment, I sometimes didn't remember what I'd left the monitor's screen depth set at. When you're looking at photo-realistic images on a screen with only 256 colors (8 bits per pixel), versus a screen with thousands (16 bits per pixel) or millions (24 bits per pixel) of colors, it's obvious what the settings are. But the difference between 16-bit color and 24-bit color is hard to discern.

Of course, you can go to the Apple menu, open the Control Panel desk accessory (DA), and scroll through the various modules to the Monitors cdev to see how many colors each monitor is using. This approach works fine if you rarely change the monitor settings. However, using the Monitors cdev to obtain this information on a regular basis becomes an ordeal.

There had to be a better way. After all, the Mac knew what the settings were: I was just using the Monitors cdev to call up the information. Could I come up with something that could track down this information and display it? Something easier to use that would work with any number of monitors?

I got out a six-pack of Diet Jolt, a box of crackers, and Addison-Wesley's *Inside Macintosh, Volume 5*—the reference work on Color QuickDraw—and began to read.

Opening the Toolbox

Color QuickDraw is part of those ROM services called the Mac Toolbox. It's the graphics software that all Mac applications use to draw to the screen. It handles

Listing 1: *The structure of a* GDevice *and some support calls. Only the support calls used in this article are shown.*

```
/* GDevice record */
typedef struct GDevice {
        short           gdRefNum;       /* Reference number of driver handling this gDevice */
        short           gdID;           /* ID of current port client */
        short           gdType;         /* Device type: 0 = CLUT, 1 = direct */
        ITabHandle      gdITable;       /* Inverse color mapping table */
        short           gdResPref;      /* Preferred inverse table resolution */
        SProcHndl       gdSearchProc;   /* Search procedure list */
        CProcHndl       gdCompProc;     /* Complement procedure list */
        short           gdFlags;        /* gDevice attribute flags */
        PixMapHandle    gdPMap;         /* Handle to gDevice's pixel map */
        long            gdRefCon;       /* Reference field for device-specific parameters */
        struct GDevice  **gdNextGD;     /* Handle to next gDevice */
        Rect            gdRect;         /* gDevice's boundary rectangle */
        long            gdMode;         /* Current mode for this gDevice */
        short           gdCCBytes;      /* Expanded cursor information */
        short           gdCCDepth;      /* Expanded cursor depth */
        Handle          gdCCXData;      /* Handle to expanded cursor's data */
        Handle          gdCCXMask;      /* Handle to expanded cursor's mask */
        long            gdReserved;     /* Reserved for future use */
} GDevice, *GDPtr, **GDHandle;

/* gdFlags bit assignments */
#define gdDevType       0    /* 0 = grays, 1 = colors */
#define mainScreen      11   /* Set if device is main screen (has the menu bar) */
#define allInit         12   /* Set if device is initialized from 'scrn' resource */
#define screenDevice    13   /* Set if device is a screen */
#define noDriver        14   /* Set if device doesn't have a driver */
#define screenActive    15   /* Set if the device is active */

/* Some GDevice support routines */

GDHandle  thisGDevice;
  thisGDevice = GetDeviceList();              /* Returns handle to first GDevice in list */

GDHandle  thisGDevice;
GDHandle  nextGDevice;
  nextGDevice = GetNextDevice(thisGDevice); /* Returns next GDevice handle in list, or NIL */
                                            /*   if no more GDevices */

GDHandle  thisGDevice;
short     attributeFlag;
Boolean   devAttribute;
  devAttribute = TestDeviceAttribute(thisGDevice, attributeFlag); /* Tests GDevice for the */
                                                                  /*   supplied attribute */
GDHandle  thisGDevice;
short     attributeFlag;
Boolean   setValue;
  SetDeviceAttribute(thisGDevice, attributeFlag, setValue);  /* Set the GDevice attribute */
                                                             /*   to the supplied value */
GDHandle  thisGDevice;
long      mode;
short     refNum;
  InitGDevice(refNum, mode, thisGDevice);     /* Sets a display managed by the GDevice and */
                                              /*   the driver to the specified mode */
```

everything from drawing circles of a certain color on the screen to drawing styled text.

From the start, Color QuickDraw was meant to be device-independent. Color information is handled and manipulated in an internal color space, with routines that convert these colors to and from different color systems—for example, CMYK (cyan, magenta, yellow, black) and HSV (hue, saturation, value). A Mac screen can be any size, and it can operate at any screen depth. The practical screen size is set by the limits of Color QuickDraw itself. Its coordinates are signed 16-bit integers, ranging from −32,767 to 32,767, so a 72-dot-per-inch screen spanning QuickDraw's limits would be over 75 feet to a side—plenty of room for future growth, I'd say.

Pixel depth is always a power of 2 (i.e., 1, 2, 4, 8, 16, or 32 bits per pixel). Furthermore, Color QuickDraw was designed to handle multiple displays, each of which could have different capabilities and be made by different vendors. (To avoid confusion, a *display* consists of a monitor, a display board that produces an image on the monitor, and any software required to control this equipment. A *screen* is the image on the monitor.)

Apple provided for Color QuickDraw's device independence by defining a logical data structure termed a *graphic device*. Each monitor has a graphical device associated with it that describes the display's characteristics. This is called a `GDevice`.

The format of a `GDevice` structure is shown in listing 1. You can see the various entries that describe the display, such as its size and orientation with respect to other displays on the computer (`gdRect`), the reference number of the driver that controls it (`gdRefNum`), and the screen image, called a pixel map (`gdPMap`). Some of this information is provided by the monitor's display board at boot-up time; the rest of it is set up and maintained by various Mac OS Managers. Also shown in listing 1 are support calls used to access a `GDevice`'s structure.

Apple has defined a logical data structure termed a *graphic device*.

These `GDevice` structures are kept in a linked list, termed a `DeviceList`. This `DeviceList` is the key to how the Mac handles several monitors at once. To write to a particular screen, all the Mac has to do is consult the appropriate `GDevice` in the list to know what screen depth to draw at, what driver to use, and where to draw the pixels.

I'd like to say it was easy to divine this information from *Inside Macintosh*, but it's a reference manual and not a how-to guide. However, I frequently relied on Think C 4.0's source code debugger to bootstrap my understanding of how portions of the Mac Toolbox operate. The source code debugger makes it easy to wander about and examine various structures referenced by the `GDevice`.

After some spelunking and taking copious notes, and with frequent cross-checks to *Inside Macintosh*, I determined that `gdPMap`'s handle points to the monitor's pixel map, which held information

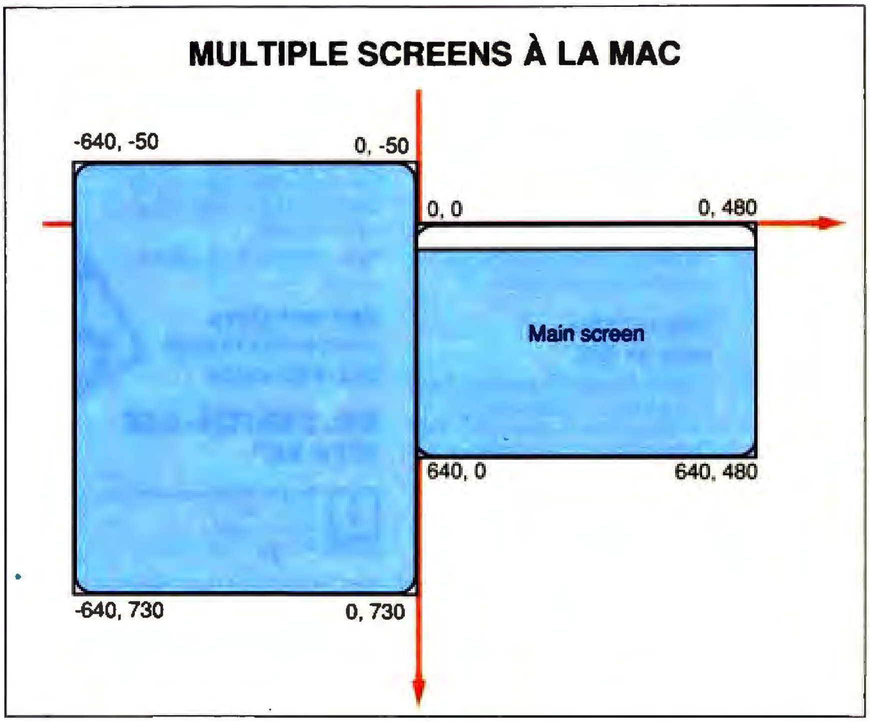


Figure 1: *When you use multiple monitors with a Mac, the system selects one monitor's display as the start-up screen. This becomes the system's main screen, which contains the menu bar (here, the screen on the right). The upper left corner of the main screen is designated as (0,0), and other monitors' displays are arranged around that point.*

on the screen's depth as well as a pointer to the screen's image.

To obtain information about every monitor, I simply had to walk through the `DeviceList`. I first used `GetDeviceList()` to get the start of the list. Next, repeated calls to `GetNextDevice()` provided subsequent devices in the list. `GetNextDevice()` returned nil when it got to the end of the list. For each `GDevice`, I examined its attribute bits (see listing 1) to ensure that the `GDevice` was managing a physical display. If it was a display, I used the `GDevice`'s pixel map to obtain the screen depth.

Now that I'd determined a way to get each active monitor's screen depth, I had to do two things. First, I needed to find an easy way to start the fact-finding code. Second, I had to show the screen depths in a meaningful way, especially since there could be one or many monitors connected.

The first part was simple: I used an FKEY. An FKEY is a small block of code that's executed when you press the Command and Shift keys and a digit key simultaneously. The decision to write an FKEY wasn't difficult. I had written one before, so I didn't have to break new ground in writing another (see "Stalking the 8-bit Spectrum," September 1989 BYTE). An FKEY also got to the heart of the original problem: It eliminated the circuitous trek to the Monitors cdev by providing the desired information with just a few keystrokes.

Where's That Screen?

The next step was the program display. I puzzled over how I might best present information from one or more monitors. As the code extracts a `GDevice`'s screen depth, it also obtains the QuickDraw coordinates for that screen from `gdRect`. This let me put the depth display window on the appropriate monitor.

To see how this is accomplished, it is necessary to understand how the Mac sets up its graphical environment. When the Mac fires up, it selects a display device to be the *start-up screen*. This screen is chosen from parameter RAM (PRAM), or, lacking that, the Mac OS scans the NuBus slots from lowest to highest addresses for the first display board it can find.

By default, the start-up screen becomes the Mac's *main screen*: the one that has the menu bar on it. This main screen is important because QuickDraw uses its upper left corner to define the origin of its coordinate system. Consequently, the coordinates of the rectangles defining additional monitor screens (remember, this information is located in each `GDevice`'s `gdRect`) are made relative to this main screen (see figure 1).

These screen rectangles can be oriented around the main screen using the Monitors cdev. When the Monitors cdev is closed, these positions are saved as a "scrn" resource in the System file. Other monitor settings (e.g., the screen depth and whether colors or grays are displayed) are also stashed in this resource. When QuickDraw is initialized at boot-up time, it uses this "scrn" resource to orient the screens and set their color and screen depth.

What happens if you yank or add a display board while the Mac is turned off? In this case, the Mac determines that the board IDs don't match those stored in PRAM, and the Mac scans the slots for display boards as described previously. Each board is set to a default operating mode of 1 bit per pixel (black and white). This forces you to again set up the monitor's layout and depths from the Monitors cdev, re-creating a valid "scrn" resource for the new setup.

Listing 2 shows the code used to extract the `GDevice` information and to convert and display it. The code was written in Think C as an FKEY code resource, with an ID of 7. I used ResEdit 2.1 to paste the resource into a Suitcase file. Either Suitcase II or MasterJuggler juggles the FKEY into the Mac's resource search path for ready access from the keyboard. Pressing Command-Shift-7 pops up a brief display across all the monitors I had connected to the system.

Problem solved, right?

Wrong. OK, I knew the screen depths. But if I wanted to *change* a monitor's depth, I still had to go to the Apple menu, open the Control Panel DA, scroll to the Monitors cdev. . .you get the picture. Wouldn't it be great if this FKEY could also alter the screen settings, like the Monitors cdev? The support call `InitGDevice()` looks like a good way of doing this, but it requires an obscure argument called a *mode*. Finding out what a mode was turned out to be a major chore. It requires that I deal with the hardware at a low level here—in the Mac's basement, so to speak.

Inside Macintosh has little detail on this low-level information. To its credit, Addison-Wesley has two books (with the jawbreaking titles *Guide to Macintosh Family Hardware* and *Designing Cards and Drivers for the Macintosh Family*) that provide the Mac's basement floor

"On sheer audacity for price-performance ratio, we loved Mix's products"

Tim Parker - Computer Language

"Power C is a heavy-weight contender - at a bantamweight price"

Stephen Davis - PC Magazine

"The Ctrace debugger is where Mix really shines. It is magnificent."

David Weinberger Computer Shopper

MIX software

Power C

combines a high-performance C compiler with superb documentation, at a price that brings chuckles from over 50,000 satisfied customers. That's because Power C performs favorably against compilers costing 10 times as much. And you can't buy a compiler that's more reliable or easier to use - at any price. Perhaps that's why Power C has won Computer Shopper's Best Buy award for three years running.

- compatible with ANSI C standard
- integrated Make utility
- library of over 450 functions
- IEEE software floating point
- supports 8088/286/386/486 CPU
- memory resident program support
- supports 8087/287/387 math chips
- small/medium/large memory models
- mixed model with near/far/huge
- allows arrays larger than 64K
- CGA, EGA, VGA & Hercules graphics
- 650 page manual with tutorial

$10.00

Power C Library Source

includes our Power C assembler, plus the C and assembly language source code to over 450 functions in the Power C library. Unlike our competitors, who charge $150.00 or more for library source code, we've made ours very affordable.

$10.00

Power C BCD Business Math

includes binary coded decimal floating point routines and financial functions to calculate interest, depreciation, etc.. BCD routines are used for dollars and cents calculations to eliminate inaccuracies caused by rounding.

Power C requires DOS 2.0 or later, 320K memory, 720K disk space. Master C requires DOS 3.0 or later, 384K memory, hard disk.

Power Ctrace

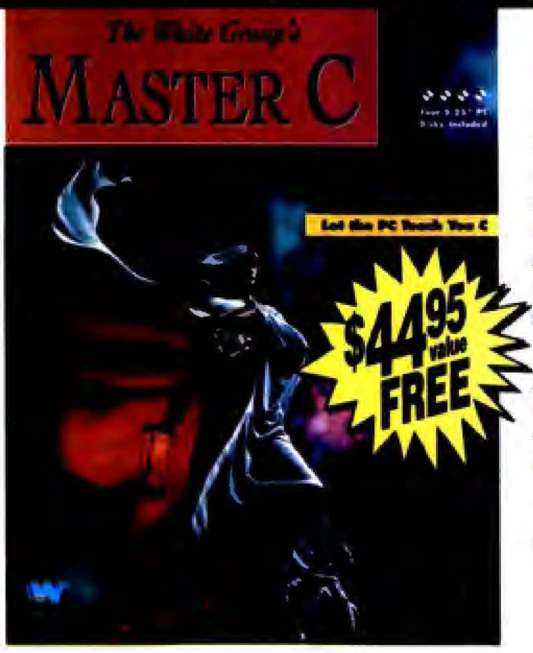
combines state-of-the-art technology with a friendly interface, making it very easy to find and correct your programming mistakes. No time consuming edit/compile cycles are needed to track down bugs. Simply compile your program once with the trace option, and Power Ctrace does the rest. Multiple windows display your C source code, the values of all your program variables, program output, watch points, and assembly instructions. Put Power Ctrace to work for you, and we guarantee that you'll be a more productive C programmer.

Order line:

1-800-333-0330

Technical Support:
1-214-783-6001
Fax: 1-214-783-1404
Mix Software, 1132 Commerce Drive,
Richardson, TX 75081

Get a FREE copy of Master C (limited time offer)



Published by the highly acclaimed Waite Group, Master C is a revolutionary book/disk package that turns your PC into a C instructor. Master C teaches you, quizzes you, notices problems you are having, and recommends action. In a pilot study at IBM, students using Master C retained 19% more knowledge than students who learned from a lecturer. Now you can receive this $44.95 package absolutely FREE when you purchase all four Power C products described above. Just ask for the Master Pack.

"Master C eschews flash for elegant competence, and it works!"

Jeff Dunteman - PC Techniques

60 day money back guarantee B

Name ____________________

Street ____________________

City ____________________

State __________ **Zip** __________

Telephone ____________________

❑ **Please send me a free brochure**

Paying by: ❑ Check ❑ Money Order
❑ MC ❑ Visa ❑ Amex ❑ Discover
Card # ____________________ Exp____

Disk Size: ❑ 5 1/4" ❑ 3 1/2"

Product(s) (Not Copy Protected)

❑ Power C ($19.95)	$______
❑ Power Ctrace ($19.95)	$______
❑ Power C Library Source ($10)	$______
❑ Power C BCD Business Math ($10)	$______
❑ Master Pack ($59.90) (includes all of the above plus Master C)	$______
Add Shipping ($5 USA - $10 Canada - $30 Foreign)	$______
Texas Residents add 8.25% Sales Tax	$______
Total amount of your order	$______

Circle 180 on Inquiry Card.

Listing 2: *Code fragment used to obtain the pixel depth from every* GDevice *handling a screen.*

```
Rect           dBox;
unsigned char  depthString[4];          /* String to display depth (formerly type Str255) */
WindowPtr      depthWindow[6];          /* Windows to display the depth. Only six slots. */
long int       centerHoriz, centerVert; /* Screen dimensions */
long int       frameHoriz, frameVert;   /* Depth box dimensions */
long int       globalLeft, globalTop;   /* Global coordinates to position our windows */
short          i;
GDHandle       nextgDevice,thisgDevice; /* Handles to our devices */
int            thisDeviceDepth;         /* Screen depth in bits */

i = 0;
SetRect(&dBox, LEFT, TOP, RIGHT, BOTTOM);      /* Set up Rect for our depth window */
nextgDevice = thisgDevice = GetDeviceList();   /* Get start of list */
while (nextgDevice != NIL)                     /* Should always have one active screen */
  {
  nextgDevice = GetNextDevice(thisgDevice);                  /* Get next device, but don't look at it */
  if (TestDeviceAttribute(thisgDevice, screenDevice) &&     /* Is it a screen? */
      TestDeviceAttribute(thisgDevice, screenActive))        /* Is it active ? **/
    {
    thisDeviceDepth = (**(**thisgDevice).gdPMap).pixelSize; /* Get physical size of pixel */
    screenBoundary = (**thisgDevice).gdRect;                 /* Get screen size for this device */
    NumToString(thisDeviceDepth, &depthString);
/* Computations to center our window */
    centerHoriz = abs(screenBoundary.right - screenBoundary.left) / 2;
    centerVert = abs(screenBoundary.bottom - screenBoundary.top) / 2;
    frameHoriz = centerHoriz - ((RIGHT - LEFT) / 2);      /* Calculate offsets from screen center */
    frameVert  = centerVert - ((BOTTOM - TOP) / 2);
    globalLeft = screenBoundary.left + frameHoriz;        /* Add back into screen coordinates to get... */
    globalTop = screenBoundary.top + frameVert;           /*   ...global coordinates on GrayRgn */
/* Make our window. */
    if ((depthWindow[i] = NewWindow(NIL, &dBox, "", INVISIBLE,
                dBoxProc, (WindowPtr) -1, NO_GOAWAY, NIL)) != NIL) /* Made window OK? */
      {
      MoveWindow(depthWindow[i], globalLeft, globalTop, TRUE);      /* Move it to screen's center */
      ShowWindow(depthWindow[i]);
      SetPort(depthWindow[i]);                /* Point to our window */
      TextFont(systemFont);                   /* Ensure we're using Chicago font */
      TextSize(24);
      if (thisDeviceDepth > INDEXED_COLORS)   /* Direct colors: need two digits */
        MoveTo(1, 26);
      else                                    /* Indexed colors: only one digit to display */
        MoveTo(9, 27);
      DrawString(depthString);                /* Draw depth value */
      i++;
      } /* end if != NIL */
    else
      {
      nextgDevice = NIL;                      /* Had a problem making a window, halt */
      SysBeep(30);                            /* Honk the horn */
      } /* end else */
    } /* end if TestAttributes() */
  thisgDevice = nextgDevice;                  /* Set up for next device */
  } /* end while */
```

plan. So don't bang your head on the pipes as we go into the cellar and learn how the Mac deals with expansion boards.

Slot Manager Basics

To change a monitor's screen depth, you must first know what pixel depths its display board supports. Remember that the Mac knows nothing at all about the board until into you plug it into the system. The NuBus standard dictates that an expansion board's address space is determined by the ID of the NuBus slot it is plugged into. This easily averts any addressing hassles that typically plague PC board installations.

To handle the software side of board installation, Apple created a collection of routines called the *Slot Manager*. At boot-up, the Slot Manager's duty is to initialize any expansion board it finds and to install any drivers the board might require. The Slot Manager provides a number of high-level calls that can query a board for its type (e.g., video display, network, or modem) and functions.

Naturally, the Slot Manager has to get this information from the board itself. The NuBus standard again requires a *configuration ROM* at the high end of its address space, but it's used only to respond to bus signals. Apple took this idea a step further: Each configuration ROM contains information that identifies the board, describes its functions, and supplies its initialization and driver code.

continued

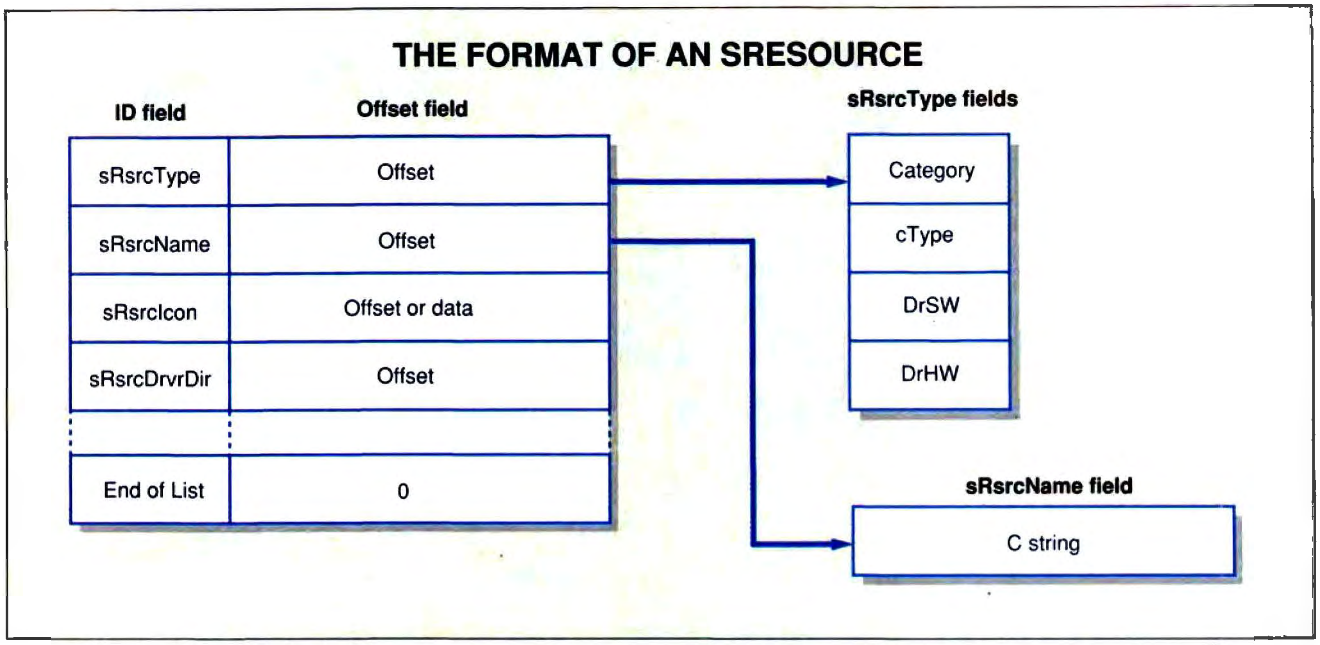


Figure 2: *In the Mac, add-in boards are defined using sResources. The format of sResources lets the Slot Manager access information in the board's ROM without knowledge of its location.*

Listing 3: *The structure of a video sResource's video parameter block. It's identical to Color QuickDraw's pixel map structure.*

```
video parameter block

typedef struct VPBlock {
   long      vpBaseOffset;   /* frame buffer offset */
   short     vpRowBytes;     /* width of each row of video memory */
   Rect      vpBounds;       /* bounding rectangle for display */
   short     vpVersion;      /* pixel map version number (always 1) */
   short     vpPackType;     /* reserved */
   long      vpPackSize;     /* reserved */
   long      vpHRes;         /* horizontal resolution (pixels per inch) */
   long      vpVRes;         /* vertical resolution (pixels per inch) */
   short     vpPixelType;    /* pixel type 0 = chunky; 2 = chunky direct) */
   short     vpPixelSize;    /* number of bits per pixel (power of 2) */
   short     vpCmpCount;     /* number of components in pixel */
   short     vpCmpSize;      /* bits per component */
   long      vpPlaneBytes;   /* reserved */
} VPBlock, *VPBlockPtr;
```

This configuration ROM code is arranged in a special format that allows the Slot Manager to locate and extract information without knowing its exact whereabouts in the ROM.

What about those Macs that have built-in video (i.e., the SE/30, IIci, IIsi, and LC)? On these systems, firmware simulates a NuBus slot. This lets these machines share common ROM code and respond to System software in a consistent manner.

For example, the Mac SE/30's built-in video uses 64K bytes of video RAM for the built-in screen's frame buffer. This VRAM is located at the same address as NuBus slot E, and 8K bytes of ROM on the main logic board emulates a video configuration ROM. The Mac IIci, IIsi, and LC operate in a similar way, but the frame buffers live in main RAM. On-board video is accessed as slot 0, which makes sense because the main logic board is always assigned as slot 0.

It's in the ROM

The configuration ROM's code and data are organized into objects called *sResources* (for slot resources). An sResource is similar, but not identical, to a Mac resource. You access both by either their ID number or type using the Slot Manager or the Resource Manager, respectively.

The configuration ROM is composed of three elements. First, there's a *format block*, which performs several functions. It tells the Mac how to address the information on the board. A cyclic-redundancy-check checksum lets the Mac validate the contents of the ROM. Finally, the format block points to the second ROM element, an *sResource directory*. This directory lists all the sResources in the ROM and provides offsets to each. The third ROM element is the sResources themselves.

The general layout of an sResource is shown in figure 2. As you can see, an sResource's organization is rather simple: It's a 32-bit block composed of an 8-bit ID field and a 24-bit field that contains either data or a signed offset to another data structure. The sResource's ID field provides a unique ID number used to identify it. Numbers in the range of 0 through 127 are reserved by Apple, while IDs 128 through 254 can be used by board vendors.

Each sResource must provide both a name (sRsrcName) and a type (sRsrcType) to identify it. An sRsrcName is simply a C-style string that's up to 254 characters in length. An sRsrcType is an offset to an 8-byte block that uses codes to decribe the sResource's category, type, driver software format, and driver hardware. The Slot Manager finds the start of an sResource by searching for its

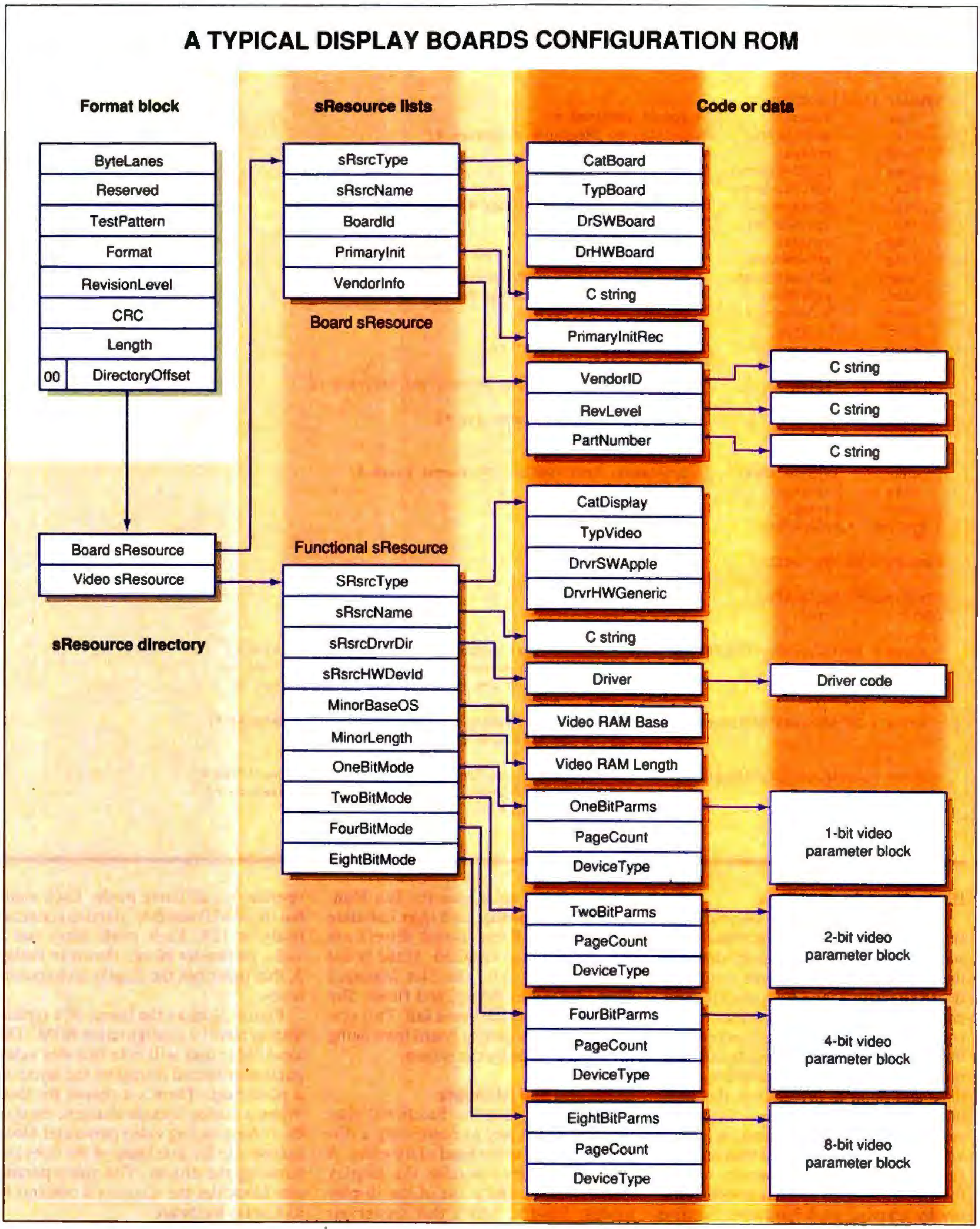


Figure 3: *All sResources point to other sResources or to code and data. The video parameter blocks resemble a pixel map's layout. (From a diagram in* Designing Cards and Drivers for the Macintosh Family, Second Edition, *by Apple Computer)*

Listing 4: *Some Slot Manager calls and data structures. Not all the Slot Manager calls are shown.*

```
Slot Manager parameter block

typedef struct SpBlock{
   long       spResult;       /* result returned */
   Ptr        spsPointer;     /* pointer to sResource structure */
   long       spSize;         /* size of structure */
   long       spOffsetData;   /* offset data field */
   Ptr        spIOFileName;   /* pointer to IO filename */
   Ptr        spsExecPBlk;    /* pointer to parameter block */
   Ptr        spStackPtr;     /* stack pointer */
   long       spMisc;         /* misc. field */
   long       spReserved;     /* reserved */
   short      spIOReserved;   /* reserved field of slot resource table */
   short      spRefNum;       /* reference number of driver for this slot */
   short      spCategory;     /* category */
   short      spCType;        /* type */
   short      spDrvrSW;       /* driver software format */
   short      spDrvrHW;       /* hardware */
   char       spTBMask;       /* mask for category, type, driver, and hardware */
   char       spSlot;         /* slot number */
   char       spID;           /* ID of sResource to search for */
   char       spExtDev;       /* ID of external device */
   char       spHwDev;        /* ID of hardware device */
   char       spByteLanes;    /* ByteLanes, from config. ROM format block */
   char       spFlags;        /* flags */
   char       spKey;          /* internal use */
} SpBlock, *SpBlockPtr;

Some Slot Manager calls

SlotBlockPtr SpBlockPtr;
OSErr        error;

  error = SNextTypesRsrc(SlotBlockPtr); /* Returns next sResource of sRsrcType. The slot */
                                        /* number, sResource ID, driver ref. number, and */
                                        /* other values are returned for the sResource. */

  error = SFindStruct(SlotBlockPtr);    /* Returns a pointer to the data structure defined */
                                        /* by the sResource ID */

  error = SGetBlock(SlotBlockPtr);      /* Copies a block from the sResource list identified */
                                        /* by the sResource ID into a new block pointed to */
                                        /* by spResult */
```

ID number or its sRsrcType.

There are two kinds of sResources: a Board sResource and functional sResources. The Board sResource identifies the board to the Mac. There's only one Board sResource, and it supplies the vendor information, an ID number, and a pointer to the board's initialization code. Functional sResources provide information about the board's hardware functions and point to driver code that must be loaded at boot-up time. Typically, each board has only one function (e.g., a video display function) and thus only one functional sResource. However, support for a multifunction board is possible simply by teaming each hardware function with its own functional sResource.

Now you see how the Mac automatically installs expansion boards. When the Mac boots up, it uses the Slot Manager to first validate and then initialize each board it finds. Board drivers are also located and installed. If the board initialization fails, the Slot Manager flags that slot as empty, and future Slot Manager calls to the board fail. This prevents a malfunctioning board from being installed or used by the system.

Using the Slot Manager

If you suspect that the functional sResources are the key to controlling a display board, go to the head of the class. A *video sResource* contains the display board's driver and a list of the display modes. Finally, here's that mysterious mode. A mode is simply a pixel depth. The term *mode* came about because each pixel depth requires that display board to operate in a different mode. Each mode has its own ID number, starting consecutively at 128. Each mode entry has a *video parameter block*, shown in listing 3, that describes the display's characteristics.

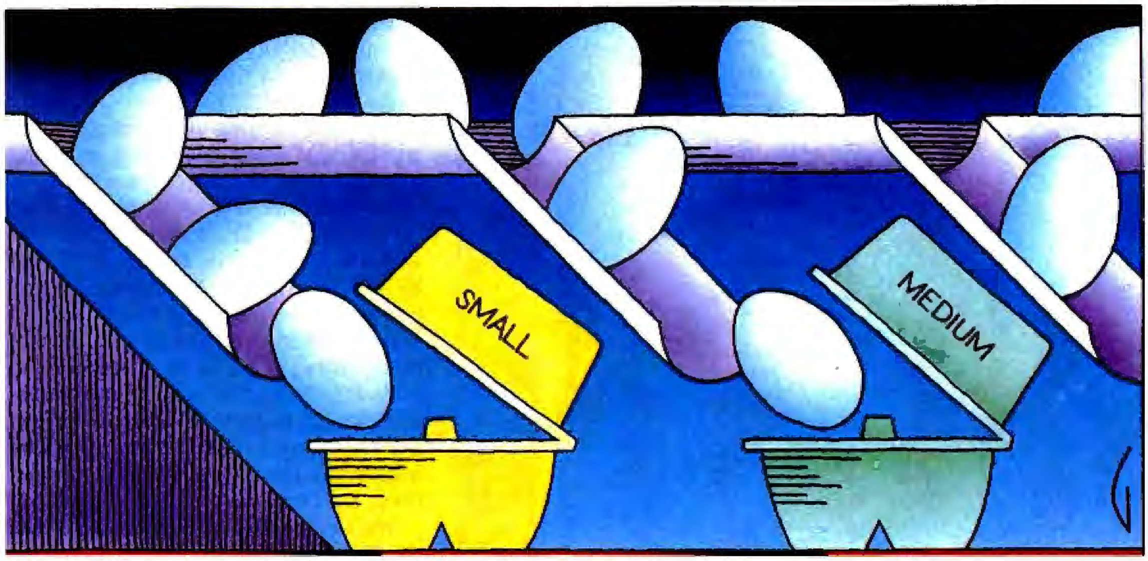
Figure 3 shows the layout of a typical display board's configuration ROM. The astute Mac user will note that this video parameter record resembles the layout of a pixel map. There's a reason for this: When a display's mode changes, most of the corresponding video parameter block is copied to the pixel map of the `GDevice` handling the display. The video parameter block ties the `GDevice`'s contents to its display hardware.

I'll use Slot Manager calls to query the display board, looking for its video sResource and its mode list. Listing 4 shows

continued on page 390

STEPHEN LACEY
AND
RICHARD BOX

A FAST, EASY SORT



A few simple modifications to a bubble sort greatly speed up this classic routine

A bubble sort is the first standard sorting algorithm most programmers learn how to code. Those who continue to write programs for mainframes, personal computers, or even programmable calculators may continue to use a bubble sort simply because it's intuitive, it's easy to write and debug, and it consumes little memory. A bubble sort would most likely be the standard sorting routine today if it were not so incredibly slow for most lists. However, a few simple modifications to this classic routine make it a fast and efficient sort for all kinds of lists.

Turtles and Rabbits

In a bubble sort, each element is compared to the next; if the two are out of order, they are swapped. It takes many passes through a list to finally get all the elements in order (see figure 1). A bubble sort is finished sorting when it makes a pass that does not require any swaps. This type of sorting routine is called a *bubble* sort because of the way low values appear to "bubble" up to the top of the list.

The comparison of two values can be the most time-consuming part of any sorting routine, and bubble sorts require comparisons proportional to the list size squared, or N^2. Faster sorting methods, such as `Quicksort`, require comparisons proportional to $N*\log_2 N$.

Bubble sorts are also slow because they are susceptible to the birth of elements we call *turtles*. A turtle (in an ascending sort) is a relatively low value located near the end of a list. During a bubble sort, this element moves up only one position for each pass (or *stroke*), so a single turtle can cause maximal slowing. Almost every long random list contains a turtle. On the other hand, a high-value element near the top of a list (a *rabbit*) is harmless. If you reverse the direction of the stroke, turtles become rabbits and rabbits become turtles. The worst possible turtle—the lowest relative value at the end of a list—forces a bubble sort to make $(N-1)^2$ comparisons. This means that a bubble sort of a 1000-item list could require nearly a million comparisons.

`Combsort` (see the text box "Combsort" on page 317) is our simple modification of a bubble sort. It eliminates turtles by allowing the distance between compared elements (the *gap*, which is always 1 in a bubble sort) to be greater than 1.

