

BYTE

THE SMALL SYSTEMS JOURNAL

AUGUST 1984 VOL. 9, NO. 8

\$3.50 IN UNITED STATES
\$4.25 IN CANADA / £2.10 IN U.K.
A MCGRAW-HILL PUBLICATION
0360-5280

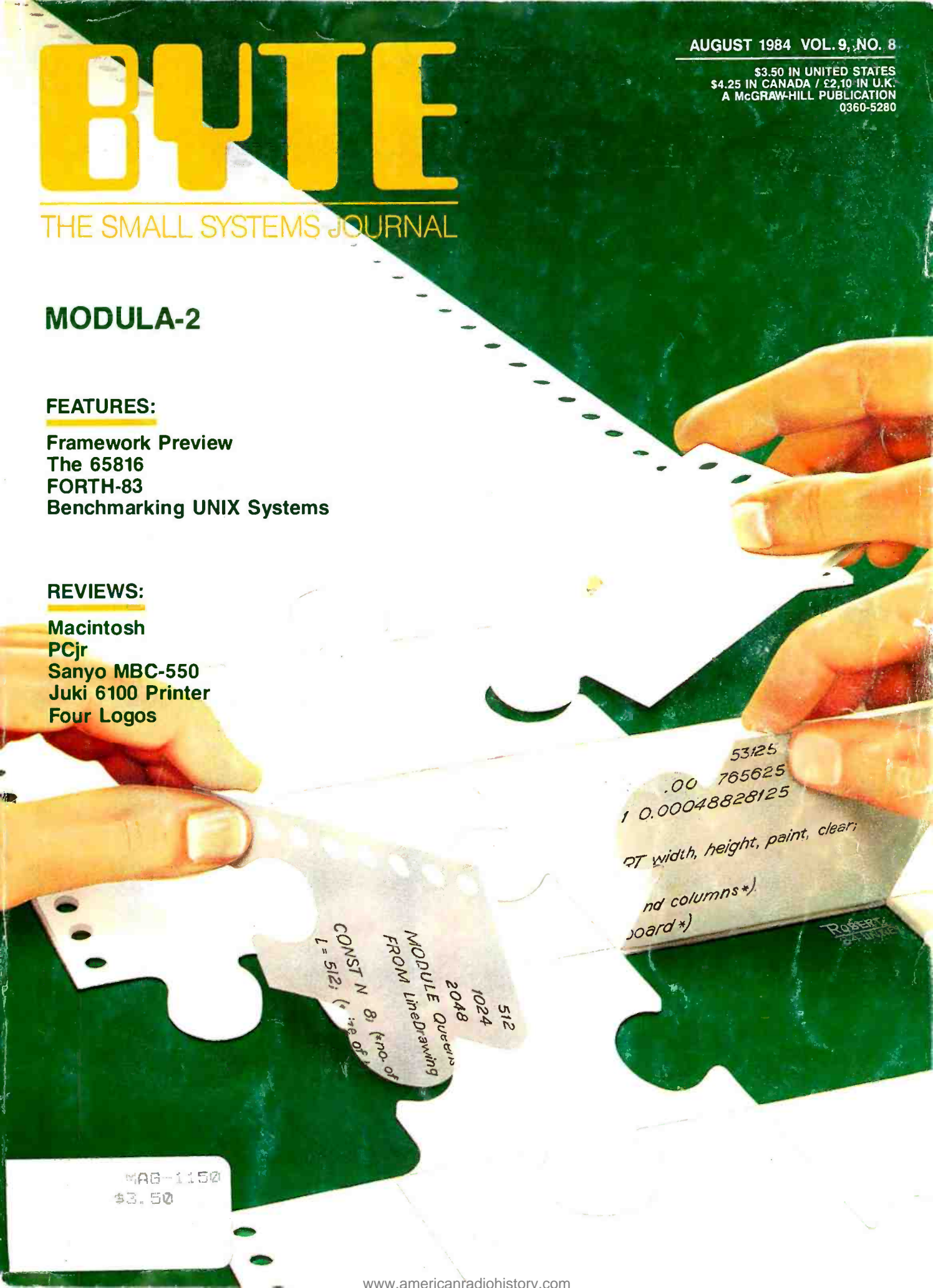
MODULA-2

FEATURES:

Framework Preview
The 65816
FORTH-83
Benchmarking UNIX Systems

REVIEWS:

Macintosh
PCjr
Sanyo MBC-550
Juki 6100 Printer
Four Logos



MAG-1150
\$3.50



Announcing a small imp

It's 12" x 11¼" x 2¼"
 It weighs less than 8 pounds.*
 And costs less than \$1,300.**
 Yet with 128K, the new Apple[®] IIc Personal Computer is a lot bigger than it looks.

The IIc has a full-size keyboard.



Because it's inherited all the talents of the eminently talented Apple IIe:

The versatility to run over 10,000 different software programs.

The ironclad reliability of the first true VLSI motherboard.

And the artistic ability of 16 high-resolution colors.

The IIc also has some talents of its very own.

For instance, a switchable 80/40-character display.

Switchable QWERTY/Dvorak keyboard.

A built-in half-high 143K single-sided disk drive.

Built-in serial ports for modems, printers and an extra half-high drive.

Even built-in mousetronics so it's ready to use a mouse and all the new Apple II mouseware.

And our newest brainchild is certainly not an orphan.

You can grow it with a whole family of Apple II accessories and peripherals.



Thin, isn't it? Even with its built-in disk drive.



Improvement on the Apple IIe.

Including the new Apple Scribe—Apple's first full-color print-on-anything printer for under \$300, it can handle anything from business graphics to term papers.

The IIc's father, of course, is the granddaddy of the whole personal computer industry, the Apple IIe. Which, lest we forget, has quite a few improvements of its own this year.

The IIe can now use our ProFile™ hard disk—so it can store about 2400

pages of anything you'd like to remember.

And the Apple IIe is still the most expandable personal computer there is.



Built-in ports for making all the right connections.

You can increase its RAM to an elephantine 512K. Add a Z-80 card to run CP/M.™

In fact, you can grow it with enough cards and peripherals to run just about any family business. Like Saudi Arabia.

So you see, the only question is whether you need an expandable Apple II. As in IIe.

Or a compact Apple II. As in IIc. Just visit your friendly authorized Apple dealer.

And tell them what size improvement you'd like.



* Don't asterisks make you suspicious as all get-out? Well, all this one means is that the IIc CPU alone weighs 7.5 pounds. The power pack, monitor, an extra disk drive, a printer and several bricks will make the IIc weigh more. Our lawyers were concerned that you might not be able to figure this one out for yourself. ** The FTC is concerned about price-fixing. So this is only a Suggested Retail Price. You can pay more if you really want to. Or less. © 1984 Apple Computer, Inc. Apple, the Apple logo and ProFile are trademarks of Apple Computer, Inc. CP/M is a trademark of Digital Research Inc. For an authorized Apple dealer nearest you, call (800) 538-9696. In Canada, call (800) 268-7796 or (800) 268-7637.

C·O·N·T·E·N·T·S



FEATURES

- INTRODUCTION** 119
- FRAMEWORK** by Rik Jadrnicek, John Markoff, and Ezra Shapiro 121
A team of BYTE editors previews an integrated software package that combines familiar features within a novel structure.
- THE 65816 MICROPROCESSOR, PART I: SOFTWARE** by Steven P. Hendrix 125
This two-part series begins with a look at software considerations for an 8-/16-bit successor to the 6502.
- CIARCIA'S CIRCUIT CELLAR: CIRCUIT CELLAR FEEDBACK** by Steve Ciarcia 129
Steve takes a break from hardware design to answer project-related queries from readers.
- BENCHMARKING UNIX SYSTEMS** by David F. Hinnant 132
Several microcomputer UNIX implementations are compared to minicomputer versions of the operating system.
- FORTH-83: EVOLUTION CONTINUES** by C. Kevin McCabe 137
A new standard corrects some problems, but FORTH is still a language in flux.

THEME: MODULA-2

- INTRODUCTION** 143
- HISTORY AND GOALS OF MODULA-2** by Niklaus Wirth 145
The creator of Pascal and Modula-2 writes on the module's coming of age.
- TUTORIAL ON MODULA-2** by Jürg Gutknecht 157
The concept of autonomous modules is fundamental to this structured programming language.
- LILITH AND MODULA-2** by Richard Ohran 181
The director of the Modula Research Institute offers a case study of high-level-language processor design.
- AN INTRODUCTION TO MODULA-2** by Robert J. Paul 195
An exploration of the differences in control structure, expressions, and general syntax between Modula-2 and Pascal puts the new language in perspective.
- PASCAL, ADA, AND MODULA-2** by David Coar 215
A system programmer compares the three languages.

REVIEWS

- REVIEWER'S NOTEBOOK** 237
- THE MACINTOSH** by Bruce F. Webster 238
Apple's new system, while not perfect, comes a long way toward achieving its design goals of being nonthreatening, quickly learned, easy to use, and fun.
- THE IBM PCjr** by Rowland Archer Jr. 254
First impressions are favorable, but a closer look reveals some problems.
- THE SANYO MBC-550** by Bill Sudbrink 270
This inexpensive MS-DOS system is IBM compatible.

BYTE is published monthly with an additional issue in August and October by McGraw-Hill Inc. Founder: James H. McGraw (1860-1948). Executive, editorial, circulation, and advertising offices: 70 Main St., Peterborough, NH 03458, phone (603) 924-9281. Office hours: Mon-Thur 8:30 AM - 4:30 PM, Friday 8:30 AM - 1:00 PM, Eastern Time. Address subscriptions to BYTE Subscriptions, POB 590, Martinsville, NJ 08836. Postmaster: send address changes, USPS Form 3579, undeliverable copies, and fulfillment questions to BYTE Subscriptions, POB 590, Martinsville, NJ 08836. Second-class postage paid at Peterborough, NH 03458 and additional mailing offices. USPS Publication No. 528890 (ISSN 0360-5280). Postage paid at Winnipeg, Manitoba. Registration number 9321. Subscriptions are \$21 for one year, \$38 for two years, and \$55 for three years in the USA and its possessions. In Canada and Mexico, \$23 for one year, \$42 for two years, \$61 for three years. \$69 for one year air delivery to Europe, 17,000 yen for one year surface delivery to Japan, \$37 surface delivery elsewhere. Air delivery to selected areas at additional rates upon request. Single copy price is \$3.50 in the USA and its possessions, \$4.25 in Canada and Mexico, \$4.50 in Europe, and \$5 elsewhere. Foreign subscriptions and sales should be remitted in United States funds drawn on a U.S. bank. Please allow six to eight weeks for delivery of first issue. Printed in the United States of America.

BYTE August

VOLUME 9, NUMBER 8, 1984

FOUR LOGOS FOR THE IBM PC by Mark Bridger.	287
Several new Logo packages offer turtle graphics of varying quality on the IBM Personal Computer.	
THE JUKI 6100 PRINTER by G. Michael Vose.	305
Juki Industries' fully formed character printer isn't fast, but it's inexpensive.	
REVIEW FEEDBACK	308
Readers respond to previous reviews.	

KERNEL

INTRODUCTION	311
COMPUTING AT CHAOS MANOR: BETWEEN CONVENTIONS by Jerry Pournelle.	313
In a hectic schedule, Jerry finds time for a Mac attack and more colorful commentary on the computing scene.	
CHAOS MANOR MAIL	334
Jerry's readers write, and he replies.	
BYTE JAPAN: PASOCOM PAGODAS by William M. Raiké.	339
Our man in Tokyo comments on a software shortage, the Sharp MZ-5500, the Fujitsu FM-11, and more.	
BYTE WEST COAST: MACINTOSH'S OTHER DESIGNERS by John Markoff and Ezra Shapiro.	347
Three original designers discuss the earliest days.	
BYTE U.K.: MICROPROCESSOR DESIGN by Dick Pountain.	361
BYTE's British correspondent looks at the Transputer and its special language, Occam.	

EDITORIAL: WHAT MAKES PERSONAL COMPUTERS SPECIAL?	6
MICROBYTES	9
LETTERS	14
FIXES AND UPDATES	33
WHAT'S NEW	44, 431
ASK BYTE	54
CLUBS AND NEWSLETTERS	67
BOOK REVIEWS	73
EVENT QUEUE	94
BOOKS RECEIVED	424
TECHNICAL FORUM	428
UNCLASSIFIED ADS	477
BYTE'S ONGOING MONITOR BOX BOMB RESULTS	478
READER SERVICE	479



Address all editorial correspondence to the Editor, BYTE, POB 372, Hancock, NH 03449. Unacceptable manuscripts will be returned if accompanied by sufficient first-class postage. Not responsible for lost manuscripts or photos. Opinions expressed by the authors are not necessarily those of BYTE. Copyright © 1984 by McGraw-Hill Inc. All rights reserved. Trademark registered in the United States Patent and Trademark Office. Where necessary, permission is granted by the copyright owner for libraries and others registered with the Copyright Clearance Center (CCC) to photocopy any article herein for the flat fee of \$1.50 per copy of the article or any part thereof. Correspondence and payment should be sent directly to the CCC, 29 Congress St., Salem, MA 01970. Specify ISSN 0360-5280/83 \$1.50. Copying done for other than personal or internal reference use without the permission of McGraw-Hill Inc. is prohibited. Requests for special permission or bulk orders should be addressed to the publisher. BYTE is available in microform from University Microfilms International, 300 North Zeeb Rd., Dept. PR, Ann Arbor, MI 48106 or 18 Bedford Row, Dept. PR, London WC1R 4EJ England. Subscription questions or problems should be addressed to: BYTE Subscriber Service, POB 328, Hancock, NH 03449.

MicroTime



800-MICRO 84

SET-UP ASSISTANCE

SOFTWARE SUPPORT

ONE YEAR SERVICE CONTRACT AVAILABLE

LOWEST PRICES ALL MODELS



IBM-PC

Xerox-Americanare Maintenance

SYSTEM SALES

NEW LOWER PRICES



IBM® COMPATIBLE
FREE ON-SITE SERVICE FOR 3 MONTHS
SOFTWARE & HARDWARE SET-UP



ZENITH

Desktop PC-150 Portable PC-160

SYSTEM SUPPORT

FAMILY PACK

HARD BOOT

WHILE THEY LAST

CALL FOR LOWEST PRICE



FRANKLIN

THE APPLE® COMPATIBLE

PERIPHERALS

AMDEK • AST • BENCHMARK • BLUECHIP
BPI • BROTHER • CITOH • DATAPRODUCTS
DATASOUTH • DIABLO • EPSON • HAYES
HOUST/INSTR • JUKI • MANN/TALLY
MOUNTAIN • NEC • NOVATION • OKIDATA
ORANGE • PANASONIC • PLANTRONICS
PROMETHEUS • QUADRAM • QUME
SILVERREED • STAR (GEMINI) • TAXAN
TRANSTAR • TOSHIBA • TTX • US ROBOTICS

800-642-7684

* Apple is a registered trademark of Apple Computers, Inc.
IBM is a registered trademark of International Business Machines, Corp.

411 West Grant Road
Tucson, Arizona 85705



BYTE

EDITOR IN CHIEF

PHILIP LEMMONS
MANAGING EDITOR

GENE SMARTE
CONSULTING EDITORS

STEVE CIARCIA
JERRY POURNELLE

SENIOR TECHNICAL EDITORS

RICHARD MALLOY, *Reviews*

C. MICHAEL VOSE, *Features*

GREGG WILLIAMS
TECHNICAL EDITORS

THOMAS R. CLUNE

GLENN HARTWIG

RICHARD KRAJEWSKI

ARTHUR A. LITTLE

BRUCE ROBERTS

KEN SHELDON

RICHARD S. SHUFORD

JANE MORRILL TAZELAAR

STANLEY WSZOLA

MARGARET COOK GURNEY, *Associate*

ALAN EASTON, *Drafting*

WEST COAST EDITORS

EZRA SHAPIRO, *Bureau Chief, San Francisco*

JOHN MARKOFF, *Senior Technical Editor, Palo Alto*

DONNA OSOOD, *Associate Editor, San Francisco*

MANAGING EDITOR, USER NEWS

GEORGE BOND

USER NEWS EDITORS

ANTHONY J. LOCKWOOD, *What's New*

MARK WELCH, *Microbytes*

CONTRIBUTING EDITORS

DENNIS ALLISON, *at large*

MARK DAHME, *video, operating systems*

MICHAEL W. ECKER, *mathematical recreations*

RIK JADRNICEK, *CAD, graphics, spreadsheets*

MARK KLEIN, *communications*

ALAN MILLER, *languages and engineering*

DICK POUNTAIN, *U.K.*

WILLIAM RAIKE, *Japan*

PERRY SAIDMAN, *computers and law*

ROBERT STERNE, *computers and law*

BRUCE WEBSTER, *software*

RICHARD WILLIS, *at large*

COPY EDITORS

ELIZABETH R. COOPER, *Chief*

DENNIS BARKER

ANNE L. FISCHER

NANCY HAYES

LYNNE M. NADEAU

PAULA NOONAN

JOAN V. ROY

BUD SADLER

WARREN WILLIAMSON

ASSISTANTS

PEGGY DUNHAM

MARTHA HICKS

BEVERLY JACKSON

FAITH KLUNTZ, *Copyrights and Permissions*

LISA JO STEINER

ART

ROSSLYN A. FRICK, *Art Director*

NANCY RICE, *Assistant Art Director*

PRODUCTION

DAVID R. ANDERSON, *Associate Director*

DENISE CHARTRAND

MICHAEL I. LONSKY

IAN MULLER

SHERRY MCCARTHY, *Chief Typographer*

NAN FORMAL

LEN LORETTE

VALERIE PAGE

DONNA SWEENEY

PUBLISHER

GENE W. SIMPSON

ASSOCIATE PUBLISHER/PRODUCTION DIRECTOR

JOHN E. HAYES

PUBLISHER'S ASSISTANT

DORIS R. GAMBLE

ADVERTISING SALES

I. PETER HUESTIS, *Sales Manager*

SANDRA FOSTER, *Administrative Assistant*

ADVERTISING

DEBORAH PORTER, *Supervisor*

MARION CARLSON

CATHY A. R. DREW

ROB HANNINGS

JEANNA REENSTIENA

LISA WOZMAK

WAI CHIU LI, *Quality Control Manager*

LINDA I. SWEENEY, *Advertising/Production Coordinator*

JULIE NELSON

CIRCULATION

GREGORY SPITZFADEN, *Director*

ANDREW JACKSON, *Subscriptions Manager*

BARBARA VARNUM, *Assistant Manager*

PHIL DECHERT

MARY EMERSON

LOUISE MEMECUS

AGNES E. PERRY

JENNIFER PRICE

JANE VARNUM

JAMES BINCHAM, *Single-Copy Sales Manager*

LINDA TURNER, *Assistant Manager*

CAROL AHO

CLAUDETTE CARSWELL

EDSON WARE

MARKETING COMMUNICATIONS

HORACE T. HOWLAND, *Director*

DOUG WEBSTER, *Director of Public Relations*

VICKI REYNOLDS, *Marketing Associate*

IONI P. VEYNE, *Assistant*

STEPHANIE WARNESEY, *Graphic Arts Supervisor*

SHARON PRICE, *Graphic Arts Designer*

MICHELE P. VERVILLE, *Research Manager*

PATRICIA AKERLEY, *Market Research Analyst*

CYNTHIA DAMATO, *Reader Service Coordinator*

ACCOUNTING

DANIEL RODRIGUES, *Business Manager/Controller*

KENNETH A. KING, *Assistant Controller*

MARY E. FLUHR, *Accounting & D/P Manager*

KAREN BURGESS

PATRICIA BURKE

LYDA CLARK

DIANE HENRY

VERN ROCKWELL

LINDA SHORT

JOANN WALTER

VICKI WESTON

TRAFFIC

N. SCOTT GAGNON, *Manager*

ANTHONY BENNETT

BRIAN HIGGINS

RECEPTIONIST

L. RYAN MCCOMBS

PERSONNEL/OFFICE MANAGER

CHERYL A. HURD

Editorial and Business Office: 70 Main Street, Peterborough, New Hampshire 03458, 603/924-9281
West Coast Offices: McGraw-Hill, 425 Battery St., San Francisco, CA 94111, 415/362-4600.
McGraw-Hill, 1000 Elwell Court, Palo Alto, CA 94303, 415/964-0624.



Officers of McGraw-Hill Publications Company: President: John C. Wrede. Executive Vice Presidents: Paul F. McPherson, Operations; Walter D. Serwatka, Finance & Services; Senior Vice President-Editorial: Ralph R. Schultz. Senior Vice President Publishers: Harry L. Brown, David I. McGrath, James R. Pierce, Gene W. Simpson, John E. Slater. Vice President Publishers: Charlton H. Callhoun III, Richard M. Larsen, John W. Patten. Vice Presidents: Kemp Anderson, Business Systems Development; Shel F. Asen, Manufacturing; John A. Bunyan, Electronic Information Services; George R. Elsing, Circulation; Michael K. Hehr, Controller; Eric B. Herr, Planning and Development; H. John Sweger, Jr., Marketing; Virginia L. Williamson, Business Development.

Officers of the Corporation: Harold W. McGraw, Jr., Chairman; Joseph L. Dionne, President and Chief Executive Officer; Robert N. Landes, Senior Vice President and Secretary; Ralph J. Webb, Treasurer.

68000-based systems. Just tell us what you need.

68000-based systems to fit your application.

Right from the pages of our catalog, we can deliver 68000-based supermicro systems to match virtually any application.

Including yours.
Here's how.

Built on the IEEE-696 (S-100) bus, Cromemco systems offer up to 21 board slots. And a family of 35 boards — CPU, memory and specialized I/O — to fill the slots any way you choose.

At the heart of each system is our 68000/Z-80 dual processor. Backed by as much as 16 Mb of error-correcting RAM. Full multi-tasking capability. I/O to handle up to 16 terminals.

And that's just the beginning. You can select single or dual floppies, 5¼" or 8" A 50 Mb 5¼" Winchester hard disk. And a nine-track tape drive.

We can accommodate your taste for the exotic, too. With boards like our SMD interface that supports up to 1200 Mb of disk storage. A fast floating-point processor. A color graphics interface. A TV camera digitizer. An IEEE-488 bus interface. Communications. And more.

Intelligent workstations.

Then, if you're designing a distributed processing system, you'll want to take a look at our C-10 personal computer. The Z-80-based C-10 can serve our 68000-based systems

as a powerful intelligent workstation in a distributed processing mode. Or as an independent personal computer with its own floppy storage.

High-level languages and applications software.

That brings us to software. It starts with CROMIX[®], our UNIX[™]-like operating system that you're free to tailor to your application.

CROMIX can execute both 68000- and Z-80-based programs. So right along with your 68000-based packages, your system will accommodate a wide selection of CP/M[®] software written for the Z-80.

And our high-level language support is second to none. From a 68000 Macro Assembler. To 68000 FORTRAN 77, PASCAL, GSA-certified high-level COBOL, C and BASIC.

Cromemco means business. Your business.

You see, when we say, "Just tell us what you need," we're not kidding.

You won't find another family of 68000-based microcomputers that can fit your needs as exactly as ours.

So if you're in the business of providing specialized computing solutions, you really should be doing business with Cromemco.