For the first stroke, the gap is the list length divided by 1.3 (the *shrink factor*)—an important value, as we explain later. Before each subsequent stroke, the gap is reduced to the previous gap divided by 1.3; if this quotient becomes less than 1, the gap is reduced to 1, collapsing `Combsort` into a bubble sort. A swap moves across the entire gap, causing turtles to jump rather

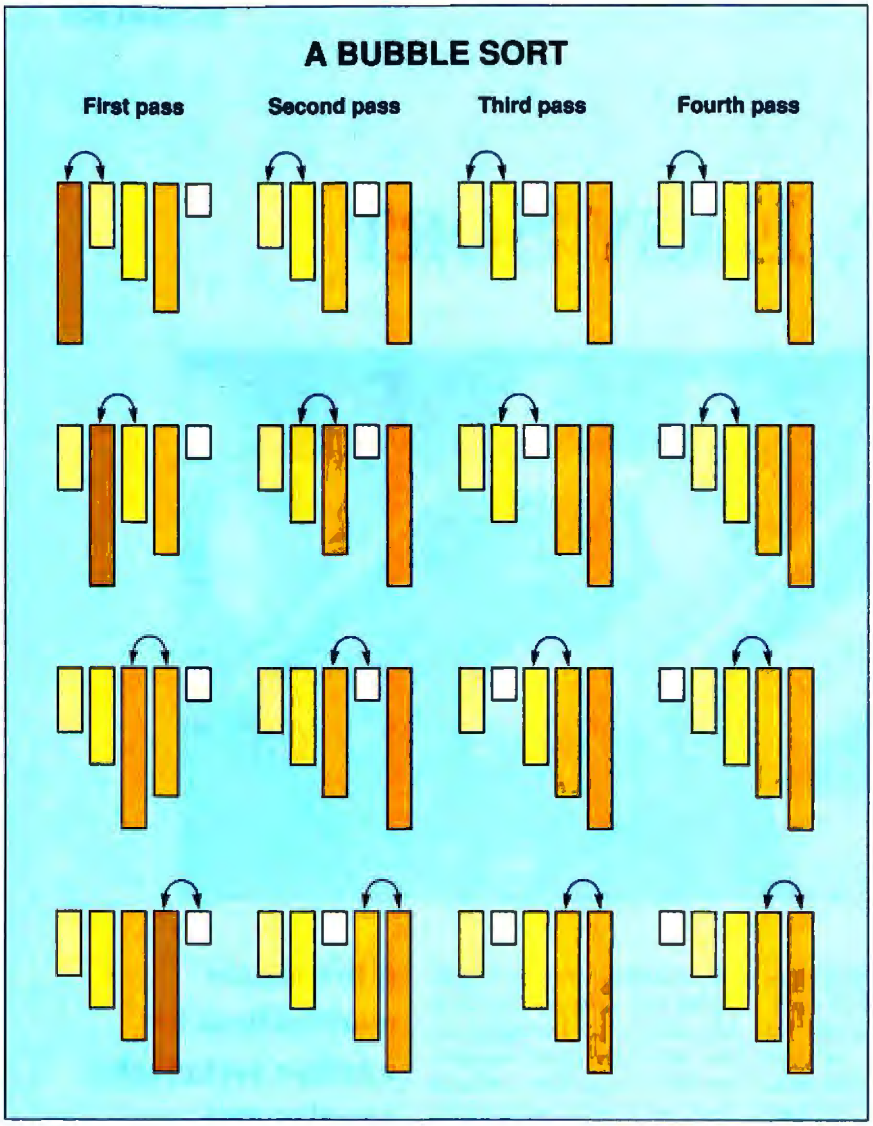


Figure 1: *In each pass of a classic bubble sort, the first two items in a list are compared and placed in the correct order. Items two and three are then compared and reordered, followed by items three and four, and then four and five. The sort continues until a pass with no swaps occurs. High-value items near the beginning of a list (such as the longest line here) move to their correct position rapidly and are called* rabbits. *Low values located near the end of a list (like the shortest line here) are called* turtles, *because they move only one position with each pass.* `Combsort11` *(see listing 1) eliminates turtles and reduces the number of passes required to achieve the correct order.*

than crawl. The key to speeding up turtles, thus speeding up the sort, is to give the turtles just enough opportunities to make large jumps.

Successively shrinking the gap is analogous to combing long, tangled hair—stroking first with your fingers alone, then with a pick comb that has widely spaced teeth, followed by finer combs with progressively closer teeth. `Combsort` has a similar shrinking effect on the gap (hence the name *comb* sort). Each stroke presorts the list (i.e., it kills or wounds some turtles). Therefore, by the time the gap has declined to unity (a bubble sort), all the elements are so close to their final positions that a bubble sort is efficient.

The Importance of 1.3

We came up with a shrink factor of 1.3 empirically by testing `Combsort` on over 200,000 random lists. As shown in figure 2, we plotted sort times versus shrink factors from 1.1 to 1.45 for random lists varying in length from 1000 to 1040 elements.

This is a *cornucopia* plot, which means that the data follows a relatively tight curve at the small shrink factors but starts to vary widely as the shrink factor increases. We looked for the best situation, a balance between short times and predictability, and we found that the optimum shrink factor (SF) is near 1.3. SF = 1.15 is slowed by excess comparisons; SF = 1.45 is erratically slowed because too few turtles are killed. From this and similar plots, it became clear to us that 1.3 is the best marriage of consistency and speed.

We tried dividing the list of gaps (the *gap list*) into geometric halves and using a different shrink factor for each half. A three-dimensional contour plot of time versus SF_1 and SF_2 looks like a crater with the ideal points at $SF_1 = 1.37$ and $SF_2 = 1.24$. This routine averages 1 percent faster than the single shrink factor of 1.3, but it forms turtles about 3 percent of the time. This is an unacceptable trade-off. The performance is not consistent enough, because SF_1 shrinks the gap too aggressively for some lists. We tried initializing the gap at 50 random positions, but there was no improvement.

We designed routines that use the number of swaps on a completed stroke to determine how much to shrink the gap for the next stroke. However, none of these methods was as consistent as `Combsort`, particularly with nonrandom lists. And also linear approaches to the decrease in gap, such as gap list = $0.9N$, $0.8N$, $0.7N$, . . ., 1, are substantially slower than `Combsort`.

We also experimented with an "exponential" shrink factor. Before each stroke, the gap was divided by a shrink factor, and the shrink factor was divided by a second factor. This routine was almost as fast as `Combsort` but was susceptible to turtles, much the same as `Combsort` with two shrink factors.

Rule of 11

The one improvement we found was to eliminate gap sizes of 9 and 10 but always include 11; the gap size becomes 11. With shrink factors near 1.3, the gap list can conclude its journey toward 1 in only three ways:

- 9 6 4 3 2 1
- 10 7 5 3 2 1
- 11 8 6 4 3 2 1

In the third case, all miniturtles are killed before the gap reaches 1. In the

Combsort

Richard Box and Stephen Lacey

If you are required to program on a calculator or in BASIC, you may not have access to programming function libraries, particularly ones with Quicksort. But you can easily program a bubble sort. With just a few extra lines of program, you can change a bubble sort into one of the fastest sorting routines (see the table).

Ascending bubble sorts compare adjacent elements (e.g., 1 and 2, and 2 and 3). A bubble sort repeats through the list until no more switches are made. Combsort is a generalization of a bubble sort that permits comparison of nonadjacent items, retaining the simplicity of a bubble sort but with a dramatic increase in speed. (See the comparison of the two sorts in listing A.)

Consider an ascending sort of a sample list with 100 elements. We call the space between compared elements the *gap*. For example, a gap of 80 would compare elements 1 and 81, 2 and 82, . . ., and 20 and 100, and would switch pairs when appropriate. Such a pass would take 20 comparisons rather than the 99 of an equivalent bubble sort. The benefit is that the swap could move the elements as much as 80 notches closer to their final destination. We have found that the ideal way to select the next gap is to divide the previous gap by 1.3. The gap remains at 1 once it reaches 1. As shown in listing A, a bubble sort is converted into Combsort by the following process:

1. Replace 1 with the gap in the inner loop.
2. Initialize the gap to *size*, the dimension of the list.
3. Recalculate the gap with the do loop by dividing the previous gap by 1.3, taking the integer part and using the result or 1, whichever is greater.
4. Repeat the loop until the gap is 1 and the switch counter is 0, indicating that the sort is finished.

SORTING SPEEDS

Note the length of time required to sort a single list of 500 real numbers using True BASIC on an Amiga 2000.

Sort routine	Sort time (seconds)
Bubble sort	162
Combsort	5.98
Heapsort	6.16
Quicksort	3.07

Listing A: *A comparative listing of a bubble sort and* Combsort, *using True BASIC.*

```
SUB BUBBLESORT(A(),SIZE)

DO

  LET SWITCH=0
  FOR I=1 TO SIZE-1
    LET J=I+1
    IF A(I)>A(J) THEN
      !SWAP THE ELEMENTS
      LET HOLD=A(I)
      LET A(I)=A(J)
      LET A(J)=HOLD
      LET SWITCH=SWITCH+1
    END IF
  NEXT I
LOOP UNTIL SWITCH=0
END SUB
```

```
SUB COMBSORT(A(),SIZE)
LET GAP=SIZE
DO
  LET GAP=MAX(INT(GAP/1.3),1)
  LET SWITCH=0
  FOR I=1 TO SIZE-GAP
    LET J=I+GAP
    IF A(I)>A(J) THEN
      !SWAP THE ELEMENTS
      LET HOLD=A(I)
      LET A(I)=A(J)
      LET A(J)=HOLD
      LET SWITCH=SWITCH+1
    END IF
  NEXT I
LOOP UNTIL SWITCH=0 AND GAP=1
END SUB
```

Listing 1: Combsort11. *This C function assumes that the entire data set is stored in the global integer array* list[].

```
#define SHRINKFACTOR 1.3

comb_sort(size)
int size;
{
int switches, hold, i, j, top, gap;
extern int list[];

gap=size;
do {
 gap=(int)((float)gap/SHRINKFACTOR);
 switch (gap)
 {
 case 0: /* the smallest gap is 1 - bubble sort */
  gap = 1;
  break;
 case 9: /* this is what makes this Combsort11 */
 case 10:
 gap = 11;
  break;
  default:
  break;
 }
 switches=0; /* dirty pass flag */
 top=size - gap;
 for(i=0;i<top;++i)
  {
  j=i+gap;
  if(list[i] > list[j])
   { /* swap */
   hold=list[i];
   list[i]=list[j];
   list[j]=hold;
   ++switches;
   } /* end of swap */
  } /* end of pass */
 } while (switches || (gap > 1) );
}/* like the bubble and shell, we check for a clean
pass */
```

first two cases, about 8 percent of lists have surviving miniturtles, causing the routine to slow by 15 percent to 20 percent. The result is Combsort11, which is described in the pseudocode of listing 1.

You may wonder whether there are nonrandom lists that decrease performance. This is an important question, because certain list types cause some implementations of Quicksort (the fastest known sort) to degenerate into an N^2 sort.

For example, a presorted list is best sorted by a bubble sort, while a reverse-sorted list is the worst case for a bubble sort. Combsort11 sorts both list types faster than it would sort a random list. In fact, all the partially ordered lists we tested sort faster with Combsort11 than a random list does.

Since we were unable to design an algorithm better than Combsort11 to select a gap list, we sought to demonstrate by exhaustion that a better gap list cannot be generated.

We refer to the difference between any list and its sorted counterpart as the *tangle*. At any point in a sort, the tangle is calculated by summing the square of the

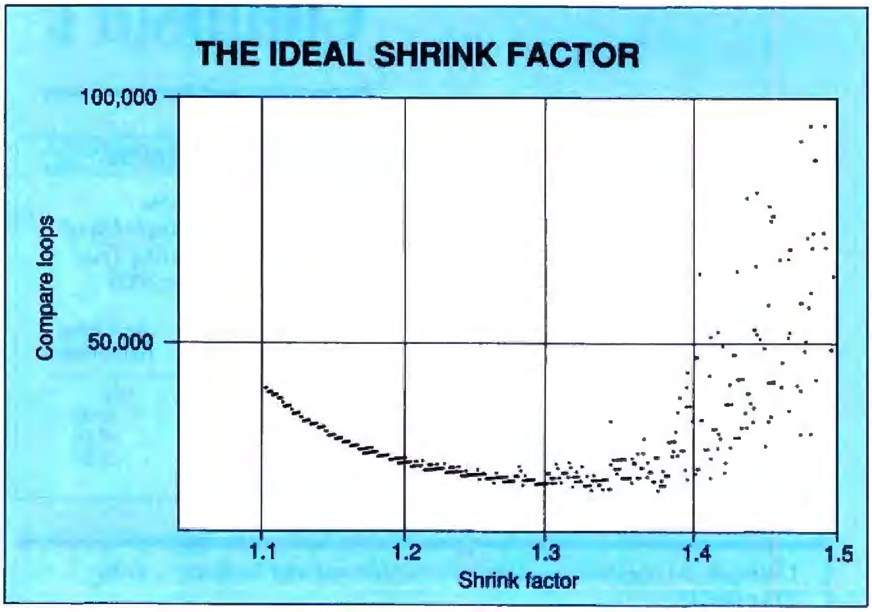


Figure 2: *The number of compares (approximately equivalent to the sorting time) for different shrink factors. The random lists have from 1000 to 1040 elements. There are better shrink factors than 1.3 for individual lists, but 1.3 gives the best balance of consistency and speed for a greater variety of lists. The sorting routine is* Combsort11 *(see listing 1).*

I N T R O D U C I N G

HARDLOCK™

Actual Size

The Ultimate in Hardware Based Copy Protection

Compatible

Hardlock is designed for the "real world". Side effects from printers, laptops and technical issues such as static and true IBM printer port compatibility are virtually non-existent.

Reliable

Our unique ASIC (Application Specific Integrated Circuit) extends the Hardlock's operating range below 2 volts. Since no idle current is required, there is no additional loading on the printer. Electronically erasable memory **requires no battery.**

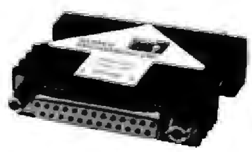
Flexible

Field programmability is now possible. Additionally our optional Crypto Programmer board permits the Hardlock to be uniquely programmed for your company.

Space-Saving

Hardlock measures only 1.75". Three of our units fit in approximately the same space as only two others. Hardlock with Memory may also be purchased on the smallest PC board you've ever seen. Perfect for those who don't want the device on the exterior of the computer.

Hardlock
Hardlock with (128 bytes) Memory
Hardlock with Memory on a Board



Hardlock . . .
Not Hardluck

The Security System You've Asked For.

GLENCO
ENGINEERING INC.
SERVING THE SOFTWARE INDUSTRY SINCE 1979
1-800-562-2543

270 Lexington Drive · Buffalo Grove, IL 60089 · 708-808-0300 · FAX 708-808-0313

Circle 120 on Inquiry Card.

distance each element currently is from its sorted position. Tangle=0 when the list is sorted. We square the distances to emphasize turtles. The *efficiency* of a stroke for a given gap at any point in the sort is defined as the percent of change in the tangle per comparison.

We plotted efficiency versus gap on a list of 100 elements, trying every possible gap. After the ideal gap had been estimated and applied, the same process of finding the tangle and efficiency was repeated for each stroke.

These putative ideal gap lists were all strikingly similar to a gap list generated by 1.3, except that they decreased faster when the gap fell below 13. This failure to follow the Rule of 11 allowed fast sorting in special cases but did not have general applicability. Even our "proof by exhaustion" revealed no gap list consistently superior to the one that was calculated by the shrink factor method using SF=1.3.

Not a Shell Sort

Although the algorithms for `Combsort` and a shell sort look very similar (both use a gap and a shrink factor), they do in fact perform significantly differently. A shell sort does a complete sort (until there are no more swaps to be made) for each gap size. `Combsort` makes only a single pass for each gap size—you might say `Combsort` is more optimistic. There are other differences that result from this optimism: The ideal shrink factor for a shell sort is around 1.7, compared with 1.3 for our `Combsort` routine. If you plot sorting time against list size (N) for a shell sort, you will see a step function that approximates $N*\log_2 N*\log_2 N$, whereas `Combsort` is not a step function and approximates the flatter curve of $N*\log_2 N$.

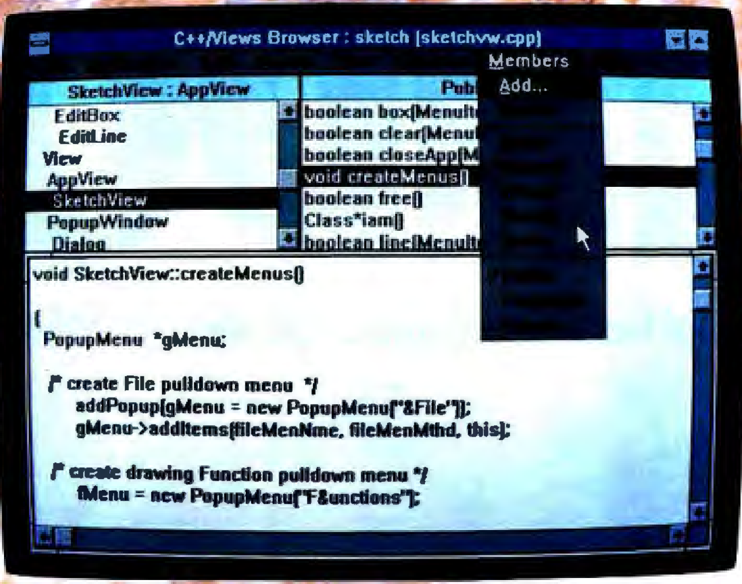
Although the algorithms for Combsort and a shell sort look very similar, they do in fact perform significantly differently.

`Combsort` and `Combsort11` represent a simple modification of a classic bubble sort; a bubble sort is actually a special case of our `Combsorts`. The stable and fast `Combsort11` is an optimized form of the general `Combsort`. The only known routines that can compete with ours in execution speed cannot compete in coding ease. ■

Stephen Lacey, M.D., is an assistant professor of internal medicine who also specializes in gene cloning at the University of Texas Southwestern Medical Center in Dallas, Texas. Richard Box is a geophysicist and mathematician working for British Gas in Houston, Texas. Both authors can be contacted on BIX c/o "editors."

C++/Views™

for Microsoft Windows



THE MICROSOFT WINDOWS 3.0 DEVELOPMENT TOOL THAT DELIVERS FROM START TO FINISH.

C++/Views is a development tool for C++ programmers that not only reduces the complexity of Microsoft Windows 3.0 but also slashes development time by up to 75%.

Delivers on the promise of Object-Oriented Programming (OOP).
Encapsulates more MS Windows 3.0 functionality than any other tool on the market today. Get MS Windows applications off to a fast start with a framework of over 75 tested and ready-to-go C++ classes.

Has the most complete C++ class library for MS Windows Development.
Get started with graphical user interface classes such as windows, views, bitmaps, dialog boxes, menus, popup menus, graphics, regions, pens, brushes, controls, buttons, listboxes, valuators, editors, printers and much more. Organize your data with foundation classes such as containers, collections, sets, dictionaries, files, strings, streams and so-on. Use other classes to manage the persistance of objects across files, to perform serial communications, and to activate timed events.

Provides support for the entire project.
Comes with a complete OOP development environment including the first fully functional C++ class hierarchy *Browser*. Also includes an *Interface Generator* for building C++ dialog classes and a *Documentor* for automatically producing high quality documentation of your classes.

Integrates leading-edge technology.
Combine C++/Views with **Borland C++** or **Zortech C++** for a cost-effective and highly productive development environment for building your next generation software systems.

Pays for itself on even the smallest project.
Only **$495.00** with no royalties.
Comes complete with source code.

C++/Views
from CNS, Inc.

CNS, Inc., Software Products Dept.
1250 Park Road, Chanhassen, MN 55317
(612)-474-7600 • FAX (612)-474-6737

MICROSOFT WINDOWS

Circle 64 on Inquiry Card.

U C I N G

S™ WORLD

From the Producers of COMDEX in cooperation with Microsoft.

THERE.

network computing—will be covered in-depth and in detail by some of the best minds in the business.

We see large crowds attracted to this event, so plan to be a part of WINDOWS WORLD '91.

FOR MORE INFORMATION, CALL 617-449-8938, TELEX 174273, FAX 617-449-2674, OR MAIL IN THE COUPON.

1991 • ATLANTA

WINDOWS™ WORLD '91
The Official Conference and Exposition for Windows Computing
at SPRING

Yes, I want to be part of WINDOWS WORLD '91.
May 20–23, 1991 • Atlanta, Georgia

Name ______________________
Title ______________________
Company ______________________
Address ______________________
City ________ State ________ Zip ________
Phone ________ Fax ________

Complete and return to: WINDOWS WORLD '91
300 First Avenue, Needham, MA 02194 U.S.A.

BM 4/91

ASK BYTE

Longing for More Accuracy

I mostly use my computer, an XT Turbo, for crunching numbers and number theory. For primality testing, I can't get more than 16 digits of accuracy using compiled BASIC. Beyond that the result is inaccurate. Could I create my own compiler or get some commercially available software to handle larger numbers?

Carlos Baranyai
Scarborough, Ontario, Canada

You don't have to create your own compiler. What you need is a better math library. BCD for BASIC from Atlantis Software (2445 Camino Capitan, Santa Fe, NM 87505) supports basic math, square roots, powers, print formatting, and comparison functions for Microsoft QuickBASIC 4.x, BASIC 7.0, and Crescent Software's PDQ library. I haven't tried it yet, but it sounds like a steal at $30.—H. E.

Perfect Writer Isn't Perfect

For several years, my company has used Perfect Writer for its word processing. It is extremely easy to use and very easy to teach within our working environment. The problem we have is that we would like to upgrade our Panasonic KX-P1624 to a laser printer.

What drivers do I use, or do I manufacture them myself using the commands suitable for a laser printer?

Also, I would like to know where I can reach Perfect Software. The phone number is no longer listed, and there is no forwarding number.

Walden Williams
Huntington Beach, CA

For the benefit of folks who may not remember Perfect Writer, it was an EMACS-style word processing module from Perfect Software. Teamed up with Perfect Formatter (a fairly powerful Scribe-based formatting package) and Perfect Speller, Perfect Writer formed the core of a very good environment for creating documents.

To answer your last question first, Perfect Software went out of business several years ago. Perfect Writer was originally licensed from Mark of the Unicorn (Cambridge, MA), which also developed Mince and Final Word. To make a long story short, Perfect Software ran into legal and financial trouble and went away rather abruptly.

Perfect Writer came with a very extensible printer driver set. For example, in your document, you specify a boldface string as "this is @B(boldface) text." The printer driver converts this device-independent syntax to a printer-specific command. Back in 1983, laser printers and proportional-spacing printers were not very common, and Perfect Writer uses overstrikes to achieve a number of its effects. That technique doesn't work on laser printers, so if you do get your new printer to work, you won't get any boldface.

Even worse, Perfect Writer uses the mica, defined as $\frac{1}{10}$ millimeter, for its measurements. The mica doesn't map very accurately to the more common decipoint (1/720 inch), so your placement of things on the page is going to be somewhat inaccurate. I've been there. I still use Perfect Writer as a programming editor, but I had to abandon it for formatted output when I bought my first LaserJet.

It looks like you're going to have to get a new word processor, but which one? The biggest expense in changing software is usually retraining your staff.

The EMACS interface on Perfect Writer is very powerful but not very common. Epsilon Text Editor is a programmer's editor with the same front end, but it doesn't have the word processing features you'll need. Microsoft Word and WordPerfect are simply too different from EMACS to make a clean transition. Your best bet is to check out Borland International's Sprint. It comes standard with a Borland-style interface but can be reconfigured with a number of interchangeable front ends; one of these is EMACS. As a word processor, Sprint is more than capable of driving your new printer.

Sprint gives you the user interface you need, but, alas, it doesn't handle the Scribe formatting commands. You'll have to convert those yourself or get a custom conversion package written. The only other caveat is that Borland is no longer developing Sprint. It's going to sell and support version 1.0 for as long as there's interest. Even so, that's your best option.—H. E.

Homeward Bound

I have a system set up in my office to run AutoCAD. It runs as a workstation on a network. I want to take it off the network and run it as a stand-alone system.

My system, a Compaq Deskpro 386/33, includes a 120-megabyte hard disk drive, two floppy disk drives, a Racal-InterLan 10Base-T network card, and an Artist Graphics XJ10 video controller.

I want to add a printer and a tape drive. Should I leave the 10Base-T card in the system, or should I replace it? What else do I need to add?

I plan to run spreadsheets, database software, and word processors, as well as AutoCAD. I appreciate any advice you can give me.

Ralph D. Adé
New York, NY

If you're not using the network card, take it out. It will only make resolving address and interrupt conflicts more difficult when you add new cards. If your company can't use it, wrap it in a static-shielded bag, put it back in the box, and put it on the shelf.

The Deskpro 386/33 includes serial and parallel ports on the system board, so you won't need any I/O card to connect to a printer. If you're looking for a good general-purpose laser printer for both printing and printer plotting, check out the Personal Computer Products Laser-Image 1030. We found it to be one of the best low-cost laser printers at handling Hewlett-Packard Graphics Language plots in July 1990's Product Focus ("Laser Printers Get Personal").

continued

I'm tempted to suggest that you contact Compaq for the tape drive. However, if you're looking for a low-cost backup solution, any tape from a reputable dealer with more than 120-MB capacity should suffice.—S. A.

Wants His Business to Slide

I want to set up a slide and transparency printing business for computer-generated images, supporting the most used graphics programs (e.g., Harvard Graphics, Applause II, and Freelance Plus). This service isn't now available in Portugal. Could you please send me the names of potential suppliers of all the hardware necessary to do it?

Antonio Málveiro Jorge
Amadora, Portugal

The easiest way to print from a number of different software packages is to invest in a copy of each. That's not cheap, but it assures you of the best results without having to worry about data loss due to file conversion. That means you'll also need a big enough computer to run anything. I'd suggest a 386 or 386SX machine and enough RAM (maybe 4 MB) to provide extended and expanded memory support. Your hard disk drive should probably be fairly large, too; a lot of software packages take up a lot of room.

A number of companies make 35mm slide printers. The list I have shows about two dozen. I've chosen two that have European sales offices. Agfa Matrix has a 4096- by 2732-pixel printer, complete with an interface card and drivers for about 100 software packages. Polaroid recently announced its CI-3000 film recorder, which comes with support for CGM files and direct drivers for Freelance Plus (support for Harvard Graphics and Applause II is coming soon). The CI-3000 handles a variety of film sizes at 2048- by 1366-pixel resolution.

As I said, there are plenty of others, with more or less resolution. These printers are not cheap, though. Figure on spending between $4000 and $25,000 for any kind of slide printer. The Agfa printer costs about $10,000; the Polaroid printer lists for $4500. Addresses for these companies are listed below.

Agfa Matrix
One Ramland Rd.
Orangeburg, NY 10962
(914) 365-0190
fax: (914) 359-3201

in Belgium:
Agfa-Gevaert N.V.
032-3-444-3924
fax: 032-3-444-3923

Polaroid Corp.
Polaroid Presentation Products
575 Technology Sq.
Cambridge, MA 02139
(617) 577-2000
fax: (617) 577-5618

in Portugal:
Polapor
Av. Eng. Duarte Pacheco
Torre 1-80.Piso - Sala 4
1000 LISBOA
351-1-684055
fax: 351-1-680819

Since you're planning to spend a large amount of money, I'd advise you to ask lots of questions and select your equipment carefully. I wish you the best of luck in your new venture.—H. E.

Dashed Hopes

Like so many unsuspecting computer users, I bought a Tandy 1000 TX. Although I have no system troubles with it, I had high hopes for using its expansion capabilities. I have written to several vendors that offer the shorter peripheral boards usable in the TX. Alas, more and more, I find this machine is less and less PC-compatible.

My expansion desires are reasonable and simple: a 40-MB card-mounted hard disk drive, VGA graphics (the TX comes with CGA on the motherboard), a 2400-bps modem, *any* other kind of keyboard, and a larger power supply for future needs. Some sort of accelerator card and faster RAM would be a dream, but with a lobotomized bus and whatever limitations written in the BIOS, this may be too much to ask.

I made a serious investment when I bought my system, and I had hopes of extending its useful life with expandability. Please don't tell me my only source is Radio Shack to get what I'm searching for! If there are no better alternatives, I have heard of a used computer equipment brokerage in New York.

Allen F. Robertson
Antioch, TN

I'm afraid the resale value of a Tandy 1000 TX is not particularly high. If your local Radio Shack store can't give you satisfaction, try the following:

Computer Peripherals Direct, Inc.
409 11th St.
Huntington, WV 25701
(800) 328-3387
(304) 529-0246
fax: (304) 529-0249

MegaHaus Hard Drives
1110 Nasa Rd. 1, Suite 306
Houston, TX 77058
(800) 426-0560
(713) 333-1910
fax: (713) 333-3024

Micro Systems
1524 County Line Rd.
York Springs, PA 17372
(800) 548-5182
(717) 528-8802

These companies sell hard disk drives that are compatible with the Tandy 1000 series of computers. Computer Peripherals Direct has a wide range of upgrade products for Tandy computers.—S. W.

There Must Be A Cache

I own a Zeos 386/25. I bought the system with 128K bytes of CPU cache, but I have been unable to figure out if the system contains this cache. I have no diagnostic software that will search for such memory, the BIOS doesn't show that such memory exists, and I can't recognize the cache's static RAM (SRAM) chips on the motherboard. When I spoke to the technicians at Zeos

YOU MAY BE MISSING THE BOAT...

If you're a C or PASCAL software engineer and haven't tried Ada yet!

Since 1983 Ada has become one of the fastest growing programming languages. Ada software engineers are in high demand. Colleges are graduating more and more Ada engineers.

From the space shuttle to the Persian Gulf, Ada's the law for all Defense Department, NASA and NATO related programming. Overseas, Ada's the law for all European Community programming. And here at home, more and more Fortune 500 companies are switching to Ada to solve their software engineering problems.

Sounds big doesn't it?

Yet few software engineers have given Ada even a glance. But Ada's coming and now you can hop on board for $149.95.

We've even made it simple. A complete, ***validated*** Ada Programming Environment that's more than just a compiler—a full color, seamless, user-friendly environment with pull-down windows, a language sensitive editor, a linker, operates on 8086, 80286, 80386, and 80486, and requires no math CoProcessor.

Everything to begin software engineering in Ada. ***Serious, production quality, software engineering!***

And we're so sure that Ada will change the way you think about software engineering, we offer a ***money back guarantee***. No questions asked. We also offer Ada tutorials and educational discounts.

So if you're currently a PASCAL or C software engineer, here's your chance to give Ada a try for only $149.95.

Your ship may have just come in.

To order call **1-800-232-3989** or send in the Coupon. For faster service **FAX (203) 624-2855.**

GEM Technologies, Inc.
1 Trumbull Street,
New Haven, CT 06511
1-800-232-3989

☐ **YES** please send me GEM Technologies Complete Ada Programming Environment for $149.95.
☐ 5¼ disc ☐ 3½ disc.
CT residents add 8% sales tax.

☐ I want to learn more about software engineering in Ada. Please send me the free Complete Ada Programming Environment Demo disc ☐ 5¼ disc ☐ 3½ disc.

Name ____________________
Address ____________________
City ____________________
State ________ Zip ____________
Telephone ____________________

☐ Check ☐ VISA ☐ MC ☐ Money Order
Card # ______________ Exp. date ________
I currently program in: ☐ COLBOL ☐ PASCAL ☐ Ada ☐ BASIC ☐ Other

GEMTECH
The Ada Company

GEM Technologies, Inc.
1 Trumbull Street, New Haven, CT 06511
(203) 865-2525 FAX (203) 624-2855

Circle 320 on Inquiry Card (RESELLERS: 321).

International, they were unable to provide me with any answers. Yet, they have been very helpful with any other questions or problems I have had.

Can you help me? I hope there is a way to verify that such memory exists, either through software or physically visualizing the chips. If not, what is to keep manufacturers from advertising a cache when it doesn't exist or there is less SRAM than advertised?

Brian C. Blackman
Friendsville, TN

I like these easy ones. The obvious place to start was with Zeos. I called its technical-support group; you were right, they were incredibly helpful. On your motherboard, the SRAM chips should be located near the left front of the machine and have gold stickers on them. If you don't have the SRAM installed, you'll find empty sockets or a spot on the motherboard for sockets.

If you still want to check your cache from software, you might try Sofwin's Syswin utility. It's a program similar to Norton's SI, except that it digs much deeper into the system's innards. It measures such things as CPU clock rate, size of the CPU cache, and seek time of the hard disk drive. You can get the latest version from Sofwin (6546 Roseland Court, Reynoldsburg, OH 43068, (614) 759-6324) for $69.

Buying a computer isn't any different than buying a car or major appliance. I wonder how many people actually time the 0–60 mph acceleration of their new car, or measure to see if that new refrigerator is really *21 cubic feet? In general, we don't hear too many horror stories about computer companies cheating customers out of things like CPU caches; it's just too easy to catch them at it. To minimize your chances of that happening, buy from reputable companies, be sure to check the packing slip carefully, and always practice a safe mail-order technique.*—H. E.

I Want My LCD

Could you help me find a bright and crisp monochrome LCD with Hercules-, EGA-, or VGA-quality resolution? I cannot understand why LCDs are not sold without an attached microcomputer. The technology seems to have advanced enough, and the price should not be exorbitant.

O. Güntzel
Liebefeld, Switzerland

Yes, we can help. How about the Safe Monitor? It's a backlit, shielded LCD that—according to its manufacturer—is virtually radiation-free. The company has even removed the power source from the monitor to a bus connector that you can locate at whatever distance you consider safe.

Safe Computing's Safe Monitor comes in a variety of models, including CGA, VGA, and Macintosh-compatible versions. For PC operation, you'll need a color graphics adapter. Although the monitor is monochrome, it represents colors either by gray scale or patterns (depending on the model). Prices range from $995 to $1695. For more information, contact Safe Computing Co., 368 Hillside Ave., Needham, MA 02194, (617) 444-7778.

—R. G.

Harness Racing

I am trying to locate a couple of items. First, I need a special cable. I need a custom Mac Plus analog-logic board wiring harness for my Mac 512KE, only with a standard hard disk drive power cable extension.

My SCSI port is a cable running out of the battery door. Now that low-power SCSI 3½- and 2½-inch drives are available, I would like to install one internally. I need some way to hook up the SCSI cables and still have an external port. I'd like to have an adapter made of a PC board, male and female DB-25 connectors, and a 50-pin stick header. This would fit in an opening in the back of my Mac case with the adapter mounted on the rear chassis rail.

I am also looking for a case to hold three external 5¼-inch full-size hard disk drives or six 5¼-inch half-height drives. The power supply should be able to handle 60 to 80 watts, have connectors for six drive devices, and have a front-mounted switch with an "on" indicator LED. The power supply can be on the top or bottom of the case. I want all drive bezels to be exposed so that I can see the drive indicator lights.

Finally, I need an I/O card for an IBM PC that has COM1, COM2, COM3, and COM4 serial ports and LPT1, LPT2, and LPT3 parallel ports. This would be one card with all the DOS serial and parallel ports. Each port must have an enable/disable jumper. The bracket should have an LPT1 DB-25 connector. All other ports should be cable-attached to header pins.

Anthony J. Oresteen
Batavia, IL

The Macintosh adapters you describe should be fairly easy to make yourself. The hard disk drive power connector is very common, and all you'd have to do is identify the correct leads on the Mac cable assembly and splice in the new connector. The same is true for the SCSI adapter: The 50-pin header is a standard item, and you can find a PC board and DB-25 connectors at your local Radio Shack.

However, if it were my Mac, I wouldn't do it. The power supply in the 512KE and Plus models is notorious for getting stressed-out and fizzling. Just upgrading a Mac Plus to 4 MB of low-power RAM is often enough to blow the supply; adding a hard disk drive is simply playing with fire. If you insist on doing it anyway, you can probably get any competent repair shop to make the adapters for you. While you're at it, be sure to add a fan to help keep the case cool.

I don't know of any PC cards like the one you describe. Putting all four COM ports and all three LPT ports on a single card would prevent you from adding any other cards or internal modems. I'd imagine that most people would rather have the flexibility of mixing and matching. Multiple printer ports are typically used in network print servers, where COM ports may not be needed. Applications calling for multiple COM ports often require more than four; in those cases, cards like Arnet's Multiport boards give you eight (or more) ports.

To get all six drives in a single case, the obvious way is to get a standard PC clone tower case. A number of these cases handle eight or more drives and are widely available from mail-order companies for around $300.

—H. E.

ADVERTISEMENT

WHAT'S NEW AT COMDEX

Springtime in Atlanta

SPRING '91 is a major new international computer industry event dedicated to information technology solutions.

It's two major shows side-by-side in Atlanta this May 20-23, an expanded **COMDEX** now reaching resellers and corporate end-user management, and **WINDOWS™ WORLD**, the first official conference and expo for Windows computing created in cooperation with Microsoft.

Some 1,000 exhibiting companies and 60,000 attendees are expected, including computer resellers, software developers, distributors and OEMs, plus corporate buyers, MIS/communications managers, CIO/IS executives, workgroup and departmental managers, and 1,000 trade and business press.

SPRING will feature a combined Conference program of more than 170 sessions -- the largest and most comprehensive forum ever put together for a computer industry event.

COMDEX Continues to Lead the Way

The 11th Spring version of **COMDEX** will continue to reach every category of reseller, with this year's expanded show featuring a host of reseller-specific educational and training support programs. These will include over 60 conference sessions specifically focused on reseller issues, as well as customized vendor presentations from leading manufacturers and suppliers.

COMDEX '91 at **SPRING** will also be the first **COMDEX** event to offer a separate End-User Conference Program with nearly 60 separate sessions. A wide variety of programs and features will also be available to the corporate end-user, from middle managers to senior information system (IS) executives.

Raymond J. Noorda, President and CEO of Novell, will deliver the COMDEX keynote address. "The spark that Ignites an Industry," an insightful overview of networked computing and its ever-increasing impact on the computer industry.

WINDOWS™ WORLD: The Official Show for Windows Computing

WINDOWS™ WORLD is the official Microsoft-sponsored event supporting Windows, the most influential computing software on the market today.

The show will feature products, support and more than 50 educational conference sessions on Windows computing for corporate users, software developers, system integrators, peripheral designers, value-added resellers (VARs), and other industry professionals.

Bill Gates, Chairman of Microsoft, will deliver the WINDOWS™ WORLD keynote address. "Windows: Changing the Face of Corporate Computing," an inside look at the contributions of Windows to corporate computing and a preview of future enhancements to Windows technology.

Networked Computing

SPRING Networked Computing Focus will include exhibitors demonstrating interoperability along with a comprehensive conference program on networking and communications, including a Corporation for Open Systems (COS) certification program.

Networking exhibits will be on both **COMDEX** and **WINDOWS™ WORLD** show floors, and almost 60 networking sessions topics will be offered in both conferences.

A Multimedia Pavilion

SPRING Multimedia Pavilion will feature an exhibit area of major industry companies, such as IBM, Microsoft Corporation, and others. In addition, **SPRING** attendees will be able to see a variety of products combining audio, video, animation, graphics and more in a separate Multimedia Presentation Theater. Approximately 20 conference sessions will address the status of this emerging technology.

Highlights of SPRING '91

- 1,000+ **COMDEX** and **WINDOWS™ WORLD** exhibitors.
- 170+ conference sessions in the **COMDEX** and **WINDOWS™ WORLD** Conferences.
- **COMDEX** keynote by Novell CEO Ray Noorda addressing critical reseller and user issues.
- **WINDOWS™ WORLD** keynote address by Microsoft CEO, Bill Gates.
- Special focus on Networked Computing and Multimedia.
- Major new programs including Vendor Presentations, New Product Awareness, User Group Meetings.
- Special focus on Networked Computing and Multimedia.

CONTACT: SPRING - featuring COMDEX and WINDOWS™ WORLD, Atlanta, May 20-23, 1991. For more information on attending call THE INTERFACE GROUP at 617-449-8938. For exhibiting information call 617-449-6600 x4023.

Conner Confusion Clarified

I have a 40-MB Conner Peripherals Intelligent Drive Electronics (IDE) hard disk drive, just like the one Dennis C. Kornbluh has (Ask BYTE, October 1990). I am afraid the tip you gave him will not help at all.

You told him to perform a nondestructive, low-level format on the hard disk drive. This may work on most hard disk drives, but it doesn't on Conner's. A Conner IDE drive has an on-board, read-ahead buffer (not a cache) to boost its speed. The buffer keeps any software from running a low-level format. This includes SpinRite and Disk Technician. Even a destructive low-level format by DOS FDISK will not work. The Conner drive is pre-low-level formatted and can be low-level formatted only in the manufacturing process, as far as I know. So, unfortunately, the only option Kornbluh has is to get the hard disk drive repaired or replaced.

Frank C. Yang
Elmhurst, NY

Sometimes, when faced with a hardware problem, the solution becomes apparent only after considerable digging. You are indeed correct about not being able to do a low-level format on a Conner Peripherals IDE hard disk drive, but for the wrong reason.

The Conner drive electronics prevents any software from doing a low-level format. The reason is that the Conner drive uses embedded servo information at the beginning of each sector for locating head positions on the platters. This servo information can be stored on the drive only with specialized equipment at the factory. If you persisted in trying to do a low-level format on a Conner drive, you would destroy the servo information and render the drive useless. Some other brands of drives use a dedicated platter for servo information.

The Conner drives also use a voice-coil mechanism for positioning the heads, so they are less susceptible to head-positioning problems (due to overheating or mechanical wear) than older drives that use stepper motors for positioning the heads.

You aren't exactly right about FDISK. It creates a partition sector or bootstrap program at the first sector on the hard disk drive (head 0, cylinder 0, sector 1) and stores the partition information at this location. BIOS loads the bootstrap program into memory, and then the bootstrap program loads the operating-system program from other locations on the hard disk drive. The bootstrap program transfers control to the operating system.

You need a low-level formatting program, such as Ontrack Computer Systems' Disk Manager, or a formatting program in ROM on some hard disk drive controllers, to do a low-level format of the hard disk drive.

After discussing Kornbluh's problem with the technical-support people at Conner Peripherals, they thought that the 2- to 3-second delay during I/O operations is due to a BIOS timing problem. They have seen this problem with certain early versions of the AMI BIOS.

If the occasional 3-second delay does not cause data-storage problems, they suggest that he either live with the problem or replace his BIOS with a newer version. If the problem continues or grows worse, Conner Peripherals technical support is available at (408) 456-3200.

My original advice is still valid: Back up your hard disk drive!—S. W. ■

NIX® is a registered trademark of AT&T. UNIX WORLD is not affiliated with AT&T.
UnixWorld's no-risk guarantee: If not satisfied, cancel and receive a full refund for the balance of your subscription.
McGraw-Hill publication

An Out-of-Towner's Introduction to the BIX Community

BIX is for people who use microcomputers for business, finance, research, and career and personal development. There's always something interesting happening here. No matter what you're into. The latest industry news. Top-notch software libraries. Private electronic mail. Real-time chatting. And every month, the complete text of *BYTE* magazine. (Read more about BIX, and how to join, on adjacent page.)

From Artificial Intelligence to Zenith Laptops...

Whatever your interest, BIX has a conference for you. Here's a partial list. (In each Exchange, Conference name appears on left, description on right.)

■ Amiga Exchange

Joanne Dow, Exchange Editor

amiga.user	Exchange ideas, solve problems, compare notes
amiga.sw	Amiga programming and developer issues
amiga.hw	Amiga hardware design, use, and hookup
amiga.arts	Artistry using the Amiga
amiga.int	Developing for the international Amiga
amiga.special	Special guests and events
amiga.dev	Commodore's conference for developers

■ IBM Exchange

Barry Nance, Exchange Editor

ibm.pc	The venerable PC
ibm.at	The AT series and workalikes
ibm.ps	The PS/2 series
ibm.os2	OS/2 operating system
ibm.dos	PC/DOS & MS/DOS operating systems
ibm.os.386	Alternative 386 operating systems
ibm.utils	Utility software for IBM computers
ibm.repairshop	Garage and Tune-up Shop
ibm.new.prods	New products for IBM computers
ibm.exchange	IBM Exchange clearinghouse
ibm.listings	Index to program files in the Exchange
ibm.other	Apps, printers, modems, etc.
microsoft	Products from Microsoft

BIX COMMUNITY CALENDAR APRIL 1991

■ Interactive Games Exchange

Rich Taylor, Exchange Editor

igx.exchange	What's new in the IGX
bridge	For Bridge lovers
chess	About the game of chess
d.horizons	Role-playing games not based on fantasy
digital.gaming	Computer gaming
fun.n.games	Fun, games, group activities
gaming.college	Learn about role-playing games
other.times	Land for fun, relaxing, and gaming
the.realms	Fantasy role-playing games
town.square	On-line meeting place

■ Macintosh Exchange

Dr. Larry Loeb, Exchange Editor

mac.apple	The word from Cupertino
mac.business	Macs in the office
mac.desktop	Publishing with a Mac
mac.external	Information from all over
mac.hack	Technical information about the Mac
mac.hypercard	Using the HyperCard programming environment
mac.news	Up-to-the-minute information
mac.novice	For beginners
mac.products	Listings of new hardware and software
mac.sandbox	For off-hours fun

■ Telecommunications Exchange

Steve Satchell, Exchange Editor

bbs	Dial-up bulletin board systems
conferencing	About computerized conferencing
ham.radio	Computing, digital electronics, amateur radio
international	Telecommunications; the global computer village
networks	Information networks
packet.nets	Packet-switching networks
protocols	Small-computer communications protocols
telecomm.pgms	Telecommunications programs
telecomm.tech	New telecommunications technology

■ Tojerry Exchange

Jerry Pournelle, Exchange Editor

tojerry	Messages for and from Jerry Pournelle
chaos.manor	Computing At Chaos Manor
astronomy	A star party for amateur astronomers
contact	Science fiction meets science
disasters	Natural and man-made disasters
education	Computers in American classrooms
mathematics	Talk about high-level mathematics
sciences	Scientific programs
space	Space exploration and development
technology	New technologies and their impact

EXPERT ADVICE

Experts from the worlds of IBM, Macintosh, Unix, and networked computing present inside information, advice, and tips for getting the most out of your computer

DON CRABB
Macinations

DAVID FIEDLER
The UNIX /bin

MEL LINDSTROM

BRETT GLASS
NetWorks

CONIGLIO STUDIO

DOUGLAS A. HAMILTON
Beyond DOS

MACINATIONS

Roger and Me: The Quest for Compatibility

Don Crabb

The Mac is a reliable software platform but has its share of compatibility problems

I just spent the better part of a day trying to fix a problem with my friend's Mac SE, and I'm no closer to a solution than I was before I started. I do a lot of "little consults" like this for my friends, especially those I got started on the Mac. This SE is Roger Ebert's, who uses it to write books, film reviews, and part of the weekly script for his syndicated TV show, *Siskel and Ebert*.

The problems with his SE surfaced when I upgraded the machine from 1 megabyte to 4 MB of RAM and from System 6.0.2 to 6.0.5.

Roger currently uses a DataDesk Mac-101 keyboard and a Kensington Microware trackball with his SE, rather than the standard Apple keyboard and mouse. According to him, the DataDesk keyboard has a better feel, and he likes all its programmable function keys.

It's this programmability, however, that has caused the problems. DataDesk supplies special System resources that you dump into your System Folder to make its key programmability magic happen. As it turns out, these resources aren't compatible with System 6.0.5 during start-up, so the machine fails to boot with the keyboard connected. Remove the keyboard, and the machine boots fine. You can then attach this keyboard—gambling that you don't short out the Apple Desktop bus (ADB) chip—and it works.

Roger and I have both gone around the bend trying to figure out what's wrong, and it comes down to a software incompatibility in the DataDesk resources during start-up. Moving to System 6.0.7 didn't fix the problem, although DataDesk thought it would. The Apple engineers I talked to said the problem was that DataDesk had violated some of Apple's System resource guidelines. DataDesk later confirmed this and sent us a patch disk with new resources. The new stuff doesn't work, either.

Well, that's too bad, you say. Roger should just buy another keyboard with function keys from some other vendor. He can do that, but it misses the whole point of the problem. He shouldn't have had to mess with this at all. This keyboard, like any Mac peripheral, should plug into its appropriate bus (i.e., ADB) and do its thing, without the need to chant incantations.

This has always been the Mac's promise: Software and hardware designed for it by third-party vendors would work right out of the box. MacFolk have learned to love their machines for this fact. You won't catch any of us wasting our time modifying CONFIG .SYS or AUTOEXEC.BAT files. We don't need to worry about memory partitions and EMS standards and all the other tedious system and software incompatibilities that plague DOS, Windows, OS/2, and Desqview—except, apparently, when vendors violate the System standards that Apple lays down, as DataDesk has done.

But considering that Apple has done this itself on more than one occasion (how many of you out there have had problems with the Apple 24-bit GC graphics board, please raise your hands!), how can you blame third parties for getting a bit lazy? It's tough following someone else's standards.

But that's precisely what Mac vendors must do. They *must* stick to the knitting as defined by Apple. And it's now

---

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 contacted on BIX as "decrabb."

time for Apple to get a heck of a lot more serious about how it defines that knitting.

System 7.0 presents Apple with the opportunity to do this. Apple must clean up any oddities in the System now. As Apple gets its own compatibility/reliability house in order, it should have a lot more clout in dealing with third-party vendors.

Apple has a big lead in the system compatibility and reliability race. It's much farther around the track than any microcomputer operating system you can think of. But now it's time to ratchet the whole enterprise up a notch. Now's the time for Apple to build perfection—in its own System and in its interfaces with third-party products.

By the end of 1991, Roger and me and other Mac users should never again have to waste hours and hours trying to fix a software compatibility problem.

Software of the Month: Tiles and TouchBASE

Someone was complaining to me recently that "the small Mac companies just aren't around anymore." I told him to pay closer attention to the Mac software market because there's plenty of great software still being produced by the small guys. This month, I have two new entries to share with you: Tiles from CE Software (sort of a large, small company) and TouchBASE from After Hours Software (definitely small).

CE calls Tiles an "Intelligent Desktop for the Mac," and it's right. With the advent of the much-delayed System 7 0, there is an unfortunate tendency among many Mac developers to not provide any improvements to the Finder and Desktop, since "Apple is taking care of that." CE's director of R&D, John Pence, however, doesn't believe that for a second. Which is one reason why he wrote Tiles: "Tiles builds on this power by anticipating the needs of the user, automatically organizing information, and presenting it graphically."

Tiles does this magic by creating graphical representations of applications and data files when they are opened. These representations are called tiles. Each tile can be stored in palettes (which are controllable through their own window bar icons) or placed on the Desktop. No matter how you choose to use tiles, you won't have to remember anything about the documents or applications they contain.

Tiles will nearly eliminate filing angst on a Mac. You no longer must remember where you stored things to use them quickly. For example, suppose you create a project tile to act as a container for your year-end report. This tile can then hold the application, document, and other tiles that relate to the report. When you want to work on that year-end report, you merely double-click on the project tile, which in turn launches the appropriate applications and opens the files. You don't have to remember anything about how the components are stored.

Costing only $99.95, Tiles is inexpensive, yet it's fully extensible. It's one of those products that the Mac seems to foster, and it will provide MacFolk with an even better working environment than the Finder alone.

TouchBASE, on the other hand, has a smaller target audience. Contact lists are its domain. How many of you keep a

Rolodex of names, addresses, and phone numbers? TouchBASE is the first product I've seen that is actually easier to use than the good old, reliable Rolodex (see the screen shot). I've tried HyperCard's Rolodex stack and products like DynoDex. The problem with them is that they try to act too much like the Rolodexes and Day-Timers they are replacing. Hey, if you've got a computer, why not think of new ways to solve information storage, retrieval, and usage problems? TouchBASE does exactly that.

This little desk accessory allows you to keep your contacts database up and ready to rock and roll all the time. It can do more heavy-duty stuff (e.g., printing labels, envelopes, fax covers, and the like). It can sort. It works in multiuser mode over a network. It can import and export data simply. It includes user-defined fields in addition to the basic ones. It even dials your phone for you. Not bad.

TouchBASE is a desk accessory that operates as a contacts database. It comes with a sample file of over 500 Macintosh "top contacts."

What TouchBASE doesn't do is overwhelm you with meaningless kitchen-sink features that bloat the software but don't add to its usefulness. More Mac software should be as well defined and compact as TouchBASE.

Tip of the Month

I've gotten into desktop publishing in a big way over the last year, teaching a few seminars on PageMaker and spending some time learning about the issues: fonts/type styles, graphics, color, resolution, printing, and paper. That's right, paper. That's the one that was the toughest to pin down because it seems like a no-brainer. If you use a laser printer for your output, you just use any decent-quality bond paper, right? Wrong, as I have learned.

The finish (i.e., texture, smoothness, and coating), water content (paper is mostly water!), and color (there are many "shades" of white) of paper all make a lot of difference in your final output. Some papers hold the toner better than others and keep it from smearing or diffusing. Other papers are biased toward providing the best possible camera-ready image. Still others can be erased, so you

can easily remove stray toner bits and flecks that always seem to stick in the wrong places on a document.

I learned all this stuff about paper (and a lot more) from Stephen Lambros of Graphic Arts Supply in New York City. The company produces some of the best desktop publishing paper I have found during my year of training. It makes a line of papers called LaserEdge, ranging from a special camera-ready single-sided heavy bond similar to resin-coated phototypesetting paper (LaserEdge HR-60RC) to a bond in three different weights (27, 32, and 38 pounds) designed to be imaged on both sides as final copy.

Using a high-quality bright-white paper like the LaserEdge products is one of the easiest ways I've found to improve the appearance and acceptability of desktop-published documents. ■

ITEMS DISCUSSED

LaserEdge High-Resolution Paper and Transparency Films
Graphic Arts Supply, Inc.
481 Washington St.
New York, NY 10013
(800) 342-5858
(212) 925-5332
fax: (212) 941-9765
Circle 1146 on Inquiry Card.

Tiles 1.0 .... $99.95
CE Software, Inc.
1801 Industrial Cir.
P.O. Box 65580
West Des Moines, IA 50265
(800) 523-7638
(515) 224-1995
fax: (515) 224-4534
Circle 1147 on Inquiry Card.

TouchBASE 1.0 ....$125
After Hours Software
5636 Van Nuys Blvd., Suite B
Van Nuys, CA 91401
(818) 780-2220
fax: (818) 780-2666
Circle 1148 on Inquiry Card.

THE UNIX /bin

Lost in the Woods

David Fiedler

How to set up your system to be ideally responsive to users so you can save time, stabilize your system, and make people happy

Sometimes you have to cut a path through the forest so you can see the trees. While using Unix generally doesn't destroy any natural resources (aside from your equanimity, occasionally), sometimes it can make you feel as if you're lost in a forest. This month's column is dedicated to methods of leaving a trail behind you, so you hopefully won't get lost more than once.

Do It Right the First Time

In the October 1989 BYTE, I covered some of the basics of running a Unix system. These days, most implementations of Unix have all kinds of built-in utilities to make adding users—and other important aspects of system administration—much easier. But the system designers don't always do things the way you want them to, with the result that you might find yourself constantly rearranging things to fit your preferred method of operation.

It takes a bit more effort than doing nothing, but *auditing* the system defaults will pay dividends in future time saved and security problems and user questions averted. I will use the familiar—and seemingly simple—task of adding a user as an example of the kinds of things I'm talking about. These concepts work well for plenty of other tasks aside from system administration, so it's worth a look.

Following Your Instincts

If you are a typical power user on Unix, you have probably made up several short shell programs and aliases that make your life easier. System administrators generally have more of these programs, since they must monitor all kinds of subsystems and file systems on a daily basis. But apart from people who simply log directly into an application, virtually all Unix users have one thing in common: They love to customize their log-in environment.

Your log-in start-up files (`.profile` for Bourne shell users, `.cshrc` and `.login` for C shell fans, and `.profile` and `.kshrc` for Korn shell folks) are your private little haven. These files give you your own identity, as well as a prompt and default command search path. I have known people who programmed their prompt to say "Yes, Master" before each command, and others who preferred colors, graphics, and Zulu time to the nearest millisecond.

Aside from these little quirks, systems evolve over time, so it is important to keep your start-up files current with the latest programs. For instance, I find that I like the operation of the `less` pager much better if I change the LESS environment variable to `-MCqse`, which is done in my `.kshrc` file. Other variables have become de facto standards on their own. When I set the environment variable EDITOR to `/bin/vi` and MAILER to `/usr/lbin/elm`, I know that any of the numerous applications that now check the contents of those variables will automatically let me use my favorite text editor and mailer. And likewise, setting SHELL to `/bin/ksh` tells `vi` to spawn a new Korn shell (rather than

David Fiedler is executive producer of Unix Video Quarterly *and coauthor of the book* Unix System Administration. *He has helped start several Unix-related publications. You can reach him on BIX as "fiedler."*

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

the Bourne shell default) when I type :sh from vi.

The point is that new users don't necessarily know all the tricks on your local system, even if they've used Unix before. The best way to ensure you have an efficient system is for the system administrator to have a little chat with some of the users who pay attention to these kinds of details and can collect as many handy hints as possible. Even system administrators are not omniscient, especially when it comes to every last flag and file reference in the Unix manuals.

You can then construct an optimum set of shell start-up files that include all the most popular local aliases, search paths, and options. One of the most important things to put in these files is a bulletproof program that, for any user, correctly sets the terminal type so that users can use screen-oriented programs. This usually is a tortuous one-liner involving the tset program, or a shell case statement based on foreknowledge about the kinds of terminals attached to particular tty lines.

Once tested, this set of files should be kept in a nonroot file system (where they won't be written over in your next system upgrade or reload), perhaps with names such as stdprofile and stdcshrc. You can then advertise their presence (via the /etc/motd file) so that interested users can study or copy them.

Make Sure for Yourself

To save even more time, find out where the system gets default start-up files when new users are installed (SCO users should look under /usr/lib/mkuser) and replace the system's defaults with your own improved versions. Save the originals in case you forget something. To find this information, by all means read the manual but also verify the information (and perhaps learn a few tricks) by looking at the program you execute to actually install new users. Now, every new user will get the benefit of your research, and a little less of the Unix "oral tradition" will be needed.

While you're at it, you can do a complete audit of the new user process. Create a new user the way your system manual recommends, generally via a program called newuser or adduser or as part of a system administration shell. Now log in as that user, and test everything. Do you get the expected shell start-up files? Can you send and receive mail, or do you run into permission problems? Can you, as this ordinary user, get into any restricted system directories, erase /unix, read other people's mail and files, or cause other mischief? When you create files as this user, do they have the correct owner, group, and permissions? Can you cd to the parent of your home directory? (Losing this capability is a problem when things are not set up right.) Have the correct entries been made in the /etc/passwd and /etc/group files?

If everything works perfectly, congratulations! But consider yourself lucky, as well. If security is of any importance to you (aside from simply correct operation), you can run more extensive tests with one of the publicly available security-checking programs. Now think about this: What is a security-checking program but one that tries, mechanically, the kinds of things that you and other administrators have found to be

important? Do you see the analogy between this and the automation of the new user process? Can you come up with any similar ways of automating things that you do often on your machine? Aren't these good candidates for shell programs or aliases? See how this is all interconnected?

Getting Around Obstacles

Sometimes Unix resembles a game of Adventure, where you have to go to different locations to do different things in order. A case in point: While I was writing this article, I had occasion to add a UUCP test account to a system. This account was specified as needing a four-character password. On older, less sophisticated Unix systems, short passwords were discouraged, but persistence won out: If you kept trying, the `/bin/passwd` program would accept a short one eventually. It was a cute way of getting around the published rules for those who knew the trick, but after all, the sole function of the `passwd` program was to let you change passwords.

But today's Unix systems are built to be tough. The `passwd` program on my SCO Unix system is a huge 90K bytes (I remember when `vi` was that size), and it has an eight-page manual entry and plenty of options and configurable settings. In fact, this new version generates random passwords for you, as well as check your new selected password against the on-line dictionary and a few other databases to ensure that it's not too easy for other people to guess it. It even makes sure your password is not a palindrome.

So how did I get a four-character password past this bouncer of a program? I read the manual, which indicated that a parameter called PASSLENGTH, normally set to five characters as a minimum password length, could be found in the file `/etc/default/passwd`. Naturally, I changed this value to four and tried again, only to come up against the database search algorithm that I mentioned earlier. It turned out that this was contained in a separate program whose path name was also stored in the default file.

Reasoning that a return code would be expected if a different program was being run, I changed the stored path name temporarily to `/bin/true` (which always returns a "good" value). Running `/bin/passwd` again, using this configuration, allowed me to get the short password stored properly.

And if the manual didn't explain this well, I could have used the famous `strings` program—the last refuge of the desperate—to find out what secrets were hidden in the binary of `/bin/passwd`.

None of this is meant as an indictment of modern security procedures or as an encouragement to bypass them. The point is that as Unix has become more complex, you must learn how to work with—and sometimes around—all the new programs and their features. But this is actually good news, since this means that there are more options open to you for getting your job done. While some installations may not need C2-level security (as has been bitterly debated in the unix.bin conference on BIX), it is certainly nice to have it available. My hope is simply that you never find out the hard way as to why you need security. ■

NETWORKS

Windows 3.0 and Networks

Brett Glass

What you don't know about Windows 3.0 and LANs can get you into a lot of trouble. Here are a few mistakes to avoid.

Early graphical user interfaces didn't offer much support for LAN users, but Microsoft designed Windows 3.0 from the start to work with networks. Workstations running Windows can access network disks and printers as if they were local. Network software can multitask or run in the background. It's even possible to modify your workstation's configuration (i.e., to add or delete network disks and printers) without leaving the Windows GUI. The file manager, print manager, and control panel are designed to *understand* networks and allow you to manipulate them gracefully.

All this power comes with a price, however. Setting up Windows to run on a network isn't simple, and many pitfalls lurk for the unwary. In this column, I have assembled a few important rules, gleaned from discussions with several experienced users, that should help you get (and stay) up and running.

Rule 1: Install the network before installing Windows.

When you first install Windows 3.0 on a machine, the Setup program gathers specific information about your system. Among this information is the type of network you're running (e.g., Novell and TOPS). Windows automatically installs its own special drivers for your network. It also remembers the logical drive to which it was installed. And if you set up icons for applications on network servers, Windows saves the path names for those applications—complete with drive letters—in .PIF files. This means that if you change the letters that are used to access network drives, you will get error messages when you attempt to launch applications. Worse yet, you might not be able to run Windows at all. To avoid this problem, you must first stabilize your network configuration and then install Windows.

If you install the network or change network vendors after installing Windows, be sure to run the Windows Setup program (which appears as an icon in the program manager's main program group) to install or update your network driver.

Rule 2: Put as much of Windows on the workstation as possible.

There are three methods of installing Windows on a LAN workstation. The first is to install Windows on the workstation's hard disk. This consumes the most hard disk space, but it is by far the fastest way to run Windows. It also has another advantage: Should the network go down, this is the only configuration that keeps running. I strongly recommend this approach.

The second method is to keep shared Windows files in a directory on the server but also keep files that are unique to each workstation on the workstation's local disk. The Windows manual (chapter 14) explains how to perform this somewhat tedious process; you must manually type in a batch file and then run it individually on each of the five Windows installation disks. You then mark all the files you create on the server as read-only, to prevent corruption. (I recommend Peter Norton's File Attribute utility for this purpose.)

To set up a workstation in this configuration, you can connect it to the Windows directory on the server and type the command `setup /n`. This approach sacrifices performance for hard disk space, and the trade may not be worth it. One user reports that even on a 386SX, it took as long as 2 minutes to load Windows over ARCnet.

The third way to install Windows on a LAN workstation is to place both the common files and the workstation-specific files on the network server. Again, you would use the `setup /n` command. This is the only choice for diskless workstation users that do not have a large RAM disk. Network overhead takes its toll in this mode, though; I'd advise against using a diskless workstation with Windows.

Windows also has the ability to speed operation in 386 enhanced mode by creating a permanent *swap file*. It uses this file, which must be contiguous, as a virtual memory pool. To attain the best possible performance, Windows bypasses DOS and proceeds straight to the BIOS to access this file, sector by sector. So, no matter what you choose to do with the other files, the permanent swap file (which you can create using the swap-file application in the Windows directory) has to reside on a local hard disk.

Rule 3: Make sure you have Windows-compatible network drivers.

Windows 3.0 is an ambitious product that cuts lots of corners and takes over much of your machine. For this reason, some low-level system programs, especially network drivers, don't work with Windows. Other programs require updates. For instance, Novell had to update its IPX, NETx, XMSNETx, EMSNETx, and NetBIOS drivers for Windows. If you bought NetWare recently, you already have Windows-compatible drivers. But if you're not sure, check to see if the version numbers on your IPX and NETx drivers are at least version 3.01a or higher.

To find out the version numbers of NetWare drivers and shells, you can invoke each program with the *i* parameter (e.g., IPX *i*, NETx *i*, and XMSNET *i*). The drivers report their version numbers

---

Brett Glass, a frequent contributor to BYTE, is a programmer, hardware designer, author, and consultant in Palo Alto, California. You can reach him on BIX as "glass."

without loading. The procedure differs for drivers from other LAN vendors.

CompuServe is a good place to pick up the latest NetWare drivers; you can download them from Data Library 16 of the NOVA forum. In all cases, check with your LAN adapter or network software vendor, who may be able to send you updated drivers.

Rule 4: Avoid running Microsoft Windows on a nondedicated server.

Some networks—especially peer-to-peer LANs—experience problems if you run Windows on the server. Even if your server is a fast i486, Windows may suck so much wind from its sails that performance is no longer tolerable. Or, worse, Windows may disable it altogether. After I had installed Windows, the server on my Network OS LAN stopped handling network requests entirely. (CBIS, makers of the Network OS, should have a fix by the time you read this.)

Rule 5: Load your network drivers high, if at all possible.

Several vendors produce network shells that can load themselves into EMS or extended memory (e.g., Novell's XMSNETx.EXE). Other shells will load high if you have a third-party memory manager, such as QRAM, QEMM-386, or 386Max. If you have these utilities, you should use them. Every TSR you load into DOS's 640K bytes of real-mode memory reduces the amount of memory that will be available in every DOS window—even in 386 enhanced mode. If you want to run large non-Windows applications (e.g., Ventura Publisher) within a DOS window, a memory manager is the only workable solution.

One caveat, however: If you use a third-party memory manager, test it thoroughly before using it with Windows on a regular basis. I am currently testing both QEMM-386 and 386Max with Windows and will report on them in an upcoming BYTE review.

Rule 6: Beware of memory, interrupt, and port-address conflicts.

Some network interface cards, such as the IBM Token Ring adapter, have RAM buffers that they map into the address region between 640K bytes and 1 megabyte. This can conflict with Windows' memory management scheme and can cause erratic operation. To keep Windows away from this memory, you may have to add a line, such as

```
EMMExclude=D000-D7FF
```

to the Windows SYSTEM.INI file. The manufacturer should be able to tell you if—and when—this line is needed.

Another common cause of conflicts is a LAN interface that attaches to a parallel-printer port. Since Windows normally goes directly to the port hardware when printing (rather than going through the BIOS), it can confuse a LAN adapter that is on the same port. The solution: tell Windows to use the LPTx.OS2 printer ports (available on the printer configuration menus). Designed for OS/2, this option forces Windows to perform well-behaved printer operations so that your LAN can reroute them to a network print server.

Are you having any trouble with Windows or the network when you move your mouse or use a communications program? If so, you may have revealed an interrupt conflict.

Circle 230 on Inquiry Card.

PC-MOS

The Multiuser DOS Platform For The '90s

The 386 and now the 486 microprocessors have focused a lot of attention on the multiuser, multitasking possibilities of advanced PCs. A myriad of software and hardware manufacturers are promising a new age of multiuser options in the '90s.

But when you take a closer look, only one solution focuses on the features you want and anticipates the capabilities you need to use your PCs to their greatest potential. That solution is PC-MOS™ from The Software Link, the first DOS-compatible, multiuser, multitasking operating system.

A Network Alternative

The advantage to the PC-MOS shared processing solution is its ability to maximize the available memory on your PC, taking full advantage of extended memory and sharing it with up to 25 users on inexpensive terminals or monitors. You can share data with the same speed and integrity of a network solution without the expense of network cards and the waste of under-utilized PCs. And no additional investment is required to get the multitasking capabilities inherent in PC-MOS.

A Network Enhancer

For affordable network expansion, PC-MOS servers can be connected to other servers with The Software Link's LANLink or with the PC-MOS GATEWAY™ to Novell's NetWare®. This connectivity lets a business configure its automation systems for departmental efficiency and expand affordably as needs grow with LANs or even WANs.

DOS Compatible

The PC-MOS alternative is clear: DOS compatibility means your users can continue to use all the popular software packages. And that means no investment loss, no retraining and no limitations in available applications.

An Unbeatable Solution

The next decade of shared processing will be clouded with choices. Only one operating system was first to offer you DOS-compatible, multiuser, multitasking solutions. Only one operating system continues to provide unbeatable multiuser solutions for over 150,000 users. PC-MOS from The Software Link. Call today and set your computing sights on a more productive horizon.

PC-MOS is a trademark of The Software Link. All other products referenced are trademarks of their respective companies. Prices, policies and specifications subject to change without notice.

THE SOFTWARE LINK

1-800-451-LINK

3577 Parkway Lane, Norcross, GA 30092

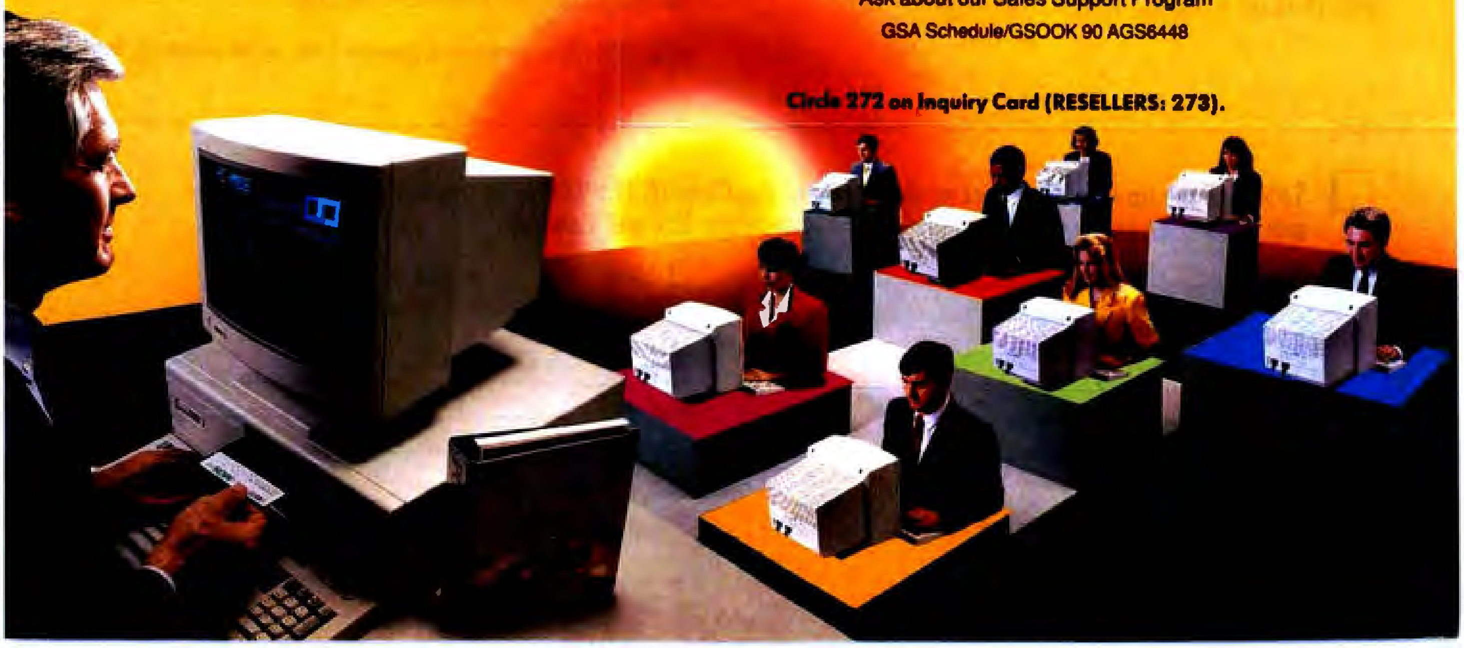
(404) 448-5465 FAX: (404) 263-6474 TELEX: 4996147 SWLINK

VARS and RESELLERS:

Ask about our Sales Support Program

GSA Schedule/GSOOK 90 AGS6448

Circle 272 on Inquiry Card (RESELLERS: 273).



Two devices can't share an interrupt on the IBM PC. Check the interrupt settings on your peripherals to ensure that this constraint is obeyed, and that your network card's port address is different from that of any other peripheral's. Port 300 hexadecimal, which IBM once documented as the port for prototyping boards, is the most common site of I/O address conflicts.

If possible, avoid using IRQ2 for a network card. This interrupt is more complex to service than the others, and some software doesn't handle it properly. If you have to use IRQ2 and you're using NetWare you can install the file VPICDA.386 (available from Novell with the Windows-compatible shells) to ensure correct operation in 386 enhanced mode.

Rule 7: Think twice before accessing the same file from two DOS sessions in standard or enhanced mode.

Any DOS program can ask the system to open a file for its own exclusive use, preventing all other programs from accessing the file. All properly designed networks respect these requests; therefore, if you open a file on the server from one workstation, another program on another workstation will not be able to access that file.

Unfortunately, each system sees Windows as a single application—even though it may actually run several applications. Therefore, if you open two instances of a database program in two separate DOS windows, both can access the same network file at the same time. The result can be seriously corrupted or lost data. I have lost databases that I created using ThinkTank by accidentally running two copies of the program on the same file from different windows.

I hope that Microsoft will address this problem in future versions of Windows. But in the interim, it's wise to keep track of the files and databases that each DOS window uses and to make sure that there's no overlap.

Rule 8: If you get stuck, consider going on-line for help.

CompuServe, BIX, GEnie, and all the other major on-line services have forums that cover LANs and Windows. You can join in on the different conferences and post your problems; odds are you'll receive an answer within a few hours.

Worth the Effort

I've exchanged E-mail with dozens of Windows and LAN users, and their opinion is pretty much unanimous: Microsoft needs to make Windows less awkward to install on a network. The good news, however, was the consensus that Windows did perform well once the initial hurdle of installing it successfully was overcome. So take heart and roll up your sleeves: Windows and LANs may not yet be the perfect couple, but if you're willing to play matchmaker, it is well worth the time and effort. ■

BEYOND DOS: WINDOWS AND OS/2

A Smaller, Faster OS/2

Douglas A. Hamilton

OS/2 1.3 is a technical success but a marketing flop

I walked into IBM's Boston office on the day of the OS/2 1.3 announcement feeling like a kid coming downstairs to see what Santa had left for Christmas. I sell software for OS/2, and if you don't have OS/2, you don't have any use for my software. That's a hard way to make a buck, because most of you don't have OS/2.

So I wondered, would this be OS/2's big break? Would printing finally work? Would mere mortals be able to install it? Would IBM finally launch the sort of marketing extravaganza that Microsoft used with such success for Windows 3.0? Just as there had been a $50 Windows 3.0 upgrade, would there now be a $50 OS/2 upgrade? To drive home just how reasonable the hardware requirements were, would they show it running on a lowly PS/1? Could this "Ultra Slim-Fast" version of OS/2 that Microsoft had fought so hard to keep off the market be the Windows killer?

The answers, sadly, were mixed. Technically, OS/2 1.3 is everything promised. Given the lackluster marketing effort, though, not many people are likely to discover that.

Douglas A. Hamilton is the founder of Hamilton Laboratories in Wayland, Massachusetts, and the author of its first product, the Hamilton C shell, an advanced command processor and utilities package for OS/2. He can be reached on BIX as "hamilton."

Delivers the Goods

I have been using version 1.3 every day, all day long, for a month now, and everything does work. It's fast and reliable. And because of the inherently superior kernel facilities, it's fundamentally more capable than Windows—and much more appealing to program. It's a fun system to use, and I have no hesitation in recommending it.

The most important improvement in version 1.3 is the ability to print. Since many of us use computers to help deforest the planet, an operating system that can't print is obviously at a disadvantage. No more. OS/2 1.3 prints properly. Even the print queues work. Watching jobs go into a queue (and then actually come out on the printer and look like they were supposed to) was almost magical. After three years of frustration, I guess I'd unconsciously given up.

Everything is much tidier now. Your root directory no longer looks like an atom bomb went off after you finish with the installation. Welcome enhancements include the REXX script language (formerly included only with the Extended Edition), a much wider choice of text fonts, and Adobe Type Manager (ATM). Version 1.3 runs in as little as 2 megabytes of RAM, although with memory now selling for $45 per megabyte, that may not be so important anymore.

REXX is an interpreted language that has been enormously popular in the IBM mainframe world and is now IBM's official Systems Application Architecture procedure language. Looking a little like PL/I, REXX encompasses and extends OS/2's batch language.

ATM is a popular extra-cost item under Windows 3.0 that comes free with OS/2 1.3. ATM uses outline fonts to let characters scale arbitrarily. Also, it will print exactly as it displays, even on dot-matrix printers, since ATM rasterizes characters for printers that do not have the appropriate fonts built in.

Version 1.3's performance isn't much different from version 1.2's. It was good before, and it's good now. I measured some text window and kernel functions, and I found few changes in speed. I did notice a difference in some large Presentation Manager (PM) applications like Lotus 1-2-3/G, where the start-up times improved by a few seconds.

For a long time, OS/2 has been a big victor in terms of productivity for developers. Coupling these latest refinements with a decent selection of word processing, spreadsheet, desktop publishing, and other core applications, OS/2 is now ready for ordinary end users.

The Marketing Fiasco

IBM's marketing is not any more aggressive than before. At the Boston office, there was just one machine tucked off in the corner running version 1.3. The marketing representative standing next to it was unsure just what sort of hardware was inside. Upgrades from OS/2 1.1 or 1.2 were announced as free, but no one knew how you were supposed to get one. A month after the announcement, IBM was still trying to decide whether you needed a dealer's signature or just the title page from your old version to get the upgrade.

Unbelievably, there's absolutely no upgrade path from DOS. At this time, there are only a few hundred thousand OS/2 users—and 50 million DOS users. You don't have to be a genius to realize that if you want to make OS/2 a success, you have got to convert some of those DOS users.

You hear all the time about companies spending anywhere from $5000 to $15,000 for a machine, loading it with all sorts of applications at $300 to $500 a pop, and having an employee use it all day long. Considering what an employee's time is worth to a company, you'd think $350 for OS/2 would be the least important consideration. It's a drop in the bucket relative to the other costs involved.

Yet, over and over, people tell me it is a big deal. And I believe them. Look what Microsoft's $50 upgrade program did for Windows 3.0. Is there anyone who didn't buy a copy? Where's IBM's promotional effort? Last summer, Microsoft spent at roughly the rate the Republicans or Democrats would to elect a president. IBM has run a few ads for OS/2, I admit, but you'd have to think hard to remember if you've seen one.