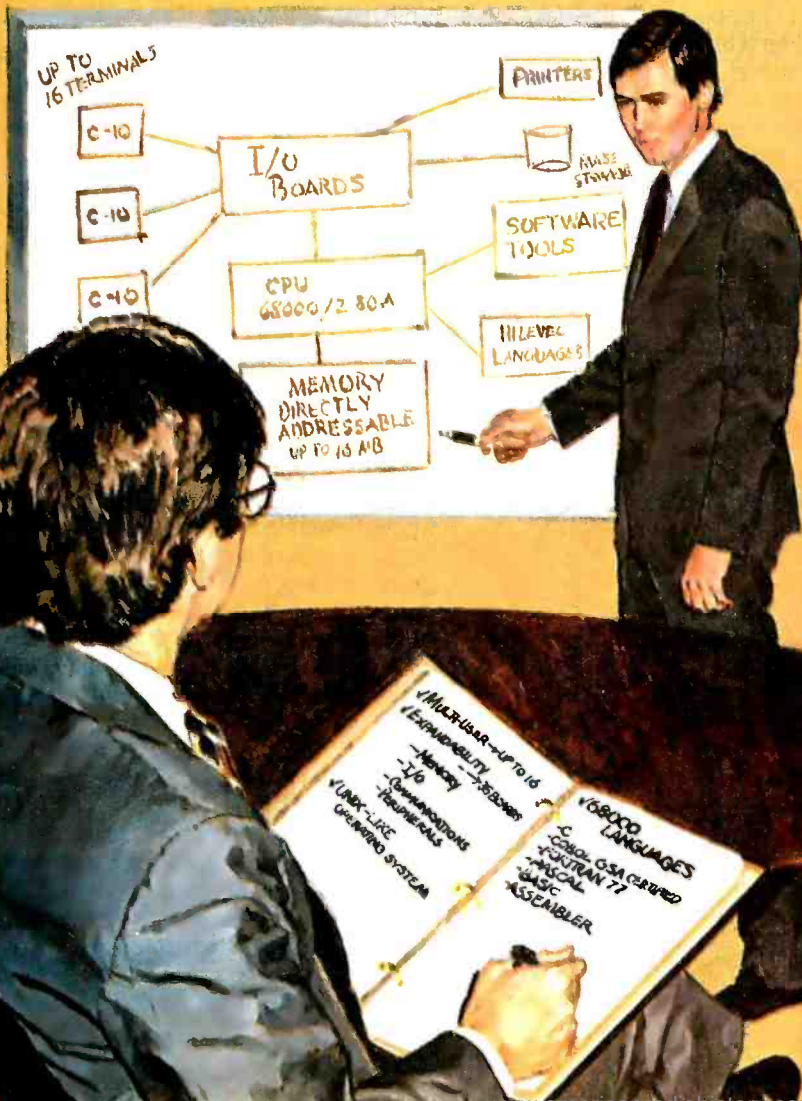
For a copy of our Systems Catalog, contact: Cromemco, Inc., 280 Bernardo Avenue, P.O. Box 7400, Mountain View, CA 94039. (415) 964-7400.

In Europe: Cromemco GmbH, 6236 Eschborn 1, Frankfurter Str. 33-35, P.O. 5267, Frankfurt Main, Germany or Cromemco Ltd., The Cambridge House, 178-182 Upper Richmond Rd., Putney, London SW15 England.

Cromemco[®]

*Cromemco and CROMIX are registered trademarks of Cromemco, Inc. [™]UNIX is a trademark of Bell Laboratories. [®]CP/M is a registered trademark of Digital Research. ©1983, Cromemco, Inc.

Circle 90 on inquiry card.



WHAT MAKES PERSONAL COMPUTERS SPECIAL?

People sometimes ask me why there's so much fuss about personal computers. Now that there are millions of them in the hands of ordinary people, personal computers are, in a sense, commonplace. Even enthusiasts may forget that personal computers are very special indeed. We would enjoy them even if they lacked practical applications and never overcame the digital indifference so often characterized as unfriendliness. To put personal computers in perspective, we should compare them with such earlier cultural watersheds as the printing press, the industrial Revolution, and the automobile.

Because it made the production of books far more efficient, the printing press made it possible for more people to learn more than ever before. But while the printing press gave creative work a wider audience and eliminated the drudgery of scribes, Gutenberg's

technology did not directly enhance the creativity of the people who wrote books.

The Industrial Revolution made the production of goods far more efficient than ever before. The efficiencies of mass production made possible the accumulation of great wealth. Unfortunately, mass production also brought about cultural impoverishment of many workers. The assembly line deprived workers of the creativity that belonged to craftsmen—the stamp of individuality that went with good handwork. The *Encyclopaedia Britannica* puts it this way: "...the discipline of the factory (a discipline often imposed by strangers), the remorseless monotony of many of the tasks, and the physical hazard and discomfort of some of the new processes took a heavy toll." Few would deny that the Industrial Revolution was, on balance, a good thing. But it did exact a great human price.

The automobile changed society for all time by broadening the experience

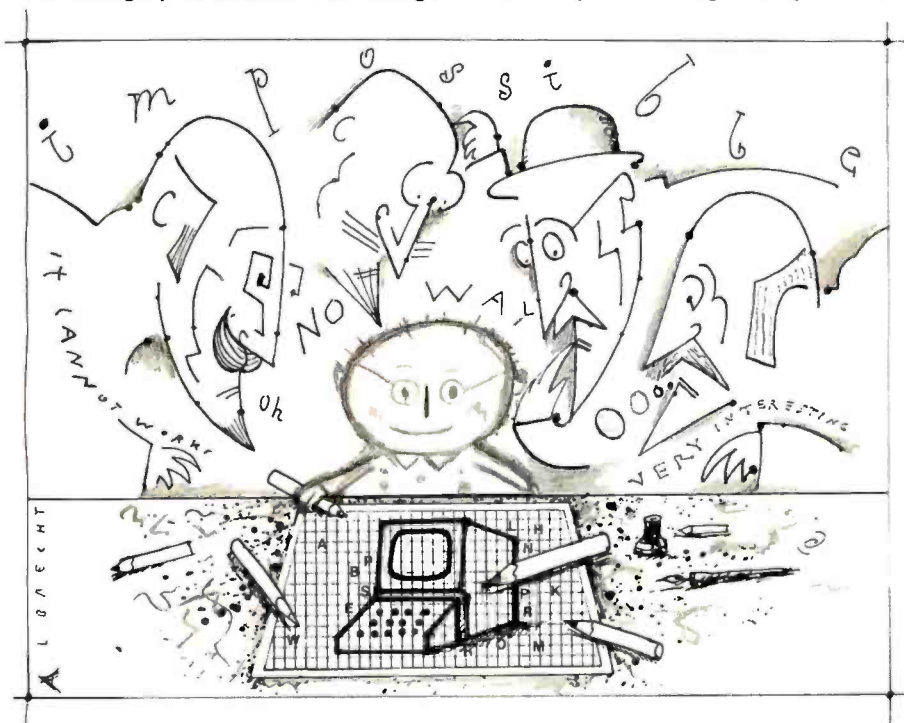
of millions of people. The ability to travel quickly and widely enabled people to see more of the world and to judge it for themselves. The automobile's influence resembled that of the printing press; while widespread book publishing extended knowledge, the mass production of automobiles extended experience. With broadened experience came wider choice in place and type of work. But the automobile did not directly enhance creativity; furthermore, the automobile was produced by the dehumanizing assembly-line methods introduced by the Industrial Revolution.

The personal computer disseminates knowledge, as the printing press did; increases productivity, as the Industrial Revolution did; and broadens experience, as the automobile did. In many applications, personal computers also reduce drudgery such as needless retyping and recalculation.

What sets personal computers apart, however, is their ability to enhance the creativity of the individual. They have justly been called "mind appliances" and "thought amplifiers." They can help us manipulate information and ideas with remarkable freedom. Rather than forcing us all to work alike under the supervision of strangers, personal computers will let us develop our own unique ways of working. Rather than requiring personal sacrifices to achieve greater social goals, personal computers will contribute to the achievement of social goals by enriching the lives of individual persons. Programs like Bill Budge's Pinball Construction Set, Bill Atkinson's MacPaint, and Warren Robinett's Rocky's Boots offer glimpses of things to come.

Will personal computers make us all geniuses or saints? No. But they will help us make the most of ourselves. That is ample reason for regarding personal computers as far more than just another major consumer item.

—Phil Lemmons, Editor in Chief



SEEQUA SHOWS YOU HOW TO GET AN IBM PC FOR JUST \$1995.

BUY A CHAMELEON BY SEEQUA.



The Chameleon by Seequa does everything an IBM PC does. For about \$2000 less than an IBM.

The Chameleon lets you run popular IBM software like Lotus® 1-2-3™ and dBase II.® It has a full 83 key keyboard just like an IBM. A disk drive like the IBM. And a bright 80 × 25 character screen just like an IBM.

But it's not just the Chameleon's similarities to the IBM that should interest you. Its advantages should, too. The Chameleon also has

an 8 bit micro-processor that lets you run any of the thousands of CP/M-80® programs available. It comes complete with two of the best programs around, Perfect Writer™ and Perfect Calc.™ It's portable. And you can plug it in and start computing the moment you unwrap it.

So if you've been interested in an IBM personal computer, now you know where you can get one for \$1995. Wherever they sell Chameleons.

The Chameleon by



**SEEQUA
COMPUTER
CORPORATION**

8305 Telegraph Road
Odenton, MD 21113

Chameleon shown with optional second disk drive.

To learn more about Seequa or for the location of the Seequa dealer nearest you, call (800) 638-6066 or (301) 672-3600.

IBM is a registered trademark of International Business Machines Corporation.



THANKS TO COMPU SERVE'S CB SIMULATOR, "DIGITAL FOX" ACCESSED "DATA HARI" AND PROCEEDED TO AN "ALTARED" STATE.

The CB Simulator, where CompuServe subscribers can access friends and influence people on 72 different channels.

Just pick your handle and get on line. From math to matrimony, there's always someone out there who speaks your language. Friends from all over the U.S. and Canada are at it 24 hours a day. Talking tech or just having fun. And if you've got a secret, just use the CB Scrambler.

That'll fool the "lurkers," those CB "see it all" who get their kicks by watching. Or you can always use the private talk mode for guaranteed one-to-one conversation.

The CB Simulator is just one of CompuServe's many electronic communications options that include a National Bulletin Board, Professional Forums and Electronic Mail. Plus, there's a world of on-line information and entertainment all for the price of a local phone call plus connect time.

You can access CompuServe with almost any computer and modem, terminal or communicating word processor.

To receive your illustrated guide to the CompuServe Information Service and learn how to subscribe, call or contact:

CompuServe

Consumer Information Service, P.O. Box 20212
5000 Arlington Centre Blvd., Columbus, OH 43220

800-848-8199

In Ohio call 614-457-0802

An H&R Block Company

AT&T Unveils Microcomputer

AT&T Information Systems introduced its long-expected IBM-compatible microcomputer in late June. The AT&T PC 6300, made by Olivetti, includes an 8-MHz 8086 processor, 640 by 400 color graphics, 128K bytes of RAM, serial and parallel ports, two 360K-byte floppy-disk drives, a clock/calendar, MS-DOS 2.11, and seven additional expansion slots for \$2810. A 10-megabyte hard-disk version is \$4985. AT&T also announced that its 3B2 and 3B5 series of UNIX computers would be available through retail channels and introduced many programs that run on the machines under UNIX System V. The AT&T PC does not use UNIX. AT&T also announced dot-matrix and daisy-wheel printers.

AT&T also introduced the Information Systems Network, a local-area network designed to link from 200 to 1920 computers. ISN uses standard twisted-pair wiring and transfers information at a speed of 8.64 megabits per second, using a proprietary "perfect scheduling" system. It costs from \$400 to \$500 per node. AT&T said it will announce a smaller network later this year.

Morrow and Visual Add UNIX-Based Multiuser Systems

Morrow, which last month introduced an IBM PC-compatible portable computer, has now unveiled Tricep, a 68000-based multiuser S-100 bus computer that uses the UNIX System V operating system. Morrow's new machine includes 512K bytes of RAM, a 16-megabyte hard-disk drive, one floppy-disk drive, and a four-user capacity for a base price of \$9000. The system can be expanded to include up to 2 megabytes of RAM, four 34-megabyte hard disks, four floppy disks, and eight users.

Visual Technology Inc. was expected to unveil an 80286-based multiuser system that uses the XENIX operating system. With 512K bytes of RAM, a 19-megabyte hard-disk drive, a streaming tape drive, and ports for six users (expandable to 16), the system will be priced in the \$10,000 to \$15,000 range. Visual hopes to sell the system both through retail channels and to other manufacturers.

Polebrook Computer Systems, Peterborough, England, says it has completed development of a 68000-based UNIX system that it says will retail for about \$2750 with a 10-megabyte hard-disk drive and 256K bytes of RAM. Polebrook is seeking a company to market the system both in the U.K. and the U.S.

IBM Speculation

IBM attended the June meeting of Committee SC-156 of the Radio Technical Commission for Aeronautics, which is studying potential hazards to airplanes by portable computers. This has fueled speculation that a battery-powered IBM portable may be in the works. SC-156 will meet again September 18-19.

Epson Brings PX-8 Notebook Computer to U.S.

Epson America Inc., Torrance, CA, announced the Geneva PX-8, the notebook computer its parent company showed at the Hannover Fair in West Germany earlier this year. The PX-8 includes an 8-line by 80-character LCD, microcassette tape drive, a Z80-compatible microprocessor, and the CP/M 2.2 operating system. MicroPro's ROM-based Portable WordStar, Portable Calc, and Portable Scheduler are bundled with the PX-8, which will retail for \$995. An optional battery-powered 3½-inch disk drive will be available for \$599. Epson will also offer a 300-bps modem, a printer, and 64K- and 128K-byte memory-expansion units.

Tektronix Announces Color Ink-jet Printer

Tektronix introduced the 4692 Color Graphics Copier, a color ink-jet printer with a resolution of 154 dots per inch. The 4692 can be used with Tektronix color-display terminals or with the 4510 Color Graphics Rasterizer, which uses an RS-232C interface to link to other computers. The 4692 Copier will be available in October for \$5995; the 4510 Rasterizer will be priced from \$4495 to \$9995, depending on memory.

(continued)

Uniform Software to Run PC-DOS Software Under UNIX

Uniform Software Systems Inc., Santa Barbara, CA, has announced the Connector, a program that allows any MS-DOS or PC-DOS software to run under UNIX. Initially, the Connector will be available for PC/IX, the UNIX version sold by IBM, but may be translated for other versions of UNIX. The program will be available in September for less than \$300.

Two New Telephone-Management Systems

Natural Microsystems, Needham, MA, was expected to announce Watson, a \$1000 telephone-management system for the IBM PC, in late July. Watson includes a 300/1200-bps modem and software to digitize voice messages so the system can be used as a telephone-answering machine. Terminal emulation and calendar software are also included.

Liberty Electronics, San Francisco, CA, announced a voice/data terminal, the Freedom 212. The \$1295 terminal includes an auto-dial 300/1200-bps modem and a built-in 25-line telephone directory.

NANOBYTES

Assimilation Process, Los Gatos, CA, has announced the Mac-Daisywheel Connection. This \$99 program allows Apple's Macintosh computer to print text using a standard daisy-wheel printer; an interface cable is included. . . . **Leading Edge Products** said it will sell a line of "Peanut" IBM PC-compatible computers beginning in late fall. . . . **AST Research** is developing a PCnet expansion card for the IBM PCjr. . . . **Teknowledge**, Palo Alto, CA, has introduced M.I., an expert-system generator for the IBM PC, priced at \$12,500. . . . **Gigabit Logic**, Newbury Park, CA, has begun shipping 12 logic and counter chips that use gallium arsenide (GaAs) instead of silicon. GaAs parts are much faster and more expensive than their silicon counterparts. . . . **Faxtel**, Toronto, Ontario, is developing software that will allow the Macintosh to be used as a NAPLPS decoder terminal. . . . **Solutions Inc.** has developed Straight Talk, terminal software for the Macintosh, to be sold by **Dow Jones** for \$79. **Apple** was expected to introduce MacTerminal in July. . . . **Advanced Storage Technology Inc.**, San Jose, CA, has announced 61- and 103-megabyte half-height 5¼-inch hard-disk drives. In large quantities, the 103-megabyte drive sells for \$1950. . . . **NEC Information Systems** announced a 55-cps daisy-wheel printer, the 8850, for \$2500, and three floppy-disk drives, including a 1.6-megabyte 5¼-inch and two 3½-inch models. NEC is also developing a \$3500 6-page-per-minute thermal-transfer printer and a \$700 HP-compatible four-color plotter. . . . **Intel** says it is shipping CMOS 256K-byte RAMs. **Motorola** will begin full production late this year. . . . The **Computer Satellite Network** hopes to offer cable programming for computer enthusiasts by late fall. . . . **Practical Peripherals**, Westlake, CA, planned to unveil an encryption device at NCC. The Data Encryption System (D.E.S.) 2000, priced at less than \$500, will attach to the computer's serial port. . . . **Xetec Inc.**, Salina, KS, will begin shipping a dual 3¼-inch disk-drive system for IBM's PCjr entry model. The \$800 unit includes a disk controller and can add a third 3¼-inch or a 5¼-inch drive. . . . **Kammerman Labs**, Beaverton, OR, is selling a 10-megabyte hard-disk subsystem for the IBM PC for \$895. . . . **Motorola** formally introduced the 68020, a 32-bit version of the 68000 microprocessor. The CMOS chip includes an on-board cache and a coprocessor interface and can run at 16 MHz. . . . **Wang** has announced a \$595 expansion card that it says makes its Wang Professional Computer fully compatible with the IBM PC. . . . **Xerox** will sell a \$795 expansion card linking the IBM PC to Ethernet. . . . **Sony** will reportedly begin private showings of a compact laser-disk read-only memory device late this summer. The drive will use the same technology as Sony's audio laser disks. . . . Keyboard maker **Key Tronic** will manufacture a version of **Display Interface Corporation's** HiFi Mouse, which uses sound to detect motion and direction. It will sell for \$65 in very large quantities. . . . **Volition Systems**, Del Mar, CA, has added a CP/M-68K version of its Modula-2 compiler. The \$495 compiler will be available next month. . . . **Telos Software Products**, Santa Monica, CA, announced FileVision, a \$195 visual database manager for Apple's Macintosh. . . . **Ricoh** introduced the LP4120, a \$14,000, 12-page-per-minute laser printer. . . . **Delphax Systems**, Mississauga, Ontario, introduced a laser printer designed to print up to 1.5 million copies per month. The \$70,000 S 6000 can print 60 pages per minute.



Integrated.

Printegrated.

Now, translate your integrated software into integrated hard copy, with the TI OMNI 800™ Model 855 printer. So versatile, it combines letter-quality print, draft-quality print and graphics as no other printer can.

It prints letter-quality twice as fast as comparably priced daisy wheel printers, yet gives you characters just as sharp, just as clear.

It prints rough drafts ten times faster than daisy wheel printers... faster than most any other dot matrix printer.

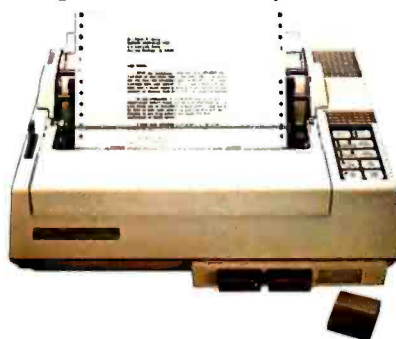
Only the TI 855 has snap-in font modules. Just touch a button; change your typestyle. The 855 gives you more typestyles to choose from than ordinary dot matrix printers. It makes them quicker, cleaner, easier

to access than any other dot matrix or daisy wheel printer.

The 855's pie charts are rounder... all its graphics are sharper than on other dot matrix printers, because the TI 855 prints more dots per inch. As for daisy wheel printers... *no graphics.*

The TI 855 Printer

The printer for all major PC's



For under \$1,000 you get twice the performance of typical dot matrix printers. Or all the performance of a daisy wheel printer, and then some, for half the price.

So get the best of all printers, and get optimum results from your integrated software. With the TI 855. See it at your nearest authorized TI dealer. Or call toll-free: 1-800-527-3500. Or write Texas Instruments Incorporated, P.O. Box 402430, Dept. DPF-182BY, Dallas, Texas 75240.

TEXAS INSTRUMENTS

Creating useful products and services for you.

™ OMNI 800 is a trademark of Texas Instruments Incorporated
Copyright © 1984 Texas Instruments Incorporated. 2763-36

“Dare to

TI makes the best software perform even better.

When choosing a computer, there are two important things to look for. Who runs the best software—and who runs the software *best*? That's why we're staging a dramatic country-wide side-by-side comparison against IBM™ called “Dare to Compare.”

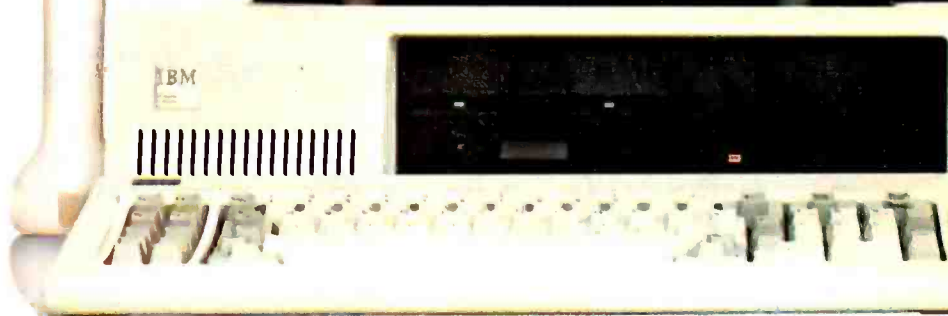
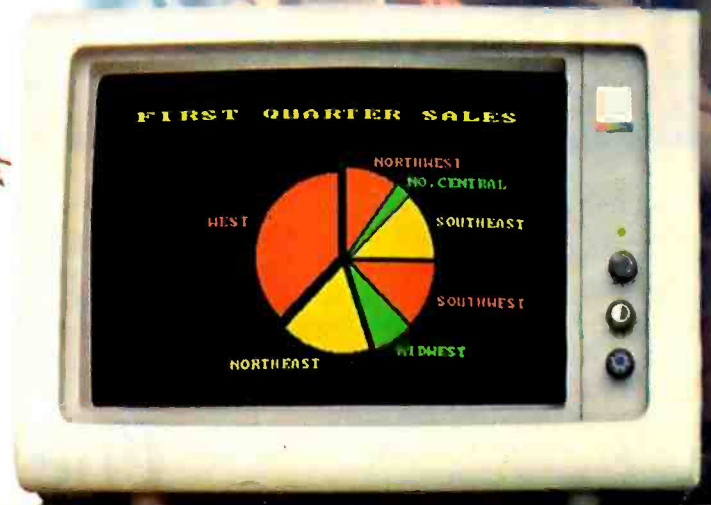
Come to a participating dealer and take the “Dare to Compare” challenge. You'll see first-hand how...

TI makes software faster to use.

Take a closer look. See how we give you more information on-screen than the IBM PC? That way you'll spend less time looking for data, and more time using it. We also give you 12 function keys, while they give you 10. Unlike IBM, we give you a separate numeric keypad and cursor controls. And that saves you both keystrokes and time. We also isolated the edit/delete keys to reduce the chance of making mistakes.

TI makes software easier to use.

TI gives you up to 8 colors on-screen simultaneously, which makes separating the data a lot easier. IBM displays only 4. Our graphics are also sharper. And easier on the eyes.



IBM Personal Computer

Compare”

And TI makes it easier to get your data on-screen. Our keyboard is simpler—it's more like the familiar IBM Selectric™ typewriter than the IBM PC keyboard is.