A Face Only a Mother Could Love

Compared to Windows 3.0, OS/2 still presents a face only a mother could love. Where are the free games like Solitaire or the pretty bit maps for the desktop? Where's the simple paint program or the (however dim-witted) free word processor? The only applications IBM and Microsoft have ever seen fit to include with OS/2, the File Manager and Borland's SideKick, are both so tediously slow I rarely run into anyone who can stand to use them. About the only good thing that can be said is that SideKick is no longer included and that File Manager is a little less tedious in version 1.3.

Compare also how you choose your colors in the PM versus Windows control panels. PM still uses a silly arrangement of three sliders for color, shade, and amount, which have nothing to do with the decimal RGB values displayed. Nor can you just type in the values you want.

With the Windows control panel, you can choose from a set of predefined colors or create your own by typing in the values as either RGB or HLS (hue-luminance-saturation) or by mousing around on a two-dimensional rainbow palette. To choose what you want to set colors for, you simply click on it. No silly menus where you have to guess what an "Action Bar Outline" is. When you're done, the color settings are saved as ASCII text in the initialization files, so you can see what the heck is in there.

Anyone comparing Windows and OS/2 right out of the box is going to prefer Windows. The technical superiority of OS/2, however convinced we might be that it's there, is simply not apparent at a first look.

Sell What You've Got

Just for good measure, in case anyone might be thinking, "Ah, it's finally time to move to OS/2," what do you suppose IBM demonstrates to potential customers? Is it version 1.3? Of course not. At the version 1.3 announcement, the demonstration for the whole audience was of OS/2 2.0.

Nothing like pointing out to people that there's really no point in bothering at all with version 1.3 since the "real" OS/2 is going to be out so soon. Adding insult to injury, nothing that they demonstrated that day couldn't have been done on version 1.3 or even 1.2 or 1.1.

Is version 2.0 coming out so soon? As I write this in mid-January, well past IBM's self-imposed end-of-1990 deadline for the first shipments of it, most of the betting seems to be that version 2.0 may be many months away from reality and that it still lacks the touted binary compatibility layer for running unmodified Windows 3.0 applications.

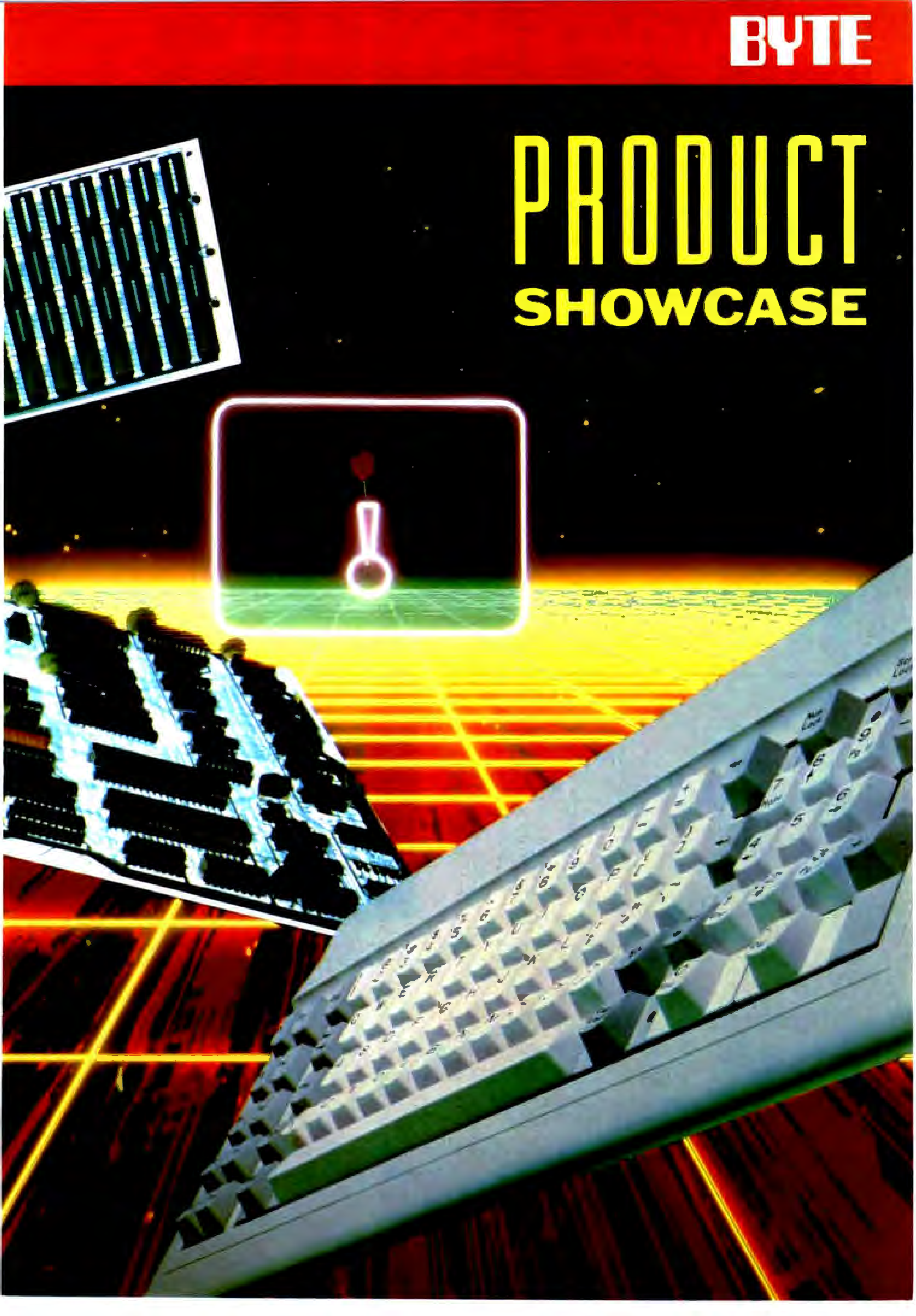
I've even heard that Microsoft is quietly advising some of its "strategic partners" not to bother at all with version 2.0 development, claiming they don't think IBM will have it ready until the end of this year, only a few months before Microsoft rolls out OS/2 NT (New Technology), the portable RISC version of OS/2.

For all its alleged marketing prowess, IBM may have forgotten that first rule: Sell what you've got, not what you haven't. What's sad about this is that OS/2 1.3 really is a fine product.

Modern Realities

OS/2 1.3 is, in many ways, the system we were promised back in the summer of 1987. It's solid and fast. The hardware requirements are neither excessive nor particularly expensive. Everything works, and virtually every item on the DOS user's "wish list"—true multitasking, a fast file system, a better scripting language, and virtual memory—is included.

But it's no longer 1987, and there's a lot more competition. Windows looks prettier and comes with more toys to acclimate new users. It's cheaper and far less risky to develop for Windows since the tools are much less expensive and the market is so much larger. Make no mistake, OS/2 1.3 is very good. I use it, and I love it. But IBM is going to have to wake up soon and begin the marketing, promotional, and developer support efforts that are needed to make it fly. ■


BYTE
PRODUCT
SHOWCASE

CATALOG SHOWCASE

Intel Development Tools

Choosing the right architecture for your embedded design is one of the most important decisions you face today. For successful embedded microcontroller development, Intel offers you a complete line of emulators, compilers and debuggers for the MCS®-51, MCS®-96, i960, x86, Intel 386™, 486™ families of Intel architectures.

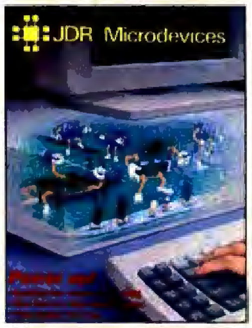
Our Development Tools Catalog lists all our embedded tools products in one guide. Call us at **1-800-874-6835**, or FAX 503-696-4633 for your free copy.

Intel Corporation, DTO, 5200 NE Elam Young Parkway, JF1-15, Hillsboro, OR 97124

1-800-874-6835 FAX 503-696-4633

Circle 144 on Inquiry Card

JDR Microdevices



Experience the JDR Difference:

- 30-day Money Back Guarantee
- 1-Year Warranty on Every Product
- Toll-free Ordering and Support

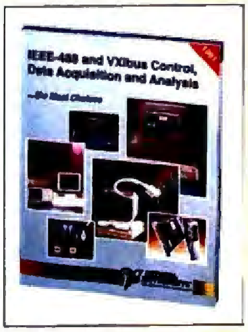
JDR offers quality products at competitive prices. Our new 100-page catalog has thousands of PC products. from motherboards, monitors and cases to drives, controllers, integrated circuits, cables and connectors. Developers will find a selection of test equipment, programmers and prototyping products. Buy with confidence from JDR!

1-800-538-5000

Mention Key #1090

Circle 148 on Inquiry Card

National Instruments



Free 488-page full-color catalog describing instrumentation hardware and software products for personal computers and workstations. Application software for data analysis and presentation and for collecting data using instruments and plug-in boards. Features GPIB interfaces, data acquisition and DSP boards, driver level software, signal conditioning and VXI controllers.

1-512-794-0100

Circle 190 on Inquiry Card

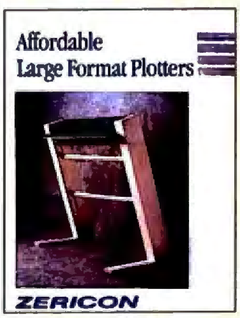
Best Power Technology, Inc.

FREE, money-saving literature tells you how to protect your computer from power problems such as surges, sags, spikes, noise, brownouts, blackouts and lightning. These power problems can damage delicate equipment and cause loss of valuable data. Learn how Best Power Technology's uninterruptible power systems, ranging from 500 VA to 18 KVA, can protect your computer. Contact: Best Power Technology, Inc., P.O. Box 280, Necedah, WI 54646.

1-608-565-7200, ext. 2171
Toll-free 1-800-356-5794, ext. 2171

Circle 40 on Inquiry Card

Zericon



Factory Direct Savings
on
Large Format Plotters

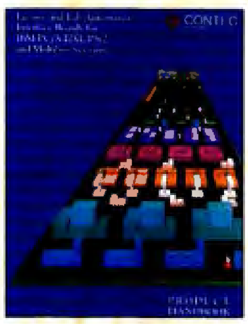
Zericon is the low-price leader, offering the following plotter lines direct from the factory. The Valuline series of "D" Size plotters offers moderate performance at 15 IPS for under $2,000. The Designer series offers high performance at 25 IPS in Multi-Pen "A-E" sizes; prices under $3,000. All Zericon products are sold with a no-risk satisfaction guarantee.

40491 Encyclopedia Circle, Fremont CA 94538

1-800-727-8380

Circle 307 on Inquiry Card

Contec U.S.A. Inc.



Catalog of data acquisition and control hardware and software for IBM PC XT, AT, 386, PS/2 computers for factory and laboratory automation. Includes a wide variety of boards from simple digital I/O to complex multi-function analog boards for measuring and controlling parameters such as voltage, current, temperature, pressure and flow.

- 3-year warranty
- 24-hour delivery
- free technical support
- 30-day money-back guarantee

Contec Microelectronics USA, Inc., 2010 N. First St., Suite 530, San Jose, CA 95131

1-800-888-8884 FAX 408-436-0206

Circle 73 on Inquiry Card

BYTE Catalog Showcase

Advertisers:

The Catalog Showcase is the most effective low-cost way to promote your product line to 500,000 technically sophisticated, knowledgeable buyers of computer products!

Call Ellen Perham for more details.
603-924-2598 FAX: 603-924-2683

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.

Effective January 1, 1991.

RATES: 1 issue—$675 3 issues—$625 6 issues—$600 12 issues—$525
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 603-924-2656. FAX: 603-924-2683.

THE BUYER'S MART

DISASSEMBLERS

80x86 .COM/.EXE files: 'Reusable Software'!!
Automatic!—Only input/output filenames are *required!*
Exhaustive flow-analysis distinguishes data from code.
Accurate!—Uses scientific methods, not 'guesswork'!
Locates even *one*-byte data items in *instruction* areas!
Complete!—Fully-labeled 80(2)86 code, data, directives!
Commented BIOS/DOS INTs give function & operands.
Compatible!— .ASM output file is MASM 5.x-compatible.
NEW! PC-DISnDATs 3.2 (5¼" disk & manual) $165

PRO/AM SOFTWARE
220 Cardigan Road, Centerville, OH 45459
(513) 435-4480 (9 A.M.-5 P.M. EST M-F)

Inquiry 741.

DISK DRIVES

IBM PS/2 HARD DRIVES

30MB	MOD 30, 30-286	$350
30MB	MOD 50Z, 55SX	450
60MB	MOD 50Z, 55SX, 70	695
120MB	MOD 50Z, 55SX, 70	795

New, genuine Big Blue Product with 1 yr. Warranty.
Call NOW—Same Day Shipping till 5 p.m.

COMPUTER TECHNIQUES
Merritt Island, FL 32953-3484
Phone (407) 453-6783

Inquiry 742.

DOS MULTITASKING

Multitasking for DOS
MultiDos Plus—the fastest multitasking DOS shell.
- Fully DOS compatible
- Tailored for real-time operation
- 4 years of proven reliability with thousands installed
- 30-day money back guarantee ($15 restocking fee)

Call our BBS for free demo (508) 650-9552
Complete software package only $99 + $2 S&H

Nanosoft Inc.
13 Westfield Road, Natick, MA 01760
(800) 678-2141 (508) 651-0091 FAX: (508) 655-8860

Inquiry 743.

DUPLICATION

SOFTWARE DUPLICATION
- DISKETTE & TAPE
- CUSTOM PRINTING
- CUSTOM PACKAGING
- FULFILLMENT

MEGASOFT, INC.
P.O. Box 710, Freehold, NJ 07728
(800) 222-0490 **(908) 462-7628**

Inquiry 744.

EDUCATION

B.S. & 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. B.S. subjects covered are: MS/DOS, BASIC, PASCAL, C, Data File Processing, Data Structures & Operating systems. M.S. program includes subjects in Software Engineering and Artificial Intelligence.

AMERICAN INST. for COMPUTER SCIENCES
2101-BY Magnolia Ave. South, Ste. 200, Birmingham, AL 35205
800-767-2427 **205-323-6191**

Inquiry 745.

ENTERTAINMENT

US $49.95 **LottoPro** Can $59.95
Provides what other lotto programs omit—exact analysis of bet combinations. Are the "beat the lottery" schemes any good? Is yours better? Find out and bet wisely with LottoPro. Check or MO.

ColorVision Consulting
Suite 80, 7305 Woodbine Ave., Markham Ont.
CANADA, L3R 3V7 (416) 739-7600

Inquiry 746.

ENTERTAINMENT

DISCOVER AMERICA'S ONLINE ADVANTAGE!
ODYSSEY BBS
• Designed for America's unique business and relaxation needs! • Low-cost local access numbers covering 850 cities in the US, Canada, Europe, and Pacific Rim countries! • Over 10,000 downloadable files! • Online stock quotes and financial databases! • Online Flight and Travel information, scheduling and reservations! • State-of-the-art E-mail features! • Live online Chat with other users! • "Bulletin board" style Forums! • Interactive, multiplayer online games! • Matchmaker database! • And much, much more!
We also can provide your company with national BBS services. Call (818) 358-0936 for details!
Information and Signup By Modem (818) 358-6968 [3/12/24 Baud, 8/N/1]

Inquiry 747.

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].
Chaos Manor 1989 User's Choice Award
BYTE 4/90, p.82

Toyogo, Inc. *The Leader in Computer Go.*
PO Box F, Dept. Y, Kaneohe, HI 96744
(808) 254-1166 or 1-800-TOYOGO-9

Inquiry 748.

FLOW CHARTS

FLOW CHARTING 3
FRIENDLY
FAST
FLEXIBLE
- High resolution print outs . . . dot matrix or laser
- Multi-page charts . . . portrait or landscape
- Import/export capabilities
- 35 shapes, 10 fonts, 4 line styles

ONLY $250

PATTON & PATTON *Call for free demo disk!* **800-525-0082 ext.1304**
Software Corporation 485 Cochrane Cr. Morgan Hill, CA 95037
See our ad on page 104.

Inquiry 749.

WINDOWS FLOWCHARTER $129
RFFlow 2.0 is a professional drawing tool for flowcharts & org charts. Requires Microsoft Windows 3.0. 100 shapes auto adjust in size. Diagonal lines and curves. Auto line routing and re-routing. Click on a shape to bring up a sub-chart. Move charts to other apps. via the Clipboard. Call for free trial disk.

RFF ELECTRONICS
1053 Banyan Court, Loveland, CO 80538
Phone: (303) 663-5767 **FAX: (303) 669-4889**

Inquiry 750.

FOREIGN LANGUAGES

FOREIGN TRANSLATION
LexiTrans: the PC foreign language translator. Language independent & translates in both directions. Russian-English; custom configurations available. From $385. **LexiScan** OCR software gives unsurpassed scanning accuracy of foreign text. From $795. VISA/MC

LexiTRANS
348 Turnstone Dr., Livermore, CA 94550
voice/fax 415-447-0596

Inquiry 751.

GRAPHICS

YOUR PHOTOS-COLOR VGA
Integrated Images can convert your photographs, slides, and video tapes to 640 by 480 (or 320 by 200), 256 color images. Formats: PCX, GIF, CUT and others. $3.25 each for < 10, $3.00 each for 10 or more. Call or write for more information or send $1.25 for disk with sample(s), specify 5.25/3.5, PCX/GIF/CUT, and 640×480/320×200.

Integrated Images Incorporated
P.O. Box 10021, Lansing, MI 48901
(517) 485-6636

Inquiry 752.

GRAPHICS

EGAD Screen Print
Prints contents of VGA, EGA, CGA displays on variety of dot-matrix, inkjet, and laser printers. Prints in gray tones or color. Crop box lets you print any region of the screen. Enlarge graphics 1 to 4 times (reduction too). Setup program for picking printer colors, etc. $35.00 Postpaid. Call or write for free catalog.

LINDLEY SYSTEMS
4257 Berwick Place, Woodbridge, VA 22192-5119
(703) 590-8890

Inquiry 753.

HARD DRIVE REPAIR

HARD DRIVE REPAIR
ALSO
DATA RECOVERY
FAST TURN!! CALL FOR DETAILS

H&W micro labs, Inc.
528-C Forest Parkway, Forest Park, GA 30050
404-366-1600

Inquiry 754.

HARDWARE

COMPLETE COMPUTER SYSTEMS
1 Year Warranty • Components also at Reasonable Prices
Standard System Features Include: 1Meg of Ram, 1.2 Floppy, Case, Power Supply, Monitor, Keyboard, 2 Serial Ports, 1 Parallel port, Floppy and Hard Drive Controller, Mono-Graphics Card. And, if ordered by 6/30/91, Get MS-DOS 4.01 Free! 286-12Mhz System $825, 386sx-16Mhz System $1025, 386-25Mhz System (No-Cache) $1325, 286-16Mhz System $675, 386sx-20Mhz System $1125, 386-33Mhz System (64K Cache) $1525, 486-25Mhz System (256K Cache) only $2575. System Upgrades Add: VGA Mono $75, VGA Color $275, Hard Drives Add: 40 Meg $249, 80 Meg $479, 106 Meg $529, 200 Meg $895. We feature a LANDMARK Diagnostics Products, Call for Prices

Blackburn & Wright • P.O. Box 1866 • Lancaster, California 93539-1866
Phone (805) 948-4410 8am-2pm Pacific Time Fax (805) 948-4412 24 Hours

Inquiry 755.

PRE-OWNED ELECTRONICS, INC.
THE Independent provider, serving the Dealer, Professional, Corporate, Government, and Educational Buyer since 1985
APPLE® II & MACINTOSH®
SYSTEMS • PARTS • EXCHANGE REPAIRS
Call for a Catalog **800-274-5343**
Int'l: 617-275-4600 • Fax: 617-275-4848
205 BURLINGTON ROAD • BEDFORD, MA 01730

Inquiry 756.

IBM® & Macintosh®
Parts • Systems • Add-ons

Shreve Systems
3804 Karen Lane
Bossier City, LA 71112
800-227-3971

This month's Special!
PS/2 55SX-031
$2099.00
International 318-742-2700
FAX 318-742-2799

Inquiry 757.

ROM BIOS UPGRADES
For Your IBM or Compatible • A New BIOS Upgrade Will:
• Support Windows 3.0 • Support 360K, 720K, 1.2 MB & 1.44 MB Floppy Drives • User defined hard drive types • Supports VGA • Novell & Netware compatible • Expanded hard drive table • Enhanced 101/102 keyboard • 100% IBM compatible • Complete documentation • Latest version • Complete set up in ROM.
Dealer/Distributor Inquiries Welcome **Authorized Award Software Inc. Dist.**
800-800-BIOS Fax 508-683-1630
800-800-2467 508-686-6468

Unicore Software
599 Canal Street, Lawrence, MA 01840

Inquiry 758.

HARDWARE/COMPUTERS

TDS9092 Forth Embedded Computer

Priced correctly for building into products this board has small size, low power and high level language. It interfaces to LCD & keyboard and has on-board multitasking, interrupts, dual RS232 ports, RAM, non-volatile EEPROM, I²C bus and 35 I/O lines. Optional precision A-D and battery-backed RAM. A data logger can run 12 months on a small battery. Use for machine control, data logging, robotics instruments and automation. Call or fax for details. Now $179 (25 qty)

The Saelig Company
1193 Moseley Road, Victor, NY 14564
Phone (716) 425-3753 Fax (716) 425-3835

Inquiry 759.

SC/FOX™ EMBEDDED COMPUTERS

PC Parallel Coprocessor Plug-in Boards: 15 MIPS avg 50 MIPS burst using the SC32 32-bit CPU or the 16-bit Harris RTX 2000®

VME Master/Slave System Controller SBC: 18 MIPS avg 70 MIPS burst, uses RTX 2000 cpu, SCSI, 2 ser, 1 ptr ports, to 640K bytes.

Stand-Alone Single Board Computers: 18 MIPS avg 60 MIPS burst, 3U or 100x100mm Eurocard-size using either SC32 or RTX 2000.

Ideal for embedded real-time control, data acquisition, robotics, and signal processing. OEM software development system included.

SILICON COMPOSERS INC (415) 322-8763
208 California Avenue, Palo Alto, CA 94306

Inquiry 760.

IMAGE DATABASE

IMAGE SOFTWARE & TOOLKITS
for High Resolution PC Imaging

The Advanced Image Toolkit $250.00, SUNSHOW "C" Language Toolkit $250.00, Database Professional $99.95, SHOWCASE Image Database $595.00, SUNSHOW Image Converter $395.00, SUNSCAN Digital Scanware $299.00. Resolutions to 1024×768×256, Scaling, Clipping, Format Conversions, Printing, Merge Images with Text, Merge Multiple Images, Device Drivers, more. Practical Imaging Applications from Cutting Edge Software Engineering.

Sun Country Software Publishers
7102 Iifield Road Southwest, Albuquerque, NM 87105
505-873-2220 Mad Max BBS 505-877-8354 505-873-4443

Inquiry 761.

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
550 CR PPA, Route 3, Ishpeming, MI 49849
(906) 486-6024

Inquiry 762.

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
- Share any device, any file, any time
- Needs only 14K of RAM

Skeptical? We make believers!

Information Modes
P.O. Drawer F, Denton, TX 76202
817-387-3339 Orders 800-628-7992

Inquiry 763.

LAPTOP COMPUTERS

Laptop Savings

Laptops: Toshiba • Zenith • NEC • Sharp • Epson • Mitsubishi • Compaq • Leading Edge • Hyundai • Panasonic • Packard Bell • Texas Instruments • Fora • Tandon

Also; Full Range of Laptop Accessories

Computer Options Unlimited
12 Maiden Lane, Bound Brook, NJ 08805
Phone: 201-469-7678 To order: (800) 424-7678
9–9 M–F 9–5 Sat. **6 days** Worldwide sales

Inquiry 764.

LAPTOP COMPUTERS

IBM CONVERTIBLE

MEMORY–128K $79 256K $225 384K $295
MODEMS–Standard $75 Enhanced $175
CRT ADAPTER–for monitors $99
SERIAL/PARALLEL ADAPTER–$120
MONITORS–Monochrome $115 Color $349
COMPACT Carrying Case $39
ENHANCED LCD–$79 **BATTERY** –$89
HARD DRIVES–20 Meg–$495 40 Meg–$695
MORE ACCESSORIES AVAILABLE

COMPUTER RESET
P.O. Box 461782, Garland, TX 75046
Phone (214) 276-8072 BBS & FAX (214) 272-7920

Inquiry 765.

LAPTOP PERIPHERALS

LAPTOP PERIPHERALS

NEW LOW PRICES ON:

- Battery Powered Printers
- Portable Hard Drives
- Laptop Expansion Systems
- Backlites AND MORE!

Call for free catalog

AXONIX CORPORATION
(800) 866-9797

Inquiry 766.

LAPTOP POWER ADAPTERS
AC and DC input

TOSHIBA INTERNAL CARDS

Fax/modems: 9600/2400bps, software, acoustic port Modems, exp: 2400 bps, acoustic or serial port Modem, dedicated: 2400 bps (notebooks, T31&3200SX) Serial IO cards: RS232, RS422, SCSI, HPIL, barcode

Contact us for more information:

PRODUCT R&D Corporation (Calif.)
805/546-9713 Fax 805/546-9716

Inquiry 767.

MAGAZINE INDEXES

BYTE® INDEX

BINDEX: the COMPLETE keyword index to BYTE magazine for IBM-compatibles. Easy-to-use, compact, comprehensive. Updated quarterly. 1990 & 1991 editions $49.95 each. Tax, shipping included. Money-back guarantee.

Esc
6197 Highway E, Abrams, WI 54101
(414) 826-5362

Inquiry 768.

MAILING LIST PROGRAMS

MAIL WITH MAIL MASTER...

It's genuinely easy to learn and use • Contains 200 pre-written letters • Uses zip codes to automatically enter cities and states • Prints labels, letters and reports • Eliminates duplicates • Holds unlimited records • Costs $99.95

ThinkSoft Corp., **1-800-533-3466**
1220 Broadway, Suite 604, NY, NY 10001

Inquiry 769.

MEMORY CHIPS

PRICE MEETING & BEATING!

DRAMS	**SIMMS/SIPPS**
64K × 1-12, 10	256K × 9-10, 80, 70, 60
64K × 4-80	1MEG × 8-10, 80, 70
256K × 1-15, 12, 10, 80, 70, 60	1MEG × 9-10, 80, 70, 60
256K × 4-80	4MEG × 8-80
1MEG × 1-10, 80, 70, 60	4MEG × 9-80
INTEL/CYRIX/IIT MATH CO'S	**PS/2 TYPE SIMMS**
80287-8,10	Model 30 286
80387-SX, 16, 20, 25, 33	Model 50, 55, 60, 70, 80

CALL DRAM COMPANY (800) 488-DRAM
P.O. Box 590127 • S.F., CA 94159 (415) 398-2987

Inquiry 770.

MEMORY CHIPS

FREE FREE FREE

- Need memory for IBM or MAC?
- Want to pay the lowest possible price?
- Want superior service?
- Want free advice?
- Wholesale source! Shipping worldwide!
- International FAX: country code+402-691-8548 24 hrs. 7 days
- International Direct: country code+402-691-8248 24 hrs. 7 days
- Free call! Free info!

McDonald and Associates
1-800-338-1531 24 HRS 7 DAYS (U.S.)
1-800-242-5751 FAX LINE 24 HRS 7 DAYS (U.S.)

Inquiry 771.

MODEMS

AirLink WIRELESS MODEMS
1200 and 2400 Baud

- Wireless communication for up to 25 MILES
- Interfaces to any standard asynchronous RS-232 port
- Point to Point, Point to Multipoint, Multipoint to Multipoint
- Interoffice, building to building, remote industrial
- Portable and weatherized versions available
- Application assistance available

(408) 371-7972 **TELEDESIGN**
721 Carlisle Way, Sunnyvale, CA 94087 **Systems, Inc.**

Inquiry 772.

OBJECT-ORIENTED

Improve Your Productivity

Get the facts you need, all from one source. Object-oriented vocabulary, examples, vendors, bibliography. No hype, no editorials, just compact, complete explanations. Source code for C & C++ examples included on diskette. Satisfaction guaranteed or your money back. Call **Annabooks** at (800) 462-1042 or (619) 271-9526. Or send for free information from:

buk-werm Information Services™
Dept B2, 16776 Bernardo Ctr. Dr., Ste. 110b, San Diego, CA 92128
24 hr FAX: (619) 469-0778 VISA & MasterCard accepted

Inquiry 773.

PROGRAMMERS' TOOLS

HYPERINTERFACE™ II

Menu Creator™ — An interactive WYSIWYG editor to generate a menu-driven user interface for your software. **Screen Creator™** — An interactive WYSIWYG editor for quick and easy screen design and a screen database manager for your software. **Advanced Library** — Extended capability for data entry for your programs. FORTRAN, Pascal, C, BASIC supported.

Avanpro Corp.
P.O. Box 969, Pacific Palisades, CA 90272
(213) 454-3866

Inquiry 774.

TLIB™ 5.0 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 **Panasophic, ADR, IBM, Unisys. DOS $139** (OS/2 **$195**). 5-station LAN **$419** (OS/2 **$595**)

BURTON SYSTEMS SOFTWARE
P.O. Box 4156, Cary, NC 27519 **(919) 233-8128**

Inquiry 775.

QuickBASIC Dialog Boxes: $95

DiaLogic creates SAA text dialog boxes exactly like those in Microsoft's current "Quick" environments.

Low-level assem routines ♦ Mouse support ♦ BASIC source code ♦ Crescent Software P.D.Q. 2.12 support ♦ Fully customizable ♦ Single-/Multi-tasking modes ♦ 2 compression utilities ♦ Supports BASIC 4.x, 6.x, 7.x ♦ Demo/tutorial ♦ 100+ pages of doc w/ examples

800-DIALOG-1 VISA/MC/Check + $6 s/h USA
Dialog Software • Box 9889 At 1101 Wilson Blvd.
Arlington • VA • 22209-0889 • USA • 703-528-1506

Inquiry 776.

THE BUYER'S MART

PROGRAMMERS' TOOLS

Bsupport for Btrieve®

The "Norton Utilities" for Btrieve users.
Bedit: DISPLAY, UPDATE, COPY, and DELETE.
EXPORT SDF to dBASE & LOTUS. RECOVER damaged files.
Edit/Insert using Data Dictionary.
Banalyze: TSR Btrieve debugger. Displays info in pop-up window.
Brun: BUTIL replacement with Run-Time and C source.
Bedit/Banalyze: $150. Brun: $169. VISA/MC/COD/PO

800/359-2721 FAX: 517/887-2366

Information Architects, Inc.

P.O. Box 4184, East Lansing, MI 48826-4184

Inquiry 777.

PLOT= >SOURCE.PAS

Unique full-function viewer for HPGL files and automatic code generator (requires Turbo Pascal)
PLOT- >PAS ver. 1.0 Lit. 80000 (about $67) plus S&H. Visa/MasterCard Accepted
DRAW with AutoCAD, DesignCAD3D, Corel Draw, Freelance, Orcad, etc., . . ; PLOT to file; RUN PLOT- >PAS: view, zoom, pan, scale, cut . . . and ENTER: your code is ready.
NEW: with source for custom output TPU, demo programs, 3.5" and 5.25" media, manual.

Ing. Marco Sillano

Via Massimi 154, I00136 — ROME, ITALY

Inquiry 778.

ATTENTION CLIPPER USERS!

Top quality **ClipTools 3** library from Holland! 280 functions on index management, networking, semaphore, complex relations in 1 code line, relation locking, mega windows, mighty menus, low level (interrupts. . . .) 500p manual. "One of the best manuals for Clipper add-ons I have ever seen." (Rick Spence) Detailed brochure available. Price for USA/CAN:550 NL guilders (± $321 US). VISA/MC/AMEX accepted.

Micro Consult Nederland

Rhijngeesterstraatweg 7B, 2343 BX Oegstgeest, The Netherlands
Fax: 31-71-156154 **Tel: 31-71-170401**

Inquiry 779.

EDLIN Alternative

Frustrated using EDLIN? Switch to EdFile — A full-screen text editor with dozens of features like:

- WP Type Edit Features
- Files up to 6 MB
- Super Copy (Merge)
- 255 Char. Lines
- On Screen Help
- Undelete Lines

800-345-3808 (VISA/MC)$49.50 + 3.50 S/H

MIPS, Inc. • Box 3072 • Hammond, LA 70404

Inquiry 780.

C and C++ DOCUMENTATION TOOLS

- **C-CALL ($59)** Graphic-trees of caller/called hierarchy.
- **C-CMT ($59)** Create, insert, update comment-blocks for each function, listing functions and identifiers used.
- **C-METRIC ($49)** Path complexity, lines/stmts/comments.
- **C-LIST ($49)** List, action-diagram, reformat programs.
- **C-REF ($49)** Local/global/parameter cross-reference.
- **SPECIAL ($169)** All 5 as DOS/OS2 **"C-DOC"** program.

SOFTWARE BLACKSMITHS INC.

6064 St. Ives Way, Mississauga, ONT Canada L5N-4M1
(416) 858-4466

Inquiry 781.

PUBLIC DOMAIN

FREE SOFTWARE FOR IBM®/clones

TRY US! GET 15/5.25" or 6/3.5" Disks full of our best selling software—FREE. Great games, utilities, business, educational, and desktop publishing, plus our 3000 disk catalog. Pay only $5.00 shipping/handling.

INTERNATIONAL SOFTWARE LIBRARY

619-931-8111

Inquiry 782.

PUBLIC DOMAIN

HUNDREDS OF NEW PROGRAMS

AS LOW AS $1.29. LATEST VERSIONS

FREE CATALOG. 1-800-292-DISK (3475)

EVERY PROGRAM CHECKED FOR VIRUSES

PRINCETON SOFTWARE INC.

200 WALL STREET, PRINCETON, NJ 08540

Inquiry 783.

FREE CATALOG

FOR IBM PD AND SHAREWARE

SELECTED PROGRAMS
LATEST VERSIONS
Low as $1.50

SOFTSHOPPE, INC.

TEL: 800-829-2378 • 313-761-7638
FAX: 313-761-7639
P.O. Box 3678, ANN ARBOR, MI 48106

Inquiry 784.

SECURITY

FIGHT PIRACY!

Since 1986, companies worldwide have been choosing Az-Tech security products. If you demand the strongest protection available, why not choose one of these "proven leaders":

- **EVERLOCK** Copy Protection
- **EVERTRAK** Software Security
- **EVERKEY** Hardware "Key" Software Security

For IBM and Compatibles. 30 day money back guarantee. Free info and demo disk available.

Az-Tech Software, Inc.

305 East Franklin, Richmond, MO 64085
(800) 227-0644 (816) 776-2700 Fax: (816) 776-8398

Inquiry 785.

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

Quite Simply The Best Ways To Protect Your Valuable Software Investment

STOPVIEW™ **STOPCOPY PLUS™**

BBI COMPUTER SYSTEMS® (301) 871-1094
14105 Heritage La., Silver Spring, MD 20906 FAX: (301) 460-7545

Inquiry 786.

Cop's CopyLock II

The professional software protection with TRUE Machine Install. Option Board safe. Supports **DOS, OS/2, Windows** and **Trace.**

LINK Computer/Dancotec N.Am.

Int'l: +45 31232350 US/CAN: 800-344-2524
Fax +45 31238448 Fax 408-923-7061

BIT-LOCK® SECURITY

Piracy SURVIVAL 8 YEARS proves effectiveness of powerful multilayered security. Rapid decryption algorithms. PARALLEL or SERIAL port-transparent security device. Complemented by economical KEY-LOK™ and multifeatured COMPU-LOCK™ including countdown, timeout, data encryption, and multiproduct protection. (Dos/Unix/Mac). Also, access control.

MICROCOMPUTER APPLICATIONS

3167 E. Otero Circle, Littleton, CO 80122
(303) 770-1917

Inquiry 787.

SECURITY

CopyControl

YOUR POWER TO PROFIT

• Ultra secure • Cost effective • Choose where, when and usage rate • Change parameters by phone • No messy dongles or special disks • Hard disk and LAN support

Choose the *NEW* Generation Copy Protection

FREE Demo Disk and Info

800-237-6400 ext. 212 816-934-8384

MICROCOSM INC.

Drawer O, Wellington MO 64097

Inquiry 788.

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/logouts
Prevents DOS FORMAT and most viruses
Drive A: Boot Protection / Hard Disk Lock
IBM PC or 100% comp.—DOS V 3.0+ —$89.95 + $3.75 S/H

SYSTEMS CONSULTING INC.

PO BOX 111209, Pittsburgh, PA 15238
(412) 781-5280

Inquiry 789.

ANTI VIRUS SYSTEM

IMMUNIZE MSDOS COMPUTERS 100%
INTERCEPT ALL VIRUS ACTIVITY

Ultimate Protection by 8-bit card.
Free Information, DEALERS WELCOME

TELSTAR ELECTRONICS

P. O. Box 317, 6190AE Beek, Netherlands, Dept. B1

Inquiry 790.

SHAREWARE

FREE SOFTWARE FOR IBM®/clones

Monthly, get 5 disks with 10+ latest programs plus catalog — FREE! Pay only $5.00 for 5/5.25" or $6.95 for 3/3.5" disks. Join today for only $19.95 membership fee and get your first volume of software—FREE!

SOFTWARE OF THE MONTH CLUB®

619-931-8111

Inquiry 791.

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

or

Fax: 603-924-2683

Inquiry 792.

SOFTWARE/ACCOUNTING

Solomon III Software

Integrated Accounting Software
Top rated last 6 years
No down time — No lost data
Unmatched Security System

Call **Debra J. Tucker**

National Trainer, CBM Training

4420 Hotel Circle Ct. #350, San Diego CA 92108
619-224-9916

Inquiry 793.

SOFTWARE/ACCOUNTING

dBASE BUSINESS TOOLS

- GENERAL LEDGER
- ORDER ENTRY
- JOB COSTING
- BILL OF MAT'LS
- PAYROLL
- PURCH ORD/INVNTORY
- ACCOUNTS RECVABLE
- JOB ESTIMATING
- SALES ANALYSIS
- 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 794.

SOFTWARE/BUSINESS

DATA ENTRY SOFTWARE

Full featured, heads-down data entry with two-pass verification, edit language, operator stats, much more! Designed for the PS/2®, PC, XT, AT or compatibles.
PC's from $395 LAN version available

FREE 30 day trial

Computer Keyes Tel: 206/776/6443
21929 Makah Rd., Fax: 206/776-7210
Woodway, WA 98020 USA: 800/356-0203

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
or
Fax: 603-924-2683

Inquiry 795.

SOFTWARE/ENGINEERING

Mass2–MASS & VOLUME CALCULATOR with MATERIALS DATABASE

Easily calculate the volume & weight of hundreds of shapes. Never need to look up material densities again! Differential and proportional comparisons made automatically. Menu driven with on-line context sensitive help. Flexible input system accepts Decimal, Fractional, and Exponential notation. For IBM PCs and Compatibles with 384K free.

DEMPSEY'S FORGE, Software Division
Rt 2 Box 407, Gladys, VA 24554

Inquiry 796.

DIGITAL DESIGNERS
MINIMIZE YOUR LOGIC

Karnaugh Map Solver for PC's Combinational, Sequential, Mealy & Moore State Machines, 2-14 Inputs, Any # Outputs, Sum of Products, Prod of Sums, JK, D, SR, and T Flip Flops, Expert Reference & Tutorial. 60 Day $ Back: $110 + $5 P&H

GOBI LABS: (407) 297-0862

Inquiry 797.