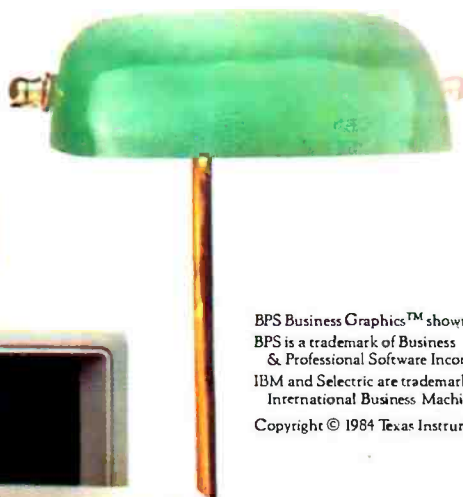
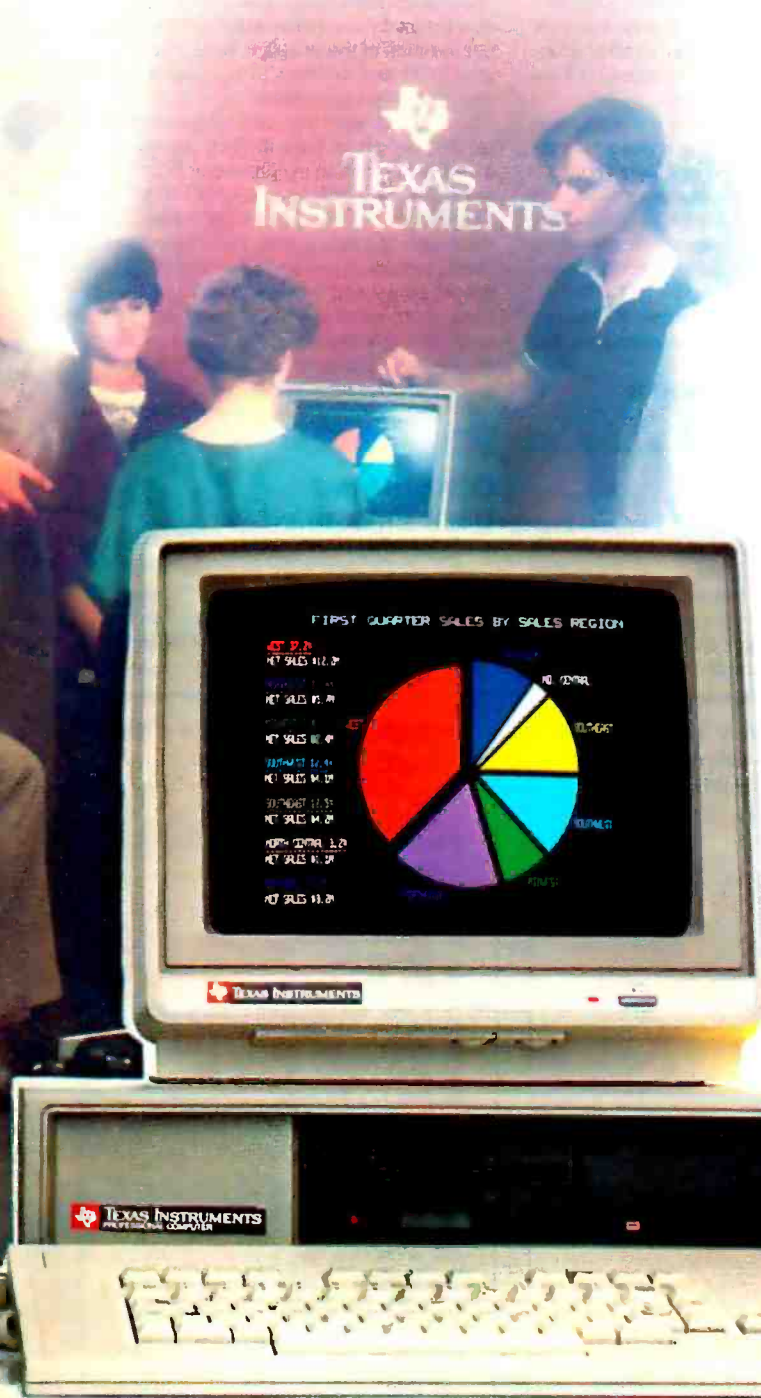
TI lets you see for yourself.

Right now, you can “Dare to Compare” for yourself at participating TI dealers all over the country. Stop in, put both machines through their paces using the same software titles, and see for yourself how the Texas Instruments Professional Computer makes the best software perform even better.

For the name of a participating dealer near you, please call TI toll-free at 1-800-527-3500, or write: Texas Instruments Incorporated, P.O. Box 402430, Dept. DCA-232BY, Dallas, Texas 75240.



**TEXAS
INSTRUMENTS**
Creating useful products and services for you.



BPS Business Graphics™ shown.
BPS is a trademark of Business & Professional Software Incorporated.
IBM and Selectric are trademarks of International Business Machines, Inc.
Copyright © 1984 Texas Instruments

Texas Instruments Professional Computer

DTC 2763-69-R1

LETTERS

IN PRAISE OF APL

I read G. T. Huxley's article "Calculating Overhead Costs by Computer" (February, page 416) with great interest. I was well written, with a good blend of history. It would be a fair program, I rather like. The article did leave the reader a bit with the statement on page 423 "In APL, the procedure is straightforward." Indeed, that is true. It is unfortunate that Dr. Huxley did not demonstrate this. Consequently, I have picked up the challenge I am enclosing the APL function that generates the same numeric data for the least BASIC program or the least spreadsheet approach does.

The first step of the spreadsheet solution is to compute the set of four equations on page 416. A set of four equations in four unknowns. Spreadsheet will put these into standard form. Thus if you desire, I on the main diagonal of the matrix of distribution factors, it becomes the matrix of coefficients for the set of linear equations. Negating the initial values makes them the constants for the set of linear equations. Thus, in APL, the expression that produces the answer is simple:

```
(-RIVAL VALUES) ÷ DISTRIBUTION
```

Listing 1 (presented here) is an extended APL function that will accept the initial approximate values and the distribution matrix and produce the data in the form of table 3 on page 423. I did this on my IBM PC using IBM's PC APL.

It is unfortunate that many of the computing community is not aware of this powerful general-purpose programming language. There are at least five different APL implementations of APL on the IBM PC. I believe that APL is the most powerful general-purpose programming language currently available on microcomputers.

Richard D. Poznic
Rugbytown, NY

THE SIEVE BENCHMARK ON A HEATH H-80

After reading "SIEVE APL/PC" and IBM PC APL, two APLs for the IBM PC (March, page 145), I decided to put my machine to the test and run the Sieve program in Listing 2. I used a Heath H-80 with CP/M 3.23 and Microsoft BASIC. I modified the program slightly to provide indications of error and completion, and to automatically repeat the program. Running

my version (bearing 2, presented here) and able to obtain results averaging 294.51 seconds per iteration of the program. Note that my program is longer. It tries to be consistent with the benchmarks presented in DTTC.

Needless to say, I was surprised to obtain the results I did. I have been thinking about adding a FORTRAN upgrade to my microcomputer. I am using a stock 3-MHz machine. If I were to do so, my only real machine would not keep with the mighty Big Blue and its 10-MHz powerhouse. I had considered purchasing an IBM PC clone for my computing needs, but now I believe I'll hang on to what I've got. Thank you for the enlightening article and also for sending my already-arrived-in-the-UK CD-ROM Microsoft BASIC and Heath.

Frank H. Rowlett
Redignon, NC

QUANTIFYING USER FRIENDLINESS

Thank you for William J. Rubel's article "A Professional's Perspective on User-Friendliness" (May, page 116). His equation for quantifying

(continued)

Listing 1: An APL adaptation of a BASIC program for determining the initial value set attached among the four departments of a hypothetical company. The function accepts the initial approximate value and the distribution matrix and produces data in the form shown in table 3 on page 423 of the February DTTC.

FUNCTIONS

```
Ⓜ 3←RNT NUMBER DEPT.
Ⓜ 4←INITIAL DEPT. COST SET
Ⓜ 5←DISTRIBUTION FACTORS AS A MATRIX
Ⓜ 6←COST INITIAL ROW=10
Ⓜ 7←DEPT. WITH
Ⓜ 8←(ROW) TOTAL EXPENSE DEPT
Ⓜ 9←LAST ROW NET EXPENSE DEPT
Ⓜ 10←NET OF THE ROW ARE THE DISTRIBUTED EXPENSES
Ⓜ 11←OF EACH DEPT TO EACH OTHER DEPT(S)
Ⓜ 12←LAST COST INITIAL DEPT COST SET I.E. INT
Ⓜ 13←
Ⓜ 14←PUTTING 1 ON EACH DIAGONAL OF P
Ⓜ 15←T←OP←1/OP
Ⓜ 16←TOTAL EXPENSE DEPT
Ⓜ 17←I←INT
Ⓜ 18←DEPT INDIVIDUAL DISTRIBUTIONS
Ⓜ 19←T←OP
Ⓜ 20←BOLD OUTPUT MATR
Ⓜ 21←I←INT
Ⓜ 22←I←INT
Ⓜ 23←I←INT
```

Listing 2: A modified version of the Sieve of Eratosthenes program.

```
1 FOR I=3 TO 0.1/STEP 1
2 FOR J=1 TO 0.1
3 NEXT J
4 PRINT "IS" ("O")
5 NEXT I
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
```


FIND A COMPUTER THAT'LL OUTPERFORM OURS AND WE'LL GIVE YOU A HEADSTART.TM FREE.



If you can find a microcomputer, equally priced or less, that'll beat only half of 10 standard features we've selected on our HeadStart Model 512, we'll give you a HeadStart absolutely free. How can we make this incredible offer? Because looking for a better computer than our new HeadStart is like looking for a needle in a haystack. You're more apt to come up with a case of hay fever:

HeadStart is simply the fastest, smallest, most powerful business computer in its class. Period.

In fact, we're so certain we have an unbeatable machine, we're offering you this challenge. If, by some inconceivable circumstance, you *should* find a business computer that is even equal to ours, we'll give you a HeadStart. Absolutely Free.

If you'd like to accept our challenge and learn more about this small wonder of microcomputer technology we call HeadStart, call us or fill out and return the coupon.

You could come up with a free HeadStart, which is nothing to sneeze at.

**HERE'S YOUR CHANCE TO WIN
A FREE COMPUTER AND GET A
HEADSTART ON THE COMPETITION.**



Intertec, Dept. "HeadStart"
2300 Broad River Road, Columbia, SC 29210
Phone: 1-803-798-9100

I accept your challenge. Please send me details on how I can beat the HeadStart VPU 512.

HeadStart sounds terrific. Tell me more.

Name _____

Title _____

Company Name _____

Phone _____

Address _____

City _____

State _____ Zip _____

intertecTM

MidWest Micro-Peripherals

Save with Confidence

Let us earn your trust
as we have that of others:
Goodyear • General Motors • US Navy • Bell Labs
Conrail • Texas A&M University • General Electric
and General Dynamics

	List	Our Price
PRINTERS		
StarGemini 10X (120 CPS)	\$399.00	\$269.00
Star Gemini 15X	549.00	419.00
Star Delta 10 (160CPS)	549.00	399.00
Star Delta 15	795.00	589.00
StarRadix 10-15	\$CALLS	\$CALLS
Epson RX 80 (100 CPS)	399.00	269.00
Epson RX-80F7 (100CPS)	499.00	349.00
Epson FX 80 (160CPS)	689.00	489.00
Epson LQ 1500 (200CPS)	1395.00	1299.00
Okidata 92P-80Col. (160CPS)	599.00	429.00
Okidata 82A-80 Col. 120CPS	349.00	319.00
Okidata 93P-136 Col. 160CPS	999.00	649.00
Pacemarc 2350P-350CPS	2695.00	\$CALLS
Pacemarc 2410P-350CPS	2995.00	\$CALLS
Riteman Portable (Epson Compat.)	399.00	279.00
DAISYWHEEL PRINTERS		
SilverReed EXP 400	399.00	299.00
SilverReed EXP 500 16CPS	599.00	459.00
SilverReed EXP 550 19CPS	699.00	539.00
SilverReed EXP 770 36CPS	1295.00	859.00
Juki 6100 18CPS. Bi-dir	599.00	439.00
Daisywiler 2000 40CPS	1495.00	998.00

SOFTWARE			\$CALLS and \$SAVES
Lotus 1-2-3	Think Tank	And Other	
dBase	Multimate	Popular Titles!	
Quickcode	PFS		

DISK DRIVES FOR IBM PC OR XT		
All Drives Pretested With Complete Instructions.		
Panasonic Half Heights (2 or more)	279.00	159.00 ea
Panasonic Drive Kit	599.00	329.00
(Complete hardware & instructions)		
Tandon 100-2 (IBM Standard)	399.00	199.00
Maynard-10Meg Internal	1395.00	998.00
(Hard drive complete kit - software included.)		

VERBATIM DISKETTE SALE		
SS/DD	10-90	100-Ub
DS/DD	1.79	1.59
	2.39	2.19

MODEMS		
Smartmodem 300	289.00	219.00
Micromodem 11e	299.00	229.00
Smartmodem 1200	699.00	489.00
Smartmodem 1200B	599.00	419.00
Smartcom 11		\$CALLS

MONITORS		
Amdek 310-A	230.00	199.00
Amdek Color II	529.00	459.00

MEMORY SPECIALS		
Memory chip kit-64K,200ns-9chips	99.00	54.00

EXPANSION CARDS		
AST		
Six Pac Plus, 64K, S/P/C+S/W	395.00	269.00
Megaplus II, 64K, 2S/P/C	495.00	269.00
VO Plus II	215.00	129.00
Complete AST Line		\$CALLS

QUADRAM		
Quadboard, Expandable 384K	295.00	199.00
Complete Quadram Line		\$CALLS

HERCULES		
Graphics Card	449.00	339.00

IBM PC SYSTEMS

Will configure to your needs
for PC's, XT's and Jr's.
Save on complete systems
Ask for ext. 20!



OUR PRICE COMMITMENT
MidWest will try in good faith to beat
any nationally advertised price.

Call Today!
1-800-423-8215
In Ohio 1-800-321-7731
Information - Ordering

We accept VISA and MASTERCARD (Add 3%).
certified checks, money orders, and COD's.



MidWest Micro-Peripherals
(Division of Intelco, Inc.)
135 South Springfield St.
St. Paris, Ohio 43072

AD #B-105

LETTERS

user friendliness is a noble attempt to take an advertising slogan and make it a tool for better program design.

However, I would like to point out that in his example (Standard PC versus Script versus Lisa) he uses Script to imply a command that will correctly do exactly what a user wants with no additional decisions by the user. Essentially, this means that any variation in the task performed would require that an entirely new Script be produced or the user would be required to resort to the underlying command structure. Neither of these would be acceptable with Mr. Raduchel's assumption that $P_0 = 1.0$ (that the user will always pick the right action). Therefore the Script case is the theoretical maximum—that one command is all the user needs to consider. Mr. Raduchel's results do indicate an approachable goal, though—to make frequently used sequences available as a single command.

The inclusion of Script (or macros) into another command (either Standard PC or Lisa cases) seems to be logical. Before looking too closely, I would like to define the cases. Standard PC is used to indicate a system where the user initiates all information transfer. If the user wants to move a file but does not remember the name or how much room is on the disk, he or she must ask for a directory. The Lisa approach implies that the system will supply the user with the necessary information at the time and location it is needed. Although this definition is simplified, it describes the fundamental difference between Script and Lisa. Windows and icons are used in a Lisa-type approach because of the large volume of different information displayed at the same time. In essence, windows are simply organized groups of information, displayed together and manipulated as a unit. And if a picture is worth a thousand words, an icon must be worth a dozen or so.

But both Lisa and Script approaches can support macros. Neither approach has any inherent limitation to prevent it from taking advantage of macros. In fact UNIX assumes that a shell (in effect, macros) will be used in an application environment. I also agree with Mr. Raduchel that the Lisa approach, if properly supported with hardware and consistent throughout all applications, will produce higher user friendliness than the Standard PC approach. Therefore, it would seem logical to conclude that a shell, similar in concept to a UNIX shell and optimized for each type of application, coupled with a Lisa-like environment, would produce the most user-friendly programs.

J. L. MAHOWALD
Overland Park, KS

COMPUTERS AND LAWYERS

I am a subscriber to, and regular reader of, your excellent magazine. I would like to comment on Robert P. Wilkins's article "How Lawyers Can Use Microcomputers" (May, page 160).

I am a practicing attorney who is knowledgeable about office-automation issues and the computer marketplace. I know Mr. Wilkins's works well. He is an acknowledged authority

and leader in the automation area of the legal industry.

However, we differ philosophically in a key area. In his first paragraph, Mr. Wilkins states that lawyers do not need to know terms such as RAM, bps, . . . and other foreign, often unnecessary technical terms. All lawyers need to know is how computers can improve the efficiency of a legal practice."

To the contrary, the road to efficient and proper use of computers in law offices must start with lawyers and staff members having a good understanding of the new buzzwords. How else can a lawyer feel confident when walking into a computer store? You must know if 64K bytes of memory is enough, what disk drives are for, whether a hard disk is necessary, what programs are for and what they do, etc. There is no substitute for this basic education.

Lawyers are intimidated by this new world and knowledge of these words will get things going. Mr. Wilkins discussed database-management systems for lawyers, including dBASE II. I am told dBASE II is complex and requires a great deal of expertise to use. How can a lawyer use this product without knowing terms such as bits, bytes, etc.? Even using search techniques on databases is easier if you understand what a database is, how it is compiled and stored, and what the rationale is for the search methods.

Electronic mail also has its tricks and problems. The American Bar Association has gotten off to a slow start with its electronic mail network. I believe the reason is that lawyers are intimidated because they don't understand this new technology. Further, to use electronic mail, you'd better know what a modem is and how to use it.

It wouldn't be a bad idea for lawyers to subscribe to BYTE for its technical tutorials and educational materials. Lawyers must know something of computer technology and terminology.

There is another reason lawyers must learn about this new technology. Our clients are involved with computers at every level. How are we to serve our clients if we do not understand what they do or what they are telling us? How can we discuss a source-code escrow if we don't know what source code is, why it's important, and how it differs from object code?

Mr. Wilkins and I do agree 100 percent on one issue. Computers are indeed the most significant change in the way the law is practiced since the invention of the telephone and the typewriter.

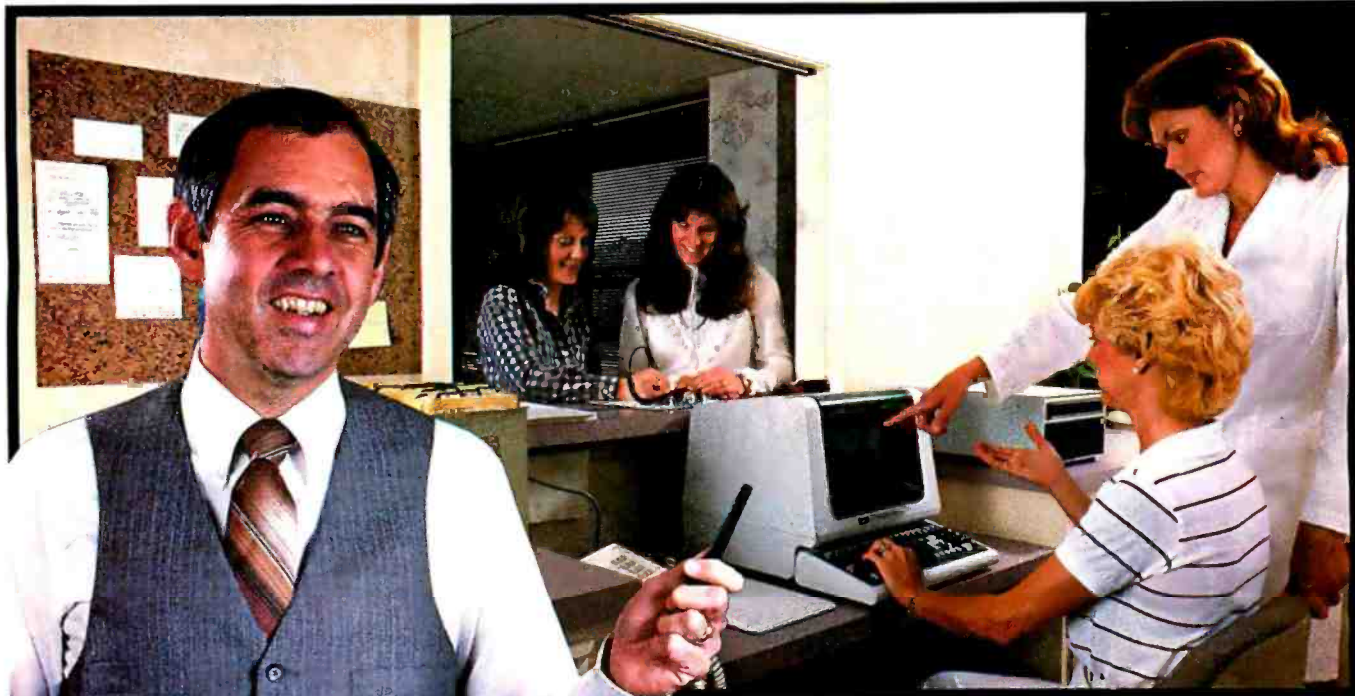
PAUL BERNSTEIN
Chicago, IL

COMPUTERS AND DOCTORS

I found George Zucconi's article "A Computer in the Doctor's Waiting Room" (May, page 108) very interesting. Programs such as his are useful for providing patients with information that they might otherwise not "bother the doctor with."

However, it cannot be overemphasized that such a computer program is not a substitute for consultation with a physician. In particular,

(continued)



“We sell IBC computers because it’s the best way to attain a low cost, high performance multi-user system.”

Roger Scaggs
President, APS Systems, Inc.
Dallas, Texas

“APS is the nation’s leading supplier of medical office management systems, serving over 1,000 practices in 30 states.

Most of our customers require more than a single-user desk top system. They need a good, fast multi-user computer without a minicomputer price tag.

We looked at many of the so-called low-cost “Supermicros” running UNIX™ but decided to continue selling **IBC-OASIS™** computers. UNIX requires a lot of horsepower to run well, and the low cost UNIX systems did not have the performance to do our customers job to our satisfaction.

APS sells high performance systems based on the OASIS multi-user operating system. OASIS provides all the features that you find on a good minicomputer multi-user operating system. OASIS is user friendly and performs very well on low cost multi-user systems.

At APS, we have selected **IBC** for our customers, because they provide a computer that allows us to efficiently run up to 16 users with our OASIS software.

Do you want a multi-user system which has hundreds of applications already available? Do you want to sell user friendly, low cost, multi-user computers that outperform the low end UNIX systems? Then I suggest you contact **IBC** immediately.”



IBC/Integrated Business Computers is the leader in multi-user technology. To find out more about the company, its products and support, please call or write:

OUTSIDE THE USA

IBC / Integrated Business Computers

21621 Nordhoff Street
Chatsworth, CA 91311
(818) 882-9007 Telex No: 215349

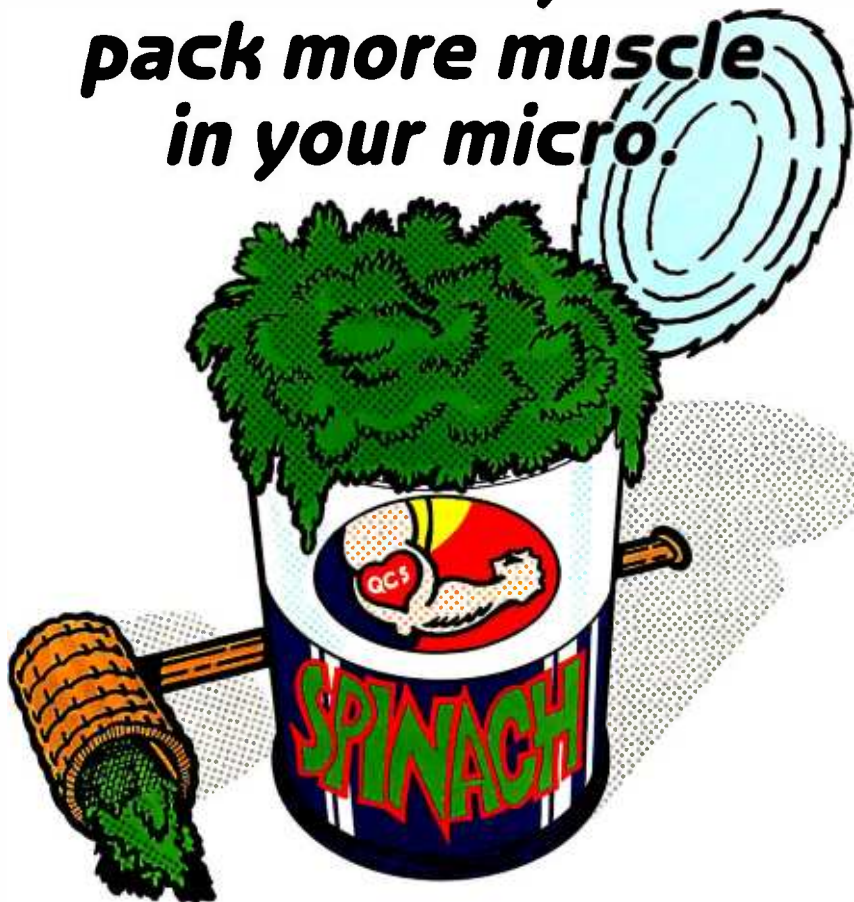
WITHIN THE USA

IBC / DISTRIBUTION

1140 36th Street, Suite 212
Ogden, Utah 84403
(801) 621-2294

UNIX is a trademark of Bell Laboratories
OASIS is a trademark of Phase One Systems

There's a better way to pack more muscle in your micro.