Macintosh CAE Tools

- Run SPICE On ALL Macintosh Computers
- Unlimited Circuit Size
- Extensive Model Libraries
- Waveform Display
- Plotting/Graphics Output

Intusoft has a complete analog circuit simulation system including everything from SPICE simulation using advanced device models to interactive waveform processing. Starting at $95 for IsSPICE, the complete system sells for under $600.

Intusoft
The leader in low cost, full featured CAE tools
P. O. Box 710, San Pedro, CA 90733-0710
(213) 833-0710 FAX (213) 833-9658

Inquiry 798.

SOFTWARE/ENGINEERING

Worstcase Gets Even Better!
Analog Circuit Simulation

ECA-2 Electronic Circuit Analysis offers the best Monte Carlo and Worst-Case analyses with all this and MORE included:

- AC, DC, Transient Fourier, Temperature
- Sine, Pulse, PWL, SFFM, and Exponential generators
- Interactive/batch modes
- Full nonlinear simulator
- On Line, Real Time Graphics
- Multiple plots

Tatum Labs, Inc.
3917 Research Park Dr., B-1, Ann Arbor, MI 48108
(313) 663-8810

Inquiry 799.

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 too! 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

Inquiry 800.

SOFTWARE/GRAPHICS

Graphics Gems

edited by **Andrew S. Glassner**

This handbook compiles the "tricks of the trade" providing practical solutions to graphics problems. With this essential tool you'll save time and energy in your daily programming activities.
1990, 844 pp., $49.95/ISBN: 0-12-286165-5
*Coming in July 1991, **More Graphics Gems!***

ACADEMIC PRESS
Book Mktng. Dept. #09041, 1250 Sixth Ave., San Diego, CA 92101
CALL TOLL FREE 1-800-321-5068

Inquiry 801.

QuickGeometry Library

All the C geometry and DXF routines you expect . . . and more!

(617) 628-5217

Building Block Software
PO Box 1373, Somerville, MA 02144

Inquiry 802.

FRACTAL GRAFICS

is a radical new drawing program for your PC. Create breathtaking images and scientific models interactively with your mouse. Add dramatic effects to any PCX image. On-line tutorial, extensive Guidebook, and 200+ hands-on examples help you use and understand fractals and Chaos. Only $79, FREE Brochure!

Cedar Software
R1 Box 5140, Morrisville, VT 05661
(802) 888-5275

Inquiry 803.

The Ultimate CAD/CAM Engine

TurboGeometry Library 3.0. The most complete tool box of 2D & 3D routines available today! Over 300 routines. Surfacing, Solids, Hidden line, Volumes, Areas, Transforms, Perspectives, Decomp, Clipping, Tangents & more. 30 day guar., $199.95 w/source S&H Incl. Foreign $225.00. MS/PC DOS 2.0+. Turbo Pascal, Turbo C, MSC, MIX C, Zortec C++. VISA/MC, PO, Chk, USA funds only.

Disk Software, Inc.
2116 E. Arapaho Rd., #487, Richardson, TX 75081
(214) 423-7288, (800) 635-7760, FAX (214) 423-7288

Inquiry 804.

SOFTWARE/GRAPHICS

RAINDROP™

FAST, compact PrtScrn Utility for end users AND developers. Hardcopy as fast as 10 secs. Average binary size - 6 kbyte. 14 video graphic standards. Scale, rotate, colorize and more. 'CALL' from user-written programs. Complete 9- & 24-pin dot-matrix, inkjet, and laserjet library $44.95+$3 s/h.

ECLECTIC SYSTEMS
8106 St. David Ct., Springfield, VA 22153
(703) 440-0064

Inquiry 805.

PEN PLOTTER EMULATOR

FPLOT turns your printer into an HP pen plotter. Fast hi-res output, no jagged lines. Vary line width, color. Screen preview with zoom and pan. Stand-alone, background, and device driver modes. Works with most CAD and graphics programs. Supports most printers. New version 3. $119+$3 S&H. 30 day money back. VISA/MC/Check/MO.

FPLOT Corporation
24-16 Steinway St., Suite 605, Astoria, NY 11103
718-545-3505

Inquiry 806.

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 (incl. Postscript) in up to 64 shades of gray or 256 colors. GRAFPLUS supports all versions of DOS with IBM (incl. EGA, VGA, Super VGA), Hercules, or compatible graphics boards. Linkable/OEM versions available. $59.95

Jewell Technologies, Inc.
4740 – 44th Ave. SW, Seattle, WA 98116
1 (800) 284-2574 (206) 937-1081

Inquiry 807.

FORTRAN GRAPHICS

GRAFMATIC/PRINTMATIC/PLOTMATIC LIBRARIES

GRAFMATIC-FORTRAN callable graphics Library for creating 2-D and 3-D graphics, contour plots and solid models. PRINTMATIC and PLOTMATIC provide high resolution FORTRAN callable printer and plotter drivers for your graphics.
$249.95 Supports Microsoft/Lahey/RM FORTRAN compilers.

Jewell Technologies, Inc.
4740 44th Ave. SW, Seattle, WA 98116
1 (800) 284-2574

Inquiry 808.

GRAPHIC TOOLS LIBRARY

XGLIB: Very fast. User coordinates. User defined Window & viewports. Circles, ellipses, ovals, sectors, polygons & splines. Thick lines & arcs. Fill & hatch patterns. **POLYARC** engine. Plots and charts. Text scale, align. Screen print and TSR utility. All drawing and mouse functions work in Super VGA modes. Draw in bitmaps. Modes up to 1024x768x16-256. **$195.** Most "C", MS Basic 4.0-7.1.

NOVA INC.
2600 W. Higgins Road, #1144 CALL **708-882-4111**
Hoffman Estates, IL 60195 FAX **708-882-4173**

See our ad on page 137.

Inquiry 809.

GRAPHICS LIBRARIES for C, FORTRAN, PASCAL & QuickBASIC

- Supports VIDEO, PRINTERS & PLOTTERS.
- Linear, log, polar, smith, bar & pie charts.
- Scalable fonts, line types, markers.
- Multiple plots on a page.
- Over 100 routines with full source code.
- 240 page manual. No royalties.

$350.00 (713) 491-2088

Sutrasoft
10506 Permian Dr. • Sugar Land, TX 77478

Inquiry 810.

THE BUYER'S MART

SOFTWARE/GRAPHICS

ImageAccess®
Create or work with image files?
ImageAccess, a quick way to search, display, print and organize. Create a data-base of pictures for EGA, VGA, 8514A, MSP, PCX, TIFF formats, needs MS-DOS, 512K. See Jerry Pournelle's recommendation in *InfoWorld* 11/12/90. $49.95 USA, $59.95 Overseas. Check, M.O., P.O. Satisfaction guaranteed.
Wierenga Software
P.O. Box 595, Muskegon, MI 49443

Inquiry 811.

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
or
Fax: 603-924-2683

Inquiry 812.

SOFTWARE/LANGUAGES

IntegrAda
Standard Air Force PC Ada Compilers & environments for MS-DOS and UNIX. Integrated programming systems include validated Ada compilers, language sensitive editors, complete libraries and other Ada programming tools. FREE demo.
AETECH, Inc. *From* ***$795***
380 Stevens Ave., Ste. 212 Solana Beach, CA 92075
(619) 755-1277 Fax: (619) 755-7540

Inquiry 813.

DRUMA FORTH-83
Break the 64K barrier without speed/space penalty. Powerful, attractively priced. '83 Standard.
- 1Mb+ automated memory management
- Full OS interface, extensive utilities
- On-line documentation, ASCII/block files
- Other products: windows, modules, profiler
- IBM PC/XT/AT including 386 compatibles

FREE learn/utility disks with purchase
DRUMA INC.
6448 Hwy. 290 East E103, Austin, TX 78723
Orders: 512-323-5411 **Fax: 512-323-0403**

Inquiry 814.

SOFTWARE/MARKETING

The "Software Success Reference Book (1987-1988)" is a MUST READ if you want to market your software products successfully. Written by David H. Bowen, publisher of Software Success™, the monthly newsletter on successfully running a software business, the Reference Book is a 268-page guide, organized by topic. Covers Lead Generation, Promotion, Pricing, Distribution, Support, etc. Only $25. Check or Credit Card (Visa/MC/AEX).
100% Money Back Guarantee
Software Success
PO Box 9006, San Jose, CA 95157
(408) 446-2504 **FAX (408) 255-1098**

Inquiry 815.

SOFTWARE/MATHEMATICS

MATH EDITING FOR THE PC

$$x_i^2 = \sum_{k=0}^{\infty} \left[x_k^{2m} \binom{n}{k}\right] + \left(\frac{\int\int F\,ds}{\sqrt[3]{\alpha \pm \beta x}}\right)$$

- *MathEdit constructs math equations to be inserted into WordPerfect, Word, WordStar, and others.*
- *WYSIWYG interface—no codes need to be learned.*
- ***MathEdit—$199***

K-TALK
COMMUNICATIONS
30 West First Avenue, Suite 100
Columbus, Ohio 43201
(614) 294-3535

Inquiry 816.

SOFTWARE/MATHEMATICS

DERIVE®
A Mathematical Assistant
Makes math more inspiration and less perspiration! Combines the power of computer algebra with 2D & 3D plotting and a friendly menu-driven user interface. Does equation solving, calculus, trigonometry, vector & matrix algebra, and more. **Derive** requires a PC compatible computer & 512K memory.
Soft Warehouse, Inc.
3615 Harding Ave., Suite 505, Honolulu, HI 96816
(808) 734-5801

Inquiry 817.

SOFTWARE/SCIENTIFIC

FREE CATALOG
A great selection of scientific software products for plotting, non-linear curve fitting, chemical equilibrium, simulation, statistics, symbolic algebra, and more. Prices range from $150-$1000. Call:
1-800-942-MATH
MicroMath, Salt Lake City, UT 84121-0550

Inquiry 818.

Axum® Technical Graphics
FREE BROCHURE
800-548-5653 ext. 067
Create publication-quality graphs quickly and easily on your PC!
TriMetrix, Inc. 444 NE Ravenna Blvd., Ste 210-BY
Seattle, WA 98115 FAX 206-522-9159

Inquiry 819.

3D Surface & Mapping Software for your Macintosh
Produce 5 types of 3D surface plot and contour, dot-density, shadowgram & point location maps. Accepts gridded data & randomly scattered XYZ values as input. Also world maps to 12+ projections showing coastlines, lakes, rivers, international borders (data supplied) and add your own features.
WTC Scientific
152 Buxton Road, Macclesfield, Cheshire SK10 1NG, UK
Phone +44 625 420210

Inquiry 820.

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 Btrieve and dBASE. Unlimited file sizes, multiple keys and much more! MS-DOS **$149.** OS/2, XENIX, UNIX **$249.**
(702) 588-3737
Opt-Tech Data Processing
P.O. Box 678 — Zephyr Cove, NV 89448

Inquiry 821.

SOFTWARE/TRANSLATORS

100% PASCAL → C
P2C translates Turbo Pascal 3/4/5 into C code (Turbo, Microsoft, TopSpeed, ANSI) and supports all TP features: sets, nested functions, with, variant records, strings, files, interrupts, const expressions, graphics, units, dynamic memory management, mem & port arrays, absolute variables; in short—everything except inline and object-oriented features. Comes with full TP runtime library emulation and automatically generates project, make, header, and C files. English manual (130+ pages) included. Professional Edition includes complete source code for emulation library.
Standard Ed. $395 Professional Ed. $595 (MC, VISA, AMEX)
LAUER & WALLWITZ GmbH, Erlkoenigweg 9,
D-6200 WIESBADEN, Germany, Phone +49 (611) 42771

Inquiry 822.

SOFTWARE/VOICE

MULTI-VOICE® TOOLS
Multi-Voice Tools is a complete development Toolkit for Pascal or "C" to access all the features for most speech processing boards available today. It helps you write MULTI-LINE VOICE APPLICATION systems in minutes. A number of programming examples are provided. All programs and libraries are delivered with source code.
Dialogic, Rhetorex, Pika: $599. Watson (Single Line): $99. ALSO AVAILABLE: FAX Programmer's Toolkit ($199). Based on CAS specifications. Visa/MC accepted.
ITI Logiciel
1706 St. Joseph E, Suite 4, Montreal, Can. H2J 1N1
(800) 567-6765 or (514) 861-5988

STATISTICS

Statistical Advisor Speaks English!
Statistical Navigator Professional™ lets you describe your research goal in plain english then guides you to the appropriate statistical analysis. Natural language interface, detailed report, extensive hypertext help, & pull-down menus. $150+s/h.
VISA, MC, AMEX, PO #, Check.
The Idea Works, Inc.
607 Jackson St., Columbia, MO 65203
1-800-537-4866 **FAX 1-314-875-5812**
Outside USA: 1-314-875-5827

Inquiry 823.

NCSS 5.x Series — $125
Easy-to-use menus & spread sheet. Multiple regression. T-tests. ANOVA (up to 10 factors, rep. measures, covariance). Forecasting. Factor, cluster, & discriminant analysis. Nonparametrics. Cross Tabulation. Graphics: histograms, box, scatter, etc. Reads ASCII/Lotus. Many new add-on modules.
NCSS
329 North 1000 East, Kaysville, UT 84037
Phone: 801-546-0445 **Fax: 801-546-3907**

Inquiry 824.

SCA STATISTICAL SYSTEM
The *only* statistical software encompassing
Forecasting & Time Series Analysis
Quality and Productivity Improvement
General Statistical Analysis
Available on DOS, OS/2 and Mac operating systems.
Call today for more information
Scientific Computing Associates
4513 Lincoln Ave., Suite 106, Lisle, IL 60532, USA
Phone: (708) 960-1698 **FAX: (708) 960-1815**

Inquiry 825.

UNISTAT-IV Statistical Package
Menu/mouse driven stats package featuring a fully-fledged spreadsheet, a wide range of statistics and powerful graphics. Export/Import Lotus, dBase 3&4, DIF, Sylk, fixed and free format ascii. String data and missing data handling. Full array of 2D and 3D plots, charts and histograms, curve and distribution fitting. More than 40 parametric and nonparametric tests, crosstabulation, breakdown, OLS, weighted, polynomial and stepwise regressions, balanced/unbalanced ANOVA, ANCOVA, etc. Demo system and 440pp. user's guide available separately
US & Canada: $395 ADHOC Inc., Dept BT, 28 Brunswick Woods Dr., East Brunswick, NJ 08816. Tel. 201-254-7300, Fax: 201-254-7310
Elsewhere: £295. UNISTAT Ltd., Dept BT, PO Box 383, Highgate, London N6 5UP, England. Tel. +44 (0)81 883 7155, Fax. +44 (0)81 444 9512

Inquiry 826.

TELECOMMUNICATIONS

TELECOMMUNICATIONS
Via PC Telecommunications Software turns your existing PC and modem into a full blown telecommunications workstation. Send and receive messages via FAX, TELEX, TWX and/or MODEM all through one easy to use, integrated software package.
$595.00 plus shipping—includes faxboard!
Call 1-800-626-5444 ext. 511 and order Via PC today!
IDR UniCom, Incorporated
400 Stenton Avenue, Plymouth Meeting, PA 19462
Phone: 215-825-6500 **Fax: 215-825-6188**

Inquiry 827.

TYPESETTING

CATALOG $99.99

Prepares typesettings for creating catalogues, brochures, etc., both in color and B&W. Imports text from a text editor and inputs color video pictures directly from OCULUS-10 (by Coreco) or from PCX color format files (mode 13h). Exports PCX color files. Supports HP PaintJet and laserjet II printers. CATALOG requires the use of Pizazz Plus™ (by Applications Techniques) to print. For XT or AT compatibles with 640K RAM and mouse. Specify XT or AT when ordering.

Backus Computer Services
P. O. Box 830793, San Antonio, TX 78283-0793
(512) 433-4982

Inquiry 828.

UNINTERRUPTIBLE POWER

HOW TO PROTECT YOUR COMPUTER
And Make It Last Longer

FREE money-saving literature tells you how to protect your computer and make it last longer with an uninterruptible power supply. 500VA through 18KVA models from the world's largest manufacturer of single-phase UPS.

Best Power Technology, Inc.
P.O. Box 280, Necedah, WI 54646
Toll-Free (800) 356-5794, Ext. 2131
Telephone: (608) 565-7200, Ext. 2131

Inquiry 829.

UPS

TAKE THE BYTE OUT OF POWER LINE DISTURBANCES.

- Power protection for your PC or Network.
- Risk FREE Offer.

Call for FREE UPS Selection Guide

SOLA
1717 Busse Rd., Elk Grove Village, IL 60007
Phone: 1-800-TRY-SOLA

Inquiry 830.

UTILITIES

UNIX under DOS
Get the Feel & Power of UNIX

Include awk, cb, cp, diff, find, grep, ls, make, more, mv, rm, sed, sort, & 22 others. All System V and BSD 4.3 options included. Thorough documentation.

THE BERKELEY UTILITIES $200
call 800-542-0938

OPENetwork
Power Tools for Power Users
215 Berkeley Place, (B2), Brooklyn, NY 11217

Inquiry 831.

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

COPYWRITE

CopyWrite
Removes
Copy Protection
No more diskettes,
manuals or
codewheels.
1000's of products copied.

US $75

QUAID SOFTWARE LIMITED
45 Charles St. E. 3rd Fl, Dept B.
Toronto, Ontario, Canada M4Y 1S2
(416) 961-8243 Fax (416) 961-6448

UTILITIES

REMOVE HARDWARE LOCKS

Software utility allows for the removal of hardware locks. Don't wait for your lock or key device to fail or be stolen. *Guaranteed* to work! The following packages are available:

PCAD	$199.00	CADKEY	$ 99.00
MICROSTATION	$99.00	PERSONAL DESIGNER	$199.00
MasterCAM	$250.00	SmartCAM	$250.00
TANGO PCB	$ 99.00	CADVANCE	$99.00

PLUS SHIPPING AND HANDLING
PHONE (204) 669-4639 FAX (204) 668-3566
VISA and MASTERCARD Welcome

SafeSoft Systems Inc.
191 Kirlystone Way, Winnipeg, MB, Canada, R2G 3B6

Inquiry 832.

Why You Want BATCOM!

BATCOM is a batch file compiler that transforms your .bat files to .exe files to make them faster. BATCOM extends DOS with many new commands so you can read keyboard input, use subroutines, and much more. In addition, BATCOM protects your source code. No royalties! Only $59.95. Order today!

Wenham Software Company
5 Burley St., Wenham, MA 01984
(508) 774-7036

Inquiry 833.

VIRUS

VIRUS ELIMINATOR BOARD

Prevents virus infections that invade while the system is on. Protects existing files from over 100 known virus infections. Activated prior ro DOS loading. Password protection with battery backup. Keyboard lock for added security. Does not occupy any RAM or impact system performance. For IBM Compatibles. Supports Novell workstations. Takes only minutes to install. Provides highest level of system security.

$199.95 + $5 S/H

Information Systems for Profit
P.O. Box 4529, Middletown, N.Y. 10940
1-800-274-3007

Inquiry 834.

VOICE PROCESSING

NEW! VOICE PROCESSING BOARDS

- Digital Voice Recording: 2Kbps 1 hr=1MB
- Text-to-Speech: Human Voice Output
- Pulse/Tone Signal Detection
- VoiceMail/AutoAttendant/E-Mail
- Voice Print for Access Control

100% Satisfaction Guaranteed
$599.00"AT" Board & Software

Technologia Systems Ltd.
155 N. Michigan Ave. Call 312-938-1919
Chicago, IL 60601 Fax 312-938-1024

Inquiry 835.

WINDOWS TOOLS

Hermes DDE Library

The Hermes DDE Library is a powerful library of high level routines for MS-Windows™ programmers. Hermes provides support for DDE at a much higher level than that provided in the Windows SDK. Your program attains added functionality by interacting and communicating with other Windows applications. Compared to the Windows SDK, Hermes reduces the code required to implement DDE by hundreds of lines of 'C'. Hermes is priced at $295.

Raindrop Software Corporation
845 E. Arapaho, Suite 105, Richardson, Texas 75081
(214) 234-2611 Fax (214) 234-2674

See our ad on page 148.

Inquiry 836.

WORD PROCESSING

Replace Proofreading

Key, edit, or proof any file on your PC with **WordProofer™**, then import to your application. *New* two-pass proofing is faster, more accurate than proofreading or document comparators. Single $295. Multicopy discounts. Network version.

Computer Keyes 800/356-0203
21929 Makah Rd. 206/776-6443
Woodway, WA 98020 Fax: 206/776-7210

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 837.

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

or Fax:

603-924-2683

Circle 204 on Inquiry Card

Announcing an advance of very small proportions:

While everyone else is downsizing and simplifying computers and peripherals, 9-track manufacturers have somehow managed to buck this trend with tape drives that are huge and heavy or awkwardly manual loading.

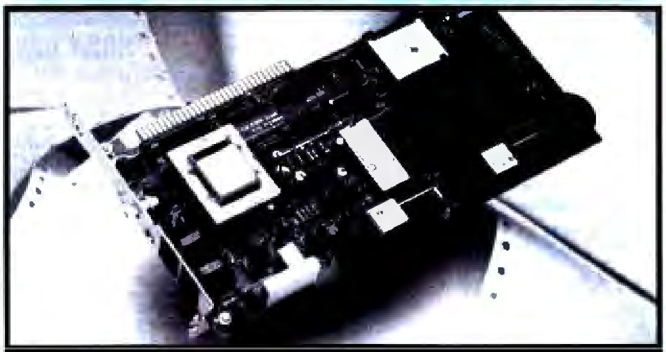
Too bad for them. Introducing the OD3210, designed and built by Overland Data to bring 9-track into the modern office. It's incredibly compact. Whisper quiet. Uses only 45 watts. And is extremely reliable. No other drive has fewer moving parts. Best of all, it's surprisingly affordable.

The OD3210 comes with a two year warranty, expert toll-free support, and the ODI Special Service Program. So call us. And find out why some of the best advances are the smallest ones.

1-800-PC9-TRAK

OVERLAND DATA
San Diego, CA

Circle 68 on Inquiry Card



COMPUcom

9,600-38,400 bps MODEM...$169

NOW you can afford a ***SPEEDMODEM***™ The ***CHAMP***™ has a raw speed of 300 - 9600 bps and 4:1 data compression for throughput up to 38,400 bps. Dynamic Impedance Stabilization™ provides robust performance on noisy telephone circuits. The ***COMBO***™ adds 9600 bps send/receive, full-featured **FAX** with **VOICE MAIL** upgrade...total communications capability–only $279. Both come with a 30-day money back guarantee, 5-year warranty and made in USA. **BYTE** magazine said our 2400bps modem was "a real deal"*...well we've done it again! See for yourself... *3/89p.102

408732-4500 ***CALL NOW 800 228 6648*** Fax 408732-4570

VOICE MASTER KEY® SYSTEM II

VOICE RECOGNITION & SPEECH RESPONSE FOR IBM PC/XT/AT/386, PS/2, LAPTOPS, COMPATIBLES

FOR PRODUCTIVITY, PRESENTATIONS, SOFTWARE DESIGN, ENTERTAINMENT, LANGUAGE TRAINING, EDUCATION, MORE...

SPEECH/SOUND RECORDING AND PLAYBACK. Desktop Audio sound editing allows you to create custom sound applications. Variable sample rate (to 20 KHz) and compression levels. A four-voice music synthesizer is included also!

VOICE RECOGNITION TSR utility allows you to add voice command keyboard macros to your CAD, desktop publishing, word processing, spread sheet, or entertainment programs. Up to 64 voice commands in RAM at once--more from disk.

HARDWARE SYSTEM contains built-in speaker with separate volume and tone controls, external speaker and headphone jacks. Enclosure made of sturdy vinyl-clad steel. Attaches to parallel printer port without affecting normal printer operation (U.S. Patent 4,812,847). Headset microphone, printer cable, 9 volt AC adapter (110 volt UL/CSA listed), and comprehensive user manual included.

QUALITY THROUGHOUT. MADE IN USA. ONLY $219.95

ORDER HOTLINE: (503) 342-1271 Mon-Fri, 8 AM to 5 PM PST

Visa/MasterCard, company checks, money orders, CODs (with prior approval) accepted. Personal checks subject to 3 week shipping delay. Specify computer type when ordering. Add $5 shipping charge for delivery in USA and Canada. Foreign inquiries contact Covox for C&F/CIF quotes. OEM configurations available.

30 DAY MONEY BACK GUARANTEE IF NOT COMPLETELY SATISFIED.

CALL OR WRITE FOR FREE PRODUCT CATALOG

COVOX INC.
675 Conger Street
Eugene, Oregon 97402

TEL (503) 342-1271
FAX (503) 342-1283
BBS (503) 342-4135

Circle 78 on Inquiry Card (RESELLERS: 79)

FAST PS/2 & AT DISKS.

Failsafe Novell Subsytems

Flawless Performance

The power user's first choice, Perisol's subsystems offer failsafe peak performance without stretching your budget. DOS, OS/2, Xenix, Netware 286 & 386 for both AT & PS/2s. No compatibility issues. No problems. It's that simple.

✓ Caching Controllers ✓ Disk Mirroring & Duplexing
✓ Torture-Tested Drives with 24-hour Burn-in

1 GB Opticals

1 GB Erasable Optical Subsystem
For Novell $5249
For DOS $4851

5 Years

"We back our 5.25" Drives for 5 Years!"

Straight From the Box Integration!

System	Capacity	Access	Interface	Price
AT	86 MB	18 ms	IDE	$455
AT	120 MB	18 ms	ESDI	$803
AT	120 MB	18 ms	IDE	$549
AT	158 MB	14 ms	ESDI,SCSI	$996
AT	200 MB	15 ms	IDE	$871
AT	213 MB	15 ms	SCSI	$961
AT	338 MB	16 ms	ESDI,SCSI	$1443
AT	652 MB	16 ms	ESDI,SCSI	$2065
PS/2	150 MB	14 ms	ESDI	$1269
PS/2	330 MB	16 ms	ESDI	$1736
PS/2	652 MB	16 ms	ESDI	$2343

Maxtor

❒ Drive, Controller, Cables and Software included with Subsytems.

Perisol TECHNOLOGY

Call for Perisol's Complete Product Catalog

800-447-8226

Fax: 408-988-4431 Support: 800-228-8489
International Tel: 408-988-2232

Circle 213 on Inquiry Card

Circle 285 on Inquiry Card.

UNIVERSAL MEMORY PRODUCTS

ORDER 800-678-8648
FAX 714-751-2023
15411 REDHILL AVE SUITE B TUSTIN CA 92680

WE ACCEPT VISA/MC/AMEX
PO'S FROM QUALIFIED FIRMS UNIVERSITIES AND GOVT AGENCIES WESHIP COD
OPEN M-F 7AM-5PM SAT 8AM-2PM
20% RESTOCK FEE NONDEFECT RETURNS

IBM PS/2 MEMORY

6450604......$139
2MG MODULES FOR 55SX, 50Z, 70E61/121
6450608......$149
2MG MODULE FOR 70A21
6450379......$247
2MG FOR 80-111/311
6450375......$135
1MG MODULE FOR 80-041
34F2933......$399
4MG MODULES
30F5360......$149
2MG KIT FOR 30-286
6450605......$460
2-8MG BOARD W/2MG MODEL 70 & 80
6451060......$550
4MG FOR 80 A21/A31
34F3011......$649
4-16MB BOARD W/4MB MODELS 70&80

COMPAQ MEMORY

DESKPRO 386 20/20E 25/25E 286E 386S
1MG MOD..............$119
4MG MOD..............$299
1MG BRD..............$199
4MG BRD..............$495

SIMM SIPP MODULES

4X9-80NS......$355
1X9-70NS......$59
1X9-80NS......$53
1X9-100NS......$52
1X9-120NS......$51
256X9-60NS......$29
256X9-70NS......$24
256X9-80NS......$19
256X9-100NS......$17
256X9-120NS......$15

MAC/AMIGA SIMMS

1X8-80NS......$62
1X8-100NS......$55

HP LASERJET

SERIES II & IID
1MG......$90
2MG......$165
4MG......$295
SERIES IIP & 3
1MG......$100
2MG......$169
4MG......$290

AST PREMIUM 1MG MODULES ONLY $69

DRAM CHIPS

1MG X 1
1MGX1-80NS......$5.50
1MGX1-100NS......$5.25
1MGX1-120NS......$5.10

256K X 4
256X4-80NS......$5.75
256X4-100NS......$5.50

256K X 1
256X1-70NS......$2.95
256X1-80NS......$1.99
256X1-100NS......$1.95
256X1-120NS......$1.65
256X1-150NS......$1.50

64KX4
64X4-120NS......$2.25
64X4-100NS......$2.50
64X4-80NS......$2.95

64KX1
64X1-150NS......$1.05
64X1-120NS......$1.50
64X1-100NS......$200

STATIC COLUMN
256X1-100NS......$2.50
256X1-80NS......$3.00
256X1-70NS......$3.95

MATH CO'S

IIT
2C87-8......$169
2C87-10......$199
2C87-12......$255
2C87-20......$289

CYRIX
83D87-16......$289
83D87-20......$329
83D87-25......$429
83D87-33......$519
NEW CYRIX FOR 386SX
83S87-16......$270
83S87-20......$350

INTEL
8087-2......$115
80287-8......$179
80287-10......$179
80287XL......$220
80387-16......$305
80387-20......$350
80387-25......$450
80387-33......$549
80387-SX......$299

EXPANSION-BOARDS FOR ALL PC'S

BOCA RESEARCH

BOCARAM AT...$119
TO 2MG EXP FOR AT,S
BOCARAM XT...$119
UP TO 2MG EXP FOR XT'S
BOCARAM.AT/IO+
2-4MG W/SER & PAR $157

Acculogic

FULL LIM 4.0 POWER FOR WINDOWS OS/2 UNIX
RAMpAT......$129
2-16MG LIM 4.0 FOR AT'S
SIMMpLY-RAM......$179
2-8MG LIM 4.0 PC/XT/AT
PS/2-16..............$199
2-8MG MDL 50, 60, 55SX
PS/2-32..............$249
1-16MG MDL 70&80
USES 1,2 OR 4MG PS/2 SIMMS

AST 6PAK 286... $119
WITH 4MGS $329

TOSHIBA LAPTOP

1MG FOR T1000SE/XE $287
2MG FOR T1000SE/XE $314
2MG FOR T1200XE......$183
2MG FOR T1600..........$193
2MG FOR T3100SX......$183
4MG FOR T3100SX......$489
2MG FOR T3100E..........$183
2MB FOR T3200SX......$183
4MB FOR T3200SX......$489
3MB FOR T3200..........$274
2MB FOR T5100..........$193
2MB FOR T8500..........$183

MONTHLY SPECIALS SAVE $$$

BOCARAM AT PLUS
2-8MG LIM 4.0
ONLY $119 2MG $227

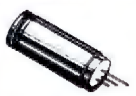
3.5" FDD
FOR COMPAQ ONLY
1/3 HEIGHT
ONLY $129

AST RAMVANTAGE
UP TO 3MG
EXTENDED MEMORY
W/128K ONLY $47

INTERNATIONAL ORDERS ACCEPTED
5 YEAR WARRANTY ON ALL PRODUCTS
CALL THE PC UPGRADE SPECIALISTS !!!

UNICORN - YOUR I.C. SOURCE!

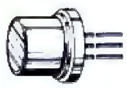
COLLIMATOR PEN (INFRA-RED)



- Output: 2.5 mW (max.)
- Current: 90-150 mA
- Operating Voltage: 2.2-2.5V
- Wavelength: 820nm
- Collimation: .18mrad (typ.)
- Size: 11mm diameter

STOCK #	PRICE
SB1052	$39.99

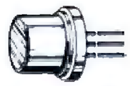
LASER DIODE (INFRA-RED)



- Output: 10 mW (max.)
- Current: 90-150 mA
- Operating Voltage: 2.2-2.5V
- Wavelength: 820nm

STOCK #	PRICE
SB1053	$9.99

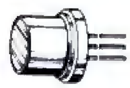
LASER DIODE (VISIBLE-RED)



- Output: 5 mW (max.)
- Current: 65-100 mA
- Operating Voltage: 1.75-2.2V
- Wavelength: 780nm

STOCK #	PRICE
LS022	$19.99

LASER DIODE (VISIBLE-RED)



- Output: 4 mW (max.)
- Current: 20 mA
- Operating Voltage: 2.2-3.0V
- Wavelength: 665nm

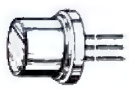
STOCK #	PRICE
LS3200	$99.99

POWER SUPPLY

- Input: 115/230v
- Size 7" L x 5¼" W x 2½ H
- Output: +5 volts @ 3.75 amps
- Output: +12 volts @ 1.5 amps
- Output: −12 volts @ .4 amps

STOCK #	PRICE
PS1003	$19.99

LASER DIODE (VISIBLE-RED)



- Output: 3 mW
- Current: 85-100 mA
- Operating Voltage: 2.3-3.0V
- Wavelength: 670nm

STOCK #	PRICE
LS9200	$49.99

LASER POINTER

- Output: 3.5 mW
- Wavelength: 670nm
- Power Supply: 2xAAA Batteries (Included)
- Beam: Approx. 3" @ 100 yards

Quantity Discounts Available

STOCK #	PRICE
LSPOINT	$199.99

EPROMS

STOCK #	1-24	25-99	100+	STOCK #	1-24	25-99	100+
1702	4.59	4.36	3.92	2764A	3.49	3.32	2.99
2708	6.49	6.17	5.55	TMS2564	5.79	5.50	4.95
2716	3.29	3.13	2.82	27C64	3.29	3.13	2.82
2716-1	3.79	3.60	3.24	27128-20	4.99	4.74	4.27
TMS2716	5.79	5.50	4.95	27128	4.79	4.55	4.09
27C16	3.99	3.79	3.41	27128A	4.79	4.55	4.09
2732	4.19	3.98	3.58	27C128	4.79	4.55	4.09
2732A-2	3.79	3.60	3.24	27256-20	5.29	5.03	4.53
2732A	3.69	3.51	3.16	27256	4.79	4.55	4.09
2732A-4	3.19	3.03	2.73	27C256	4.29	4.08	3.67
TMS2532	5.79	5.50	4.95	27512-20	6.49	6.17	5.55
TMS2532P	1.99	1.89	1.70	27512	5.99	5.69	5.12
27C32	3.79	3.60	3.24	27C512	5.99	5.69	5.12
2764-20	4.29	4.08	3.67	27C1024	12.99	12.34	11.11
2764	3.99	3.79	3.41	68764	13.99	13.29	11.96
2764A-20	3.99	3.79	3.41	68766	12.99	12.34	11.11

DYNAMIC RAMS

STOCK #	1-24	25-99	100+	STOCK #	1-24	25-99	100+
MK4027	.59	.56	.50	4464-100	2.99	2.84	2.56
4116-120	1.39	1.32	1.19	4464-120	2.79	2.65	2.39
4116-150	.99	94	.85	4464-150	2.29	2.13	1.96
4116-200	.89	85	.77	41256-60	2.99	2.84	2.56
4116-250	.59	56	50	41256-80	2.79	2.65	2.39
4164-100	1.89	1.80	1.63	41256-100	1.99	1.89	1.70
4164-120	1.69	1.61	1.55	41256-120	1.89	1.80	1.63
4164-150	1.59	1.51	1.36	41256-150	1.79	1.70	1.53
4164-200	1.39	1.32	1.19	511000-70	6.49	6.17	5.55
4416-120	1.99	1.89	1.70	511000-80	5.99	5.69	5.12
4416-150	1.79	1.70	1.53	511000-100	5.49	5.22	4.70

UNICORN ELECTRONICS

ORDER BY PHONE

10010 Canoga Ave., Unit B-8 • Chatsworth, CA 91311
OUTSIDE CALIFORNIA: (800) 824-3432 (Orders Only)
IN CALIFORNIA: (818) 341-8833
ORDER BY FAX: (818) 998-7975
Minimum Order $15.00 • 24-hour ordering available

Now That You Know Which Laptop or Notebook to Get, We Think You Ought to Know Where to Buy It.

Guaranteed at Least 10% Lower Than the Best Current Advertised* Price on the Best Laptops & Notebooks!!

Competitive Price Must Be Presented To Us Prior To Purchase From Us.

AST® Premium® Exec™

286/20MB with

1MB .... N/A
2MB $2098.00
5MB $2498.00
8MB $2998.00

286/40MB with

2MB $2418.00
5MB $2818.00
8MB $3318.00

386SX/20 with

2MB .... N/A
5MB $2898.00
8MB $3348.00

386SX/40MB with

2MB .... N/A
5MB $3218.00
8MB $3668.00

386SX/60MB with

2MB .... N/A
5MB $3538.00
8MB $3988.00

Texas Instruments Travelmate

TM2000/20MB w/2 MB $2408.00
TM2000/20MB w/3MB $2548.00
TM3000/20MB w/4MB $3498.00
TM3000/20MB w/6MB $3788.00
TM3000/40MB w/4MB $3788.00
TM3000/40MB w/6MB $4078.00
TM3000/60MB w/4MB $4078.00
TM3000/60MB w/6MB $4368.00

Panasonic

CF-170/20MB w/640K .... N/A
CF-170/20MB w/1.6MB $1738.00
CF-270/20MB w/3MB $2198.00
CF-270/20MB w/5MB $2428.00

TOSHIBA

T1000SE with

2MB $1138.00
3MB $1278.00
5MB .... CALL
9MB .... CALL

T1000XE/20MB with

2MB $1558.00
3MB $1698.00
5MB .... CALL
9MB .... CALL

T1000LE/20MB with

2MB $1738.00
3MB $1878.00
5MB .... CALL
9MB .... CALL

T1200XE/20MB with

3MB $2188.00
5MB $2368.00

T1200XE/40MB with

3MB $2548.00
5MB $2728.00

T1600SX/20MB with

3MB $2368.00
5MB $2548.00

T3100e/40MB with

3MB $2488.00
5MB $2668.00

T2000SX/20 MB with

2MB $3218.00
3MB $3358.00
5MB .... CALL
9MB .... CALL

T2000SX/40MB with

2MB $3518.00
3MB $3658.00
5MB .... CALL
9MB .... CALL

T3100SX/40MB with

3MB $3678.00
5MB $3858.00
7MB $4108.00
9MB $4268.00
11MB $4528.00
13MB $4768.00

T3100SX/80MB with

3MB $3858.00
5MB $4038.00
7MB $4288.00
9MB $4458.00
11MB $4708.00
13MB $4948.00

T3200/40MB with

4MB $2748.00

T3200SX/40MB with

3MB $3258.00
5MB $3438.00
7MB $3688.00
9MB $3858.00
11MB $4108.00
13MB $4348.00

T3200SX/120MB with

3MB $3858.00
5MB $4038.00
7MB $4288.00
9MB $4458.00
11MB $4708.00
13MB $4948.00

T3200SXC/120MB with

3MB $5638.00
5MB $5818.00
7MB $6068.00
9MB $6238.00
11MB $6488.00
13MB $6728.00

T5100/100MB with

4MB $3488.00

T5200/40MB with

4MB $4568.00
6MB $4748.00
8MB $4928.00
12MB $5358.00
14MB $5528.00

T5200/100MB with

4MB $4928.00
6MB $5108.00
8MB $5288.00
12MB $5718.00
14MB $5888.00

T5200/200MB with

4MB $5338.00
6MB $5518.00
8MB $5698.00
12MB $6118.00
14MB $6298.00

T5200C/200MB with

4MB $5983.00
6MB $6118.00
8MB $6298.00
12MB $6718.00
14MB $6898.00

"If the laptop or notebook you're considering isn't on this list, then maybe it's not worth considering!"

TOSHIBA T8500 Power Desktop
14MB RAM, 100MB Hard Disk, VGA Display
Windows 3.0, Excel, Dbase, WP5.1, etc
ONLY $4188.00

TOSHIBA T1200F
2-Floppies, Windows 3.0, 1MB RAM, 2400B Den. Modem
ONLY $1268.00

10% better than the best current advertised price you find on memory upgrades, modems & fax/modems

We want to make your life simpler. Instead of wasting valuable time and effort haggling with various dealers over the phone, we suggest you simply look for the lowest current advertised price you can find on memory upgrades, modems and fax/modems. And that applies to ANY PUBLICATION! Take 10% off that price, and that is what you'll pay us. You see, when you buy memory upgrades from us you're doing business direct with the factory. And everybody knows that nothing beats that. Remember, time is money!!

All prices subject to change without advanced notice. We are not liable for typographical errors.

tote-a-lap

"Experts in portable intelligence"

(415) 578-1901, ext. 924 • FAX (415) 578-1914

Always call for most current price before ordering. All listed prices reflect cash discounts.

Limited to stock on hand. All prices reflect cash discounts.

GUARANTEED AT LEAST 10% LOWER THAN THE BEST CURRENT ADVERTISED PRICE ON THE BEST LAPTOPS & NOTEBOOKS !

(COMPETITIVE PRICE MUST BE PRESENTED TO US PRIOR TO PURCHASE)

AST EXEC 286/20MB WITH 1MB	N/A	AST EXEC 286/20MB WITH 5MB	$ 2,498.00	AST EXEC 286/40MB WITH 4MB	$ 2,768.00
AST EXEC 286/20MB WITH 2MB	$ 2,098.00	AST EXEC 286/20MB WITH 8MB	$ 2,998.00	AST EXEC 286/40MB WITH 5MB	$ 2,818.00
AST EXEC 286/20MB WITH 4MB	$ 2,448.00	AST EXEC 286/40MB WITH 2MB	$ 2,418.00	AST EXEC 286/40MB WITH 8MB	$ 3,318.00
AST EXEC 386SX/20MB WITH 2MB	N/A	AST EXEC 386SX/40MB WITH 2MB	N/A	AST EXEC 386SX/60MB WITH 2MB	N/A
AST EXEC 386SX/20MB WITH 4MB	$ 2,848.00	AST EXEC 386SX/40MB WITH 4MB	$ 3,168.00	AST EXEC 386SX/60MB WITH 4MB	$ 3,488.00
AST EXEC 386SX/20MB WITH 5MB	$ 2,898.00	AST EXEC 386SX/40MB WITH 5MB	$ 3,218.00	AST EXEC 386SX/60MB WITH 5MB	$ 3,538.00
AST EXEC 386SX/20MB WITH 8MB	$ 3,348.00	AST EXEC 386SX/40MB WITH 8MB	$ 3,668.00	AST EXEC 386SX/60MB WITH 8MB	$ 3,988.00
TI TRAVELMATE TM2000 WITH 2MB	$ 2,408.00	PANASONIC CF-170 WITH 640K	N/A	PANASONIC CF-270 WITH 3MB	$ 2,198.00
TI TRAVELMATE TM2000 WITH 3MB	$ 2,548.00	PANASONIC CF-170 WITH 1.64MB	$ 1,738.00	PANASONIC CF-270 WITH 5MB	$ 2,428.00
TOSHIBA T1000SE WITH 2MB	$ 1,138.00	TOSHIBA T1000XE/20MB WITH 2MB	$ 1,558.00	TOSHIBA T1000LE/20MB WITH 2MB	$ 1,738.00
TOSHIBA T1000SE WITH 3MB	$ 1,278.00	TOSHIBA T1000XE/20MB WITH 3MB	$ 1,698.00	TOSHIBA T1000LE/20MB WITH 3MB	$ 1,878.00
TOSHIBA T1000SE WITH 5MB	CALL	TOSHIBA T1000XE/20MB WITH 5MB	CALL	TOSHIBA T1000LE/20MB WITH 5MB	CALL
TOSHIBA T1000SE WITH 9MB	CALL	TOSHIBA T1000XE/20MB WITH 9MB	CALL	TOSHIBA T1000LE/20MB WITH 9MB	CALL
TOSHIBA T1200XE/20MB WITH 3MB	$ 2,188.00	TOSHIBA T1600X/20MB WITH 3MB	$ 2,368.00	TOSHIBA T2000SX/20MB WITH 2MB	$ 3,218.00
TOSHIBA T1200XE/20MB WITH 5MB	$ 2,368.00	TOSHIBA T1600X/20MB WITH 5MB	$ 2,548.00	TOSHIBA T2000SX/20MB WITH 3MB	$ 3,358.00
TOSHIBA T1200XE/40MB WITH 3MB	$ 2,548.00	TOSHIBA T3100e/40MB WITH 3MB	$ 2,488.00	TOSHIBA T2000SX/20MB WITH 5MB	CALL
TOSHIBA T1200XE/40MB WITH 5MB	$ 2,728.00	TOSHIBA T3100e/40MB WITH 5MB	$ 2,668.00	TOSHIBA T2000SX/20MB WITH 9MB	CALL
TOSHIBA T2000SX/40MB WITH 2MB	$ 3,518.00	TOSHIBA T3100SX/40MB WITH 3MB	$ 3,678.00	TOSHIBA T3100SX/80MB WITH 3MB	$ 3,858.00
TOSHIBA T2000SX/40MB WITH 3MB	$ 3,658.00	TOSHIBA T3100SX/40MB WITH 5MB	$ 3,858.00	TOSHIBA T3100SX/80MB WITH 5MB	$ 4,038.00
TOSHIBA T2000SX/40MB WITH 5MB	CALL	TOSHIBA T3100SX/40MB WITH 7MB	$ 4,108.00	TOSHIBA T3100SX/80MB WITH 7MB	$ 4,288.00
TOSHIBA T2000SX/40MB WITH 9MB	CALL	TOSHIBA T3100SX/40MB WITH 9MB	$ 4,268.00	TOSHIBA T3100SX/80MB WITH 9MB	$ 4,458.00
		TOSHIBA T3100SX/40MB WITH 11MB	$ 4,528.00	TOSHIBA T3100SX/80MB WITH 11MB	$ 4,708.00
TOSHIBA T3200/40MB WITH 4MB	$ 2,748.00	TOSHIBA T3100SX/40MB WITH 13MB	$ 4,768.00	TOSHIBA T3100SX/80MB WITH 13MB	$ 4,948.00
TOSHIBA T3200SX/40MB WITH 3MB	$ 3,258.00	TOSHIBA T3200SX/120MB WITH 3MB	$ 3,858.00	TOSHIBA T3200SXC/120MB WITH 3MB	$ 5,638.00
TOSHIBA T3200SX/40MB WITH 5MB	$ 3,438.00	TOSHIBA T3200SX/120MB WITH 5MB	$ 4,038.00	TOSHIBA T3200SXC/120MB WITH 5MB	$ 5,818.00
TOSHIBA T3200SX/40MB WITH 7MB	$ 3,688.00	TOSHIBA T3200SX/120MB WITH 7MB	$ 4,288.00	TOSHIBA T3200SXC/120MB WITH 7MB	$ 6,068.00
TOSHIBA T3200SX/40MB WITH 9MB	$ 3,858.00	TOSHIBA T3200SX/120MB WITH 9MB	$ 4,458.00	TOSHIBA T3200SXC/120MB WITH 9MB	$ 6,238.00
TOSHIBA T3200SX/40MB WITH 11MB	$ 4,108.00	TOSHIBA T3200SX/120MB WITH 11MB	$ 4,708.00	TOSHIBA T3200SXC/120MB WITH 11MB	$ 6,488.00
TOSHIBA T3200SX/40MB WITH 13MB	$ 4,348.00	TOSHIBA T3200SX/120MB WITH 13MB	$ 4,948.00	TOSHIBA T3200SXC/120MB WITH 13MB	$ 6,728.00
TOSHIBA T5200/40MB WITH 4MB	$ 4,568.00	TOSHIBA T5200/100MB WITH 4MB	$ 4,928.00	TOSHIBA T5200/200MB WITH 4MB	$ 5,338.00
TOSHIBA T5200/40MB WITH 6MB	$ 4,748.00	TOSHIBA T5200/100MB WITH 6MB	$ 5,108.00	TOSHIBA T5200/200MB WITH 6MB	$ 5,518.00
TOSHIBA T5200/40MB WITH 8MB	$ 4,928.00	TOSHIBA T5200/100MB WITH 8MB	$ 5,288.00	TOSHIBA T5200/200MB WITH 8MB	$ 5,698.00
TOSHIBA T5200/40MB WITH 12MB	$ 5,358.00	TOSHIBA T5200/100MB WITH 12MB	$ 5,718.00	TOSHIBA T5200/200MB WITH 12MB	$ 6,118.00
TOSHIBA T5200/40MB WITH 14MB	$ 5,528.00	TOSHIBA T5200/100MB WITH 14MB	$ 5,888.00	TOSHIBA T5200/200MB WITH 14MB	$ 6,298.00
TOSHIBA T5100/100MB WITH 4MB	$ 3,488.00	TOSHIBA T5200C/200MB WITH 6MB	$ 6,118.00	TOSHIBA T5200C/200MB WITH 12MB	$ 6,718.00
TOSHIBA T5200C/200MB WITH 4MB	$ 5,938.00	TOSHIBA T5200C/200MB WITH 8MB	$ 6,298.00	TOSHIBA T5200C/200MB WITH 14MB	$ 6,898.00

All prices subject to change without notice.

TOSHIBA T8500 POWER DESKTOP
14MB RAM, 100MB HARD DISK, VGA DISPLAY,
WINDOWS 3.0, EXCEL, DBASE, WP5.1, ETC.
ONLY $4,188.00

tote-a-lap

"experts in portable intelligence"

PHONE: (415) 578-1901, ext. 924 • FAX: (415) 578-1914

TOSHIBA T1200F
2-FLOPPIES, WINDOWS 3.0
1MB RAM, 2400B DED. MODEM
ONLY $1,268.00

Circle 274 on Inquiry Card.

Custom Imprinted IBM Key Caps

Hooleon SnapCap Kits Supporting:
WordPerfect 5.0™ or IBM® 5251 Emulation
For **101-Key Keyboards**

Customize Your Keyboard with:
- **Custom Key Imprinting**
- Keytop Label Kits for Software
- **Relegendable Keys** for Cherry™, Wyse™ & Key Tronic™
- **Custom Keytop Label Imprinting**
- Keyboard Protectors & More

Call for your FREE CATALOG!

800 937-1337
602 634-7515 FAX: 602-634-4620

Hooleon P.O.B. 230, Dept. BYTE, Cornville, AZ 86325

Circle 127 on Inquiry Card.

MULTIMEDIA BOARDS

VIDEO CAPTURE/DISPLAY
16 Miln Clrs / 256 Gry Lvls
HIGH RESOLUTION
Fast / Slow Capture
VGA to VCR
Camera to VGA etc..
LASERPRINT IMAGES WITH TEXT!
Custom boards and software available.
NTSC Composite Video
IBM AT / 386 compatible
1 YEAR WARRANTY
30 dy Money Back Guarantee.

1753 Mass. Ave.
EECS Cambridge MA 02140
Tel: 617-498-9838 FAX: 617-491-6808

Circle 101 on Inquiry Card.

9 Track Tape Subsystem for PC/XT/AT/386/PS2

$1995 for 1600/3200 BPI
$4995 for 1600/6250 BPI
$6995 for 800/1600/3200/6250 BPI
CALL 1-800-266-4TAPE

Laguna Conversion Systems
26941 Cabot Road
Laguna Hills, CA 92653
Tel: 714-367-0497, Fax: 714-367-0508

Circle 154 on Inquiry Card.

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 10½" 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 222 on Inquiry Card.

!!!!! NEW !!!!! 32 I/O <–> RS-232

- FINALLY ANY COMPUTER CAN HAVE I/O
- PLUGS INTO ANY STANDARD RS-232 PORT
- 16 DIGITAL INPUTS, 16 DIGITAL OUTPUTS
- ALL I/O OPTO-ISOLATED PROTECTED
- NO ADDITIONAL HARDWARE REQUIRED
- NO MORE SPECIAL PLUG-IN CARDS
- EASY TO PROGRAM IN ANY LANGUAGE
- UP TO 4 BOARDS CONNECT TO ONE RS-232
- IDEAL FOR REMOTE MONITOR & CONTROL
- USED IN INDUSTRY, SCHOOLS, LABS & HOBBY
- INDUSTRIAL VERSION AVAILABLE
- RS-422/485 VERSION AVAILABLE
- GRAFCET CONTROL SOFTWARE AVAILABLE
- COMES WITH PC BASIC PROGRAM DEMO DISK
- STANDARD UNIT PRICED AT ONLY $ 349 QTY 1
- DEALER INQUIRIES ARE WELCOME

P. SHERMAN ENTERPRISES (514) 331-3712

Circle 221 on Inquiry Card.

Advertise your computer products through BYTE BITS (2" x 3" ads)

For more information call Mark Stone at
603-924-2695

BYTE
One Phoenix Mill Lane
Peterborough, NH 03458

Circle 51 on Inquiry Card.

486 $1595

11 MIPS

Made in U.S.A.

JC GOLD BOARD

The JCS 486, the New Performance Leader in Personal 486 Systemboards

- Intel 80486/25 CPU
- 8KB cache intergrated in CPU
- Math coprocessor intergrated in CPU
- Up to 32MB memory on board
- Shadow RAM for video & system BIOS
- Optional second level cache memory
- Weitek 4167 numeric coprocessor socket
- AMI BIOS

486 Complete System..................$2895
Include 4MB memory, 200MB(15ms) HDD, IDE controller, 1.2 or 1.44 MB FDD, 2 serial / 1parallel, 101 Keyboard.

80486/33 CPU Board	$2095
80386/33 CPU Board	$ 895
80386/25 CPU Board	$ 595
80386SX/16 CPU Board	$ 315

Dealer Inquiries Welcome

JEMINI Electronics
3400 De La Cruz Blvd. Unit T
Santa Clara, CA 95054
TEL (408)727-9986
FAX (408)727-7687

Circle 149 on Inquiry Card.

DEVELOPERS' TOOLS

The Total Solution Programmer
The best-selling Programmer since 1985
Appreciated by over 50,000 users worldwide

TUP-300
Universal Programmer & Tester (PC based)
from $695.-

- 40-Pin ZIF socket can be expanded up to 68 Pin for 8 to 68 Pins DIP or PLCC chips
- Programs 20 to 68 Pin PLD (PAL, CPAL, IFL, GAL, PEEL, EPLD, EEPLD), EPROM (up to 16 Mbit), EEPROM, Serial PROM, Special PROM, Bipolar PROM & MPU (8741/42/48/49, 8051/51FA, FB, FC 521 541 252 751/752 552/451, 8796 97 68705, Z8611 21, TMS7742, TMS77C82, 8755A)
- Tests TTL (74/54), CMOS (40/45), SRAM, DRAM, SIP DRAM and SIM DRAM
- Full screen edit, HEX to OBJ, 2-way or 4-way Binary File Splitter and Shuffler, & MPU Dis-assemblers
- 34 various adapters (4 sockets, ROM RAM, PLCC ...) from $95
- Other high quality programmer cards at low cost available from $119
  UV Eraser (UV 32) for 32 pcs at $95

Call us today for complete product line
- **1 year warranty, 30 days money back guarantee**
- **1 year free software updates and Customer Support**

TRIBAL MICROSYSTEMS
Tel: (415)623-8859 Fax: (415)623-8925
44388 S. Grimmer Blvd. Fremont CA 94538

Circle 278 on Inquiry Card (RESELLERS: 279).

DEVELOPERS' TOOLS

TPT-100 $145.-
POCKET IC TESTER
- Tests TTL (74/54), CMOS (40/45) and DRAM
- 9V battery operated
- LCD display
- Search unknow IC

TRE-200 $295.-
8/16 BIT ROM/RAM EMULATOR (PC based)
- 8 or 16 Bit
- ROM: 2764, 128, 256, 512
- RAM: 6264, 62256
- Fast down/up load
- Screen edit
- Dis-assembler for 6 MPUs

TLK-PLD	**PLD Learn Kit**	$85.-	TLK-GAL	**GAL Learn Kit**	$85.-
TLK-PEEL	**PEEL Learn Kit**	$85.-	TLK-8051	**8051 Learn Kit**	$85.-

- Enable beginners to design their own PLD/PEEL/GAL/MPU within a short period of time.
- Design & Experiments manuals and Experiment PCB Kit

Call us today for complete product line
- **1-year warranty 30 days money back guarentee**

TRIBAL MICROSYSTEMS
Tel: (415)623-8859 Fax: (415)623-8925
44388 S. Grimmer Blvd. Fremont CA 94538

Circle 318 on Inquiry Card (RESELLERS: 319).

IBM

PS/2 model 55SX-60 meg	2595
PS/2 model 70-60 meg	3195
PS/2 model 65SX-60 meg	3325
PS/2 model 70-A21	4725
PS/2 model 95-320 meg	14950

*** Monitor Extra ***

COMPAQ

DeskPro Models

286E-40/120 meg	1995/2150
386S-20 MHz 120 meg	2575
386/20E-120 meg	2995
386/25E-120 meg	4395
386/33L-320 meg	8325

*Call for other models – Monitor Extra *

NOVELL SPECIALS

ELS I	599
ELS II	1250
Advance 286 V 2.15	2150
Advance SFT V 2.15	2999
Advancg 3.1	4995

LOW PRICES

SINCE 1983

International Orders

We Honor Manufacturer's Warranties

Call for details

LAPTOP

Texas Instruments TM2000	2295
Texas Instruments TM3000	3495
AST Exec. 386SX/20-4 meg	3150
Compaq LTE/286-40 meg	2875
Compaq LTE/386-60 meg	4995
Sharp 6220-20 meg	2595

CALL FOR OTHER BRANDS

LAPTOP MEMORY

2 meg Toshiba 3100SX	179
2 meg Toshiba 5200	185
2 meg Toshiba 3200SX	180
1 meg Compaq SLT/LTE	220

EVEREX

Everex System II CALL

Everex Step 386SX-2 meg
40 meg VGA card and monitor

Everex System III CALL

Everex Step 386/33-4 meg
150 meg VGA card and monitor

* Call for models & configurations *

AGI COMPUTER

AGI 386SX-1 meg **1595**
40 meg VGA card and monitor
CALL FOR OTHER MODELS

AST

Bravo 386SX-40 meg	1625
Bravo 386SX-120 meg	1895
Premium 386/25-120 meg	3595
Premium 386/33-200 meg	4345
Bravo 486/25-120 meg	3575
Premium 486/33-200 meg	6450

All AST Systems have VGA Card and two megs memory

Call for other models

DISKS

DYSAN 5.25 HD/3.5 HD	13/26
MAXELL 5.25 HD/3.5 HD	12/25

Minimum 10 box order

WE STOCK Toshiba

CITIZEN, OKIDATA, EPSON, HITACHI, TALLGRASS, ARCHIVE, NEC, ALR, WYSE, HOUSTON INSTRUMENTS, MICROSOFT, SUMMAGRAPHIC, INTEL, PC MOUSE, CALCOMP

HARD DISKS

CONNER

CP3044 40 meg	305
CP3104 100 meg	525
CP30104 120 meg	575
CP3204F 220 meg	845

MAXTOR

XT8760E 676 meg	1895
XT8760S 676 meg	2150

Call for Optical and W.O.R.M. Drives

Call for other brands

SOFTWARE SPECIAL

dBase IV	455
Wordperfect 5.1	260
Aldus Pagemaker	495
Ventura Publisher	525
Clipper	535
WordStar 5.5	150
EasyExtra	40

PACIFIC DATA PRODUCTS

P. Page II	345
P. Page IIP	355
P. 1-2-4 Mem II	140
P. One Meg IIP	145
P. 25 in One	250
P. Headlines	245

NOVELL Authorized Dealer

LAN BOARDS

8 bit Arcnet	110
16 bit Arcnet	220
8 bit Ethernet	190
16 bit Ethernet	275
8 port Active Hub	325
Token Ring Card	399
Tokenhub 4-port	355

Call for other LAN Accessories

SPECIALS

HP Scan Jet	1425
Hp Paint Jet	965
Lotus Ver. 3.1	365
Kodak 150P	345
Canon BJ 10	345
Intel Satisfaxtion	425
Okidata 391	615
Epson LQ 1050	625
HP-7475 Plotter	1495
IBM Token-Ring	655
Panasonic 1124	299
Intel 80387-33	565

LASER PRINTERS

HP Laser IIID	2550
HP Laser 2P	995
HP Laser III	1650
Panasonic 4450	1395
NEC 2 Model 90	1695
NEC 2 Model 290	2675
TI PS17	1595

MODEMS

Everex 2400 Int/Mnp	179
Hayes 2400B	315
Hayes 9600B	875
USRobotics Hst/Dual	1150
More in stock	Call

Corporate Accounts Welcome

Call for Volume Discounts

Consultants Call for Pricing

Exports Available

Computerlane

Outside California: 1-800-526-3482

Inside California: 818-884-8644 • FAX: 818-884-8253

22107 Roscoe Blvd., Canoga Park, CA 91304 • 1/2 Block west of Topanga

Hours: Monday - Friday 9 -6 Saturday 10 - 6

Compaq is a Registered Trademark of Compaq. IBM is a Registrered Trademark of International Business Machines.

ALL QUOTED PRICES ARE CASH PRICES ONLY

Visa and MasterCard 3% higher, American Express 5% higher

Prices subject to change without notice.
*Quantities are limited

Circle 72 on Inquiry Card.

IEEE 488.2

Hardware for IBM PC/AT, Micro Channel, Sun, Macintosh, DEC, and NeXT.

Software for DOS, UNIX, VMS, menu-driven and icon-driven environments.

IEEE 488 extenders, analyzers, converters, analog I/O, and digital I/O.

Call for your free IEEE catalog

IOtech

IOtech, Inc. • 25971 Cannon Road
Cleveland, Ohio 44146 • (216) 439-4091

Circle 145 on Inquiry Card.

8051 68HC11

EMULATORS

For info call:

Australia	(02) 654 1873
Austria	(0222) 38 76 38
Benelux	+31 1858-16133
Canada	(514) 689-5889
Denmark	(42) 65 81 11
Finland	90-452 1255
France	(01) 69 412 801
Germany	08131-25083
Great Britain	0962-73 3140
Israel	(03) 484832
Italy	(011) 7710010
Korea	(02) 784 7841
New Zealand	(09) 392464
Portugal	(01) 81 50 454
Scandinavia	+46 40922425
Singapore	(065) 284-6077
Spain	(93) 217 2340
Switzerland	(01) 740 41 05
Taiwan	(02) 7640215
Thailand	(02) 281-9596

NOHAU CORPORATION
51 E. Campbell Ave. • Campbell, CA 95008
(408) 866-1820 FAX (408) 378-7869

Circle 193 on Inquiry Card.

LET SPEEDBOARD SPEED UP YOUR XENIX/UNIX MULTIUSER SYSTEMS

HIGH SPEED LOW PRICE

- 16MHz 80186 processor
- 128K RAM (512K opt.)
- 8/16 ports up to 64 users
- 50-38400 bps
- Modem supported by each port

$795--SPEEDBOARD II-8
$995--SPEEDBOARD II-16

price is complete. 16-port pannel and software included.

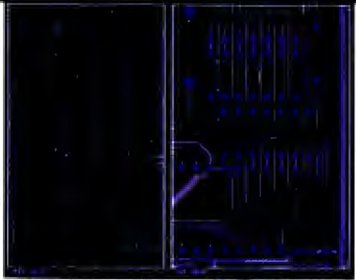
5 Years limited warrenty

Distributors, Dealers, VARs' inquiry welcomed

SCO XENIX/UNIX Operating System bundled package available at low price.

1-800-368-1688
DATATRANS SYSTEMS, INC.
35-28 154 Street,
Flushing, N Y 11354

Circle 86 on Inquiry Card.



New Schematic and PCB Software

With support for extended and expanded memory, HiWIRE II can handle your most demanding schematic and PCB designs quickly and easily. The unique HiWIRE editor allows you to display and edit schematics and PCBs simultaneously, using the same commands for each. HiWIRE II is $995, and is guaranteed.

WINTEK Corporation
1801 South Street, Lafayette, IN 47904
(800) 742-6809 or (317) 448-1903

Circle 299 on Inquiry Card.

HYPERCROSS – asm *
Multi–Target Macro Cross Assembler

Fast One Pass "Library Driven" Execution.
Full Featured PC–asm Style Directives and Expressions.

PROCESSORS SUPPORTED:

8048	6801	1800	7800	320C1X	Z8
8051	6805	6502	70XXX	320C2X	Z80
8085	6809	65816	TMP4300	TMS370	Z180
8086	6811	COP400	TCP4600	TMS7000	Z280
8096	68000	COP800	TMP4700	TMS9900	SUPER8
80196					64180

Popular Vendor Style Input Source Code Syntax Rules.
Six Run Code Format Choices & Program List Option.

Host: IBM PC or Compatible (PC-DOS/MS-DOS).

COMPLETE SYSTEM: $249.00 US
Macro Cross Assembler, 31 Processor Libraries, Sample Programs, Single User License, User Manual, 3 1/2 or 5 1/4 Diskette Option, US Shipping & Handling.

ENTRY LEVEL SYSTEM: $129.00 US
23 Processor Libraries, No Macros, Directive Subset, Sample Programs, Single User License, User Manual, 3 1/2 or 5 1/4 Diskette Option, US Shipping & Handling.

K & M Associates (404) 971-2849
P.O. Box 670054
Marietta, GA 30066

* Trademark Hypersys Corp.

Circle 153 on Inquiry Card.

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/XT/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

Circle126 on Inquiry Card.

Instant Microcontroller

Instant C Programming

Don't use a microprocessor, use a **SmartBlock™** microcontroller module to build your custom controller. Our low cost Dynamic C™ makes programming a snap. 3.5 x 2.5 inch module includes microprocessor, memory, time/date clock, eeprom, watchdog, serial ports and more. As low as $59. The efficiency of a custom design without the headaches.

Z-World Engineering
1340 E. Covell Blvd., Davis, CA 95616
Tel: (916) 753-3722
Fax: (916) 753-5141

Circle 310 on Inquiry Card.

Little Giant™

New! Tiny Giant™

C Programmable Controllers

$159
(Tiny Giant Digital, qty. 1)

We have miniature controllers with parallel I/O, solenoid drivers, A/D and D/A converters, clock, watchdog, LCD interface, RS485 serial, built-in power supply and much more! Use them to control anything. Our $195 interactive Dynamic C™ development system makes software development easy. These units have high performance and serious software support. We also have design-your-own-board core modules as low as $59.

Z-World Engineering
1340 Covell Blvd., Davis, CA 95616 USA
(916) 753-3722
Regular Fax: (916) 753-5141
Automatic Fax: **(916) 753-0618**
(Call from your fax, hear computer voice, use touchtone dial to request desired data sheets.)

Circle 311 on Inquiry Card.

Workstations

External SCSI Drives

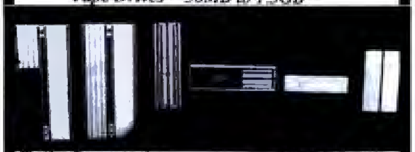
286/386/486, Macintosh, Silicon Graphics, Sun, IBM RS6000, VAX, NeXT....

Half Shell size 1.4"x5.5"x7.5" weight 2.5 lb
Hard Drives 20MB to 120MB

Hermit Crab size 2.8"x5.5"x7.5" weight 4 lb
with additional shock mount
Hard Drives 20MB to 120MB

A-Hive Jr size 2.2"x7.1"x7.1" weight 6 lb
Hard Drives 20MB to 400MB
Tape Drives 50MB to 600MB
Floppy Drives 720K to 3MB

A-Hive size 4.3"x9.6"x9.9" weight 11 lb
Hard Drives 20MB to 1GB
Cartridge Drive 44MB
Tape Drives 50MB to 1.3GB



Tulin Corporation
2156H O'Toole Ave., San Jose, CA 95131
Tel: 408-432-9025
Fax: 408-943-0782

Circle 282 on Inquiry Card.

H. Co. Computer Products

Your #1 Source For All P.C. Memory Upgrades

Call Toll Free 1-800-RAM-CHPS Ext. 202

FULL TECHNICAL SUPPORT ★ LIFETIME WARRANTY ON ALL MODULES
BUY DIRECT ★ BEST PRICES ★ BEST SERVICE

IBM

Part # EQ	Works With	
30F5348 (512K)	30-286	$ 46.00
30F5360 (2MB)	30-286	$ 145.00
6450375 (1MB)	80-041	$ 125.00
6450379 (2MB)	80-111, 311	$ 195.00
6451060 (4MB)	80-A21, A31, 111, 311	$ 509.00
6450603 (1MB)	502, 55SX, 70-E61, 70-121, P-70	$ 75.00
6450604 (2MB)	502, 55SX, 70-E61, 70-121, P-70	$ 139.00
6450608 (2MB)	70-A21, A61, B-21, B61	$ 152.00
78X8955 (128K)	25	$ 16.00
34F2933 (4MB)	55SX, 65SX	$ 349.00
6450605 (2–8MB)	All 70's and 80's (Board)	$ 409.00
6450609 (2–16MB)	50, 502, 55SX, 60, 65SX (Board)	$ 429.00
1039136 (1MB)	Laser Printer 4019, 4019e	$ 169.00
1039137 (2MB)	Laser Printer 4019, 4019e	$ 219.00
1038675 (3.5MB)	Laser Printer 4019, 4019e	$ 289.00

Call for Other IBM Upgrades

CALL US, for ALL your drive needs!

Teac 1.44/1.2

$69.00

COMPAQ

Model	Memory Added	Part # EQ	PRICE
DESKPRO 386/33-486/25	2MB MODULE	115144-001	$ 159.00
DESKPRO 386/20-25 286e	1MB MODULE	113131-001	$ 114.00
	4MB MODULE	113132-001	$ 280.00
DESKPRO 386/20e-25e	1MB BOARD	113644-001	$ 179.00
	4MB BOARD	113645-001	$ 479.00
	1MB MODULE	113131-001	$ 114.00
	4MB MODULE	113132-001	$ 280.00
DESKPRO 386s	1MB BOARD	113633-001	$ 179.00
	4MB BOARD	113634-001	$ 479.00
	1MB MODULE	113646-001	$ 120.00
	4MB MODULE	112534-001	$ 339.00
PORTABLE III	512K KIT	107331-001	$ 49.00
	2MB KIT	107332-001	$ 135.00
DESKPRO 386/16	1MB BOARD	108069-001	$ 325.00
	2MB BOARD	108069-W/71	$ 449.00
	4MB BOARD	108070-001	$ 669.00
	8MB BOARD	108072-001	$ 999.00
DESKPRO 386 PORTABLE	1MB KIT	107651-001	$ 229.00
	4MB BOARD	107653-001	$ 769.00
SLT/286	1MB MODULE	110235-001	$ 166.00
LTE/286	1MB BOARD	117081-001	$ 135.00
	2MB BOARD	117081-002	$ 185.00

Ask About Other Compaq Upgrades

Apple

Model	Memory Added	Part # EQ	PRICE
MACII, IIx; IIcx IIcx & SE/30	1MB KIT	MO218	$ 60.00
	2MB KIT	MO219	$ 115.00
	4MB KIT	MO2707	$ 225.00
	16MB KIT		$ 1199.00
MACIIci	4MB KIT	MO292LL-A	$ 225.00
	16MB KIT		$ 1199.00
MAC SE & PLUS	1MB KIT	MO218	$ 60.00
	2MB KIT	MO219	$ 115.00
	4MB KIT	MO2707	$ 225.00
MAC PORTABLE	1MB KIT	MO248	$ 249.00
	2MB KIT	N/A	$ 699.00
	3MB KIT	N/A	$ 699.00
	4MB KIT	N/A	$1199.00
MACIIfx	4MB KIT	M0376LL-A	$ 289.00
	16MB KIT	N/A	$1199.00
LASER WRITER II/NTX	1MB KIT	M6005	$ 65.00
	4MB KIT	M6006	$ 289.00

AST

Model	Memory Added	Part # EQ	PRICE
BRAVO/286	128K KIT	500510-011	$ 40.00
	512K KIT	500510-010	$ 55.00
	2MB KIT	500510-002	$ 150.00
	4MB KIT	500510-008	$ 300.00
PREMIUM/286 ADVANCED	512K KIT	500510-001	$ 55.00
	1MB KIT	500510-007	$ 100.00
	2MB KIT	500510-002	$ 150.00
	4MB KIT	500510-008	$ 300.00
FASTBOARD /386	1MB KIT	500510-007	$ 100.00
	4MB KIT	500510-008	$ 300.00
PREMIUM WKST/286	512K KIT	500510-010	$ 55.00
	2MB KIT	500510-002	$ 150.00
PREMIUM WKST 386/SX	512K KIT	500510-010	$ 55.00
	1MB KIT	500510-007	$ 100.00
	2MB KIT	500510-002	$ 150.00
	4MB KIT	500510-008	$ 300.00
PREMIUM 386/16	1MB KIT	500510-007	$ 100.00
	4MB KIT	500510-008	$ 300.00
PREMIUM 386	1MB KIT	500510-003	$ 140.00
	4MB KIT	500510-004	$ 320.00
PREMIUM 386c	1MB KIT	500510-007	$ 100.00
	4MB KIT	500510-008	$ 300.00
PREMIUM 386/25/16ex	1MB SIMM	500718-001	$ 69.00
PREMIUM 386/33	1MB SIMM	500718-002	$ 69.00

TOSHIBA

Model	Memory Added	Part # EQ	PRICE
Portable T1000SE & XE	1MB KIT	PC14-PA8311U	$ 199.00
	2MB KIT	PC14-PA8312U	$ 299.00
Portable T1200XE	2MB KIT	PC13-PA8306U	$ 175.00
Portable T1600	2MB KIT	PC-PA8302U	$ 175.00
Portable T3100c	512K KIT	PC-PA8340U	$ 135.00
	2MB KIT	PC-PA8341U	$ 175.00
Portable T3100SX	2MB KIT	PC15-PA8308U	$ 175.00
	4MB KIT	PC15-PA8310U	$ 459.00
Portable T3200sx	2MB KIT	PC-PA8307U	$ 175.00
Portable T3200	3MB KIT	PC-PA7137U	$ 329.00
Portable T5100	2MB KIT	PC-PA8301U	$ 175.00
Portable T5200	2MB KIT	PC-PA8304U	$ 175.00
DESKTOP T8500	2MB KIT	PC-PA8301U	$ 175.00

Ask About Other Toshiba Upgrades

Cyrix Math Co-Processor

Up to 200% Faster Than Intel Math Co-Processor
100% Compatible — 5 Year Warranty

Part #	PRICE	Part #	PRICE
83D87-16	Call	83D87-33	$ 469.00
83D87-20	$ 295.00	83D87SX-16	$ 259.00
83D87-25	$ 369.00	83D87SX-20	Call

NEC — Ask for other NEC upgrades

Model	Memory Added	Part # EQ	PRICE
Power Mate SX Plus	1MB Board	APC-H850E	$ 275.00
	2MB Board	N/A	$ 475.00
	4MB Board	APC-852E	$ 699.00
	8MB Board	N/A	$1325.00

HEWLETT PACKARD

Model	Memory Added	Part # EQ	PRICE
LASER JET II & IID	1MB MODULE	H33443B	$ 99.00
	2MB MODULE	H33444B	$ 149.00
	4MB MODULE	H33445B	$ 249.00
IIP & III	1MB MODULE	H33474B	$ 99.00
	2MB MODULE	H33475B	$ 149.00
	3MB MODULE	N/A	$ 199.00
	4MB MODULE	N/A	$ 249.00

STANDARD SIMMS / DRAM

STANDARD SIMMS Part#	PRICE	DRAM Part#	PRICE
256 X 8-12	$ 17.00	1 X 1-100	$ 5.50
256 X 8-10	$ 18.00	1 X 1-80	$ 5.75
256 X 8-80	$ 19.00	1 X 1-70	$ 6.25
256 X 9-12	$ 17.00	256-150	Call
256 X 9-10	$ 17.00	256-120	$ 1.85
256 X 9-80	$ 18.00	256-100	$ 1.90
256 X 9-70	$ 21.00	256-80	$ 2.00
256 X 9-60	$ 28.00	256-70	$ 2.30
1 X 8-10	$ 50.00	256-60	$ 3.00
1 X 8-80	$ 51.00	256 X 4-10	$ 5.75
1 X 8-70	$ 90.00	256 X 4-80	$ 6.00
1 X 9-10	$ 55.00	4464-10	$ 2.20
1 X 9-80	$ 56.00	4464-80	$ 2.40
1 X 9-70	$ 57.00	4164-15	$ 1.40
4 X 8-80	$ 289.00	4164-12	$ 1.85
4 X 9-80	$ 289.00	4164-10	$ 2.00

EPROM/CPU/SRAM/VRAM Also Available

intel / IIT Math Co-processors

intel Part #	PRICE
8087-3	Call
8087-2	Call
8087-1	Call
80287-6	Call
80287-8	Call
80287-10	Call
80287XL (12.5 MHz)	$ 229.00
80287XLT (12.5 MHz)	Call
80387-16	$ 305.00
80387SX-16	$ 290.00
80387SX-20	$ 315.00
80387-20	$ 350.00
80387-25	$ 450.00
80387-33	$ 550.00

IIT Part # EQ	PRICE
2C87-8	$ 175.00
2C87-10	$ 185.00
2C87-12	$ 215.00
2C87-20	$ 255.00
3C87-16	Call
3C87SX-16	Call
3C87-20	$ 325.00
3C87-25	$ 365.00
3C87-33	$ 465.00

We will meet or beat any advertised price.

We also carry memory upgrades for

ACER • AT&T • DELL • DTK • EPSON • ZENITH • EVEREX • HP Vectra • SAMSUNG • SUN • Canon Printer • SILICON GRAPHICS • WYSE • and other AT & XT clones

1228 Village Way, Unit D • Santa Ana, CA 92714 • (714) 542-8292 • FAX (714) 542-8648 • Hours 8:00 AM–5:00 PM PST

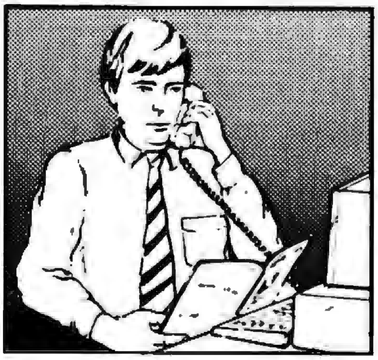
DEALER'S INQUIRIES WELCOME

Prices are subject to change

Circle 130 on Inquiry Card (RESELLERS: 131).