The HarDrive™ by QuCeS. More bytes for your buck. In a flash.

If you're looking for a way to get more performance out of your microcomputer, look no further than QuCeS.

With a QuCeS HarDrive subsystem, you can make your micro behave almost like a mainframe. 10 to 114 megabytes of mass storage lets you handle data bases that would make the normal micro blow a fuse. And you can access, update and process data so incredibly fast, you won't believe your eyes. A QuCeS HarDrive with an optional 5 megabyte backup cartridge, also means you won't have to rely on a very unreliable storage medium for your crucial data—namely floppy disks—ever again.

Another QuCeS plus is compatibility. It interfaces with most popular microcomputers like IBM, Radio Shack, Apple, DEC, Epson—you name it. Installation couldn't be easier, our software is easy to use, and each HarDrive is backed by a 1-year warranty.

The QuCeS HarDrive. It will make your micro mightier and faster than ever before.

For complete details, contact

Quality Computer Services



3 Quces Drive, Metuchen, N.J. 08840 (201) 548-2135
TELEX 299410 QCS



LETTERS

drugs for diabetes, hypertension, and acne, as well as related medications, are not covered in Dr. Zucconi's program, *Drugs in Pregnancy*.

SAMUEL NEFF, M.D.
Narberth, PA

PROGRAM COMMENTS

I enjoyed the article "Using Comments to Aid Program Maintenance" by Richard A. Thomas (May, page 415), and I think that an article that attempts to demonstrate some good (and bad) commenting techniques would also be useful. I have found that the usual reason for bad comments is that the programmer doesn't know how to do it any better. My company has developed fairly rigid standards regarding code and documentation, and we avoid some of the problems stated in the article by stressing that you can't move on to a new project if no one else can maintain your old one.

We consider the most useful comments to be the program and subroutine headers. Our program headers contain the name of the program, the system it belongs to, the name of the programmer, a complete revision history, and a brief description of the program's function. Our subroutine header contains the name of the subroutine, a description of the subroutine's function, and the input and output parameter details. These headers seem to be the biggest help to a maintenance programmer and we insist that they be kept up to date at all times.

D. P. KERKHOFF
Orlando, FL

DEAR THIEVES

Judging by the letters and articles in microcomputer publications, the controversy over software piracy seems to have died down recently. However, from my own experience I feel that it is as much a problem as ever and is merely reaching the level of general acceptance. Let it arrive at that point and doom us forever to the curse of sophisticated and costly protection schemes. I submit the following:

An open letter to software pirates:

I am constantly amazed at a practice so prevalent among microcomputer owners that a person who does not participate in it is almost considered a freak. I refer of course to the practice commonly referred to as software piracy. I prefer, however, to call it by its correct name—software THEFT. I am not referring only to those who copy software for profit or underground distribution, but to anyone who copies copyrighted software they did not purchase. The law is clear on this point. You have the legal right to copy software you have purchased for your own use. Any other copying, even if you give, not sell, the copies to friends, school, users groups, or anyone else, is *illegal*. In spite of this, I know people who would not think of violating the 55-miles-per-hour speed limit but freely and frequently copy copyrighted software from

(continued)

Meet the Standard.



AST SixPakPlus™ has set the standard 100,000 times.

We have manufactured and shipped more than 100,000 SixPakPlus multifunction boards in less than a year — an event that proves quality and quantity are compatible.

Important as it is, quality is just one factor that has made SixPakPlus the most popular, most respected multifunction board available today.

Performance is another. SixPakPlus provides IBM PC, XT, and compatibles users with an ideal combination of enhancements:

- Run sophisticated software programs and process more data with an additional 64K to 384K RAM memory capability.
- To add peripherals such as printers, modems, mice, plotters or joysticks, we give you more Input/Output ports—serial, parallel and optional game adapter.

Circle 5 on inquiry card.

- More convenience, thanks to a built-in clock-calendar that provides automatic time and date stamping.
- More productivity with SuperPak™ utility diskette including SuperDrive™, PC World's User Survey award-winner, that works like a drive but fifty times faster—and SuperSpool™ so you can print and input at the same time.

Quality extends to documentation, too. SixPakPlus is one of the easiest hardware/software packages to install and operate.

And, with our new audio cassette, you don't even have to crack our manual to learn how to take full advantage of SixPakPlus' features and functions.

Meet the standard for multifunction enhancement boards in person. Get a SixPakPlus from a dealer near you. SixPakPlus is a member of the complete AST family of multifunction boards, Micro-to-Mainframe communications, LAN and graphics products.

Contact:

AST Research Inc.
2121 Alton Avenue
Irvine, CA 92714
Phone: (714) 863-1333
TWX: 753699ASTR UR



*IBM PC and XT are registered trademarks of International Business Machines.

AST

RESEARCH INC.

AUGUST 1984 • BYTE • 19

WANTED



SOMETHING TO RELIEVE THIS MESS!

If you've ever found yourself searching for a calculator, notepad or appointment book when you've got a computer right in front of you, then you know the absurd situation we're illustrating.

Sure, there are clumsy little programs you can boot up to accomplish one or the other of these tasks . . . but that's generally meant first stepping out of the software you're working with.

What's always been needed is one powerful piece of software, occupying only a few K, that would be tucked away in an unused part of RAM no matter what program you're running.

Whether you were running dBasell, Lotus 1-2-3, WordStar or even Turbo Pascal® . . . it would always

be ready for lightning-fast use. You could just hit a button and open a window for a notepad, another for a calculator. Hit the button, again, and your work would be saved to disk and you'd be right back in your original software!

While we're at it, it should also have a perpetual calendar linked to a datebook. And even an autodialer, with a built-in phonebook.

Is this piece of software possible? At a price you can afford . . . now?

WANTED DELIVERED

Something totally new in applications software from Borland, the folks who make Turbo Pascal®

JUST A KEYSTROKE AWAY...

NO MATTER WHAT SOFTWARE YOU'RE RUNNING!

- A CALCULATOR
- A NOTEPAD
- AN APPOINTMENT CALENDAR
- AN AUTO DIALER
- AN ASCII TABLE
- AND MUCH MORE

ALL AT ONCE... OR ONE AT A TIME.

ANYWHERE ON THE SCREEN YOU LIKE.

ANOTHER KEYSTROKE, AND YOU'RE RIGHT WHERE YOU LEFT OFF IN YOUR ORIGINAL PROGRAM!

(you never really left!)



SIDEKICK®

INTRODUCTORY OFFER

\$49.95

Available only for the IBM PC, XT, jr. and Compatibles.

SIDEKICK

NOW... Whether you're working in dBaseII, Lotus 1-2-3, WordStar or whatever... You'll have your SIDEKICK®, too!

Something brand new. Crafted in Assembly language as carefully as Borland's famous Turbo Pascal®, so that it's lightning-fast and as compact as only Borland knows how to make it! With a notepad that has a full-screen editor that saves your notes to disk. You can even swap information back and forth between your applications software and your Sidekick.

Suppose you're working with a spreadsheet, and you suddenly have an important idea. Just hit the button, a window opens, you write the note and hit the button again. You're right back where you left off in the spreadsheet.

Need to make a phone call? Whether the number is in an existing database, your own Sidekick phone directory, or you've just typed it on the screen... put the cursor next to the number, hit the keystroke, and Sidekick dials for you!

There's lots more, too. You can move the Sidekick windows anywhere on the screen you like. And you can have as many on screen at a time as you need.

We designed it because we needed it. If you've ever been writing a report and needed to do a quick calculation, or jot down a note, then you understand why.

*Only with Hayes Smartmodem and compatibles.

YOU CAN ORDER YOUR COPY OF SIDEKICK® TODAY!

For Visa and MasterCard orders call Toll Free **1-800-227-2400 ext 953** in California **1-800-772-2666 ext 953** (lines open 24 hours, 7 days a week) Dealer and Distributor Inquiries Welcome 408-438-8400

SIDEKICK® \$49.95

(plus \$5.00 shipping and handling • Shipped UPS)

Check Money Order
VISA MasterCard

Card # _____

Expiration Date _____

Please be sure your computer is an IBM PC, XT, jr., or true compatible!

NAME _____

ADDRESS _____

CITY/STATE/ZIP _____

TELEPHONE _____

California residents add 6% sales tax. Outside U.S.A. add \$15.00. (If outside of U.S.A. payment must be by bank draft payable in the U.S. and in U.S. dollars.) Sorry, no C.O.D. or Purchase Orders. S D15

BORLAND INTERNATIONAL

Borland International
4113 Scotts Valley Drive
Scotts Valley, California 95066
TELEX: 172373

Circle 40 on Inquiry card.

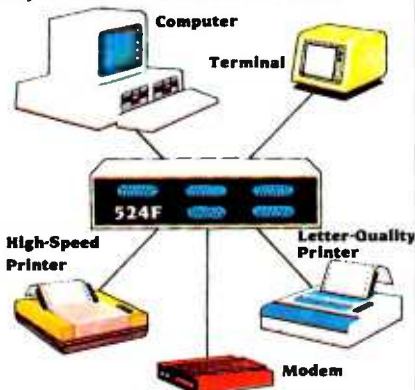
dBase II is a trademark of Ashton-Tate, WordStar is a trademark of MicroPro, Lotus 1-2-3 is a trademark of Lotus Development Corporation.

affordable & reliable...

NETWORKING



Networking begins with your fine computer. Where it goes is unlimited when you interface your peripheral devices with a 4, 8 or 18 port BayTech Serial Port Expander. With BayTech's units you can mix-and-match other computers and/or peripheral devices of different configurations without the need to reconfigure. Port configuration of the peripheral device ports may be changed by the user with BayTech's menu-driven software.



BayTech's versatile networking multiports, capable of any-port-to-any-port interconnection, have virtually unlimited applications. With their features and low cost, the user can create a local network providing simultaneous communication for 5, 9, or 18 RS-232C devices.



A few companies make a good, expensive Serial Port Expander. One company makes an excellent, affordable line of them - BayTech.

- Model 524F \$ 329.
- Model 528F \$ 619.
- Model 5218F \$1750.

"We design and price BayTech Multiports so everyone can have an affordable and reliable computer network. To solve your networking problems, call us."

Charles R. Ramsey, President
Bay Technical Associates, Inc.

1-800-523-2702

BAY TECHNICAL
ASSOCIATES, Inc.

HIGHWAY 603, P.O. BOX 387
BAY ST. LOUIS, MS 39520 18011 467-8231

LETTERS

others or to give to others.

I have heard and read more rationalizations for this practice than I could possibly list. They are just that—rationalizations of those who must make excuses for their actions. One of the most common I hear is "software is overpriced." To that I say, if you absolutely cannot live without a piece of software then, whatever its price, it is worth it to you to pay it. Otherwise, don't buy it, don't copy it, and don't use it. If it truly is overpriced and people do not buy it or use it, the price will come down or it will disappear from the market. We should encourage and support such software publishers as A.P.P.L.E., Penguin, Beagle Bros., and others who have chosen to reduce their costs and their prices by not copy-protecting their software. These publishers sell top-quality software for reasonable prices. I encourage you to buy and use their products, but please do not rip them off by stealing their software.

For those of you whose only ethical standard is "it's OK if I don't get caught," I don't expect to make much of an impression on you. You are right about one thing: if you don't sell bootlegged software you probably won't get caught. But I am writing this to those of you who hold to some form of ethics or morality that says it is wrong to steal, whether or not you might get caught. Consider what you are doing when you accept or give copies of copyrighted software: consider the example you are setting for your children and friends. You are stealing, regardless of your rationalizations to the contrary.

Just because software piracy does not receive the press attention it once did does not mean that it is no longer a problem. In reality, it is bigger than ever as more and more people buy computers. I don't expect that this letter will make much of a difference in the overall problem, but if a few who may be unwittingly copying software accept the reality of what they are doing and refuse to continue the practice, then it is worth it.

WILLIAM G. WRIGHT
Oceanside, CA

RECONFIGURING PERFECT WRITER COMMANDS

Recently, I bought a Kaypro 2 computer to use primarily for word processing. After looking through the manuals, I decided to use the Config program provided to program the number keys to replace many of the Control-X commands in Perfect Writer. I thought it would be nice to replace three- or four-keystroke commands with one-keystroke commands. I quickly found two problems. First, the documentation is terrible. No instructions are given to explain how to use the Config program with Control or Escape sequences. Second, once I found the necessary information in the Perfect Writer manual (which is also terrible), it turned out that the hexadecimal codes for these commands are all three characters long, which will not work with the Config program.

I finally worked out a way of doing everything I wanted. Perhaps it is not the easiest way but

it does work, and I thought many of your readers who own Kaypro 2s would be interested. The process follows:

1. Copy the following files onto a blank formatted disk from the Perfect Writer Installation disk: PWBIND.COM, FUNCTS.TXT, PWSYM. Copy the following files onto the same disk from the Perfect Writer Edit disk: PW.COM, PWSWP, PW.HLP.

2. Edit the-FUNCTS.TXT file by typing PW FUNCTS.TXT at the A > prompt. Then, pick out any 14-line section of FUNCTS.TXT that consists of all unknown commands and whose hexadecimal codes are two characters long. Numbers 161-174 are ideal since the corresponding hexadecimal codes are A1, A2, A3, . . . , AD. Find in the Perfect Writer manual the printout of FUNCTS.TXT and the commands you want. Then replace just the items in the third and fourth columns of each line (161-174) with the commands you want. When done, save the edited version with Control-X, Control-S, then exit with Control-X, Control-C.

3. Call up PWBIND.COM by simply typing "PWBIND" at the A prompt. PWBIND will do the rest.

4. Next, copy PW.COM, PWSWP, and PW.HLP back to the Perfect Writer Edit disk. The commands corresponding to the lines you edited will now work. (If you use Perfect Speller, it will be necessary to copy these to the Perfect Speller disk, too.)

5. Next, put the new PW Edit disk into drive B, and the CP/M disk into drive A. Then, at the A > prompt, type CONFIG. Choose number 4 from the menu (change the number pad) and then number 2 to actually change them. Then enter the new hexadecimal codes into the chart (if you used 161-174 then the next hexadecimal codes will be A1-AD) in accord with your wishes (a hand-drawn chart comes in handy). Then press Esc twice, then answer Y when asked if you want to keep the changes made.

6. Finally, put the reconfigured Edit disk in drive A, and then push the reset button. After this, the number pad will be reconfigured the way you want it.

Although there are a number of steps involved here, this procedure is not difficult. It is unfortunate that both Kaypro and Perfect Software chose to make this all sound so difficult in their manuals. However, once it is done, life with Perfect Writer is much nicer.

I find it convenient to have a STAT file on the same disk as my word-processing software. This is no problem on WordStar because there is plenty of room left on the disk. However, on the Perfect Writer disk there is all of 1K byte left. The PW.HLP file is exactly the same length as STAT.COM, though, and, since I never use the on-screen help feature, I erased it from the Edit disk (I did save it on the PW LESSONS disk) and copied STAT.COM to Perfect Writer. This allows me to know the remaining space on a disk without changing to the CP/M disk.

BARRY D. SMITH
Carbondale, IL

LETTERS

A CALL FOR QX-10 SUPPORT

I am the owner of an Epson QX-10 with an MX-80 FT as well a Comrex CR-11. I purchased this primarily for business use and am happy with it except for one thing. There is virtually no one putting out any educational software to use under the CP/M-80 operating system. I realize that the QX-10 is relatively new but CP/M isn't. Why don't the good educational-program writers who work for Atari and Apple understand that CP/M system users have children who could benefit from such software?

And what about all those ingenious add-on board builders? Why hasn't someone made one that will run Apple and IBM PC programs on the QX-10?

DAVID M. BOYD
Tampa, FL

SUPERMICROS

I would like to suggest that technology has advanced enough to warrant a shift of focus for "the small systems journal."

Many of the articles in BYTE seem to be pitched to the level of systems with a 6502, 8088, or 8086 central processing unit. But there are a number of "small systems" on the market using 68000s and calling themselves supermicros. I have been following the product announcements of Cadmus, Pixel, Callan, and Wicat for a while, hoping that I might win the state lottery so I could buy one. Actually, given another year or two, I might be able to afford a supermicro without the lottery. But now my interest has been aroused by the appearance of 32-bit "supermicros."

DEC has announced its Microvax, and now AT&T is about to market its 3B2/300. Both of these are true 32-bit machines and yet they are being promoted as small systems, i.e., not quite minicomputers. At this point, all I know is that I would like to own one of these machines, without knowing what they could offer me. One of the things I'm looking for is the capability of doing graphics more on the level of computer-aided design than pie charts, but AT&T tells me that the 3B2 doesn't support graphics as yet.

So now I want to suggest that BYTE extend its coverage of slightly more sophisticated machines. Before you object that none of your readers can afford these machines unless they have a healthy business going, let me mention that I am an individual without such a business who will probably buy a 68000-based system running UNIX, and who is very interested in reading about and learning more on the generation of 32-bit microcomputers.

JAY STEINBRUNN, PH.D.
South Hadley, MA

REQUEST FOR HELP

I recently bought a Radio Shack Model 4 and now I need help with some conversions from my old Model 1.

First I would like to know if anyone knows what patches must be applied to Microsoft's muMATH for the Model 1 to make it run on a Model 4 (either in Model III or Model 4 mode).

I would also like to know where I can buy a disk-controller board so that an 8-inch disk drive from my old Model 1 will run on the Model 4. I want to use the 8-inch drive with three 5¼-inch drives under DOSPLUS 3.5, DOSPLUS IV, NEW-DOS/80 (Model III mode), Montezuma MICRO CP/M version 2.2, and Radio Shack CP/M version 3.0.

JAMES R. PRIMM
Paris, MO

A SUBSCRIBER COMPLAINS

I look forward to the delivery of my BYTE each month because I enjoy it and it is a method of keeping up with my peers who also subscribe to BYTE. My complaint is in regard to my perceived view of your mailing practices. My last name is Zehnder and I work with a gentleman whose last name is Anderson who is also a BYTE subscriber. We live within 30 miles of each other. I have noticed that over the last several months he has received his issue of BYTE four to five days earlier than I.

At this point I would like to note two features of BYTE magazine: it is of broad interest and substantial content, i.e., it has a large physical structure (my wife still thinks it's a catalog); and it has a large subscription base because it is a leading reference magazine in the computer field (everybody gets it). These two features lead me to believe that McGraw-Hill has trouble mailing all of one month's issues on the same day.

My conclusion is that McGraw-Hill makes their monthly mailing over a period of about one week with the output sequenced alphabetically.

I feel that you are discriminating against those whose last name begins with a letter toward the end of the alphabet.

If BYTE is an influential information source, which I believe it is, then I think that the practice of mailing alphabetically means that those whose names begin with the letters "A," "B," or "C" rise in corporate structures faster in relation to their current information sources. I don't have the resources to perform a meaningful study to substantiate these assumptions, but the results of such a study would be interesting.

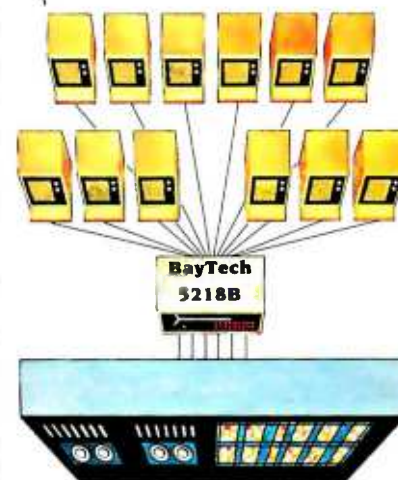
If BYTE is discriminatory in its mailing practices and if it is influential, then it is leading people whose names begin with something other than "A," "B," or "C" to take one of two actions: they can do nothing but also not rise in the corporate structure due to their lack of timely information; or they can inform BYTE that their "mailing name" is Aardvark or Aaron or the like. The second solution is only temporary because, as more people discover the problem and use this solution, an "alphabetic war" will break out. This will cause much havoc as subscribers race to change their names and move up on the BYTE mailing list.

Let me address a possible solution to this problem. I assume that BYTE has a computer-

(continued)

affordable & reliable... PORT
CONTENTION

Add more users to your multi-user computer without expensive hardware or software modifications. A BayTech Port Contention unit will maximize utilization of available ports, thereby minimizing idle, valuable system time. With 6-to-3, 8-to-4 and 12-to-6 port models available, Port Contention problems can be solved from micro to mainframe computers.



The graphic above illustrates a typical BayTech Model 5218B Port Contention application. By adding a single 5218B unit, a 6-port multi-user computer gains six additional users, thereby doubling accessibility to the computer.

- Model 528B: 6 ports to 3 ... \$ 625.
- Model 5212B: 8 ports to 4 ... \$1095.
- Model 5218B: 12 ports to 6 ... \$1750.

To solve your port contention problems ...

1-800-523-

BAY TECH
ASSOCIATES
HIGHWAY 603
BAY ST. LOUIS, MS

Now
You're
Talking!™

ized mailing list (it would be ludicrous to assume otherwise) and that the BYTE and McGraw-Hill staffs are computer literate (don't they read their own magazine?). Thus these staff members must be capable programmers who are only guilty of not completing the project. It should only take a small change in the algorithm to solve the problem. One solution might be to move the starting position by one-twelfth of the total subscription base each month. In this way each subscriber would get

their issue on the first day once each year. This would at least even out the information gap. Although, as a point of justice, you might consider sending BYTE out in reverse alphabetic order for a period of time to correct past inequity (and let me get mine first).

I hope that you take prompt action to avert a major "alphabetic war" and the subsequent loss of personal integrity by your subscribers.

DON ZEHNDER
Tacoma, WA

In fact, our subscriber copies are mailed by ZIP Code rather than alphabetically. Our circulation department is taking steps to speed up delivery. We hope that these steps bring your BYTE to you earlier.

MORE ON THE MAC

.....

I feel that I must defend Gregg Williams's Product Preview of the Apple Macintosh (May Letters, pages 14-20). I was an "Apple hater" before the company came out with this marvelous machine (I still don't like the IIe). If a previewer is justifiably excited about a new product, he should convey that excitement to the readers.

I can see why some people are thrilled about this radical new machine. If you have any idea of how ingenious the design of the Macintosh is, you probably are jumping for joy. It's about time a company comes out with a new machine rather than another clone.

I also would like to address the problem of the 128K-byte memory limitation. This is similar to the power race in home-stereo equipment several years ago. Everyone was trying to build the most powerful amplifier in the world (300 watts and above). Now the only place to find such behemoths is at flea markets. Can anyone recall that the Apple II and the Radio Shack Model III ran every piece of software imaginable with only 48K-bytes? With memory limits currently approaching 1 megabyte, sloppy programmers will continue to eat up all the memory they have until... (where will it end?)

Look hard at this machine and compare the hardware and software and you'll see how different the Mac is. Look at the potential it has compared with all the CP/M and IBM clones and you'll share the excitement too!

WAYNE DANIEL
Lafayette, LA

I'm college educated, worked as a nuclear engineer for several years in the Navy, taught high school for two years, and am employed by a major national corporation working with computer simulations. I've been working with computers since 1970 and even have designed several micros (I even have an 8008). Daily I work with state-of-the-art mainframes, minis, and micros, yet according to Gerald Evenden (May Letters, page 20) I am one of BYTE's "less-sophisticated readers" because this letter was drafted and typed on a Macintosh. The worst part is that I probably could have used this machine for years without ever realizing what Mr. Evenden was so quick to point out. I feel so ashamed!

JONATHAN L. POLAND
Berkeley, MO

In the bewildering personal computer marketplace, buyers often look to dependable, accurate, and honest magazines like BYTE for information. Many times they are misled by "experts" who recommend or condemn machines after only superficially examining them.