Buy with

Confidence



In an effort to make your telephone purchasing a more successful and pleasurable activity, The Microcomputer Marketing Council of the Direct Marketing Association, Inc. offers this advice, "A knowledgeable buyer will be a successful buyer." These are specific facts you should know about the prospective seller before placing an order:

Ask These Important Questions

- *How long has the company been in business?*
- *Does the company offer technical assistance?*
- *Is there a service facility?*
- *Are manufacturer's warranties handled through the company?*
- *Does the seller have formal return and refund policies?*
- *Is there an additional charge for use of credit cards?*
- *Are credit card charges held until time of shipment?*
- *What are shipping costs for items ordered?*

Reputable computer dealers will answer all these questions to your satisfaction. Don't settle for less when buying your computer hardware, software, peripherals and supplies.

Purchasing Guidelines

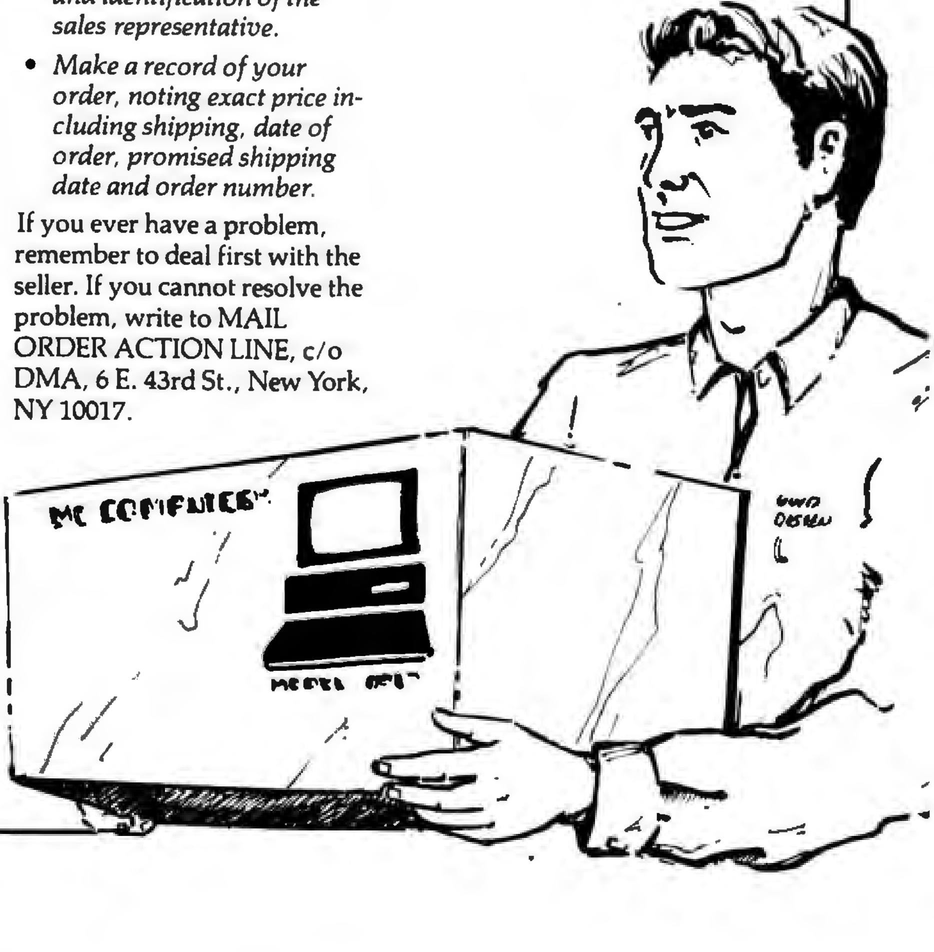
- *State as completely and accurately as you can what merchandise you want including brand name, model number, catalog number.*
- *Establish that the item is in stock and confirm shipping date.*
- *Confirm that the price is as advertised.*
- *Obtain an order number and identification of the sales representative.*
- *Make a record of your order, noting exact price including shipping, date of order, promised shipping date and order number.*

If you ever have a problem, remember to deal first with the seller. If you cannot resolve the problem, write to MAIL ORDER ACTION LINE, c/o DMA, 6 E. 43rd St., New York, NY 10017.

This message is brought to you by:

the MICROCOMPUTER MARKETING COUNCIL
of the Direct Marketing Association, Inc.
6 E. 43rd St.,
New York, NY 10017

MMC
MICROCOMPUTER MARKETING COUNCIL
of the Direct Marketing Association, Inc.



ARC TANGENT PROFESSIONAL MAIL $695

Complete Mailing List Management Software

The most advanced, professional-level mailing list management system available for IBM and compatible microcomputers. Save thousands of dollars on postage, printing, and processing costs.

- Unlimited number of names and addresses
- Sophisticated merge/purge duplicate detection
- Complete postal presorting and barcoding
- Custom letters, labels, reports
- Convert data from *dBase*, ASCII, other formats

Arc Tangent, Inc.
121 Gray Avenue
Santa Barbara, CA 93101-1831
(805) 965-7277

Circle 25 on Inquiry Card (RESELLERS: 26).

ROM BIOS UPGRADES

ROM BIOS FEATURES

THE ROM BIOS UPGRADES SUPPORT 360K, 720K, 1.2MB & 1.44MB FLOPPY DISK DRIVES, COMPLETE SET-UP IN ROM, EGA AND VGA SUPPORT, OPTIONAL BUILT-IN DIAGNOSTICS IN ROM (AMI ONLY), NOVELL AND NETWARE COMPATIBLE, SUPPORTS UP TO 48 DIFFERENT TYPES OF HARD DRIVES PLUS TWO USER DEFINED, 84, 101 & 102 KEY KEYBOARD SUPPORT, 100% IBM COMPATIBLE, SUPPORTS 0 1 OR 2 WAIT STATES, COMPLETE DOCUMENTATION, LATEST VERSIONS. WE ARE THE LARGEST STOCKING BIOS DISTRIBUTOR IN AMERICA!

XT BIOS UPGRADES

AMI-XT BIOS	49.95	PHOENIX-XT BIOS	49.95

AT 286 BIOS UPGRADES

AMI-286 INTEL BIOS	69.95	AMI-286 VLSI BIOS	69.95
AMI-286 CHIP & TECH BIOS	69.95	PHOENIX-286 INTEL BIOS	69.95
		PHOENIX-286 AST BIOS	69.95

AT 386 BIOS UPGRADES

AMI-386 INTEL BIOS	69.95	AWARD-386 CHIP & TECH BIOS	69.95
AMI-386 CHIP & TECH BIOS	69.95	PHOENIX-386 INTEL BIOS	69.95
AMI-386 VLSI BIOS	69.95	PHOENIX-386 COMPAQ BIOS	69.95
AMI-386-SX INTEL BIOS	69.95	PHOENIX-386 CHIP & TECH BIOS	69.95
AMI-386-SX CHIP & TECH BIOS	69.95	PHOENIX-386-SX INTEL BIOS	69.95
AWARD-386 INTEL BIOS	69.96		

IBM BIOS UPGRADES

PHOENIX-IBM-PC BIOS	79.95	PHOENIX-IBM-AT BIOS	89.95
PHOENIX-IBM-XT BIOS	59.95	AWARD IBM AT BIOS	89.95

KEYBOARD BIOS UPGRADES

AMI-286/386 KEYBOARD BIOS	34.95
AWARD-286/386 KEYBOARD BIOS	34.95
PHOENIX-286/386 KEYBOARD BIOS	34.95

UPGRADES ETC
(800) 541-1943

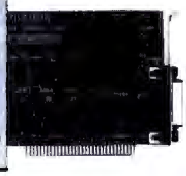
15822 N.E. 165TH ST
WOODINVILLE WA 98052
(800) 541-1943 ORDERS
(206) 882-3634 TECH SUPPORT
(206) 881-8294 FAX

VISA • MC • COD

Circle 286 on Inquiry Card.

Circle 53 on Inquiry Card.

LOW COST INTERFACE AND DATA ACQUISITION / CONTROL 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. sftwr.
- **High speed** version available (supports baud rates up to **256KB**) - **$165**

Dual-Port RS-485/422[PCL743] $175
- Two independent channels / UARTs; 2 or 4 wire operation. Max. Baud 56KB.
- Dipswitch configurable as COM1-4 (IRQ2-7). On board terminator resistor.

IEEE-488 Card[PC488A/C] $145/445
- Includes **DOS Device Driver** and sample Communication program in **BASIC**.
- Additional sample programs in C, **Pascal & Assembly - $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.
- I/O Addresses and Control Registers compatible with NI's **GPIB-PCII.**
- PC488C card version with Built-In Bus Analyzer hardware and software. (Allows Real Time 488 Bus Data Capture in background operation mode.)

Digital I/O & Counter [PCL720] $175
- 32 Digital Input and 32 Digital Output Channels, 3 channel programmable counter/timer. User configurable clock source. Bread board area.

144 Bit Digital I/O [PCL722] $345
- 144 lines (24 bits x 6 ports) of TTL compatible digital I/O. Output buffers sink 24mA, source 15mA. Interrupt handling capability.Opto-22 module compatible.

Relay & Isolated D/I [PCL725] $240
- 8 Relay actuator outputs; 8 Opto-isolated digital inputs. Relay driver circuits.
- LED indicators for activated relays. On board signal conditioning.

10 Channel Counter [PCL830] $345
- 10 Independent 16 bit up/down couunters. Programmable frequency output.
- 16 bit TTL input and 16 bit TTL output ports. Selectable interrupt channel.

6 Channel 12 bit D/A [PCL726] $495
- Output Ranges: 0 to +5V, 0 to +10V, ±5V, ±10V or sink 4-20mA.
- Settling time: 70μS. Linearity: ±1/2bit.Voltage output driving capacity: ±5mA
- **Digital I/O:** 16 digital inputs and 16 digital outputs; TTL compatible.

12 Bit A/D & D/A [PCL711s] $295
- **A/D converter:** 8 single-ended channels; Device: AD574; Conversion time less than 25μsec; Input range: ±5V; Software Trigger Mode only.
- **D/A converter:** 1 channel; 12 bit resolution; 0 to +5V/10V Output Range.
- **Digital I/O:** 16 Input / 16 Output channels; All I/Os TTL compatible.
- **External Wiring Terminal Board** with mounting accessories included.
- Utility Routines and Demo/Sample Programs for **BASIC** and **Quick-BASIC.**

12 Bit A/D & D/A [PCL812] $395
- **A/D converter:** 16 single ended inputs; Device : AD574; Conversion time less than 25 μsec; Built-in programmable pacer; **Input ranges:** ±10V, ±5V, ±1V.
- **D/A converter:** 2 channels ; 12 bit resolution.; Output Range 0-5V .
- **Digital I/O:** 16 Input / 16 Output channels; All I/Os TTL compatible.
- **Counter:** 1 channel programmable interval counter/timer; Uses Intel 8254.
- DMA and interrupt capability. Utility software for Basic included.

12 Bit w/ Pgm Gain [PCL812pg] $450
- **A/D converter:** 16 single ended inputs; Device:HAD574; Conversion time less than 25 μsec; Built-in programmable pacer;
- **Software Programmable Multiple Input Ranges:** ±10V, ±5V, ±2.5V, ±1.25V, ±0.625V, ±0.3125V.
- **D/A converter:** 2 channels ; 12 bit resolution.; Output Range 0-5V .
- **Digital I/O:** 16 Input / 16 Output channels; All I/Os TTL compatible.
- **Counter:** 1 channel programmable interval counter/timer; Uses Intel 8254.
- DMA and interrupt capability. Utility software for Basic included.

Fast 12 Bit A/D/A [PCL718] $785
- **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 **60,000 smpls/sec** (standard), **100,000 smpls/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 OUT, 16 IN; TTL compatible; All I/Os TTL compatible.
- **Counter:**16 bit progr. interval counter/timer; Uses Intel 8254; Pacer clock;
- **Software:** Utility software for BASIC and QuickBASIC included. Supported by LabDAS ($195/495), ASYST, LABTECH, UnkelScope

Fast 12 Bit w/ Pgm Gain [818] $875
- **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 100,000 samples per second.
- **Software Programmable 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 OUT, 16 IN; TTL compatible; All I/Os TTL compatible.
- **Counter:**16 bit progr. interval counter/timer; Uses Intel 8254; Pacer clock;
- **Software:** Utility software for BASIC and QuickBASIC included. Supported by LabDAS, ASYST, LABTECH, UnkelScope

Stepper Motor Card [PCL838] $395
- Capable of independent and simultaneous control of up to 3 **stepper motors.**
- **Programmable speed** from 1 to 10,000 pps; Steps per command 1 to 65535.
- **DIP switch selectable** I/O port base address and wait state.24 bit TTL I/O port.
- Crystal based timing; **All control signals opto-isolated.**

Circle 54 on Inquiry Card.

MC / VISA / AMEX

Call today for datasheets!

B&C MICROSYSTEMS INC.
750 N. PASTORIA AVE., SUNNYVALE, CA 94086 USA
TEL: (408)730-5511 FAX: (408)730-5521 BBS:(408)730-2317

PLD Design Software

Get Started with CUPL™ for only
$149.95

Now you can have a PLD Starter Kit that gives you all the horsepower that the CUPL PLD compiler offers, at a fraction of the cost. For more information, call 1-800-331-7766 or 305-974-0967.

LOGICAL DEVICES, INC.

Circle 159 on Inquiry Card (RESELLERS: 160).

Program Your Chips

In Sets of 4 for $495.00

Special offer Now Includes:
Free UV eraser, CUPL starter Kit and a $300.00 Factory Rebate with the PDT-1 EPROM, EPLD, Micro Progammer.

LOGICAL DEVICES, INC.
1-800-331-7766

Circle 161 on Inquiry Card (RESELLERS: 162).

DESIGN TOOLS
EISA & MICROCHANNEL BUS

EISA PROTO — Proto-Type Card for Eisa Bus	$35.00
EISA EXTENDER — Extender Card for Eisa Bus	$65.00
PROTO 16 — Proto-Type Card for 16-Bit Microchannel Bus Includes Video Signal	$35.00
PROTO 32 — Proto-Type Card for 32-Bit Microchannel Bus	$65.00
PROTO 16 WITH I/O — Proto-Type Card with POS and ID Decode Circuit For 16-Bit Microchannel Bus	$65.00
PROTO 32 WITH I/O — Proto-Type Card with POS and ID Decode Circuit For 32-Bit Microchannel Bus	$65.00
EXTENDER 16 — Extender Card for 16-Bit and Video Microchannel	$65.00
EXTENDER 32 — Extender Card for 32-Bit Microchannel Bus	$65.00
DESIGN DOCUMENT — Detail Document to Aid the Design of Microchannel Add-On Card and Diagnostic Software	$65.00

ams 1-800-972-3733

Advanced Microcomputer Systems, Inc.
1321 N.W. 65th Place, Fort Lauderdale, FL 33309
PHONE: 305-975-9515 • FAX: 305-975-9698

Circle 21 on Inquiry Card.

FREE CATALOG

RS-232C INTERFACE & MONITORING EQUIPMENT CATALOG

WRITE or CALL for YOUR *FREE* COMPREHENSIVE B & B ELECTRONICS CATALOG TODAY! Pages and pages of photographs and illustrated, descriptive text for B&B's complete line of RS-232 converters, RS-422 converters, current loop converters, adapters, break-out boxes, data switches, data splitters, short haul modems, surge protectors, and much, much more. Most products meet FCC Part 15J. Your RS-232 needs for quality, service and competitive prices will be more than met by B&B ELECTRONICS. **Manufacturer to you, no middleman!** Money-back guarantee! Same-day shipment! One-year warranty on products! Technical support is available.

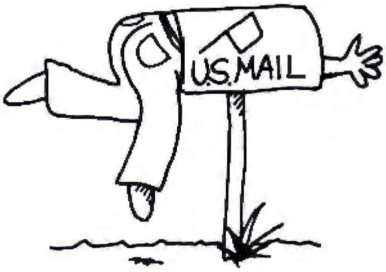
Order direct from manufacturer TODAY & SAVE!

Write For Your FREE Catalog Today!

B&B electronics MANUFACTURING COMPANY
4000 Baker Road P.O. Box 1040 • Ottawa, IL 61350
Phone: 815-434-0846

Circle 36 on Inquiry Card.

Subscription Problems?



We want to help!

If you have a problem with your BYTE subscription, write us with 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

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

READER SERVICE

* Correspond directly with company.

ALPHABETICAL INDEX TO ADVERTISERS

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.*

BYTE ADVERTISING SALES STAFF:

Steven M. Vito, Associate Publisher/V.P. of Marketing, One Phoenix Mill Lane, Peterborough, NH 03458, tel. (603) 924-9281
Arthur Kossack, Eastern Advertising Director, Two Prudential Plaza, 180 North Stetson Ave., Chicago, IL 60601, tel. (312) 616-3341
Jennifer L. Bartel, Western Advertising Director, 14850 Quorum Drive, Suite 380, Dallas, TX 75240, tel. (214) 701-8496
Liz Coyman, Inside Advertising Sales Director, One Phoenix Mill Lane, Peterborough, NH 03458, tel. (603) 924-2518

NEW ENGLAND
ME, NH, VT, MA, RI, CT, ONTARIO
CANADA & EASTERN CANADA
Dan Savage (617) 860-6344
Scott Gagnon (603) 924-2651
McGraw-Hill Publications
29 Hartwell Avenue
Lexington, MA 02173
FAX: (617) 860-6999

EAST COAST
NY, NYC, NJ, DE, PA
Kim Norris (212) 512-2645
Ariane Casey (212) 512-2368
Patricia Payne (603) 924-2654
McGraw-Hill Publications
1221 Avenue of the Americas—
28th Floor
New York, NY 10020
FAX: (212) 512-2075

SOUTHEAST
NC, SC, GA, FL, AL, TN, VA,
MS, AR, LA, DC, MD, WV, KY
John Y. Schilin (404) 843-4782
Patricia Payne (603) 924-2654
McGraw-Hill Publications
4170 Ashford-Dunwoody Road
Suite 520
Atlanta, GA 30319
FAX: (404) 252-4056

MIDWEST
IL, MO, KS, IA, ND, SD, MN,
WI, NE, IN, MI, OH
Kurt Kelley (312) 616-3328
MaryAnn Goulding (603) 924-2664
McGraw-Hill Publications
Two Prudential Plaza
180 North Stetson Ave.
Chicago, IL 60601
FAX: (312) 616-3370

SOUTHWEST,
ROCKY MOUNTAIN
CO, OK, TX,
Alison Keenan (214) 701-8496
Patricia Payne (603) 924-2654
McGraw-Hill Publications
14850 Quorum Drive
Suite 380
Dallas, TX 75240
FAX: (214) 991-6208

NORTH PACIFIC: San Francisco, CA
NORTHERN CA, OR, ID, MT,
WY, NORTHERN NV
Roy J. Kops (415) 954-9728
McGraw-Hill Publications
425 Battery Street
San Francisco, CA 94111
FAX: (415) 954-9786

NORTH PACIFIC: Campbell, CA
SILICON VALLEY, HI, WA, AK,
W. CANADA
Bill McAfee (408) 879-0381
Leslie Hupp (408) 879-0381
McGraw-Hill Publications
1999 South Bascom Ave.
Suite #210
Campbell, CA 95008
FAX: (408) 879-9067

SOUTH PACIFIC: Los Angeles, CA
LOS ANGELES COUNTY, AZ,
NM, SOUTHERN NEVADA
Alan El Faye (213) 480-5243
Jonathan Sawyer (603) 924-2665
McGraw-Hill Publications
3333 Wilshire Boulevard #407
Los Angeles, CA 90010
FAX: (213) 480-5249

SOUTH PACIFIC: Costa Mesa, CA
ORANGE COUNTY,
SAN DIEGO COUNTY, UT
Ron Cordek (714) 753-8140
Jonathan Sawyer (603) 924-2665
McGraw-Hill Publications
15635 Alton Parkway
Suite 290
Irvine, CA 92718
FAX: (714) 753-8147

BYTE BITS (2x3)
Mark Stone (603) 924-2695
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

The Buyer's Mart (1x2)
Brian Higgins (603) 924-3754
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

Regional Advertising
James Bail (603) 924-2533
Barry Echavarria (603) 924-2574
Larry Levine (603) 924-2637
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

BYTE Deck
Ed Ware (603) 924-2596
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

Catalog Showcase
BYTE International Direct
Response Postcards
Ellen Perham (603) 924-2598
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

Peterborough, NH Office
Inside Sales FAX: 603-924-2683
Advertising FAX: 603-924-7507

International Advertising Sales Staff:

Uwe Kretzschmar, European Advertising and Marketing Manager, BYTE Publications,
McGraw-Hill Publishing Co., Wimbledon Bridge House, One Hartfield Road, Wimbledon, London, SW19 3RU, England, Tel: 44 81 543 1234, Fax: 44 81 540 3833

GERMANY, SWITZERLAND,
AUSTRIA
Uwe Kretzschmar (44 81 545 6268)
UNITED KINGDOM
Roz Weyman (44 81 545 6269)
McGraw-Hill Publishing Co.
Wimbledon Bridge House
One Hartfield Road
Wimbledon, London SW19 3RU
England
Tel: 44 81 543 1234
FAX: 44 81 540 3833
TELEX: 892191

BENELUX
Ellen Pardede
Batenburg 103
3437 AB Nieuwegein
The Netherlands
Tel: 31 34 02 49496
FAX: 31 34 02 37944

FRANCE, ITALY
Zena Coupé, Amanda Blaskett
A-Z International Sales Ltd.
70 Chalk Farm Road
London NW1 8AN
England
Tel: 44 71 284 3171
FAX: 44 71 284 3174

ISRAEL
Dan Ehrlich
Ehrlich Communication International
P.O. Box 11297
Tel Aviv 61112
Israel
Tel: (972) 3 449823
FAX: (972) 3 5468168

JAPAN
Masaki Mori
McGraw-Hill Publishing Co.
Overseas Corp.
Room 1528
Kasumigaseki Bldg.
3-2-5 Kasumigaseki,
Chiyoda-Ku
Tokyo 100, Japan
Tel: 81 33 581 9811
FAX: 81 33 581 4018

SWEDEN
Media Marketing AB
Karlbergsvagen 89A
S-10031 Stockholm
Sweden
Tel: 46 8 301280

HONG KONG
Stephen Marcopoto
Seavex Ltd.
503 Wilson House
19-27 Wyndham St.
Central, Hong Kong
Tel: 852 868 2010
Telex: 60904 SEVEX HX
FAX: 852 810 1283

SINGAPORE
Jocelyn Domingo
Seavex Ltd.
400 Orchard Road, #10-01
Singapore 0923
Republic of Singapore
Tel: 65 734 9790
Telex: RS35539 SEAVEX
FAX: 65 732 5129

TAIWAN
Summer Chien
Tina Lai
Acer TWP Corp.
2 Fl., No. 19-1, Lane 231
Fu-Hsin North Road
Taipei, Taiwan R.O.C.
Tel: 886 2 713 6959
Fax: 886 2 715 1950

READER SERVICE

* Correspond directly with company.

INDEX TO ADVERTISERS BY PRODUCT CATEGORY

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.

REQUEST *FREE* PRODUCT INFORMATION BY FAX

Just fax this page to 1-413-637-4343. Your request for information will be processed *immediately!*

1 Circle the numbers on Inquiry Card below which match the inquiry numbers assigned to items of interest to you.

2 Check off the answers to questions "A" through "E".

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 primary job function/principal area of responsibility? (Check one.)
1 ☐ MIS/DP
2 ☐ Programmer/Systems Analyst
3 ☐ Administration/Management
4 ☐ Sales/Marketing
5 ☐ Engineer/Scientist
6 ☐ Other

B. What is your level of management responsibility?
7 ☐ Senior-level
8 ☐ Middle-level
9 ☐ Professional

C. Are you a reseller (VAR, VAD, Dealer, Consultant)?
10 ☐ Yes 11 ☐ No

D. What operating systems are you currently using? (Check all that apply.)
12 ☐ PC/MS-DOS
13 ☐ DOS + Windows
14 ☐ OS/2
15 ☐ UNIX
16 ☐ MacOS
17 ☐ VAX/VMS

E. For how many people do you *influence* the purchase of hardware or software?
18 ☐ 1–25
19 ☐ 26–50
20 ☐ 51–99
21 ☐ 100 or more

Inquiry Numbers 1-495

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

Inquiry Numbers 496-990

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

Inquiry Numbers 991-1479

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	1201	1202	1203	1204	1205	1206	1207	1208	1209	1210
1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	1221
1222	1223	1224	1225	1226	1227	1228	1229	1230	1231	1232
1233	1234	1235	1236	1237	1238	1239	1240	1241	1242	1243
1244	1245	1246	1247	1248	1249	1250	1251	1252	1253	1254
1255	1256	1257	1258	1259	1260	1261	1262	1263	1264	1265
1266	1267	1268	1269	1270	1271	1272	1273	1274	1275	1276
1277	1278	1279	1280	1281	1282	1283	1284	1285	1286	1287
1288	1289	1290	1291	1292	1293	1294	1295	1296	1297	1298
1299	1300	1301	1302	1303	1304	1305	1306	1307	1308	1309
1310	1311	1312	1313	1314	1315	1316	1317	1318	1319	1320
1321	1322	1323	1324	1325	1326	1327	1328	1329	1330	1331
1332	1333	1334	1335	1336	1337	1338	1339	1340	1341	1342
1343	1344	1345	1346	1347	1348	1349	1350	1351	1352	1353
1354	1355	1356	1357	1358	1359	1360	1361	1362	1363	1364
1365	1366	1367	1368	1369	1370	1371	1372	1373	1374	1375
1376	1377	1378	1379	1380	1381	1382	1383	1384	1385	1386
1387	1388	1389	1390	1391	1392	1393	1394	1395	1396	1397
1398	1399	1400	1401	1402	1403	1404	1405	1406	1407	1408
1409	1410	1411	1412	1413	1414	1415	1416	1417	1418	1419
1420	1421	1422	1423	1424	1425	1426	1427	1428	1429	1430
1431	1432	1433	1434	1435	1436	1437	1438	1439	1440	1441
1442	1443	1444	1445	1446	1447	1448	1449	1450	1451	1452
1453	1454	1455	1456	1457	1458	1459	1460	1461	1462	1463
1464	1465	1466	1467	1468	1469	1470	1471	1472	1473	1474
1475	1476	1477	1478	1479						

☐ *I subscribe to BYTE.* ☐ *I do not 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.*

JDR Microdevices®

ORDER TOLL-FREE 800-538-5000

BUY WITH CONFIDENCE FROM JDR!
- 30-DAY MONEY BACK GUARANTEE
- 1 YEAR WARRANTY
- TOLL-FREE TECH SUPPORT

INTEGRATED CIRCUITS

DYNAMIC RAMS

PART#	SIZE	SPEED	PINS	PRICE
4116-150	16384x1	150ns	16	1.49
4164-150	65536x1	150ns	16	2.49
4164-120	65536x1	120ns	16	2.89
4164-100	65536x1	100ns	16	3.39
TMS4464-12	65536x4	120ns	18	3.95
41256-150	262144x1	150ns	16	1.95
41256-120	262144x1	120ns	16	2.15
41256-100	262144x1	100ns	16	2.25
41256-80	262144x1	80ns	16	2.75
414256-100	262144x4	100ns	20	8.95
414256-80	262144x4	80ns	20	9.95
1MB-120	1048576x1	120ns	18	7.95
1MB-100	1048576x1	100ns	18	8.95
1MB-80	1048576x1	80ns	18	9.95
1MB-70	1048576x1	70ns	18	10.75
1MB-60	1048576x1	60ns	18	11.05

SIMM/SIP MODULES

PART#	SIZE	SPEED	FOR	PRICE
41256A9B-80	256K x 9	80ns	SIMM/PC	33.95
421000A8B-10	1MB x 8	100ns	SIMM/MAC	79.95
421000A9B-10	1MB x 9	100ns	SIMM/PC	79.95
421000A9B-80	1MB x 9	80ns	SIMM/PC	89.95
421000A9B-60	1MB x 9	60ns	SIMM/PC	99.95
256Kx9SIP-80	256K X 9	80ns	SIP/PC	33.95
256Kx9SIP-60	256K X 9	60ns	SIP/PC	38.95
1MBx9SIP-10	1MB x 9	100ns	SIP/PC	79.95
1MBx9SIP-80	1MB x 9	80ns	SIP/PC	89.95

MATH CO-PROCESSORS

intel

- *Manual*
- *Software guide*
- *5 Year Warranty*

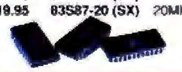
PART#	SPEED	PRICE
8087	5 MHz	89.95
8087-2	8 MHz	129.95
8087-1	10 MHz	169.95
80287-XL	12 MHz	199.95
80387-16	16 MHz	359.95
80387-20	20 MHz	399.95
80387-25	25 MHz	499.95
80387-33	33MHz	649.00
80387-SX	16 MHz	299.95
80387-SX20	20 MHz	399.95

CYRIX CO-PROCESSORS

STATE-OF-THE-ART TO SAVE YOU LONGEVITY WORRIES! MANUAL & SOFTWARE GUIDE, FULL 5-YEAR GUARANTEE!

83D87-16	16 MHz	$299.95	83D87-33	33MHz	$549.00
83D87-20	20 MHz	319.95	83S87-16 (SX)	16MHz	269.95
83D87-25	25MHz	419.95	83S87-20 (SX)	20MHz	329.95

EPROMS



PART#	SIZE	SPEED	Vpp	PINS	PRICE
2716-1	2048x8	350ns	25V	24	4.95
2732A	4096x8	250ns	21V	24	3.95
2764	8192x8	450ns	12.5V	28	3.95
2764-250	8192x8	250ns	12.5V	28	3.95
2764-200	8192x8	200ns	12.5V	28	4.49
27128	16384x8	250ns	12.5V	28	3.95
27128A-200	16384x8	200ns	12.5V	28	4.95
27256	32768x8	250ns	12.5V	28	4.95
27C256	32768x8	250ns	12.5V	28	5.95
27512	65536x8	250ns	12.5V	28	6.95
27C101-20	131072x8	200ns	12.5V	32	17.95

EPROM PROGRAMMER

$129.95

- PROGRAMS 27XX AND 27XXX EPROMS UP TO 27512 • SPLIT OR COMBINE CONTENTS OF DIFFERENT SIZED EPROMS (VARIOUS FORMATS AND VOLTAGES)
- READ, WRITE, COPY, BLANK CHECK AND VERIFY • HEX TO INTEL HEX CONVERSION SOFTWARE

MOD-EPROM

DATARASE II EPROM ERASER

$39.95

- SMALL SIZE! • ERASES ALL SIZE EPROMS UP TO 4 AT A TIME • WALL PLUG POWER SUPPLY

DATARASE II

LITHIUM BATTERIES

FOR 286/386
- WITH CONNECTOR
- VELCRO MOUNTING

$10.95

LITHIUM-6V

MORE AVAILABLE —CALL US!

MCT'S MODULAR PROGRAMMING SYSTEM

USE 1 SLOT TO PROGRAM EPROMS, PROMS, PALS & MORE!

HOST ADAPTOR CARD/CABLE $29.95

- UNIVERSAL INTERFACE FOR THE PROGRAMMING MODULES! • SELECTABLE ADDRESSES PREVENTS CONFLICTS

MOD-MAC

UNIVERSAL MODULE $499.95

- PROGRAMS EPROMS, EEPROMS, PALS, BI-POLAR PROMS, 8748 & 8751 SERIES DEVICES; 16V8 AND 20V8 GALS(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
- TEXTOOL SOCKET FOR .3" TO 6" WIDE I CS (8-40 PINS)

MOD-MUP $499.95
MOD-MUP-EA 4-UNIT ADAPTOR $99.95

EPROM MODULE $119.95

- PROGRAMS 24-32 PIN EPROMS, CMOS EPROMS & 16K TO 1024K EEPROMS • HEX TO OBJ CONVERTER • AUTO, BLANK CHECK/PROGRAM/VERIFY • VPP 5, 12.5, 12.75, 13, 21 & 25 VOLTS • NORMAL, INTELLIGENT, INTERACTIVE & QUICK PULSE PROGRAMMING ALGORITHMS

MOD-MEP $119.95
MOD-MEP-4 4-EPROM PROGRAMMER $169.95
MOD-MEP-8 8-EPROM PROGRAMMER $259.95
MOD-MEP-16 16-EPROM PROGRAMMER $499.95

PAL MODULE $249.95

- PROGRAMS MMI, NS, TI 20 & TI 24 PIN DEVICES • BLANK CHECK, PROGRAM, AUTO, READ MASTER VERIFY AND SECURITY FUSE BLOW

MOD-MPL

PAL DEVELOPMENT SOFTWARE $99.95

ENTRY LEVEL PAL DEVELOPMENT KIT FROM CUPL

MOD-MPL-SOFT

OTHER PROGRAMMING MODULES...

MOD-MMP	MICROPROCESSOR PROGRAMMER	179.95
MOD-MIC	DIGITAL IC & MEMORY TESTER	129.95
MOD-MBP	BI-POLAR PROM PROGRAMMER	259.95

MOLDED CABLES

100% SHIELDED

- 6, 12 OR 25' PRINTER CABLES
- DB-25 TO 36-PIN CENTRONICS

CBL-PRINTER 6 FT CABLE $9.95
CBL-PRNTR-12 12 FT CABLE $12.95
CBL-PRNTR-25 25 FT. CABLE $15.95

CBL-PRNTR-RA	RIGHT ANGLE PRINTER CABLE	$15.95
CBL-DB25-MM	DB25 MALE-DB25 MALE 6 FT.	$9.95
CBL-DB25-MF	DB25 MALE-DB25 FEMALE 6 FT.	$9.95
CBL-9-SERIAL	DB9 FEMALE-DB25 MALE 6 FT.	$6.95
CBL-CNT-MM	36-PIN CENTRONICS-M/M	$14.95
CBL-KBD-EXT	KEYBOARD EXTENSION	$7.95
CBL-MNT-9	9-PIN MONITOR EXTENSION	$6.95

MANY MORE AVAILABLE —CALL US!

SLIM GENDER CHANGERS

GEN-25MM	DB25 MALE/MALE	$4.49
GEN-25FF	DB25 FEMALE/FEMALE	$4.49
GEN-9MM	DB9 MALE/MALE	$3.95
GEN-9FF	DB9 FEMALE/FEMALE	$3.95
GENDER-VGA	DB9-HIGH DENSITY DB15 ADAPTOR	$4.95
GENDER-9-25	DB9 TO DB25 SERIAL ADAPTOR	$4.95
GENDER-NM	NULL MODEM ADAPTOR DB25P-DP25S	$4.95

MANY MORE AVAILABLE —CALL US!

BREAKOUT BOXES

RS-232 BOX W/24 SWITCHES, 12 LINE MONITORS • 10 BI-POLAR LEDS; JUMPER WIRES

BRBOX-BO $34.95

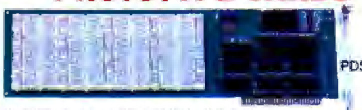
DATA SWITCHBOXES

RSS-2	2-WAY DB25S	$24.95
RSS-3	3-WAY DB25S	$27.95
RSS-4	4-WAY DB25S	$29.95
RSS-X	SERIAL CROSSOVER	$29.95
RSP-2	2-WAY FEMALE CEN36	$24.95
RSP-3	3-WAY FEMALE CEN36	$27.95
RSP-4	4-WAY FEMALE CEN36	$29.95
RS9-2	2-WAY DB9S	$24.95
RS9-4	4-WAY DB9S	$29.95
RSP-X	PARALLEL CROSSOVER	$29.95

LET TWO OR MORE PC'S USE SAME DEVICE OR VICE-VERSA

MANY MORE AVAILABLE —CALL US!

PROTOTYPE CARDS



PDS-601

8-BIT SOLDERLESS 8088 BREADBOARD WITH DECODE $79.95

- ADDRESS DECODING LOGIC, DATA BUFFERING, 2 LSI CIRCUITS FOR PROGRAMMABLE DIGITAL I/O & COUNTER-TIMER FUNCTIONS • LOGICALLY GROUPED • ACCESSES ALL 62 I/O SIGNAL CONNECTIONS • CLEARLY LABELLED BUS LINES
- ACCEPTS UP TO 24 FOURTEEN-PIN ICS ACCEPTS 9, 15, 25 OR 37-PIN D-SUB CONNECTORS

PDS-601 .... $79.95
PDS-600 ABOVE CARD WITHOUT DECODE $49.95
PDS-611 16-BIT BUS BREADBOARD WITH DECODE . $89.95
PDS-610 ABOVE CARD WITHOUT DECODE $59.95

JDR-PR2

MORE PROTOTYPE CARDS:

FR-4 EPOXY GLASS LAMINATE WITH GOLD-PLATED EDGE-CARDFINGERS AND SILK-SCREENED LEGENDS

JDR-PR1	8-BIT WITH +5V AND GROUND PLANE	$27.95
JDR-PR2	AS ABOVE, WITH I/O DECODING LAYOUT	$29.95
JDR-PR2-PK	PR2 BUFFERING/DECODE PARTS KIT	$8.95
JDR-PR10	16-BIT WITH I/O DECODING LAYOUT	$34.95
JDR-PR10-PK	PR10 BUFFERING/DECODE PARTS	$12.95
JDR-PR16	16-BIT WITH I/O DECODING FOR PS/2	$49.95
JDR-PR16PK	PR16 PARTS KIT	$15.95
EXT-8088	8088-COMPATIBLE EXTENDER CARD	$29.95
EXT-80286	286-COMPATIBLE EXTENDER CARD	$39.95

PCODE DIAGNOSES SYSTEM PROBLEMS! $49.95

TO DIAGNOSE, PLUG IT INTO A CARD SLOT, READ THE DISPLAY & CHECK THE MANUAL FOR THE POWER-ON SELF-TEST CODE. SWITCHLESS AND JUMPERLESS DESIGN. COMPAT W/80286 & 80386-BASED SYSTEMS.

PCODE $49.95
PCODE+ W/QA PLUS VER.3.12 $69.95

Derick's HIGH-TECH SPOTLIGHT

Many times I am asked the question, "Should I buy a 286, 386SX or 386DX based motherboard?" To partially answer that question, refer to this matrix:

	80286	80386SX	80386DS
RUNS EXISTING 8088 SOFTWARE	YES	YES	YES
RUNS EXISTING 80286 SOFTWARE	YES	YES	YES
RUNS 80386 SPECIFIC SOFTWARE (1)	NO	YES	YES
RUNS EXISTING 8-BIT HARDWARE (2)	YES	YES	YES
RUNS EXISTING 16-BIT HARDWARE	YES	YES	YES
RUNS RUNS 32-BIT MEMORY HARDW.	YES	YES	YES

No provision has been made for comparing speed of execution for the three processors. Existing benchmarks usually run 8088 code which is unfair to the 286 and 386 based boards. Even 80286 code will penalize an 80386 processor because it fails to take advantage of its expanded capabilities.

When upgrading from an 8088-based computer, be aware of of the following: 1) You will probably need a new keyboard. 2) Most of your hardware will work in a new motherboard with the exception of some serial ports (which can usually be upgraded to work). 3) If you move an existing 8088-based hard disk controller to a 80286 or greater machine, you should tell the set-up routine that no hard drives exist.

DERICK MOORE, DIRECTOR OF ENGINEERING

(1) 80386 software includes specific versions of Unix, Xenix, Network operating software, OS/2, Windows, DesqView, and many high-end scientific solutions including CAD/CAM/CAE.
(2) Some 8-bit hardware won't operate at higher bus speeds.