I'm writing in regard to a letter by George
(continued)

Winchester power for your PC



The proven Winchester subsystem drives for your IBM or compatible PC. 10, 15, 25, or 33 megabytes of big system storage in a DiskSystem® you simply plug into your system and it's ready to use. At prices that make the speed and storage of a Winchester practical. Only \$1495 for a 10 megabyte DiskSystem, \$1795 for 15 megabytes, \$2245 for 25 megabytes, or \$2795 for 33 megabytes. DiskSystems can be bootable from the Winchester. See your dealer today for DiskSystem power for your PC.



Interface Inc

21101 Osborne Street
Canoga Park, CA 91304
(818) 341-7914 • Telex: 662949

Dealer Inquiries Invited

DiskSystems is a copyright of Interface Inc. IBM is a registered trademark of IBM Corporation. Prices are suggested retail and are subject to change without notice.



DATA ACQUISITION SOFTWARE THAT SPANS TWO WORLDS

Now one IBM PC can direct high speed acquisition of analog signals, and simultaneously read and control instruments on the IEEE-488 bus. Connect your analog signals to the Keithley DAS Series 500 Measurement and Control System; connect IEEE-488 instruments to our new Plus500 Instrument Control System. The same software environment controls both interfaces at the same time.

■ *Soft500 and new Plus500 software make measurement and control accessible.*

Soft500 and Plus500 software are enhancements of BASIC, the language of personal computing. As easy to use as BASIC itself, Soft500 and Plus500 add

powerful data acquisition and control capabilities to a higher level language.

■ *You can trust the data.*

Soft500's foreground/background scheduling carefully times multiple tasks to ensure that successive readings from the same channel maintain precisely the same sampling interval. And there's still time for simultaneous data analysis.

■ *The Series 500 is fully modular.*

Seventeen modules form an extensive and growing family that supports analog input, analog output, digital I/O, current loop output, pulse counting, and AC/DC relay control. And now the Plus500 Instrument Control System allows simultaneous access to the IEEE-488 bus as well.

■ *Quality manufacturing, quality service.*

The Series 500 is built like an instrument. It has the highest accuracy, the lowest noise, and the best thermal stability of any personal computer based data acquisition workstation. That's why it comes with a one-year warranty and a free product support hotline.

■ *For more information*

Call us toll free at 1-800-552-1115. In Massachusetts, call 617-423-7780. We'd like to tell you more about the Series 500 measurement and control family.

349 Congress Street
Boston, Massachusetts 02210

KEITHLEY 

Softline

FOR YOUR
BOTTOM LINE.

Lotus
1-2-3
\$319

dBase II
\$369

WordStar
Professional
\$359

Multi Mate
\$279

WORD PROCESSING/ EDITORS

Easywriter II System (3 pak)	\$219
Edix/Wordx	\$269
Final Word	\$189
Microsoft Word	\$239
Microsoft Word/Mouse	\$299
Multimate	\$279
PeachText 5000	\$219
Perfect Writer/Speller	\$249
PFS: Write	\$ 95
Samna Word II	\$ 99
Select Word Processor	\$199
Spellbinder	\$179
SuperWriter	\$179
Volkswriter Deluxe	\$179
The Word Plus (Oasis)	\$109
Word Perfect (SSI)	\$Call
WordPlus-PC with The Boss	\$329
WordStar	\$239
WordStar Professional (WS/MM/SS/SI)	\$359
WordStar Options Pak (MM/SS/SI)	\$189

DATABASE SYSTEMS

Alpha Data Base Manager II	\$179
Condor III	\$329
dBase II	\$369
DBplus	\$ 89
Friday	\$179
InfoStar	\$269
KnowledgeMan	\$299
Perfect Filer	\$159
Personal Pearl	\$199
PFS: File/PFS: Report	\$169
Powerbase	\$289
QuickCode	\$169
R-base 4000	\$289
T/Maker III	\$199
TIM IV	\$269
Versaform	\$249

SPREADSHEETS/ INTEGRATED PACKAGES

Framework	\$Call
InteCalc	\$189
Jack 2	\$329
Lotus 1-2-3	\$319
Multiplan	\$135
Open Access	\$399
Ovation	\$Call
SuperCalc 3	\$239
Symphony	\$Call
TKI Solver	\$289
VisiCalc IV	\$159

PROJECT MANAGEMENT

Harvard Project Manager	\$269
IntePert/Plan	\$239
Scitor Project Scheduler	\$229
VisiSchedule	\$199

GRAPHICS/STATISTICS

Abstal	\$279
BPS Business Graphics	\$229
Chartman Combo (II&IV)	\$349
Chartmaster	\$259
dGraph	\$189
Energraphics	\$259
Fast Graphs	\$199
Graphwriter Combo	\$429
PC Draw	\$289
PFS: Graph	\$ 95
Statpac	\$299

ACCOUNTING MODULES

Ask Micro Accounting	\$299
BPI Accounting	\$369
IUS EasyBusiness System	\$319
MBA Accounting	\$369
Open Systems Accounting	\$459
Peachpak 4 (GL/AP/AR)	\$239
Peachtree Accounting	\$399
Real World Accounting	\$469
Star Accounting Partner (GL/AP/AR/PAY)	\$269

PROFESSIONAL DEVELOPMENT

Management Edge	\$139
Think Tank	\$179

HOME/PERSONAL FINANCE

Dollars and Sense	\$119
Financier II	\$119
Home Accountant Plus	\$ 99
Tax Preparer 84	\$189

LANGUAGES/UTILITIES

Access Manager	\$239
Digital Research C Compiler	\$219
Display Manager	\$299
Microsoft C Compiler	\$329
MS Basic Compiler	\$249
MS Fortran	\$239
Pascal MT+86	\$249
Norton Utilities	\$ 59

COMMUNICATIONS/ PRODUCTIVITY TOOLS

Crosstalk	\$119
Memory Shift	\$ 79
Move II	\$109
Prokey 3.0	\$ 95
Smartcom II	\$109

HARDWARE PERIPHERALS*

AST Six Pack Plus (64k)	\$269
Quadboard (0k)	\$209
Hayes 1200B with Smartcom	\$399
Hayes Smartmodem 1200	\$499
Hercules Graphics Board	\$349
Epson FX-100 Printer	\$Call
Comrex II Printer	\$Call
C 10h Prowriter	\$Call
C 10h Starwriter	\$1199
Okidata 93A	\$749
64K Memory	\$ 55

*Call for shipping.

R: base
4000
\$289

Word &
Mouse
\$299

Microsoft C
Compiler
\$329

Smartmodem
1200B
\$399

free!

Diskette
Library
Case
with your order



DISCOUNT COUPONS

With each order,
we offer
discount coupons
worth up to
\$10 on your next order.

1-800-221-1260

In New York State call (212) 438-6057

TERMS:
Checks—allow 14 days to clear. Credit
processing—add 3%. COD orders—cash, M.O.
or certified check—add \$3.00. Shipping and
handling UPS surface—add \$3.00 per item.
(UPS Blue 36 00 per item). NY State
Residents—add applicable sales tax. All prices
subject to change.

Softline
Softline Corporation
3060 Bedford Ave., Brooklyn, N.Y. 11210
TELEX: 421047 ATLNL UI



LETTERS

Snoga (May Letters, page 14). It was disheartening to see someone try to compare a PCjr to a Macintosh. I was glad Gregg Williams pointed out that a Mac is much more of a PC than a PCjr, but I feel he should have gotten the point across more clearly. BYTE must maintain its respectability as a magazine by answering tough questions with tough answers. Mr. Williams's reply answered the letter writer but left me uneasy and hungry for more.

I'm surprised that Mr. Snoga said that the Mac isn't much more powerful than a PCjr because it lacks slots. Slots originally came into existence so hardware could be added to expand a machine. In those days it was necessary for microcomputers to share the microprocessor with the peripherals through the use of slots. Microprocessors were too expensive to individually implement on each and every peripheral. Today, single-chip micros cost about \$8 apiece, they are inexpensive enough to put into modems, printers, plotters, etc. It is no longer necessary to have a direct processor bus connection for each peripheral because it is also no longer necessary to share the processor.

One of the best ways for the computer and it's intelligent peripherals to communicate is by means of the high-speed serial ports Macintosh uses. They transfer data at 1 megabit per second, unlike the slow RS-232C. With this arrangement you don't have to concern yourself with whether certain cards or peripherals are compatible with each other. Also, you can daisy-link the peripherals attached to the serial ports, meaning you can have more than one device on each serial port. You will *not* have to scrap your system. *Mac is truly expandable.*

As Mr. Williams pointed out, the only kinds of peripherals you can't add on are coprocessors and the like. If you really want to add this type of hardware to your machine, and if there is a very good reason for it, third-party vendors will probably pick up your problem and figure out a way around it. Besides, the speech/sound synthesizer, clock/calendar, disk controller, monitor/display circuitry, mouse interface/drivers, and serial ports are *all* built in. These are exactly the things you would fill up most expansion slots with anyway. People describe the IBM PC as having *only* five slots. But because almost everything is built in on the Macintosh, and because peripherals can be daisy-linked, it is unfair to say that the Mac has only two ports and is unexpandable.

I must admit that at first glance the PCjr and the Mac appear to be similar. Yet upon closer examination, it becomes obvious that a Macintosh is at least equal to the PC, if not better. IBM officially has no option for a second drive for the PCjr; only third-party vendors supply such. The Mac has a second drive from Apple. The Mac does not have a maximum memory of 128K bytes. The memory-upgrade motherboard (to 512K bytes using 256K-bit chips) will soon be available. The PCjr has minimal hardware expandability—it doesn't have high-speed serial ports to add peripherals as the Mac does, and it doesn't have true, open slots. You might say the Mac is upwardly compatible with the Lisa 2, but I like to view it simply as compatible.

(continued)

The Ultimate Spreadsheet Display For Apple®

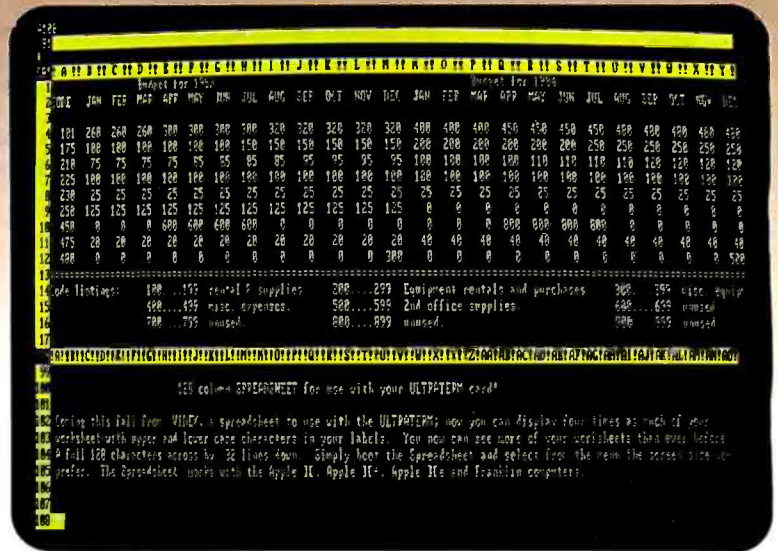
128 Columns by 32 Lines, 80 Columns by 48 Lines, and More!

UltraPlan™

SPREADSHEET CALCULATOR

**Software
For use with Apple**

- EASY TO FOLLOW MENUS
- VARIABLE COLUMN WIDTHS
- SHIELDS CONFIDENTIAL INFORMATION
- PREVENTS ACCIDENTAL CHANGES
- EASY CURSOR MOVEMENT



Actual photo of 128x32 screen.

UltraPlan—an advanced spreadsheet program—makes planning, forecasting, and budgeting easy, fast, and accurate. UltraPlan can make full use of the UltraTerm, Videoterm, and can use additional memory cards for models as large as 512K. UltraPlan is compatible with VisiCalc® data files and features advanced commands not found in VisiCalc. UltraPlan is compatible with the Apple II and Apple IIe computers.

UltraTerm™

A DISPLAY PERIPHERAL

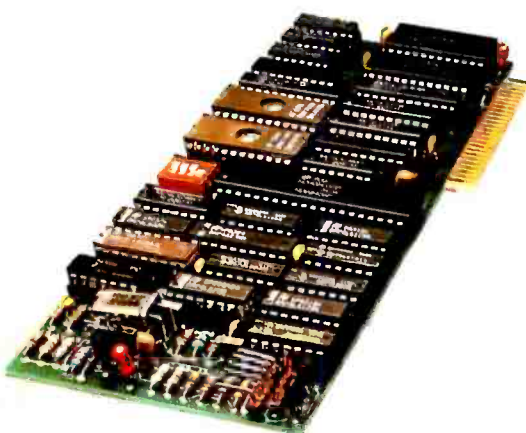
To display more than 80 columns or 24 lines, you will need an UltraTerm video display card. This card gives your Apple II or Apple IIe the ability to display more characters than ever. Nine display modes that can display as many as 4096 characters allow you to choose the number of columns and rows best suited to your application.

UltraTerm utilizes 8 x 9 or 8 x 12 dot character matrix (versus the normal 5 x 7) to deliver superb resolution in the crispest, cleanest characters available anywhere.

Other display attributes such as highlight/lowlight, inverse, and half-intensity backgrounds can be chosen to suit your own viewing preferences.

Videoterm™

The Videoterm—the best selling 80 x 24 display card for the Apple II—can be used with UltraPlan. The advanced software features and expanded memory capability of UltraPlan are also available to Videoterm users.



Videx Inc.

1105 N.E. Circle Blvd. • Corvallis, OR 97330
503-758-0521

Apple is a registered trademark of Apple Computers, Inc. UltraPlan, UltraTerm and Videoterm are registered trademarks of Videx, Inc. VisiCalc is a registered trademark of VisiCorp.

In the battle between the IBM PC, there can be

Hear the guns?

It's a battle for your desktop. Apple® versus IBM®
The easy-to-use Macintosh against the serious business
computer from Big Blue.

And the winner? Epson.® That's right, Epson. Because
for the person who simply wants to buy one relatively
perfect personal computer, the Epson offers an opportunity
for peace in our time.

A computer that is easy to use, like the Mac, but also
runs all sorts of business software, like the PC.

And aren't those two computers exactly the one you need?

**An easier way to be easy...
A more serious way to be serious.**

The Epson is easy because
its keyboard works in English,
not computerese. And only

the Epson comes with *Valdocs*,™ a powerful integrated
software system that takes you step-by-step through the five
most important business functions: word processing,
business graphics, telecommunications, electronic filing and
daily scheduler.

As a result, while IBM owners are still pondering their
manuals, and Macintosh owners are still drawing sneakers,
Epson owners are churning out productive work with
electronic speed and accuracy.

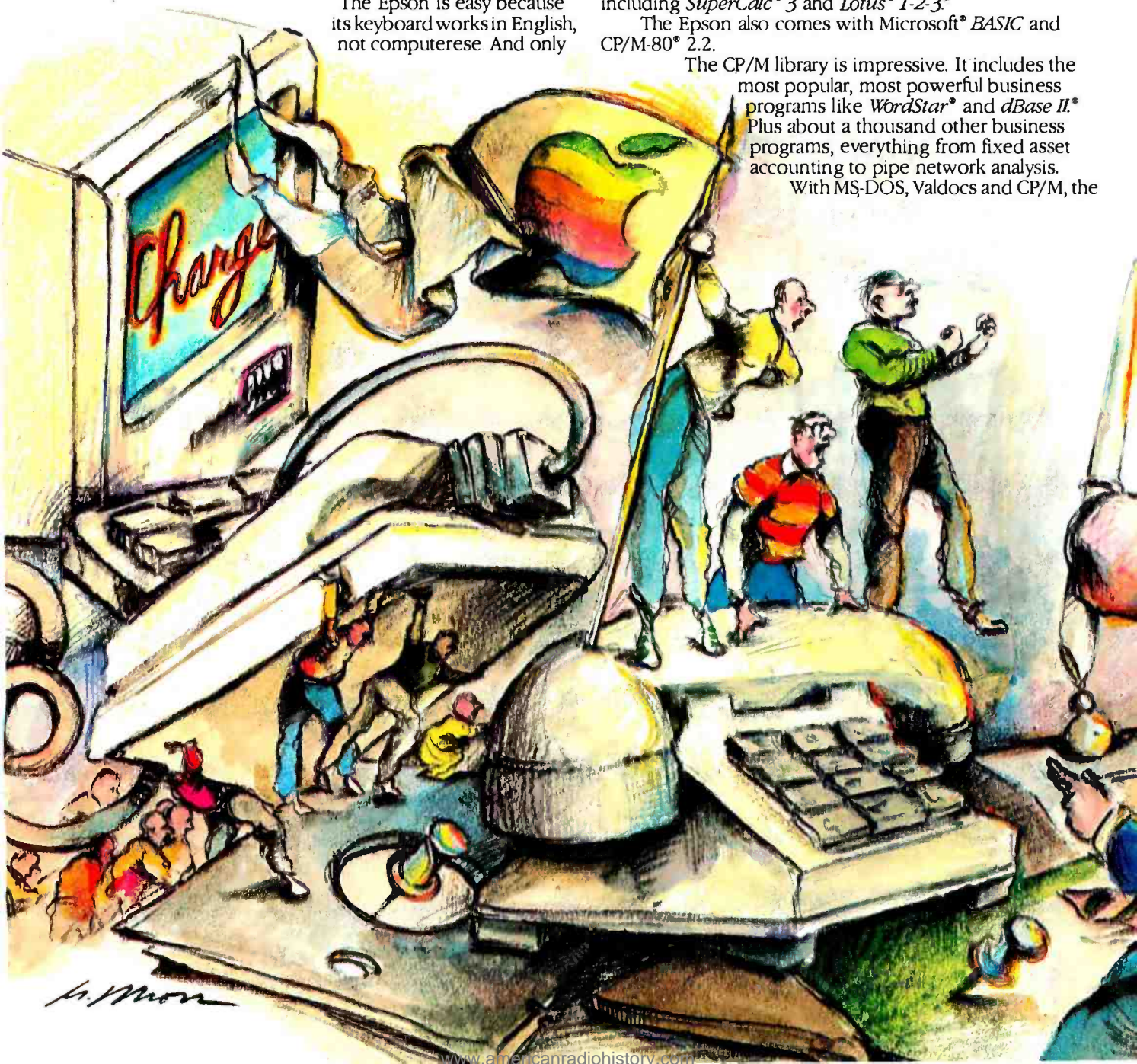
The Epson also opens the doors of your disk drives
to the largest collection of software in captivity. In fact, the
Epson runs *more* business programs than the IBM PC.*

To start, the Epson is available with an optional 16 bit
co-processor so you can use almost any MS-DOS program,
including *SuperCalc*® 3 and *Lotus*® 1-2-3®.

The Epson also comes with Microsoft® *BASIC* and
CP/M-80® 2.2.

The CP/M library is impressive. It includes the
most popular, most powerful business
programs like *WordStar*® and *dBase II*®.
Plus about a thousand other business
programs, everything from fixed asset
accounting to pipe network analysis.

With MS-DOS, Valdocs and CP/M, the



G. Mon

the Apple Macintosh and only one winner. The Epson.

Epson should be able to handle any future business need. And that should make you feel very good about siding with Epson today.

The ultimate technical specification: value.

The Epson QX-10 comes complete with a 12" high resolution monitor, 600 x 400 Pixels, driven by one of the most powerful graphic processors available. With screen resolution this good, text and graphics will leap off the screen. And when you add a graphics program, like *Q-plotter*,™ you can produce presentation graphics of the highest order.

Standard issue on the Epson also includes 256K memory, plus 128K resident video memory, dual 380K Epson-made disk drives, a CMOS Realtime Clock/Calendar with battery backup, a 1-year warranty, an RS-232C port and a parallel port; thus freeing the five—that's right, five—



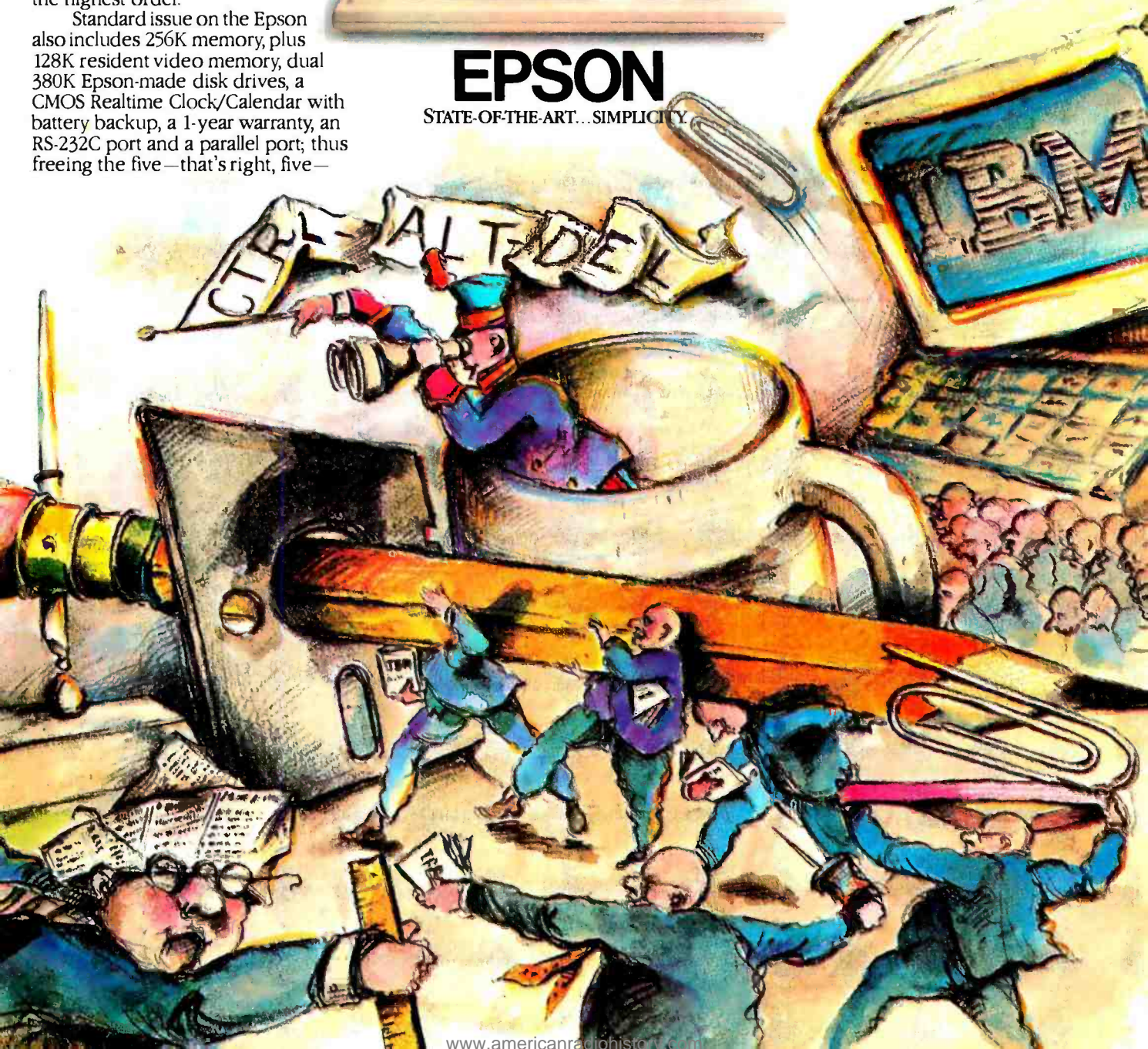
option slots for some real options.

Best of all, everything is Epson quality; the same quality that has made Epson the number one manufacturer of computer printers, worldwide. And when you consider that Epson gives you a complete computer system at a price a thousand dollars less than either Apple or IBM, you understand why this computer can not only bring peace to your desktop, but to your budget, as well.

*With optional MS-DOS board. Apple, the Apple logo, IBM, Epson, SuperCalc 3, Lotus 1-2-3, CP/M-80, Microsoft, WordStar and dBase II are registered trademarks of Apple Computers, Inc., IBM, Epson Corp., Sorcim, Lotus, Digital Research, Microsoft, Micropro and Ashton-Tate respectively. Valloccs, MS, Q-plotter are trademarks of Rising Star, Microsoft and Metro Software respectively.

EPSON

STATE-OF-THE-ART...SIMPLICITY.



PC SOFTWARE SALE!

WE'LL MATCH PRICES ON MOST PRODUCTS

LOTUS CALL	WORDSTAR \$229
RBASE 4000 \$315	dBASE II/III CALL
WORDSTAR PROF PAK \$359	EASYWRITER II SYSTEM \$185
HAYES SMARTMODEM 1200 \$489	AST SIX PAK PLUS \$269

LOOK AT THESE SPECIAL PRICES!

ATI Training Power	CALL
Crosstalk	\$ 99
dBase II/III	CALL
Database Manager II	\$199
EasyWriter II System	\$185
Hayes Smartmodems	CALL
InfoStar	\$249
IUS Accounting	CALL
Lotus 1-2-3/Symphony	CALL
MicroPro Products	CALL
Microsoft Word	\$289
Microsoft Products	CALL
Multimate	\$269
Peachtext 5000	\$189
ProKey	\$ 87
Quadram Quadboards	CALL
RBase 4000	\$315
SuperCalc 2	\$155
SuperCalc 3	\$219
VisiCorp Products	CALL
Volkswriter Deluxe	\$175
Wordstar	\$229
Wordstar Prof. Package	\$359
All Other Products	CALL

To order:
Call TOLL-FREE:
800-227-4780 or 415-845-2651

Or write:
ECONOMY SOFTWARE
2040 Polk Street
San Francisco, CA 94109

ECONOMY SOFTWARE

- We guarantee our products against manufacturer's defects.
- Quantity discounts available. We are experienced with Corporate accounts.
- No surcharge added for charge cards. No charges until products are shipped.
- Purchase orders accepted.
- Call for shipping charges.
- Prices subject to change.

LETTERS

ble. The Lisa 2 is still slower than a Macintosh. It makes up for this by being able to do multi-tasking, but this difference may blur when Macintosh is expanded to 512K bytes. And, as Mr. Williams pointed out, who says the Macintosh can't have hard disks? There are at least two vendors working on it, excluding Apple itself. And as far as price goes, the PC and Mac are amazingly alike. After reading Mr. Williams' "Update on Apple Macintosh and Lisa 2" (May, page 339), I have to agree that the Mac would better penetrate the computer market if it were cheaper, but even at its present price, it represents a great value. Where else can you get a system with such power, fast bit-mapped graphics, and the unique user interface with the mouse for the price? Mac may no longer be inexpensive, but it's still a bargain.

Macintosh represents a breath of fresh air into the dry and dull world of me-too computers led by IBM. If Macintosh is a success, the innovation that computer companies used to put into their products will once more be felt.

J. JASON KIM
Honolulu, HI

Thanks to Gregg Williams for giving Apple the "one-two" in "Update on Apple Macintosh and Lisa 2" (May, page 339). I too feel that the Macintosh is overpriced but I bought one anyway. And let me tell you, I'm glad I did.

It's a fabulous machine that allows me the direct visual response I crave as an artist. I can't imagine going back to the old green screen after this. All computers should look this good. It looks even better with MacPaint and MacDraw. They turn this computer into a real computer-aided-design system.

I think that the Mac has a fine future, but Apple could have assured it if the Mac were priced about \$500 cheaper. Maybe Apple will let us upgrade to 512K bytes for free, then it won't be so bad. One day a computer company is going to make a big hit when it realizes that price is an important consideration for the buyer, but until then, those characters look so nice. . . .

MICHAEL BRODSKY
Mt. Crawford, VA

MORE ON CLOCK-TIME BENCHMARKS

In response to Philip Ender's letter (May, page 26) regarding my article "Benchmarking FORTRAN Compilers" (February, page 218): while the user ultimately sees wall-clock time, Mr. Ender fails to note that there are all types of mainframe work loads. Also, you may have to wait in line to use a shared single-user office microcomputer or you may have to wait for a slow 16-character-per-second printer to finish printing. Because each mainframe installation may have various loads and types of loads, there is no way to include all these in a benchmark article without taking measurements at several places (such as Los Alamos, which has many heavy number crunchers; a university, with many users who do light editing; and

Draper Lab, consisting of a mix of users). Usually the average waiting time in the execution-job queue is known for each mainframe site, thus no new information would be gained by including it in a benchmark. In fact, it would make comparisons difficult. Because a user also knows the difference in speeds between a slow teletype and a fast laser printer, no new information would be gained by including these I/O times in the benchmark. If a mainframe installation supports the recommended number of users and loads, then the mainframe still wins. Also note that the microcomputers are fast catching up with mainframes. Job-Step time is still the most accurate bound for comparing respective systems; you can go no faster with an unloaded mainframe system or when you don't have to wait in line to use a shared single-user office microcomputer.

AVRAM TETEWSKY
Cambridge, MA

FUTURE THEME SUGGESTED

In the Thinktank letter by John Glazer (May, page 32), Mr. Glazer states: "It is interesting to reflect on how the writing process itself is being transformed by what the computer makes possible."

This strikes me as food for thought for a future theme for BYTE: "Computers: How are they changing (can they change) the social sciences?"

In another flash of my imagination I can see BYTE keeping track of these changes.

A. C. POSADA
Charlottesville, VA

DISK PROTECTION

In regard to Steven A. Green's inquiry about airport security screens erasing his disks (May Letters, page 36): radiation is to varying degrees inhibited by lead foil; magnetic fields are not. I suggest he have someone weld him a mu-metal box big enough to hold his disk-file containers. This should protect them from all but the most intense fields he could encounter.

There are no end of devices that generate fields that can damage the fields on a disk (which are relatively feeble). Even an electric-window motor in a car or almost any solenoid valve could damage a disk close to it.

BILLY R. POGUE
Thatcher, AZ

CLOSING THE DEBATE

Douglas Davidson ("Address Calculation: The Forgotten Sort," November 1983, page 494) wrote that he had discovered a method of sorting n elements in time proportional to n . Greg Scragg (April Letters, page 20) wrote that this was impossible since it contradicted a well-known result in Knuth's *The Art of Computer Programming* that any sorting method requires time at least proportional to $n \log n$. The seeming

(continued)

In the Hard Disk Jungle Tallgrass Clears A Path



In today's hard disk jungle, Tallgrass clears a path by offering high performance, integrated mass storage solutions for the IBM® PC/XT, the T.I. Professional and related computers.

TALLGRASS INNOVATIVE FEATURES

MASS STORAGE SYSTEMS with formatted HardFile™ capacities of 6, 12, 20, 35 and 70 Mb, all with built-in tape backup.

CONVENIENT INTEGRAL TAPE BACKUP SYSTEM allows rapid tape "image" streaming, or incremental file-by-file backup and restore on ANSI standard inexpensive data cartridges, instead of the usual floppies, video cassettes, or low-capacity removable Winchester devices.

NETWORK READY and fully compatible with networks such as PCnet® and EtherShare™.

HIGH RELIABILITY with dual directory and read-after-write verify options. A dedicated landing zone, where the read/write heads reside when the disk is idle, provides data protection during powerdowns and transportation.

Follow the Tallgrass path to your local computer dealer and watch your personal computer transform into a powerful data processing system.

Available from COMPUTERLAND®, Entré® Computer Centers, MicroAge® Computer Stores and other participating computer dealers.

New! IBM-XT Cartridge Tape Backup

World Headquarters: Tallgrass Technologies Corp. / 11100 W. 82nd St.
Overland Park, KS 66214 / 913/492-6002 / Telex: 215406 TBYT UR

Canadian Headquarters: Tallgrass Technologies (Canada), 1775 Meyerside Drive
Mississauga, Ontario, Canada L4V 1H2 / 416 / 673-3244

European Distributor: CPS Computer Group, LTD
Birmingham, England B276BH / (021) 7073866

Australian Headquarters: Tallgrass Technologies (Australia) / Five Dock Plaza,
Suite 12/50 Great North Road / Five Dock / Sydney, N.S.W. 2046 / (02) 712-2010



**Tallgrass
Technologies**
Corporation

contradiction is due to misconceptions by both of the writers. Scragg slightly misquotes Knuth's result. The result is that any method based on comparisons requires at least $n \log n$ comparisons to sort an arbitrary array of n elements.

Davidson makes the assumption that his method, which is actually the well-known technique of hashing, is a sorting method. In the simplest case, each element in the array gets sent to a different address according to some predetermined hash function. The order im-

parted by this hash function is no more a sorted order than is calling array element 1 smallest, array element 2 next smallest, etc.

Hashing is primarily a method of processing an array so that searching can take place rapidly. To find where a key is, simply compute its hash function and look in that location. This provides searching efficiently without having to sort first.

The most common situation has many elements in the array having the same hash value. These collisions are to be expected to occur

frequently. They are generally resolved by using a field of each location for a pointer to a location for the colliding element, setting up a linked list. The standard measure of performance is the length of the array times the average length of the list.

RONALD J. LEACH
Washington, DC

I read with interest the article by Mr. Davidson on the subject of hash coding and the letter from Mr. Scragg in which he takes Mr. Davidson to task for his contention that the sort method he outlines performs in a time proportional to the number of items to be sorted: $O(n)$.

In his letter, Mr. Scragg quotes two sources that he says carry proof of this assertion that no sort can perform in a time faster than $O(n \log n)$. Unfortunately he is guilty of not reading the text quoted completely.

In *Fundamentals of Data Structures*, page 350, Horowitz and Sahni state quite definitely that the best time performance that can be achieved is a time proportional to n times the log base $2n$, e.g., $O(n \log n)$. This is exactly as stated by Mr. Scragg but in this case Horowitz and Sahni were discussing sort algorithms in which the only operations allowed on the keys were comparisons and interchanges. In hash coding, this is not the case, as the order of the keys is partially determined by a calculation performed on the key itself and thus it is possible to get execution time proportional to the number of elements to be sorted.

That is not to say that the method as described by Mr. Davidson is ideal or even approaching ideal. As implemented by him, the method is inefficient because it always requires much more data storage than elements to sort. It is this that produces the linear-time performance as the ratio of hits to collisions is kept nearly constant.

The real value of hash coding is in the implementation of look-up tables where there is no requirement for the data to be stored in lexicographical order and where, with more sophisticated collision-handling methods and hash-coding functions, very high percentage usage of storage can be achieved with little deterioration in response time.

The whole realm of storing and searching is complex with a great number of methods available, each with its advantages and disadvantages. It is important that before any one method is chosen all the factors are considered.

R. KENNETH
LaSalle, Quebec, Canada

LETTERS POLICY: To be considered for publication, a letter must be typed double-spaced on one side of the paper and must include your name and address. Comments and ideas should be expressed as clearly and concisely as possible. Listings and tables may be printed along with a letter if they are short and legible.

Because BYTE receives hundreds of letters each month, not all of them can be published. Letters will not be returned to authors. Generally, it takes four months from the time BYTE receives a letter until it is published.

GET UP THE RAMP

WITH OUR EE/EPROM PROGRAMMERS & UV ERASERS

Reliability
Affordability
Maintainability
Program



Choose from our **Stand Alone, Intelligent, RS-232 units.**
COMPATIBLE WITH ANY COMPUTER OR TERMINAL

GANGPRO-8 \$995.00

High throughput. Gang 8 EPROMs with the fast Algorithm. Optional 512K buffer. Programs ALL 24 pin & 28 pin EPROMs. Other units to gang 24 EPROMs.

PROMPRO-8 \$689.00

Powerful commands, easy communications. 128/256K buffer. Alpha Display. Simulation and Keypad option. Programs ALL EPROMs & MPU's.

PROMPRO-7 \$489.00

32K RAM buffer. Ideal for programming 8748, 8749, other Intel MPU's and 16K-128K EPROMs.

BIPOLAR & PAL Programmers...Call!

UV ERASERS

ECONOMY MODEL QUV-T8/1 \$49.95
Erases over 15 EPROMs. Plastic case.

INDUSTRIAL QUV-T8/2N \$68.95
Metal case. UV indicator, tray, erases over 15 EPROMs in 15 minutes.

INDUSTRIAL QUV-T8/2T \$97.50
With 60 minute timer and safety switch.

INDUSTRIAL QUV-T8/Z \$124.95
Fast Eraser. 15 EPROMs in 7 minutes, 30 EPROMs in 15 minutes.

PRODUCTION UNIT \$149.95
Model. ULTRA-LITE™. Erases 50 EPROMs in 15 minutes.

TOLL FREE **1-800-EE1-PROM**
(331-7766) • FLORIDA (305) 974-0967

AVAILABLE SOFTW.

- | | | | |
|-------------------|-----------------|-----------------|---------|
| 1. IBM PC | 2. APPLE II | 3. Intel-MDS | 4. CPM |
| 5. TEXTRONIX 8002 | 6. COMMODORE 64 | 7. TRS-80 COLOR | 8. FLEX |

LOGICAL DEVICES, INC.

DEPT. 6, 1321-E N.W. 65th PLACE • FT. LAUDERDALE, FL 33309
DISTRIBUTORS INQUIRY WELCOME



**FOR 15 YEARS,
WE'VE BEEN MAKING
THE WORLD'S
MOST POPULAR
MODEMS.**

**NOW
YOU CAN BUY
ONE.**

INTRODUCING THE MAXWELL MODEM FROM RACAL-VADIC.

It's not your fault you didn't buy one sooner.

You couldn't.

Unless, of course, you happened to be a major corporation.

They're the ones who buy the most modems. And the modems they buy most are ours.

Now we've taken everything we know about modems and made one you can buy.

The Maxwell Modem™

It was designed specifically for personal computers. And the people who use them.

It's rugged. Reliable. And it even operates over low-quality phone lines that other modems can't handle.

But best of all, it's uncomplicated.

So you don't have to know how one works to work one.

There's no control panel to control. No switches to switch. No 100-page manual to memorize.

Instead, every feature makes sense. Auto-dialing. Auto-answer. Auto-selection of tone or pulse. And one feature most other pc modems don't even offer—complete unattended operation.

Which means your Maxwell Modem can keep working long after you've left work.

Our communications software is just



as good. It's called George.™ And thanks to George, The Maxwell Modem is so simple to use you may never have to open your manual.

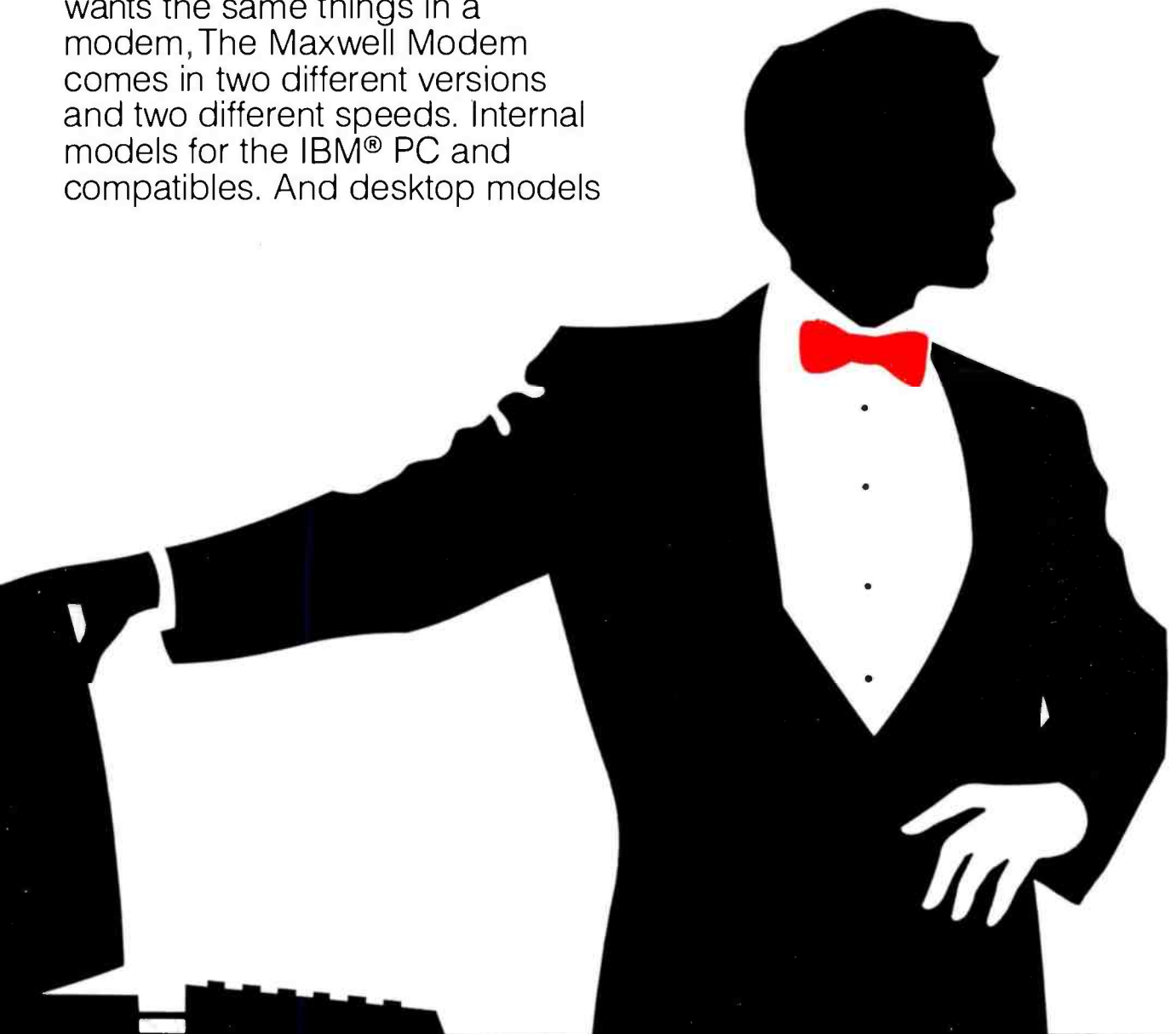
Of course, there's a lot of data communications software already on the market. Some compatible with Racal-Vadic dialing protocol and others compatible with Hayes.™ So The Maxwell Modem comes with both protocols.

It even selects the right one for you—automatically.

And because not everyone wants the same things in a modem, The Maxwell Modem comes in two different versions and two different speeds. Internal models for the IBM® PC and compatibles. And desktop models

for virtually every personal computer. Both are available with speeds of 300- or 1200-bps.

One last comforting thought: A little bit of Racal-Vadic comes with every Maxwell Modem. So if for some strange reason something ever happens...



YOU CAN ALWAYS CALL FOR HELP.

Every Maxwell Modem has diagnostic features built in. Both local and remote. So using your pc, your phone jack, your modem and our Remote Diagnostic Center, we can test your modem right over the phone.

Naturally, The Maxwell Modem comes with a one-year limited warranty on all parts and labor.

So where can you get your hands on a Maxwell Modem?

Well, rather than take another page or two to list all the stores from Pittsburg to Petaluma, we have a better idea.

Do what modems do. Call.
800-4-VADICS.



THE MAXWELL MODEM.

Racal-Vadic 1525 McCarthy Blvd. Milpitas, CA 95035 (408) 946-2227

**The Maxwell Modem and George are trademarks of Racal-Vadic. ©IBM is a registered trademark of International Business Machines Corp. ©1984, Racal-Vadic.
***Hayes is a trademark of Hayes Microcomputer Products, Inc.

F·I·X·E·S A·N·D U·P·D·A·T·E·S

DEVELOPMENTS

Product News

VISICORP has cut the prices of its VisiSeries software. The price for the IBM PC version of VisiCalc has tumbled from \$250 to \$99. VisiWord Plus for the IBM PC has the top price in the line—\$195. It once sold for \$375. VisiSchedule and VisiLink for the Apple can now be bought for \$149, dropping from \$300 and \$250, respectively. VisiCorp also announced that it recently inked a distribution agreement with First Software Corporation for 10,000 copies of FlashCalc, a \$99 spreadsheet. FlashCalc, designed for the Apple IIc and IIe/II+, has variable-width columns and extensive formatting features.

MEAD DATA CENTRAL of Dayton, Ohio, has announced software that lets Apple and Wang microcomputer users gain access to its NEXIS, LEXIS, NAARS, and other information-retrieval services.

IBM ENTRY SYSTEMS DIVISION unveiled 256K-byte versions of the PC and PC XT, while at the same time reducing the price of the PC Portable and the PCjr. An entry-level PC with a 360K-byte floppy and 256K bytes of memory costs \$1995. A 256K-byte PC XT starts at \$4395. The Portable now costs \$2595, or \$3020 with a factory-installed drive. The base price of the PCjr now stands at \$599. The larger version with 128K bytes of RAM and a drive has been reduced to \$999.

INNOVATIVE SOFTWARE has begun marketing an enhanced version of its T.I.M. IV database-management system. New features added to T.I.M., which runs on the IBM PC, let you transfer data between files while doing calculations and accumulating totals in a separate but related file. T.I.M.'s data files can handle 32,000 records; 128K bytes of memory is required. The price is \$495. Owners of earlier versions can contact the company for update procedures.

EAGLE COMPUTER of Los Gatos, California, has unveiled the Turbo GT, an enhanced version of the Turbo XL. The GT comes with a 32-megabyte hard disk, 512K bytes of RAM, and a \$6995 price tag. The \$4995 XL has a 10-megabyte fixed disk and 256K bytes of RAM.

CORONA DATA SYSTEMS of Thousand Oaks, California, has announced 15 to 21 percent price reductions on its line of IBM PC-compatible computers. You can get a Corona desktop PC with 128K bytes of RAM, one disk

drive, a keyboard, BASIC, and MS-DOS for \$1950. With a monitor included, both the desktop model and the Portable PC cost \$2195.

MORROW has unbundled the software packages from its Micro Decision line because surveys indicated that a majority of users didn't need most of the software packaged with the Micro Decision. The single-drive MD-1E and the MD-3E now come with the NewWord word-processing program. The MD-3E also includes a spelling checker. They go for \$999 and \$1499, respectively. Versions of the Micro Decision with the complete package of five application programs will still be marketed, according to spokespeople for the San Leandro, California, manufacturer.

INFOCOM's complete line of interactive fiction games now runs on the Apple Macintosh. Based in Cambridge, Massachusetts, Infocom publishes the Zork trilogy as well as a variety of whodunits and adventures.

CYBERLYNX COMPUTER PRODUCTS of Boulder, Colorado, recently demonstrated a version of its Smarhome I home-automation package that puts to work certain features of the Apple IIc. A starter kit costs \$499.

VOLITION SYSTEMS recently reduced the price of its Modula-2 compilers and development systems. For the Apple II and III the prices are \$295 and \$395, respectively. Both the IBM PC and PC XT versions are \$395. The price is \$495 for Sage II/IV computers. The Advanced System Editor is \$150. Volition Systems is located in Del Mar, California.

NORTH STAR COMPUTERS has slashed prices and bundled new software for its Horizon and Advantage systems. For \$5400, you can get a 15-megabyte Horizon. Twice the storage can be picked up for \$6400. Advantages with similar storage capacities are \$200 less. A single floppy-disk drive Horizon now costs \$2800, while a dual-drive Advantage goes for \$2600. North Star, headquartered in San Leandro, California, is also offering fixed bundles of software at savings of from \$600 to \$1000 if purchased separately.

ATRON CORPORATION of Saratoga, California, recently held a series of technical seminars that demonstrated versions of its PC Probe and Software Probe that apply Microsoft's Windows environment. The Windows option includes enhancements to debug multiple programs and data areas running under different windows, hook up with symbol tables, and automatically track symbol tables and breakpoints after

memory reallocation. Windows is available as an add-on software package.

NEC HOME ELECTRONICS is now selling its PC-8200 notebook computer and 14 programs for \$599. For \$799, you can buy a 24K-byte PC-8200 with a 300-bps modem. NEC is based in Elk Grove Village, Illinois.

LOTUS DEVELOPMENT CORPORATION, Cambridge, Massachusetts, announced that Hewlett-Packard's Portable Computer is the first system to have the 1-2-3 spreadsheet built into ROM. In a related development, a Lotus spokesperson said that 1-2-3 is available for the dual-disk and Winchester-disk-drive versions of Zenith Data Systems' Z-150.

LEADING EDGE PRODUCTS has revised the pricing of its Personal Computer. The new base price is \$2695. A version of the Leading Edge computer with color graphics starts at \$200 more. The company operates out of Needham Heights, Massachusetts.