JDR Microdevices®

2233 BRANHAM LANE, SAN JOSE CA 95124

BUY WITH CONFIDENCE FROM JDR!
- 30-DAY MONEY BACK GUARANTEE
- 1 YEAR WARRANTY
- TOLL-FREE TECH SUPPORT

UPRIGHT CASE $249.95

- FOR STANDARD, FULL SIZE AND MINI-MOTHERBOARDS
- 250WATT POWER SUPPLY
- MOUNTS FOR 3 FLOPPY AND 4 HARD DRIVES
- TURBO AND RESET SWITCHES
- SPEED DISPLAY, POWER, DISK LEDS
- MOUNTING HARDWARE, FACEPLATES AND SPEAKER INCL.

CASE-100 .... $249.95

MORE CASES...

CASE-200 UPRIGHT HOLDS 11 DRIVES $499.95
CASE-120 MINI-UPRIGHT W/200 WATT PS $199.95
CASE-70 FULL SIZE 286 STYLE CASE $89.95
CASE-50 MINI-SIZE 286 STYLE CASE $59.95
CASE-FLIP FLIP-TOP XT-STYLE CASE $39.95
CASE-SLIDE SLIDE TYPE XT-STYLE CASE $39.95
CASE-JR MINI SIZE CASE WITH 150W PS $149.95
CASE-JR-200 MINI SIZE CASE WITH 200W PS $189.95

REMOVABLE HARD DISK RACK $69.95

- FIXED RACK MOUNTS IN STD. 5.25" DRIVE SLOT
- REMOVABLE TRAY FITS STD. 3.5" DRIVE FOR ST-506 INTERFACE HARD DRIVES
- CABLES & CONNECTORS

MOBRK-3.5 .... $69.95

$99.95 1.44MB 3-1/2" DRIVE

- 80 TRACKS • 135 TPI • HIGH DENSITY
- READ/WRITE 720K DISKS, TOO
- INCLUDES ALL NECESSARY MOUNTING HARDWARE

FDD-1.44X BLACK FACEPLATE $99.95
FDD-1.44A BEIGE FACEPLATE $99.95
FDD-1.44SOFT SOFTWARE DRIVER $19.95
MF355A 3-1/2" MITSUBISHI 1.44MB, BEIGE $129.95
MF355X 3-1/2" MITSUBISHI 1.44MB, BLACK $129.95
FDD-360 5-1/4" DOUBLE-SIDED DD 360K $69.95
FD-55B 5-1/4" TEAC DOUBLE-SIDED DD 360K $89.95
FDD-1.2 5-1/4" DOUBLE-SIDED HD 1.2M $89.95
FD-55GFV 5-1/4" TEAC DOUBLE-SIDED HD 1.2M $99.95

POWER SUPPLIES

135 WATT FOR 8088 $59.95

PS-135 135 WATT FOR 8088 .... $59.95
PS-150 150 WATT FOR 8088 .... $69.95
PS-200X 200 WATT FOR 8088 .... $89.95
PS-200 200 WATT FOR 286/386 .... $89.95
PS-250 250 WATT FOR 286/386 .... $129.95

"Thanks again for the high quality your company provides."
—D.DuBois, San Jose, CA

Seagate HARD DRIVE KITS

20 MB $249 30 MB $279

KITS INCLUDE HARD DRIVE, DRIVE CONTROLLER, CABLES & MANUAL

Seagate HARD DRIVES

21 MB $199 · 65 MB $349
32 MB $219 · 84 MB $449
42 MB $299 · 122 MB $699

FORM	MODEL #	STORAGE	FORMAT	AVG. SPEED	PRICE
5-1/4"	ST-225N	21.3MB	SCSI	65MS	$279
5-1/4"	ST-225	21.4MB	MFM	65MS	$199
3-1/2"	ST-125	21.4MB	MFM	40MS	$259
3-1/2"	ST-125A	21.4MB	IDE	28MS	$259
3-1/2"	ST-125N	21.4MB	SCSI	40MS	$299
3-1/2"	ST-138	32.1MB	MFM	40MS	$269
3-1/2"	ST-138R	32.1MB	RLL	40MS	$289
3-1/2"	ST-138A	32.1MB	IDE	28MS	$269
3-1/2"	ST-138N	32.1MB	SCSI	40MS	$299
5-1/4"	ST-238	32.7MB	RLL	65MS	$219
5-1/4"	ST-251N	42.8MB	SCSI	40MS	$399
5-1/4"	ST-251-1	43.1MB	MFM	28MS	$299
3-1/2"	ST-157A	48.6MB	IDE	28MS	$299
3-1/2"	ST-157N	48.6MB	SCSI	40MS	$359
5-1/4"	ST-277N-1	64.9MB	SCSI	28MS	$439
5-1/4"	ST-277-1	65.5MB	RLL	28MS	$349
5-1/4"	ST-4096	80.2MB	MFM	28MS	$569
5-1/4"	ST-296N	84.9MB	SCSI	28MS	$449
5-1/4"	ST-4144R	122.7MB	RLL	28MS	$699
3-1/2"	ST-1144A	125MB	IDE	19MS	$649
3-1/2"	ST-1201A	180MB	IDE	15MS	$799

MICROPOLIS DRIVES

161 MB $899

- HALF-HEIGHT 5-1/4" HARD DRIVES • 14-16 MS AVG. ACCESS TIMES • 10MB/S TRANSFER RATE

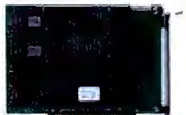
*FULL HT. DRIVE

FORMAT CAPACITY	MODEL	AVE. SPEED	INTER-FACE	PRICE
161MB	1654	16MS	ESDI	$899
158MB	1674	16MS	SCSI	$949
345MB	1664	14MS	ESDI	$1449
340MB	1684	14MS	SCSI	$1449
676MB	1568*	16MS	ESDI	$2195
668MB	1588*	16MS	SCSI	$2195
1,034MB	1598*	14MS	SCSI	$3995

MODULAR CIRCUIT TECHNOLOGY INTERFACE CARDS

DRIVE CONTROLLERS

1.44MB FLOPPY $49.95



- 8088/286 COMPATIBLE
- SUPPORTS 2 FLOPPIES (360K, 720K, 1.2MB & 1.44MB)
- USER SELECT AS PRIMARY OR 2ND (3RD OR 4TH) FLOPPY

MCT-FDC-HD $49.95

HIGH DENSITY 4-FLOPPY CARD $59.95
- INTERFACES UP TO 4 FLOPPY DRIVES • CABLES FOR 4 INTERNAL DRIVES • BIOS FOR ANY COMBO OF DRIVES

MCT-FDC-HD4

FLOPPY DISK CONTROLLER $29.95
- INTERFACES UP TO FOUR 360K/720K FLOPPY DRIVES
- DB37 CONNECTOR FOR EXTERNAL DRIVES

MCT-FDC

HARD DISK CONTROLLER $79.95
- SUPPORTS 16 DRIVE SIZES INCLUDING 10, 20, 30 AND 40MB • CAN DIVIDE 1 LARGE DRIVE INTO 2 LOGICAL DRIVES

MCT-HDC
MCT-RLL RLL CARD SUPPORTS 2 RLL DRIVES $89.95

16-BIT FLOPPY/HARD $149.95
- 1:1 INTERLEAVE FOR IMPROVED PERFORMANCE
- CONTROLS 2 HARD & 2 FLOPPY DRIVES (360K/720K/1.2MB/1.44MB) • CONCURRENTLY USE HARD AND FLOPPY DRIVES

MCT-FAFH
MCT-AFH-RLL 16-BIT F/H RLL CONTROLLER $199.95

16-BIT IDE MULTI-IO $89.95
- SUPPORTS 2 IDE HARD DRIVES & 2 FLOPPIES • 2 SERIAL & 1 PARALLEL PORT • SUPPORTS COM 1 & 2, LPT 1, 2 OR 3

MCT-IDEIO

MULTIFUNCTION I/O CARDS

MULTI I/O CARD $59.95
- SERIAL PORT • CLOCK/CALENDAR WITH BATTERY
- PARALLEL PORT IS ADDRESSABLE AS LPT1 OR LPT2

MCT-IO

MULTI I/O FLOPPY $79.95
- SUPPORTS UP TO 2 360K FLOPPIES
- SERIAL, PARALLEL, GAME PORT AND CLOCK/CALENDAR

MCT-MIO

16-BIT MULTI I/O CARD $59.95
- SERIAL, PARALLEL AND GAME PORTS • USES 16450 SERIAL SUPPORT CHIPS FOR HIGH SPEED OPERATION

MCT-AIO

16-BIT ALL-IN-ONE-CARD $129.95
- MONOCHROME GRAPHICS • SUPPORTS 2 IDE HARD DRIVES AND 2 FLOPPIES • 2 SERIAL AND 1 PARALLEL PORT

MCT-MGEIO

MEMORY CARDS

576K RAM CARD $49.95
- USER SELECTABLE CONFIGURATION TO 576K • USES 64K AND 256K DRAMS (ØK INSTALLED)

MCT-RAM

16-BIT EMS CARD $129.95
- USER EXPANDABLE TO 2MB USING 1MB DRAMS • CONFORMS FULLY TO LIM EMS 3.2 • RAM DISK SOFTWARE

MCT-AEMS $129.95
MCT-AEMS-256 USES 41256 DRAMS $129.95
MCT-EMS 8-BIT EMS CARD 2MB CAPACITY $129.95

16-BIT EEMS CARD $149.95
- EXPANDABLE TO 4MB USING 256K X 4 DRAMS IN INCREMENTS OF 512K • CONFORMS TO LIM 4.0

MCT-EEMS

DISPLAY CARDS

MONO GRAPHICS/PRINTER $49.95
8088 OR 286/386/486 COMPATIBLE • HERCULES COMPATIBLE MONOGRAPHICS • SUPPORTS LOTUS 1-2-3 • 720 X 348 DISPLAY • ADDRESS PARALLEL PRINTER PORT AS LPT1 OR 2

MCT-MGP
MCT-CGP CGA GRAPHICS FOR RGB MONITOR $49.95
MCT-EGA EGA CARD WITH 256K RAM $149.95

8/16-BIT VGA $149.95
- 8088 OR 286/386/486 PC COMPATIBLE • 800 X 600 IN 16 COLORS • 256K VIDEO RAM • SUPPORTS ANALOG AND TTL

MCT-VGA
MCT-VGA-8 8-BIT VERSION $149.95
MCT-VGA-1024 1024 X 768 VGA $169.95
MCT-VGA-1024+ 1024 X 768 IN 256 COLORS $199.95

BARGAIN HUNTER'S CORNER

EEMS CARD $129
- 16-BIT 286/386/486 PC-COMPATIBLE CARD
- TRUE EEM (ENHANCED EXPANDED MEMORY)
- COMPATIBLE WITH CONVENTIONAL EXPANDED & EXTENDED MEMORY
- EXPANDS UP TO 4MB IN INCREMENTS OF 512K (ØKB INSTALLED) • BACKFILL CONVENTIONAL MEMORY
- INCLUDES SOFTWARE DRIVERS • COMPATIBLE WITH EMS 4.0 INCLUDING MULTI-TASKING OPERATIONS

MCT-EEMS $129.95
MCT-EEMS-2 CARD WITH 2MB MEMORY $259.95
MCT-EEMS-4 CARD WITH 4MB MEMORY $379.95

EXPIRES 4/30/91

CUSTOMER SERVICE 800-538-5001
TECHNICAL SUPPORT 800-538-5002
LOCAL/INTERNATIONAL 408-559-1200
FAX 408-559-0250

MON.-FRI. 7 A.M. TO 5 P.M., SATURDAY, 9 A.M. TO 3 P.M.

ORDER TOLL-FREE 800-538-5000

Circle 6 on Inquiry Card (RESELLERS: 7).

continued from page 314

Listing 5: *A code fragment that shows how to locate the video parameter block for a display board.*

```
#define VIDEO_TYPE                1        /* videoType */
#define CATEGORY_DISPLAY          3        /* displayCat */
#define APPLE_FIRMWARE_FORMAT     1
#define IGNORE_HARDWARE        0x01        /* Mask to exclude hardware in sResource search */
#define FIRST_VIDEO_MODE        128        /* First video mode ID in sResource list */
#define VIDEO_MODE_PARAMS         1        /* ID of video mode block */

int             devRefNum;                 /* Driver ref. number for video board's slot */
OSErr           error;
short           i;
SpBlock         SlotBlock;                 /* Our slot parameter block */
SpBlockPtr      SlotBlkPtr;                /* The pointer to our block */
int             theseDepths[6];
long            theseModes[6];
AuxDCEHandle    thisDeviceDCE;             /* Device Control Entry (DCE) table for this slot */
int             thisMode;
Ptr             videoModeListPtr;

error = 0;                                     /* Will go nonzero when done */
devRefNum = (**thisGDevice).gdRefNum;                   /* Get screen's device ref. number */
thisDeviceDCE = (AuxDCEHandle) GetDCtlEntry(devRefNum); /* Get device's auxilliary */
                                                        /*   control table */
SlotBlkPtr = &SlotBlock;                           /* Point to our local SpBlock */
SlotBlock.spSlot = (**thisDeviceDCE).dCtlSlot;     /* Fetch slot number from DCE */
SlotBlock.spExtDev = (**thisDeviceDCE).dCtlExtDev; /* ... and its external number */
SlotBlkPtr = &SlotBlock;                           /* Point to our local SpBlock */
SlotBlock.spID = 0;                            /* IMPORTANT: Clear resource ID */
SlotBlock.spCType = VIDEO_TYPE;                /* Set the board type we want */
SlotBlock.spCategory = CATEGORY_DISPLAY;       /* ...Now its category */
SlotBlock.spDrvrSW = APPLE_FIRMWARE_FORMAT;    /* We can only deal with this format */
SlotBlock.spTBMask = IGNORE_HARDWARE;          /* Don't care whose video board it is */
error = SNextTypesRsrc(SlotBlkPtr);            /* Look for video sResource */
if (!error)
  {
  videoModeListPtr = SlotBlock.spsPointer;
  thisMode =  FIRST_VIDEO_MODE;                /* Video mode sResources start at ID 128 */
  while (!error)                               /* Loop until we get all video modes */
    {
    SlotBlkPtr = &SlotBlock;                   /* Point to our local SpBlock */
    SlotBlock.spID = thisMode;                 /* Plug in new mode sResource ID */
    SlotBlock.spsPointer = videoModeListPtr;
    error = SFindStruct(SlotBlkPtr);           /* Get pointer to video mode sResource */
    if (!error)
      {
      SlotBlkPtr = &SlotBlock;                 /* Point to our local SpBlock */
      SlotBlock.spID = VIDEO_MODE_PARAMS;      /* Want parameter list for this mode */
      error = SGetBlock(SlotBlkPtr);           /* Copy the data to where we can use it */
      if (!error)
        {
        theseModes[i] = thisMode;              /* Save modes board supports in array */
        theseDepths[i] = (*(VPBlock *) SlotBlock.spResult).vpPixelSize; /* same for depths */
        DisposPtr((Ptr) SlotBlock.spResult);   /* Throw away the copy */
        i++ ;                                  /* Bump array index */
        } /* end if !error */
      } /* end if !error */
    thisMode++ ;                               /* Look for next video mode */
    } /* end while !error */
  } /* end if !error */
```

the data structures and Slot Manager calls I'll use. One potential problem is that to use the Slot Manager calls, I must first supply a slot number. The solution is to use the GDevice's driver reference number. I use this value with a Device Manager call to fetch the driver's device tables. (The Device Manager is a set of routines that handle the Mac's device I/O.) For a driver handling an expansion board, this device table provides the board's slot number.

Listing 5 is a code fragment that shows exactly how it's done. I start by using the board's video sResource to find its mode list. Since the mode list IDs start at 128 and ascend in order, a loop walks me through this list. For each mode entry I find, I make a temporary copy of its video parameter block to get the mode's pixel depth. I dispose of the temporary copy and search for the next mode by incrementing the mode ID number. Once I run out of parameter blocks, the Slot Manager reports an error, and I exit the loop. I stuff the mode IDs into an array for later use.

Controlling the Board

Now that I have the mode information in hand, I'm (at last!) ready to put it to use. But I've got one more pipe to duck before I'm done. I need to change the mode. Apple defined a specific set of Device Manager calls that the display board has to respond to—and in precise ways. This lets the Mac not care what's in the board driver it installs, yet at the same time QuickDraw and other software have consistent control functions available to it. I've summarized these Device Manager calls in the table.

QuickDraw itself doesn't use device I/O calls to draw to the display. Instead, for performance, it uses a pointer to write directly to the board's frame buffer. This pointer is provided to QuickDraw by the board's driver (see the table). If this seems a bit un-Mac-like, remember that Mac applications always use QuickDraw to write to the screen. QuickDraw handles getting the application's pixels into a frame buffer, whether it's located in RAM on the Mac IIci, VRAM on the Mac LC's main logic board, or VRAM on a NuBus board inside a Mac IIfx. QuickDraw uses the device I/O calls in the table when it changes the display's color tables or changes the display's mode at boot-up time.

Having said that, you'll be surprised to find that I won't make the device I/O calls myself to change the screen depth. Instead, I let `InitGDevice()` do that by calling it with the corresponding mode value. Changing a display from colors to grays or vice versa requires that you use `SetDeviceAttribute()` on the `GDevice` while setting the appropriate flag.

I wrote both an application and an FKEY to change a monitor's screen depth. The application presents a dialog box showing the depths supported by the board. Clicking on a different screen depth has the application call `InitGDevice()`, using the appropriate value from the mode array. The code has worked reliably with every display board that I've used so far, including boards from RasterOps, Radius, and SuperMac Technology, and it works with A/UX 2.0 and an early beta version of System 7.0. The source for the application is available in electronic format (see page 5) as DEPTH.SIT, a StuffIt archive file.

There's enough information here to get you started on examining the secrets of other expansion boards in your Mac. I recommend Jasik Designs' Debugger V2, an industrial-strength debugger for the Mac, when you're working with the Mac at this level of detail. At $350, it isn't cheap, but its multiwindow display for examining data structures and disassembling code will pay for itself by the time it saves you on debugging jobs.

Interestingly, since I started this project, Apple has introduced two new calls, `HasDepth()` and `SetDepth()`, which are described in Tech Note #276. These two calls let you easily obtain a board's various modes and change the mode without going through the Slot Manager. These two new calls are available in System 6.0.5 or higher.

DEVICE MANAGER CALLS

Device Manager control and status calls as defined by Apple for display boards. Not all the calls are shown.

Codes for PBControl()

0	The board is reset to its initial state: the default pixel depth (1 bit per pixel). The video RAM's base address is returned to the caller.
1	All current and pending I/O requests are killed.
2	For a video mode ID provided by the caller, the board changes to the corresponding display mode (pixel depth).
3	For an indexed color board, its color lookup tables (CLUTs) are changed to those provided by the caller. This has no effect on direct (24-bit) boards.
6	For an indexed color board, the CLUT maps either to actual colors or to gray values, as determined by a mode value sent by the caller. A mode value of 0 maps the display to colors; a value of 1 maps to grays. This has no effect on direct boards.

Codes for PBStatus()

2	The board returns the current video mode.
3	The board returns the board's CLUT to the caller.
4	The board returns the video pages available in this mode.
5	The board returns the base address of the video page supplied by the caller.
6	The board returns a 0 if operating in color and a 1 if using gray scales.

Toward a Virtual Machine

As you can see, I learned a lot about how the Mac makes plug-and-play installation of display boards possible. The Mac's basement is remarkably well organized: Applications are able to examine and access expansion-board features by using high-level Slot Manager calls. Even something as hardware-dependent as display board I/O can be handled through the Toolbox's Device Manager calls. In those instances where an application might have to directly access the board, the address can usually be obtained through the Device Manager.

Any Mac application that uses the Mac OS exclusively should run on any Mac, regardless of its hardware configuration. That's because you let the Mac OS worry about how and where it directs your I/O. This way, your application should operate across the entire Mac product line, including future Macs. The best example proving this concept of good application design is Consulair's Edit. Although written in 1986 (the Mac Plus era), it runs on the Mac Classic, IIsi, and LC without problems today.

This embodies the concept of a virtual machine: a computer whose hardware details are hidden from view and that you deal with only through well-defined operating-system calls. This virtual machine concept makes a move to a future RISC-based Mac possible. If the Mac Toolbox is fully implemented in RISC code, porting a Mac application to the new processor would be simply a matter of recompiling the application using a RISC compiler. ■

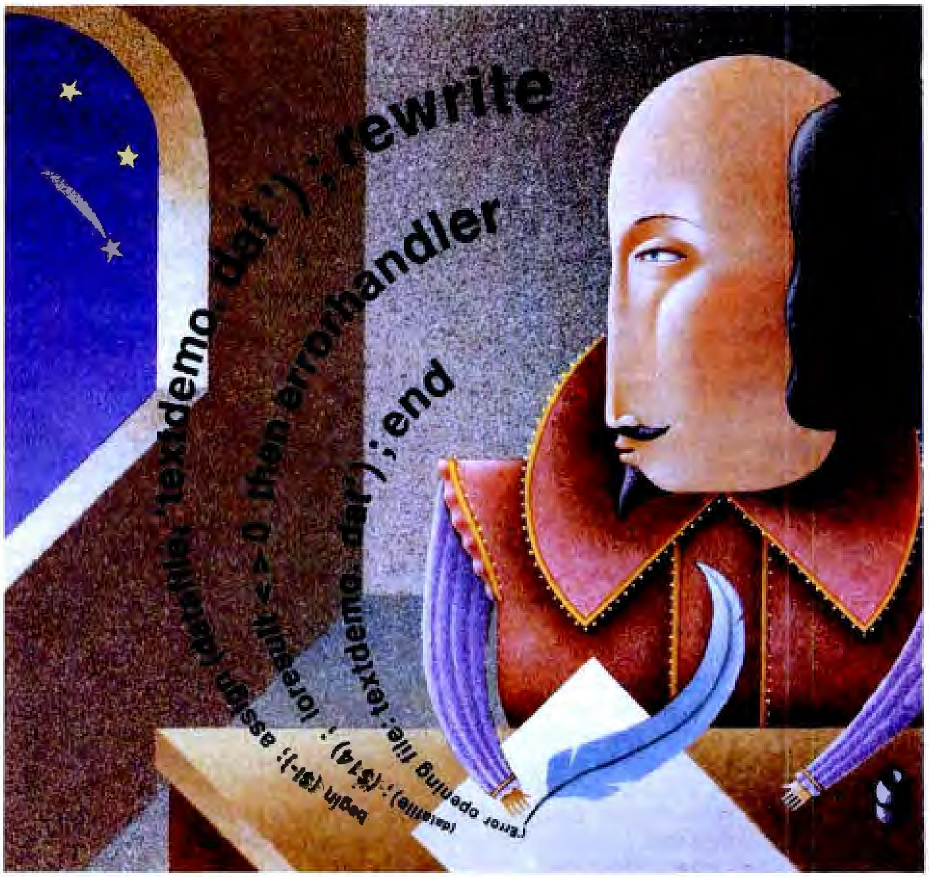
Tom Thompson is a BYTE senior editor at large with a B.S.E.E. degree from Memphis State University. He can be reached on BIX as "tom_thompson."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

HUGH KENNER

Poets and Sleepwalkers

Is programming more like poetry or mathematics? Several new books and journals take sides in the debate.



Remember the early 1980s? Back then, small-system computerdom, still impelled by fun, o'ersoared the mere dull ground. And learning what could be done within 64K bytes of memory. . . well, compare the Renaissance passion for testing the limits of the 140-syllable sonnet. John Donne in the 1620s packed an apocalypse into a sonnet. Likewise, hobbyists developed assembly expertise just to fit mainframe games of Adventure into laughably tiny address space.

And as Elizabethans bought books of sonnets, so in gone years many of us bought packaged Adventure, and we too had our reward. Programmers, though, like the sonnet-makers, were enjoying a different fulfillment. In doing nothing conspicuously useful—just coding recreations—they themselves felt recreated by what they happily called "recreational programming."

But recreational programming, if we trust the magazines, now seems to have followed the sonnet into limbo. Journals that once enticed tinkerers with something that was frankly meant just to allure, are strict now in their targeting of "professionals." And when *Scientific American* not only consigned A. K. Dewdney's Computer Recreations column to mere bimonthly status but changed the word *Computer* to *Mathematical*, grim handwriting was plainly on the wall. Sure, computers everywhere, the message ran. But they're now for *work*.

So Dewdney's *The Magic Machine* (W. H. Freeman, 1990, \$15.95) seems a souvenir of a lost time. Like his *The Armchair Universe*, which I reviewed in the August 1988 BYTE, it repackages a sampling of those golden columns; themes include chaos, viruses, and artificial landscapes. Meanwhile, he has started his own 28-page bimonthly newsletter: *Algorithm* (Algorithm, P.O. Box 29237, Westmount Postal Outlet, 785 Wonderland Rd., London, Ontario, Canada N6K 1M6, US\$29.95 for six issues). It's reached issue 1.7 as this is written, and back issues from 1.1 can still be had.

An address like Wonderland Rd. does suggest fantasies, and what *Algorithm* peddles *is* fantasy, broadly defined. Nowadays that tends to mean graphics, which, like the fractals I've mentioned here more than once, can yield a visual experience quite unhitched from their mathematical rigor. *Algorithm* 1.1 offered "Inside the Mandelbrot Set" by IBM's Clifford Pickover, and if you think there is nothing inside that set but a heart-shaped black hole, you have a surprise coming. What we've normally marveled at consists of samplings "from the area just outside the set, near its infinitely complicated fractal boundary." But we can get *inside* by trusting a 13-line algorithm, which leaves details (e.g., choosing parameters and coloring points) to eager readers.

And such is the way of *Algorithm*, which calls itself "The Personal Programming Newsletter." Supplement lucid principle with a rigorous but compressed recipe, the kind that specifies nested loops, boundaries, and plottings. Let each recreational programmer ad-lib the details, in some language of choice, with an eye to whatever hardware is available. And if half the fun is viewing the result, the other half is making the

ILLUSTRATION: ROBERT FORSBACH © 1991

thing work, and then making it work better.

Pickover has a regular column called Personal Programs. So has Michael W. Ecker, who calls his Easy Pieces. Those are so easy he'll even illustrate via BASIC code (yea, antient BASIC, ye olde kynde with lyne numbers). And, every issue, Dewdney in top form.

The ad pages offer news, too. Ecker, I learn, runs a magazine of his own, *Recreational & Educational Computing*, of which I've yet to see a copy (not his fault, mine). And what a number of fractal implementations! Fractals now lure programmers as Adventure once did. The most original version I've seen recently is Fractal Grafics (Cedar Software, Rt. 1-5140, Morrisville, VT 05661, (802) 888-5275, $79). I'll be reporting when I've used it enough to feel comfortable. The most elegant presentation is *Nature's Chaos*, 103 wonderful color photos by the late Eliot Porter, with text by James Gleick (Viking, 1990, $29.95). Porter shows you ferns, cracked mud, tree trunks, lava, flowing water, some 2000 flamingos, as you never saw them before Mandelbrot adjusted your eyes. Gleick helps persuade you that, yes, numbers can describe these images, chiefly by fractals.

Fractals now lure programmers as Adventure once did.

And as numbers can describe images, words can prescribe numbers. Such a prescription, set forth as sparely and exactly as possible, is what we mean by an algorithm. The Pascal language, when it left Niklaus Wirth's hands, was a teaching device that let you spell out algorithms in near-English. The Pascals that we buy have been vastly complicated by hooks to operating systems and hardware, details Wirth was in a position to finesse. He said that a compiler could be made to understand unambiguous instructions written in English. The intent of the language was to define "unambiguous."

And here we encroach on controversial ground. In using "recipe" for "algorithm," I've implied that the ensuing code depends greatly on the chef. But in *Binding Time: Six Studies in Programming Technology and Milieu* (Ablex Publishing, 1990, $27.50), Mark Halpern alludes to a sect he calls the calculists, who'd wish for much austerer claims. Calculism causes its victims to suppose (1) that there exists a seamless transhuman domain called mathematical discipline; and (2) that computerdom should aspire to that realm. And the most humane of computer theorists—even Edsger Dijkstra, father of structured programming—have not always been immune to calculism.

Halpern's other word for calculists is *sleepwalkers*: "People doing good work in pursuit of illusory goals." May waking them be dangerous to their productivity? No, he's confident he'll not wreak that order of damage. "The ability of seasoned sleepwalkers to shrug off signals from the waking world is impressive." But he has hopes of immunizing the rest of us to their decades-old incantations. Himself a theme-weaver since at least 1963, he's not squeamish about citations from 30 years back. For, "It's only when the sailor looks back on his wake that he can see that he's been going in circles."

In what circles? Well, the ones that chase their tails in pursuit of mathematical perfection. The calculists say, "First, programming languages should be recast along the lines of mathematical notation, so as to capture that notation's rigor, precision, and economy—and perhaps even its supposed creative power.... Second, programs can and should be validated and proved correct, by means very similar to those used in the proof of a mathematical theorem." And, "Nuts!" says Halpern.

Oh, he does say it more politely. He's after all a software development executive (also one of the few people to have resigned from IBM twice). But throughout the book his norm is natural language. Math notation is but an encoded subset of that, and a math proof (surprise!) is a natural-language prose narrative—"Let $F(x)$ be a y such that..."—with symbolic summaries interposed along the way. Those do not carry the burden of the proof; they serve to let readers "forget everything that preceded so as to clear their minds for the next step." Thus, symbols "isolate for inspection important milestones," but no reader is likely to dwell on them unless out of suspicion that an error lurks.

So, "Calculism is based...not on achieved insight, but on a mere hope that if we mimic the outward forms of mathematical practice, insight will follow." And the sole sound basis for computer programs—here I elide countless details Halpern confronts explicitly—remains natural language. ("How *un*professional!" You can hear the snorts.)

Yet Isaac Newton, who was no calculist, wrote the *Principia Mathematica* in a language natural to the learned of his time, Latin. He dealt with the ambiguities inherent in natural languages the way all sensible writers do, by keeping a hawk's eye on his phrasing. Page through the *Principia* and you're looking at prose, interspersed with diagrams and rare equations.

It follows that the correctness of programs *cannot* be proved. (The notion that they can be derives from the notion that a proof just tumbles through formalisms.) It follows, too, that an algorithm can't be proved, either. You find out how well it works by testing it. For draw a deep breath and imagine what you'd be trying to "prove." That it does what it's supposed to do? Hah, write your rigorous specification for *that*. "Algorithms, like executable programs, are unverifiable because they are themselves the best attempts we can make at expressing our intentions; there is nothing we can test them by, because if we could come up with better expressions, *they* would be our algorithms/programs."

(And it's doubtful if any two Dewdney fans write exactly the same code for anything. There are many ways to get a principle working. None is bug-proof.)

The text formatter I still use comes from a disk dated 19 July 1983. For some months before that, I was a beta-tester. One bug I chanced on was a lockup should a \ happen to alight on the first tab stop. How foresee such a flaw? Where locate it, in the intricate transactions among algorithm, DOS, C compiler? Well, it did get found and swatted. That's how "software development" works. Halpern has ideas about how it could be made to go less chancily. For those, read his book; and let object-oriented programming fans pay special attention. He promotes an expanding inventory of small, tight, reusable "boxes," energized like ballad stanzas, and would savor OOP more could it dispense with the "neologisms and misnomers" its promoters troll for attention.

So we head back toward programming as poetry, even as fun. Let miseries be left to the law courts: beasts a-circling, eyes aglare, fangs bared. Today, at ease with megabytes of memory, feel free to aspire beyond the sonnet: if not to the epic, at least to a polychromed ode. ■

Hugh Kenner is a professor of English at Johns Hopkins University. He writes for publications ranging from the New York Times *to* Art & Antiques. *His recent books include* Mazes *and* Historical Fictions. *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.

STOP BIT

ALUN
WHITTAKER

LET MY PCs GO

Is the personal computer revolution really over? Remember when, several years ago, we stomped into our department supervisor's office, slammed a stack of smeary, green-striped printouts on the desk, and demanded a personal computer? We were sick of the temperamental, bug-ridden software available on corporate minicomputers and mainframes, sick of the uncooperative attitude of corporate MIS staff, and weary of their promises that the capabilities promised in the system specifications would actually be delivered real soon now.

In the mad rush to connectivity, have we forgotten the point of the PC revolution?

Then we pulled out a copy of BYTE. Indicating a review of a Z80, an Apple II, or an IBM PC, we explained that these machines were self-contained and were so cheap that we could set up a system without involving corporate computer departments, their policies, or their budgets. With tools like Microsoft BASIC, WordStar, VisiCalc, and dBASE, we could develop in-house applications, saving time and effort.

The PC revolution was on its way.

As the combined PC activity of individual departments came to rival or even outrun that of the corporate mainframe, corporate MIS management found their empires (and budgets) threatened. Unable to compete with the PC revolution and unwilling to join it, they attempted to retain control by becoming the corporate regulators of PCs.

At first they had little success. Then the PC world provided MIS managers the break they had been hoping for: "connectivity," the PC buzzword of the mid-1980s. Connecting all the PCs, in all departments, letting them access each other's data and peripherals—that was surely a corporate function. A single corporate voice was needed to settle questions of communications protocols, cable routing, and network procedures. Who better to do this than the established corporate computer staff?

It was a small step from standardized computer connections to standardizing the computers themselves, and then the software, printers, graphics cards, and so on. Soon there were corporate directives on subdirectory names, organization of subdirectories, and even the color of the floppy disk labels. The counterrevolution was rolling.

On the heels of networks came another lucky break for the regulators—viruses. Warnings were soon circulated: Infection by nonstandard software can bring the corporation to its knees. Sure, it's not very likely. Most well-publicized cases of virus or worm attacks have involved the exploitation of operating-system deficiencies on intensively managed and regulated systems.

The counterrevolution was close to complete. IBM launched OS/2 with the promise of PC-to-mainframe links. Unix running on PC networks started to look like the banked minicomputers of yesteryear. Over the horizon came the MIS manager's dream: the diskless PC, a terminal in all but name.

Sure, modern PCs are more powerful than ever. But the PC revolution was about freedom, not power. The first PCs were puny compared to the minicomputers and mainframes of their day, yet they offered us, the users, a new personal freedom of choice. We could shop for and configure our own computer systems, select or develop our own software, and use it all in a way that suited and enhanced our natural creativity. We made our own choices on how to enter, organize, process, output, and occasionally trash our own data.

In response to our enthusiasm, hardware became more reliable, compatible, and easy to install. Software became easier to use, better documented, and cheaper. Now there's more software out there, but we are restricted to choosing it from corporate stockrooms or a few bulky and expensive library boxes tastefully arranged on the pastel shelves of computer stores.

What worries me most is that networks are bringing corporate computer management style from major corporations into the smallest, most innovative companies. I've seen companies in which even four or five PCs are linked, and some "system manager," under the guidance of network consultants, handbooks, or columnists, is writing procedures, establishing standards, and ruling over accessibility to the network.

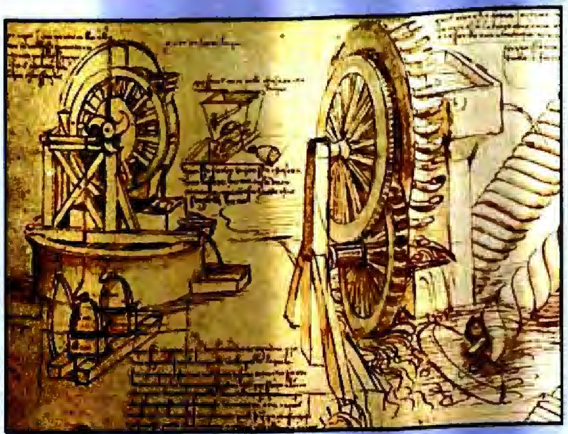
There is no doubt that network management is necessary. Let's just be sure that control of the machines doesn't mean restricting the creativity of their users. ■

Alun Whittaker is an author of technical documentation and video scripts. He can be reached on BIX c/o "editors."

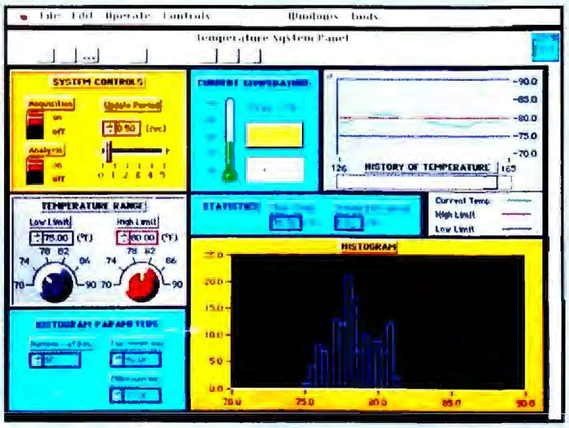
Stop Bit is a forum for informed opinion on personal computing topics. The opinions expressed are those of the author and not necessarily those of BYTE. Your contributions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

Leonardo's Career Combined Art and Science

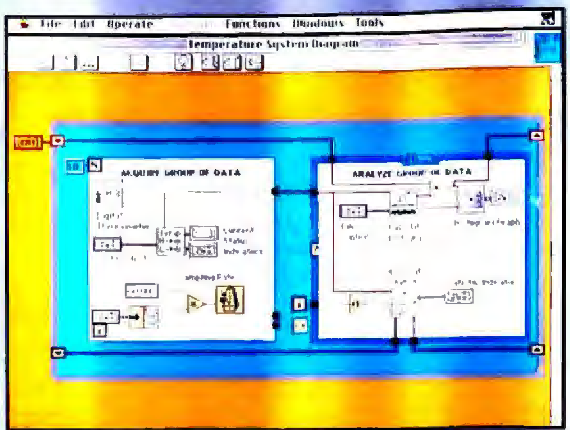
Mona Lisa



Sketch from Leonardo da Vinci's notebook



LabVIEW 2 front panel



LabVIEW 2 block diagram program

Using LabVIEW® Yours Can Too!

Leonardo da Vinci was both artist and scientist. Artistically, he employed an innate sensitivity and great technical skill. As a scientist and inventor, he visualized revolutionary machines and experimental apparatus centuries ahead of their time. With LabVIEW, you can be as artistic as Leonardo by using LabVIEW's graphical user interface to make ground-breaking discoveries, far ahead of your colleagues.

Yes, that's right! LabVIEW lets you do your job faster–and with style. LabVIEW 2 is a revolutionary graphical programming system for data acquisition and instrument control applications. Pioneering engineers and scientists are using LabVIEW to make discoveries and breakthroughs of the order of Leonardo's. In short, LabVIEW not only helps you do your job, but helps you do it with class–artistically.

Graphical User Interfaces are now industry standard. In fact, studies confirm that graphical user interfaces make computer users much more productive. LabVIEW is the first graphical user interface available for engineering and scientific data acquisition. LabVIEW combines a front panel user interface with data flow programming technology to make it an exceptionally productive tool for programming a variety of applications. And LabVIEW gives your career, like Leonardo's, some style!

NATIONAL INSTRUMENTS®
The Software is the Instrument®
6504 Bridge Point Parkway
Austin, TX 78730-5039

Call for *FREE* Catalog

(512) 794-0100 or (800) 433-3488 (U.S. and Canada)

1990 WINNER MacUser
MacUser Editors' Choice

Nihon National Instruments K.K. (Japan) 03 3788 1921 • **National Instruments France** 1 4865 3370 • **National Instruments Italy** 02 4830 1892
National Instruments Netherlands BV 01720 42142 • **National Instruments Switzerland** 056 45 58 80 • **National Instruments United Kingdom** 0635 523 545
National Instruments Germany GmbH 089 436 1447

Circle 189 on Inquiry Card.