FUJITSU MICROELECTRONICS reduced the price of its Micro 16s to \$2350. The Micro 16sx with a 10-megabyte drive is \$4250.

MICROSTUF's Crosstalk XVI data-communications software system is now included with Rixon's PC212A card modem for the IBM PC.

GENERAL ELECTRIC Information Service Company of Rockville, Maryland, has introduced and demonstrated an IBM Personal Computer interface to its computer-based comprehensive wire-transfer system, MoneyNET. MoneyNET allows corporate treasurers to initiate fund transfers and transaction processing with the Federal Reserve Bank and correspondent banks.

Industry Updates

THORN EMI COMPUTER SOFTWARE has acquired a license for the exclusive worldwide marketing and distribution rights for all products of Perfect Software Inc. The Berkeley-based Perfect Software is well known for its business applications software, including Perfect Calc and Perfect Writer. In a related development, Thorn spokesperson said that the company will publish and distribute personal computer software for business, entertainment, and education beginning in mid-1984. Thorn EMI Computer Software is a \$7 million start-up company and a part of the Information Technology Group of Thorn EMI plc, a London-based multinational corporation with annual revenues in excess of \$4 billion.

(continued)

WHY JOHNNY CAN'T READ HIS OWN CODE

Johnny's
A Good
Programmer,
Even Brilliant,
But—

Johnny works in 8080/Z80 assembly language, with a conventional assembler. That can make yesterday's brilliance today's garble, a maze of mnemonics and a jumble of meaningless labels. Johnny's program is less than self-explanatory—even for Johnny.

Johnny *could* read his own code if he used SMAL/80—the *superassembler*—and so can you. SMAL/80 boosts your program's clarity and your productivity by giving you:

- Familiar algebraic notation in place of cryptic mnemonics—"A = A-3" for example, instead of "SUI 3" (if you know BASIC or Pascal, you *already* know SMAL/80)

- Control structures like BEGIN...END, LOOP...REPEAT WHILE, and IF...THEN...ELSE... to replace tangled branches and arbitrary label names (eliminating up to 90% of labels with *no* overhead imposed)

- Complete control over your processor—because SMAL/80 is a true assembler, it doesn't reduce execution speed or burden your program with its own runtime routines.

SMAL/80, the assembler that handles like a high-level language, lets you do it right the first time, and lets you read and understand your work afterward—the next day or a year later. Users say SMAL/80 has doubled and even tripled their output of quality code. But don't take our word for it—**TRY IT!**

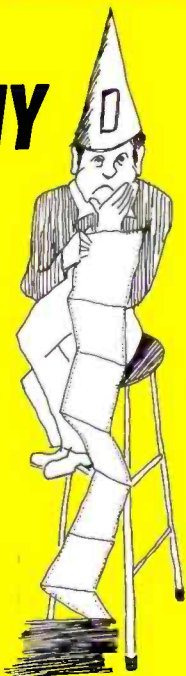
Use SMAL/80 for 30 days. If you're not completely satisfied with it—for any reason—return the package for a full refund.

SPECIAL BONUS: Order before Sept. 30, 1984, and get *Structured Microprocessor Programming*—a \$25 book **FREE!**

SMAL/80 for CP/M-80 systems (*all* CP/M disk formats available—please specify); produces 8080/8085 and Z80 code. Now supports Microsoft .REL. **ONLY \$149.95**

SMAL/80 for CP/M-80 systems, 8080/8085 output only. **SAVE \$20: \$129.95**

NEW! SMAL/80X65—for Apple II and IIe (requires Z80 card and CP/M); produces Z80 and 6502 object code. **\$169.95**



Mastercard
Visa
C.O.D.'s

SMAL/80
CHROMOD ASSOCIATES
(201) 653-7615

We pay
shipping on
prepaid
orders

1030 Park Ave. Hoboken, N.J. 07030

FIXES AND UPDATES

COMPUTER ASSOCIATES INTERNATIONAL has acquired all the assets of Sorcim Corporation, makers of SuperCalc. Terms called for cash payments totaling \$17.6 million over a five-year period, plus contingent payments of almost \$9 million. Headquarters for Computer Associates is in Jericho, New York. Sorcim is based in San Jose, California.

PRACTICORP INTERNATIONAL is the new name resulting from the merger of Micro Software International and Computer Software Associates. Both companies developed and marketed PractiCalc and other products bearing the Practi- prefix for Apple, Commodore, and now IBM computers. Practicorp International Inc. maintains corporate offices in Newton Upper Falls, Massachusetts.

TAVA CORPORATION has agreed to bundle Computer Creations' Ultimate 5-in-1 with its IBM PC-compatible computer. The Ultimate is a combination package containing Z-Com electronic-mail, dictionary, word-processing, database-management, and mail-merge abilities.

SOFTECH MICROSYSTEMS announced an agreement with Business Solutions to market Jack2, an integrated package with word-processing, graphics, spreadsheet, and database-management capabilities. The list price is \$495.

BYTE'S BITS

TDI Brings ETH Modula-2 Software to Commercial Market

TDI Ltd. has signed an agreement with Niklaus Wirth and ETH Zürich that allows TDI to offer a family of portable, modifiable Modula-2-based operating systems and application programs derived from software created at ETH. The agreement allows TDI to license the enhanced software to commercial users (along with extensive documentation and support) for a per-machine price and to educational users at a lower per-site price. This is said to be in keeping with TDI pricing policies that "encourage the widest possible distribution and use of the software."

The software line, called Liberator, promises several advantages to both users and programmers because of the company's commitment to creating high-performance software that will run only on 32-bit microprocessors. Its use of Modula-2 guarantees that programmers can more easily modify software and move it to other computer systems (TDI will sell the source code for all products for an additional fee). Both operating-system and application software will use windows, menus, and mice; users can modify menu descriptions, error messages, and Help files by editing text files associated with the program.

TDI's first major product is a Modula-2 programming environment/operating system called Moses. Future products will include application programs and more sophisticated operating

systems. TDI is serving as a clearinghouse for unsupported Modula-2-related compilers and application programs originally available from ETH Zürich. In a related development, TDI said that it will occasionally make changes or extensions to the Modula-2 implementations it provides; the company pledges that it will only make changes approved by Niklaus Wirth. For more information contact TDI Ltd., 29 Alma Vale Rd., Bristol BS8 4NI, England; telephone (0272) 742796.

Omikron Reorganizes Under Chapter 11

On February 21, 1984, Omikron filed for bankruptcy under Chapter 11 of the Federal bankruptcy laws. Omikron made a name for itself supporting CPM products for the Radio Shack TRS-80 microcomputer. Problems arose when a number of bugs forced a delay in a major project while at the same time several competitors entered the market.

The company continues to operate, but it has had to cut back on services such as toll-free customer lines and reduce its advertising budget and personnel staff.

Customers with products on order or refunds due will receive complete information shortly. Omikron has formulated a plan to meet its obligations but must await the approval of the bankruptcy court before it can be carried out.

Omikron maintains its offices at 1127 Hearst St., Berkeley, CA 94702.

Bug Snoops Sought

Want a checkbook system for the IBM PC? If so, contact Computer Tax Service in Incline Village, Nevada. For \$30 you can pick up beta-test copies of a program called Money Street.

Testers will hunt for bugs, critique documentation, suggest improvements, and help fine-tune the product. In return, they will get the final version of Money Street free, a testers' newsletter, and discounts on future software purchases.

"We want testers to bash it, smash it, and try to crash it," says Bob Payne of Computer Tax Service. "Just to get their blood pumping, we hid a few bugs in it."

For more information, contact Computer Tax Service, POB 4845, Incline Village, NV 89450. (702) 831-4300 or 832-1001.

Kraft Announces Contest Winners

Paula Boge, a 16-year old from Dubuque, Iowa, won the grand prize trip to the EPCOT Center in Florida in the recent Kraft Kideo Game Contest. Ms. Boge elected to take the cash equivalent of the trip, approximately \$4000, and buy a computer for her family.

The Kraft Kideo Game Contest challenged students 18 and under to devise a concept for a nutrition-oriented computer game geared toward younger children. Ms. Boge's entry, called Health Habits, was awarded top spot in the competition that featured more than 800 entries from 47 states. Nibbles, the main character of her game, takes children through the adventures and misadventures of achieving good health habits.

(continued)

Quadmodem.TM The intelligent way to talk to other computers.



Ordinary modems can't do what
the QuadModem can. Because
they're not as smart.

If you expect your computer to communicate effectively with other intelligent systems, you can bet it'll need an intelligent modem. That's where the new QuadModem from Quadram comes in.

QuadModem connects directly to your phone line. From there it can dial a number from memory; detect incoming baud rates; answer the phone when another modem calls; and distinguish between dial tones, busy signals, data transmissions, and human voices (remember those?). It also automatically adjusts for rotary or Touch Tone phone systems and shows you what's happening right on your computer screen.

Even problems aren't problems.

An advanced microprocessor in QuadModem can automatically spot phone problems, and the QuadModem is fully compatible with Bell 103/212A dial up modems and the most popular modem brands.

QuadModem is the complete intelligent modem: with two different versions, an internal model for IBM PC's and most compatibles and a stand-alone for the PC and other popular brands. Both come with full supporting documentation and user manuals. Plus right now, we'll include an introductory offer from The Source.TM And to round it out, you can add QuadTalk, our very powerful, highly intelligent communications software that's menu-driven and very friendly.

If you expect your computer to communicate properly, it's got to act intelligently. It can with the new QuadModem from Quadram.

QUADRAM TM
An Intelligent Systems Company

4355 International Blvd./Norcross, Ga. 30093
(404) 923-6666/TWX 810-766-4915 (QUADRAM NCRS)

INTERNATIONAL OFFICES
Interquadram Ltd. 442 Bath Road, Slough, England SL1 6BB
Tel: 6286-63865 Tlx: 847155 Auriema G Interquadram GmbH
Fasanenweg 7, 5092 Kestlerbach, West Germany Tel: 6107-3089
Tlx: 417770 Seva G Interquadram s.r.l. 41, Rue Ybny 92522 Neuilly
Tel: 756-1240 Tlx: 630842 Iso Bur Checco Computing 6581 Kilmara
Road, Mississauga, Ontario, Canada L5N-2X5 Tel: 416-821-7600



QUADMODEMTM BY QUADRAMTM

USERS
GUIDE



IBM[®] PC, XT, PCjr, are registered trademarks of International Business Machines Corporation.

*The Source is a registered trademark of Source Telecommunicating Corporation.

©Copyright 1984 Quadram Corporation. All rights reserved.

Circle 259 on inquiry card.



SALES

UNIX™ System V from AT&T can help you close a sale, as well as open up new markets.

It's another reason why good business decisions are based on UNIX System V from AT&T.

More and more of your customers will be demanding multi-user and multi-tasking systems. The benefits of UNIX System V—portability, reliability, flexibility—make it the ideal software system for this lucrative market.

In addition, AT&T will support UNIX System V with the service, training, and documentation resellers need to prosper.

More choices, more opportunities

UNIX System V is virtually hardware independent. So you'll be able to configure systems using equipment from a variety of vendors.

You can use the flexibility of UNIX System V as a real selling

point to customers who want to add hardware that is compatible with the machines they already have.

And over the long term, UNIX System V offers continuing opportunities to upgrade and expand your customers' systems. End-user flexibility translates into market opportunity for the reseller.

Software that sells

UNIX System V offers

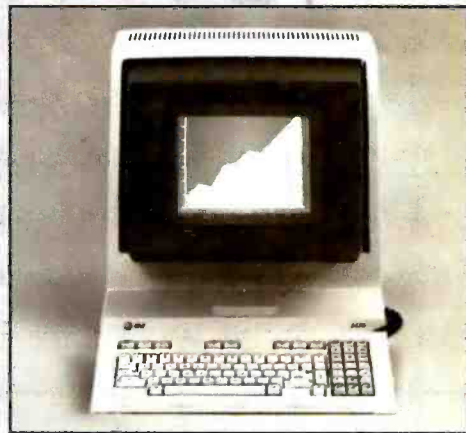
another real sales opportunity in the area of customized software.

You'll be able to sell software for a wider range of configurations. You'll have more software to offer, too! Your programmers can concentrate on developing new packages instead of rewriting old ones.

For more information, send in the coupon for a copy of our free booklet, "Why Good Business Decisions are Based on UNIX System V."

UNIX System V. From AT&T. From now on, consider it standard.

Circle 6 on Inquiry card.



Please send the free booklet "Why Good Business Decisions are Based on UNIX™ System V."
Mail to: AT&T, P.O. Box 967,
Madison Square Station,
New York, NY 10159

Name _____

Title _____

Company _____

Address _____

City _____ State _____ Zip _____

My business category (check one):

OEM/VAR Software House
 MIS/DP Mgt. General Business Mgt.

Other _____
UNIX System licensee Yes No Don't know

In all, 22 prizes were awarded by a panel of computer experts, nutritionists, educators, and whiz kids.

Multuser System Network Tested in Miami

An interactive multuser computer system that allows 45 people to participate simultaneously is being tested in the Miami area by American Software Technology. The system, called Enter-net, is designed to allow users to interact with each other and the host computer in real time.

For the test, the company has created Fazuul, an interplanetary adventure game. The player crash-lands on Fazuul, and he or she must pose questions and analyze clues to escape. Players can team up to beat the game or work against other participants. All game commands are in English.

If you live in the test area and own a 300- or 1200-bps modem, you can gain access to Enter-net by calling 866-8060. The host computer will verify your telephone number and billing information (MasterCard, VISA, or prepayment) and provide instructions on how to play the game.

Call for Papers

The conference committee for the 1985 ASME International Computers in Engineering Con-

ference and Exhibition has issued a call for papers that address the theme "Expert Systems: A New Dimension in Computer Engineering." The venue will be the Sheraton Boston Hotel, August 4-8, 1985.

Papers are solicited in all areas related to the research, development, and application of computers in mechanical engineering with a focus on expert systems, including computer-aided manufacturing, simulation, robotics, engineering software and standards, and finite-element techniques. Contributions in the form of a full-length paper or an extended abstract are sought.

A November 15, 1984, deadline has been set for the submission of abstracts. Three copies of the finished contribution must be submitted by January 15, 1985. The date for notification of acceptance is February 15, 1985. Contributions must be submitted to the appropriate technical program chairperson. For a list of names and addresses, contact the American Society of Mechanical Engineers, 345 East 47th St., New York, NY 10017.

Public-Domain Software Sales and Rentals

P.J.'s Company of Vista, California, offers non-copyrighted, public-domain software in its

original source code. Three software libraries, CP/M, SIG/M, and IBM PC, are available. Each library is a collection of volumes from a users group and is made up of game, utility, and business programs. Computerists can freely copy and exchange the libraries using Digital Research's CP/M versions 1.4, 2.2, or 3.0 and 241K-byte 8-inch single-sided single-density IBM-3740-format drives. PC-DOS and most 5¼-inch floppy-disk-drive formats are supported.

The CP/M Users Group library has 92 volumes, the SIG/M library offers 148, and the IBM PC library has more than 100. Additional services include telephone ordering and automatic updates.

The complete CP/M library can be rented for \$45. The SIG/M library rents for \$75, and the IBM PC library rents for \$99.50. Add \$7.50 for shipping, handling, and insurance. The rental term is seven days after receipt, with a three-day grace period for return. For more information, contact P.J.'s Co., 1062 Taylor St., Vista, CA 92083. (619) 941-0925.

BYTE'S BUGS

Misplaced Lines

Dr. Antonio Salvadori, associate professor of physical science at the University of Guelph in Canada, spotted a bug in Stephen Bourne's article "The Unix Shell" (October 1983, page 187). The five lines on page 190 in the third column that begin "is an append command. . . ." should be replaced with the following: "is the Shell program called temporarily to execute a file. Files have three independent attributes—read, write, and execute. If wg is executable, then . . ."

Sieve of Eratosthenes Algorithm Defended

A BYTE reader wrote us expressing his confusion over the validity of the Sieve of Eratosthenes algorithm that accompanied Jacques Bensimon's March article "STSC APL*PLUS and IBM PC APL: Two APLs for the IBM PC" (page 246). Specifically, the reader became befuddled with Mr. Bensimon's BASIC prime-number-generating program (listing 2b, page 254), which produces an answer of "'1899 PRIMES" when in fact there are only 1028 primes between 2 and 8191."

"The problem with this . . . program," the reader wrote, "seems to be a faulty method for incorporating a sure and certain speed-up of the 'standard' sieve; after discarding all multiples of 2, . . . one only has to eliminate the odd multiples of 3, 5, 7, 11, etc. . . . After spending a lot of time unsuccessfully trying to accomplish this using only one FOR. . .NEXT loop, I have come to believe that the most efficient way to obtain this speed-up is to eliminate all odd multiples of 2, 3, 5, etc., in a first pass. What remains is either prime or a power of 2. A second pass to eliminate 4, 8, 16, 32, etc., leaves only the primes. My Turbo Pascal version of this runs 10 iterations in about 13.5 seconds."

We sent a copy of the letter to Jacques Ben-
(continued)

PC FORTH™
IBM PC & XT,
HP-150,
Macintosh,
Apple II,
CompuPro,
Sage & CP/M-68K,
Wang PC,
 All CP/M and
 MSDOS computers.

Try the *professional language* offering the *utmost performance* in the *shortest development time*. Transport your applications between any of our enhanced 83-Standard compilers or expanded 32-bit versions. Choose from our wide selection of programming tools including native code compilers, cross-compilers, math coprocessor support, and B-Tree file managers. All fully supported with hotline, updates, and newsletters.

Laboratory Microsystems Incorporated
 Post Office Box 10430, Marina del Rey, CA 90295
 Phone credit card orders to (213) 306-7412



People who buy UDS modems aren't playing games!

You can often judge a personal computer user by the hardware he selects. If the modem comes from UDS, chances are he has a serious investment in computer and software, a serious data communications requirement and serious computer-based decisions to make.

UDS modems offer true pro-quality performance to the serious microcomputer owner. Data rates range from 0 to 9600bps. Depending on data rate, synchronous and asynchronous models may be selected for half- or full-duplex communications. Their prices put them within easy reach of the serious user.

If data communication has progressed beyond the game-playing stage in your microcomputer system, it's time to investigate UDS. The efficiency, reliability and potential for faster data transfer can add real professional capability. Contact Universal Data Systems, 5000 Bradford Drive, Huntsville, AL 35805. Telephone 205/837-8100; TWX 810-726-2100.

 Universal Data Systems

 **MOTOROLA INC.**
Information Systems Group

Circle 314 on inquiry card.



(Formerly Warehouse Software)

Call for programs not listed.

Technical & Other Information (602) 246-2222
TOLL-FREE ORDER LINE 1-(800) 421-3135

Call for programs not listed.

DATA BASE MANAGEMENT SYSTEMS

Dbase II and Dbase III	Call
Fox and Geller Quickcode	\$159
Knowledgeman	\$275
Condor III	\$330
NWA Statpak	\$350
Tim IV	\$249
Infostar	\$255
PFS File	\$95
FRIDAY	\$175
Personal Pearl	\$145
Fast Facts for IBM PC	\$135
RBase 4000	\$285

WORD PROCESSING

Wordstar, Mail Merge, Correct	
Star, Star Index	\$345
Wordstar	\$235
Mail Merge or Correct Star	\$130
Microsoft Word With Mouse	\$295
Word Perfect	\$295
Volkswriter for the IBM PC	\$110
Volkswriter DeLuxe	\$175
Aspen Spellchecker	\$36
Metasoft Benchmark	\$265
Multimate	\$275
Peachtext 5000	\$195

SPREADSHEETS

Calcstar	\$89
Supercalc II	\$159
Supercalc III	\$199
Microsoft Multiplan	\$139
PK Solver	\$289

ACCOUNTING

TCS. equivalent of Peachtree - Specially augmented by Warehouse Software. Customized for your IBM PC Terminal and Printer - GL, AR, PA, AP, CP/M-80, CP/M-86 for PC XT, DOS 1.1, 2.0. Each Module . . . \$75 For All Four \$275

CYMA	CALL
Dollars & Pence	\$115
MBSI Real World, GL, PA, AP, AR	
Each Module	\$350

TRANSFER PROGRAMS

Move-it	\$85
Microstuff Crosstalk	\$105

BEST PRICE IN U.S. FOR IBM PC OR CLONES
 Multifunction Board - Includes Async Adapter, Parallel Adapter, Clock with battery back-up and Software, 64K memory expandable to 512K. 1 year warranty

\$249

LANGUAGES

Lifboat Lattice C Compiler	\$295
Microsoft C Compiler	\$315
Microsoft Pascal Compiler	\$215
Microsoft Basic Compiler	\$245
Microsoft Basic Language	\$235
CBASIC 86 for IBM PC	\$135

FOR PC OOS

Norton Utilities	\$55
Copy II PC	\$34
Prokey V3.0	\$89
Harvard Project Manager	\$265
Microsoft Flight Simulator	\$38

HARDWARE

Hayes 1200 Modem	\$495
Hayes 1200b Modem for IBM PC ..	\$425
Internal Model for IBM PC	\$285
Anchor Signalman 1200baud Modem	\$285
MPI 360K Disk Drives	\$185
CDC 360K Disk Drives	\$215
1/2 Height Panasonic Drives D/S D/D	\$185
10 MB internal hard drive for IBM PC	\$995
10MB external hard drive for IBM PC	\$1095
Princeton RGB monitor	\$479

COMPUTERS

Corona or Zenith Computer Portable or Desk Top	Call
--	------

BOARDS FOR THE IBM PC OR LOOKALIKES

Quadram Color I	\$199
Quadram Color II	\$245
256K Sigma Ram Board	\$299
Maynard Sandstar Controller	\$195
STB Graphics Boards	\$285
Sigma Disk Controller	\$185

PRINTERS

Bluechip M120/0	\$249
Gemini 10X	\$269
Gemini 15X	\$369
Okidata 82A	Call
Okidata 83A	Call
Okidata 84P	\$949
Okidata 92P	\$425
Okidata 93P	\$639
Juki 6100	\$420

Call on all Epson Models

Daisywriter 2000	\$1030
Silver-Reed	Call
Diablo 620	Call
Diablo 630	Call
NEC 3550	Call

TERMS: Prices include 3% cash discount. Add 3% for charge orders. Shipping on most items \$5.00. AZ orders +6% Sales Tax. Prices subject to change.

FIXES AND UPDATES

simon, who responded by telling us ". . . the Sieve of Eratosthenes it certainly is!" According to Mr. Bensimon, the figure 1899 is the correct number of primes between 3 and 16,383 (i.e., $2 \times 8191 + 1$). The algorithm avoids even numbers entirely because it operates on flag vector F of 8191 elements, which represent all odd numbers between 3 and 16,383. The variable P steps through the 1899 distinct prime values during execution.

Tiger and Dragon Mixed with Wrong Formula

Dan Rollins's article "A Tiger Meets a Dragon" (December 1983, page 457) motivated Mexico City's Ruben Chaves Misrahi to write a Pascal program to graph dragons of different orders on his Apple IIe. In the process, Mr. Misrahi discovered a bug that has a solution that may not be obvious.

Mr. Rollins's generalized dragon formula in the last column on page 459 is incorrect. According to Mr. Misrahi, the correct formula is

$$S(n) = S(n-1) + d_n + S(n-1)$$

using $S(0) = 0$ null <sequence>

In a letter to us confirming this bug and its correction, Mr. Rollins notes that many of his article's readers failed to realize that the Gen-dragon program (listing 1, page 460) does not have to be used with the plotter emulator (listing 2, page 475). In addition, if you replace the GOSUB 1500 in line 550 with PSET (X,Y), you can transport the program to many machines. Mr. Rollins also reports that an order-11 dragon curve can be displayed directly on an IBM PC's monitor and printed out with a graphics screen-dump program.

Important Biographical Info Omitted

We inadvertently left out some important biographical information about Scot Kamins, the author of "Macintosh BASIC" (April, page 318). Mr. Kamins coauthored with Mitch Waite *Apple Blackjack: Humanized Programming in BASIC* (McGraw-Hill/BYTE Books, 1982). He has written a number of manuals for Apple Computer Inc., including the *Applesoft Programmer's Reference Manual* and the *Macintosh BASIC Reference Manual*.

Mr. Kamins is currently writing a series of books on Macintosh BASIC that is to be published in the fall. He is a senior technical writer for Technology Translated Inc. (1047 Sutter St., San Francisco, CA 94109), a technical writing concern.

We apologize for our mistake.

Greater Memory Expansion

You can expand the RAM of Digital Equipment Corporation's Rainbow 100B by 768K bytes (for a total of 896K bytes), not to 768K bytes as we erroneously reported (June What's New, page 50). We apologize for the error.

It comes with 128K bytes of RAM, a pair of 400K-byte 5 1/4-inch floppy-disk drives, and dual Z80 and 8088 processors. Without a keyboard or monitor but with CP/M-80, CP/M-86 version 2.00, and MS-DOS version 2.05, it costs \$2750. ■

TOLL-FREE ORDER LINE 1-(800)-421-3135

WAREHOUSE DATA PRODUCTS
 2701 West Glendale Ave., Suite 6
 Phoenix, AZ 85021



**C COMPILERS FOR
PC DOS MS DOS CP/M-86 CP/M-80 APPLE II, IIe, IIc
COMMODORE 64 RADIO SHACK and MACINTOSH**



AZTEC C86

NEW RELEASE

Optimized "C" compiler for PC DOS, MS DOS & CP/M-86
PC DOS, UNIX I/O, math, screen, graphics libraries
8086 assembler, linker & librarian, overlays
/PRO—library source, debug, ROM, MASM & RMAC, 8087, large model



AZTEC C II

NEW RELEASE

Optimized "C" compiler for CP/M, TRSDOS & LDOS
assembler, linker & librarian, overlays, utilities
UNIX I/O, math & compact libraries
/PRO—library source, ROM, M80 & RMAC

**NEW C COMPILERS
AZTEC C68K for MACINTOSH
VAX cross compilers**

C TOOLS & AIDS

Z editor (like Vi), C TUTOR compiler, PHACT database,
C GRAFX, UNI-TOOLS I. QUICK C, BABY BLUE for PC
to CP/M cross, QUADLINK for PC to APPLE cross



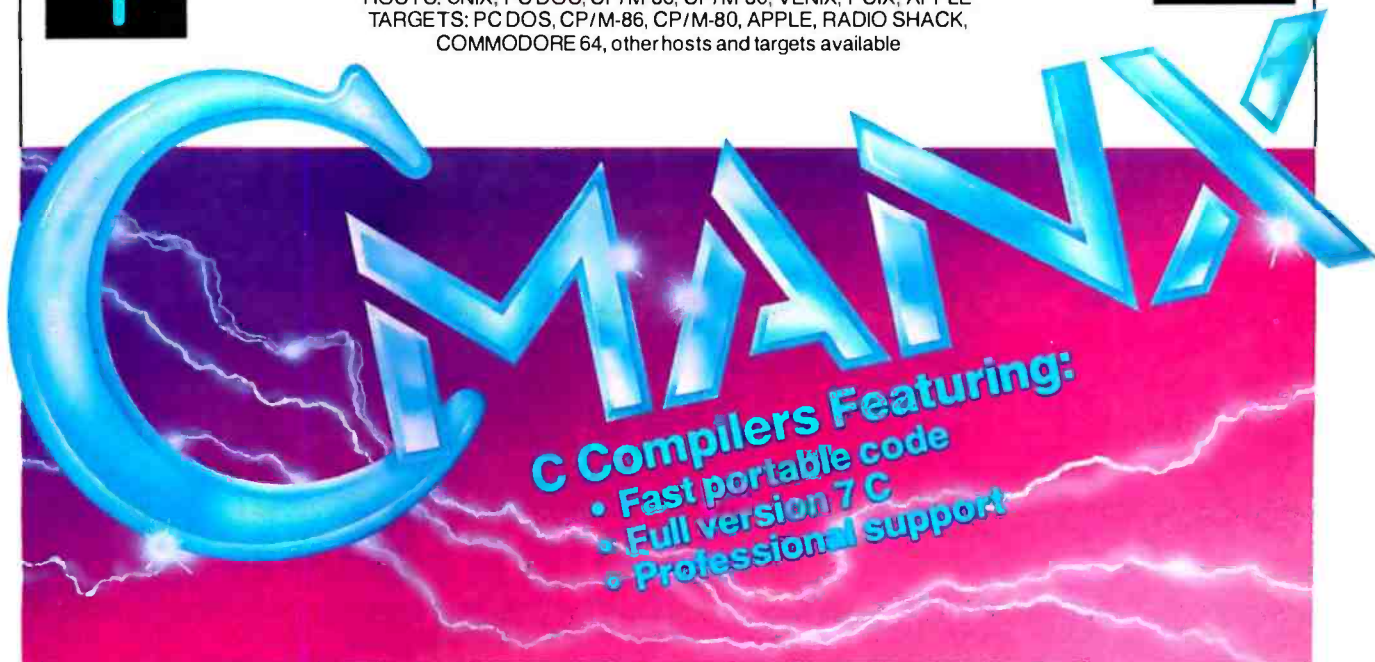
CROSS COMPILERS

Compile & link on HOST—test on TARGET machine
HOSTS: UNIX, PC DOS, CP/M-86, CP/M-80, VENIX, PCIX, APPLE
TARGETS: PC DOS, CP/M-86, CP/M-80, APPLE, RADIO SHACK,
COMMODORE 64, other hosts and targets available



AZTEC C65

"C" compiler for APPLE DOS 3.3, ProDOS or COMMODORE 64
VED editor, SHELL, UNIX & math libraries
/PRO—library source, ROM, overlays



C Compilers Featuring:

- Fast portable code
- Full version 7 C
- Professional support

PRICES

AZTEC C86 C COMPILER

PC DOS MSDOS	249
CP/M-86	249
BOTH	399
C86/PRO	499
/PRO UPGRADE	250
Z (VI EDITOR)	125
C TUTOR COMPILER	99
PHACT DATABASE	299
C GRAFX	99
SUPERDRAW	299
UNI-TOOLS I	99
QUICK C	125

AZTEC C II C COMPILER

CP/M	199
CII/PRO	349
/PRO UPGRADE	150
TRS 80 MODEL 3	149
TRS 80 MODEL 4	199
TRS 80 PRO (3 & 4)	299

AZTEC C65 C COMPILER

APPLE DOS 3.3	199
PRODOS	CALL
E EDITOR	99

AZTEC C CROSS COMPILERS

PDP-11 HOST	2000	PC DOS
PC DOS HOST	750	CP/M-86
CP/M-86 HOST	750	CP/M-80
CP/M-80 HOST	750	APPLE
APPLE HOST	750	RADIO SHACK
VAX HOST	CALL	COMMODORE 64
MACINTOSH	CALL	MACINTOSH

TRS 80 RADIO SHACK TRS DOS is a trademark of TANDY.
APPLE DOS MACINTOSH is a trademark of APPLE.

MANX SOFTWARE SYSTEMS
Box 55
Shrewsbury, NJ 07701
TELEX: 4995812



TO ORDER OR FOR INFORMATION:
CALL: 800-221-0440 (outside NJ)
201-780-4004 (NJ)

Australia: Blue Sky Industries—2A Blakesley St.—Chatswood NSW 2067—Australia 61-2419-5579
England: TAMSYS LTD—Pilgrim House—2-6 William St.—Windsor, Berkshire SL4 1BA—England—Telephone Windsor 56747

Shipping: per compiler next day USA \$20, 2 days USA \$6, 2 days worldwide \$75, Canada \$10, airmail outside USA & Canada \$20
UNIX is a trademark of Bell Labs. CP/M, CP/M-80 and CP/M-86 are trademarks of DRI. PC DOS is a trademark of IBM. MS DOS is a trademark of MICROSOFT.
N.J. residents add 6% sales tax.



We've made it possible for you to work with some unusual computer characters.

Not long ago, a group of engineers here at Digital Research had a genuine brainstorm.

Introducing VidLink.™ The software-video technology that will literally revolutionize the way you see your computer.

Using a cable that connects a Pioneer® LD-700 Laser-Disc Player to your Commodore 64™ (and soon an IBM® PC or Apple® II), VidLink lets you key up visual information from virtually any videodisc. With

IBM is a registered trademark of International Business Machines Corporation. Commodore 64 is a trademark of Commodore Business Machines Inc. Apple is a trademark of Apple Computer Inc. Pioneer LD-700 Laser-Disc player is a trademark of Pioneer Video Inc. a wholly owned subsidiary of Pioneer Electronics, Tokyo, Japan. VidLink is a trademark of Digital Research Inc. ©1984 Digital Research Inc. All rights reserved. *Price subject to tax, shipping and handling.



everything from *NFL Videodiscs* to a trivia quiz disc like *Maze Mania*.

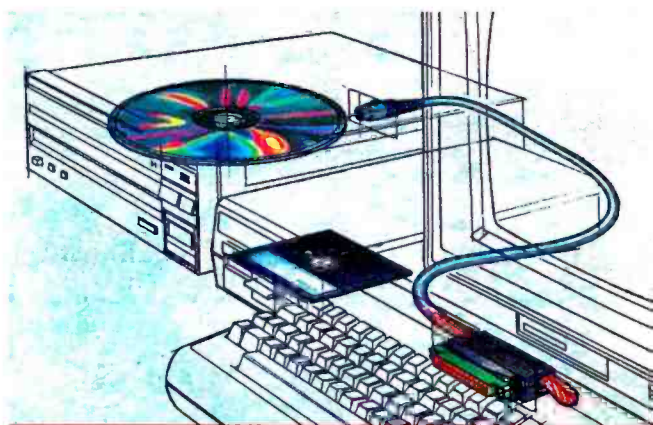
Imagine. Playing games with interactive discs like *Murder, Anyone?*, *Apollo 17: Mission to Taurus Littrow* or *The National Gallery of Art*. You'll even be free to create your own challenges. VidLink lets you invent your own games or programs to work with a wide range of existing videodiscs.

Imagine. The ability to re-program sequences on a videodisc. The possibilities are limited only by your imagination.

Hooking the computer revolution to the video revolution is a snap. A VidLink connector cable and cassette-based or floppy software running on your computer is all it takes. And instructions are simple and fully documented.

But perhaps the most unexpected feature is the price. Just \$49.00* gives you VidLink, one of the many visions we see in the future of computer-video.

VidLink is only available direct from Digital Research. To order yours, and titles like *Murder, Anyone?*, *Maze Mania* or *First National Kiddisc*, just have your American Express,[®] Visa[®] or MasterCard[®] ready. Then pick up your old-fashioned phone and enter these familiar characters: 1-800-227-6703, or in California: 1-800-632-7979.



**DIGITAL
RESEARCH[®]**
We make computers work.SM

Compaq Transportable Computers Get Stay-at-Home Brothers

Compaq Computer Corporation has expanded its product line to include four desktop machines based on a full 16-bit 8086 processor with a clock speed of 7.14 MHz. The new machines can use all software and hardware for the IBM PC and PC XT, the company says.

Because some telecommunications software and games will not run properly at the 7.14-MHz speed (the IBM's 8088 runs at 4.7 MHz), the clock can be slowed from the keyboard or by instructions in software. An LED on the front of the system unit indicates what speed the processor is operating at.

The entry-level machine in the Deskpro line is the Model 1. This \$2495 machine has a single floppy-disk drive and 128K bytes of RAM. The Model 2, at \$2995, has two floppy-disk drives and 256K bytes of RAM. The \$4995 Model 3 has 256K bytes of RAM, one floppy-disk drive, one 10-megabyte Winchester-disk drive, and a serial/clock card. The top-of-the-line Model 4 costs \$7195 and has 640K bytes of RAM, one floppy-disk drive, one 10-megabyte Winchester-disk drive, one 10-megabyte cartridge-tape drive for Winchester backup, and a serial/clock card. All models include a 12-inch green or amber monitor, an interface for an RGB color monitor, and a parallel printer port.



All models can accommodate up to 640K bytes of RAM on the main system board and support four half-height mass-storage devices in the system unit. These include combinations of up to two 360K-byte floppy-disk drives (controlled by one card, which also can control a tape-cartridge drive), two 10-megabyte Winchester-disk drives (controlled by one card), and one 10-megabyte tape-cartridge drive for Winchester backup. Technology developed for the Compaq Plus transportable with a Winchester drive is used to shock-mount all mass-storage devices in the Deskpro

series. A 200-watt, 3-amp power supply is standard and can support any combination of internal mass-storage devices.

All models have eight expansion slots, seven full-length and one short. The floppy-disk controller (with parallel printer port) occupies one slot in all configurations, as does the video board. Models with hard-disk drives add the serial/clock card in the short slot and the Winchester controller in a long slot. This leaves five long slots and one short slot open in floppy-disk configurations and four long slots open in hard-disk units.

The display features auto switching between text and graphics on the same monitor. In alpha mode, the monitor has a 9- by 14-dot character matrix and overall resolution of 720 by 350 pixels. The alpha/graphics mode drops to a character matrix of 8 by 8 dots for a standard 80-character by 25-line screen or a 16 by 8 matrix for a 40-character by 25-line screen; resolution overall is 640 by 200 pixels monochrome or 320 by 200 in four colors or gray levels (each pixel requires 2 bits).

The IBM PC keyboard layout is used, but LEDs have been added to the Cap-Lock and Num-Lock keys. A 10-character type-ahead buffer is provided.

The tape system uses 8 tracks in a serpentine pattern with 59 tracks per inch and 158 blocks per track. Recording density is 6400 bits per inch encoded using MFM method. Data transfer rate is 250K bits per second.

Software, except for a diagnostics disk, is not bundled. Compaq's MS-DOS 2.11 and BASIC cost \$60. A tilt-and-swivel stand for the monitor is \$50, and a small platform to allow storing the keyboard under the system unit is \$50.

For more information, contact Compaq Computer Corp., 20333 FM 149, Houston, TX 77070, (713) 370-7040. Circle 600 on inquiry card.

Low-Cost Plotter Produces Four Colors

Sharp Electronics has set a \$399 suggested retail price for its CE-515P four-color plotter. The CE-515P uses black, blue, green, and red pens that can be programmed to change automatically. The minimum shifting width of the ball pens is 0.2 mm. The size of an alpha-numeric character when produced in the four-step by six-

step mode is 0.8 mm wide by 1.2 mm tall. It can handle paper up to 8½ inches wide and plot on postcard-sized documents. Roll-feed paper and transparency sheets can be used.

Both EIA standard RS-232C serial and Centronics-type parallel interfaces are built into the CE-515P. The plotter can be driven by most microcomputers

that use BASIC, such as the Apple. Other built-in features include circle, paint, and axis commands.

Softkey's Keychart is bundled with the CE-515P. Keychart, which provides IBM PC compatibility, is a presentation graphics product. It uses a menu-driven fill-in-the-blank format to produce a variety of

multisized charts.

Sharp is working with a number of software houses to make a substantial software base for the CE-515P. Contact Sharp Electronics Corp., Systems Division, 10 Sharp Plaza, Paramus, NJ 07652, (201) 265-5600. Circle 601 on inquiry card.

(continued)

The automatic transmission with a \$250 differential.

What a way to travel! The Password™ modem is geared to transmit up to 120 characters a second from anywhere to anywhere else in the country at the push of a button. Adjusts automatically to any speed — moving at a high of 1200 baud, or down-shifting all the way to 300 baud.

Totally compatible, it lets any micro-computer phone-communicate with *any* other microcomputer. Easily portable, it parks almost anywhere thanks to the convenience of Velcro™ strips.

The Password modem turns out text ten times faster than an expert typist — sends thousands of words by phone for less than express mail. And our automatic transmission

comes through in the clutch by automatically dialing or answering your calls. Now look at the sticker price! At \$449, we're about \$250 less than the best-known modem. A very sizeable difference. Especially considering that both send and receive at the same speeds, and both carry a two-year limited warranty.

The Password modem. High performance at a compact price.

PASSWORD™
by U.S. Robotics, Inc.



1123 W. Washington
Chicago, IL 60607
Phone: (312) 733-0497



For a poster size reprint of this ad, send \$3.00 to U.S. Robotics, Inc.

Circle 310 on inquiry card.

www.americanradiohistory.com

MS-DOS Portable, Pivot Has Modem, Drive Built In

Pivot, a portable 16-bit computer from Morrow, combines a modem, clock, calculator, and 5¼-inch floppy-disk drive in a 9-pound package. It's available in three 128K-byte versions, with prices starting at less than \$2500.

Pivot uses Microsoft's MS-DOS 2.0 operating system, which provides access to hundreds of business applications. It's based on the CMOS 80C86 microprocessor and comes with a 16-line by 80-character, high-resolution LCD display.

The battery-backed real-time clock/calendar is accessed by

the clock icon on the Pivot's keyboard, which has 63 programmable keys, 10 function keys, and a 22-key calculator overlay. If you need to know the time in Japan, you can get the correct time there by locating it on the world map Pivot can display. The four-function calculator will accept up to 256 entries of 16 digits each, and it automatically inserts decimal points and commas.

The built-in modem operates at 300 bps under AT&T 103 protocol. ROM-based software lets Pivot emulate a dumb terminal for data communications with

electronic services. You can exit an applications program, access a database, and insert retrieved data into the application. With communications software, you can have a full-duplex modem with auto-answer and auto-dial features for both tone and rotary-pulse dialing.

All versions of Pivot run on 12-volt DC power. An optional rechargeable 1.5-pound VCR nicad battery provides up to five hours of additional power. The battery module fits inside Pivot and costs \$50. Pivot measures 13 by 13 inches when open. When shut, it measures 13 by 5.6 by 9.5 inches.

The Pivot family includes one or two double-sided, double-density 5¼-inch floppy-disk drives using nine-sectored IBM PC format with memory capacities of up to 512K bytes and bit-mapped graphics with 480-by 128-pixel resolution. They have three interface ports: a parallel port that mimics IBM PC I/O, an RS-232C serial port with programmable data rates from 300 to 19,200 bps, asynchronous or synchronous, and an RIIIC port to connect the modem to standard telephone lines. For complete details, contact Morrow Inc., 600 McCormick St., San Leandro, CA 94577, (415) 430-1970.

Circle 602 on inquiry card.

Five Programs Constitute Enable

Enable for the IBM PC comprises five integrated software modules: word processing, spreadsheet, graphics, database management, and telecommunications. You can generate a graph from the spreadsheet, then insert the graph and spreadsheet in text and print the whole package. You can select information for the database using Enable's query language and insert it anywhere without worry because Enable automatically expands the column length and modifies formulas.

It uses a master control module (MCM) that supervises the activities of each module and serves as the sole interface between you and the modules. It has a consistent set of commands, English-language menus with explanatory messages are available in each module. Menu options can be selected with the cursor or a keystroke. Expert commands that bypass the menus are available.

Enable lets you run one application, one communications, and one printing program concurrently. Its macro facility can record keystrokes and commands as they are executed. You can edit stored commands with the word processor.

Enable provides up to eight separate windows that you can size, shape, overlap, or zoom to full-screen length. Data can be cut and pasted from window to window with a minimum of keystrokes. Files created by such programs as dBASE II, Lotus 1-2-3, WordStar, VisiCalc, EasyWriter I, and Volkswriter can be used without rekeying or conversion. Enable can create files in the proper format for each of these programs.

Two disk drives and 192K bytes of memory are required. It lists for \$695. For full details on the word processor's editing features or the seven graph types of the graphics module, contact The Software Group, Northway Ten Executive Park, Ballston Lake, NY 12019, (518) 877-8600.

Circle 603 on inquiry card.

(continued)



10-Net: IBM PC Network

Fox Research markets a kit of hardware, software, and utilities for linking IBM Personal Computers into a high-speed local-area network. With 10-Net users can share applications, files, storage devices, and printers. 10-Net costs \$695 per user.

10-Net does not require a dedicated file server. It works with twisted-pair cabling and operates at 1 million bps. 10-Net extends up to 3000 feet, and repeaters increase its range to 1 mile. It's Ethernet-compatible with regard to message formatting and addressing. Record locking and several

levels of password security ensure file and data integrity. Network utilities provide a calendar and electronic mail.

As a complement to 10-Net, Fox Research has released a network version of its 10-Base relational database-management system. 10-Base permits single-query access to multiple files, and it places no restrictions on the number of files that can be created. A bridge feature lets you exchange information with more than 100 popular micro-computer programs, and a forms manager lets you design custom screens and forms.

The network version lets you

set up a distributed database. With the assistance of a system configuration table, you can locate 10-Base's data dictionary, files, and other resources anywhere within the network. Its architecture provides for 65-character path names.

Minimum system requirements are an IBM PC, PC XT, or compatible, PC-DOS 2.0 or later, 128K bytes of RAM, and a disk drive. The network version of 10-Base is \$895 per network system. Additional manuals are \$75. Contact Fox Research Inc., 7005 Corporate Way, Dayton, OH 45459, (513) 433-2238. Circle 604 on inquiry card.

Our Family Tree Is Growing Again

SBC-II A two user multiprocessing S-100 slave complete with a Z-80 CPU (4 or 6 MHz), 2 serial ports, 64K RAM, and 2K FIFO buffer for each user! A cost effective way to add users to your multiprocessing system.

HD/CTC A hard disk and cartridge tape controller combined together on one board! A Z-80 CPU (4 or 6 MHz); 16K ROM, and up to 8K RAM provide intelligence required to relieve disk I/O burden from host system CPU. Round out your multi-processing system with an integrated mass storage/backup controller.

Systemmaster[®]
The ultimate one board computer; use it as a complete single-user system or as the "master" in a multi-processing network environment. Complete with Z-80A CPU, 2 serial and

SBC-T A multiprocessing slave board computer with Z-80 CPU (4 or 6 MHz), 2 serial ports, 2 parallel ports, and up to 128K RAM. Provides unique 2K FIFO buffering for system block data transfers. When used with TurboDOS or MDZ/OS the results are phenomenal!

2 parallel ports, floppy controller, DMA, real time clock, RAM drive disk emulation package, and Teletek's advanced CP/M BIOS or TurboDOS.

4600 Pell Drive Sacramento, CA 95838 (916) 920-4600 Telex #4991834 Answer back-Teletek

TELETEK

www.americanradiohistory.com



Preprogrammed Hero

Heath's preprogrammed personal robot, Hero Jr., roams, explores, sings, and speaks English. It'll wake you in the morning (a 10-minute snooze period is built-in), play games, and guard your house with an optional security system. A Motorola 146818 CMOS 100-year calendar/clock provides the date, day of week, and time, and it adjusts itself for biannual time changes.

Hero Jr. trundles about randomly on its three wheels, and a wireless remote control lets you drive it around. For sound sensing, it has a 256-bit resolution sound sensor with adjustable range and a 200- to 5000-Hz bandwidth. A 256-bit resolution light sensor with adjustable range and a 25-degree reception angle is provided. Its ultrasonic sonar can accurately measure distances from 4 inches to about 25 feet. Speech synthesis equipment includes a Votrax SC-01, with 4 pitch levels and 64 phonemes.

It can carry up to 10 pounds on a 94-cubic-inch compartment. A 17-key keypad lets you modify its personality or initiate a special task. Eight data LEDs flash in time with its speech or indicate sound levels when it listens. Rear connectors include

a charger jack, on/off switch, sleep switch, and an RS-232C interface.

The operation of Hero Jr.'s personality traits can be increased or decreased through software. A Hero Jr. BASIC cartridge permits programming through its RS-232C port. Additional preprogrammed game/entertainment cartridges will be available.

Hero Jr. uses a Motorola 6808 microprocessor. It has 32K bytes of monitor ROM, 8K bytes of RAM, and provisions for up to 16K bytes of ROM or RAM as well as for 4K or 8K bytes of plug-in ROM cartridges. It's built with three circuit boards: microprocessor, power supply/sense, and keyboard. Two Motorola 6821 parallel interface adapters are incorporated into its design.

For steering, it uses a 180-degree rotation, stepper-type motor, and a 12-volt DC motor for the drive. It's powered by two 6-volt, rechargeable lead/acid gelled-electrolyte batteries; two optional cells double operating time. It stands 19 inches tall and weighs 21.4 pounds.

Hero Jr. costs approximately \$1000. Contact Heath Co., Dept. 150-375, Hilltop Rd., Benton Harbor, MI 49022. Circle 605 on inquiry card.

Input Console Eliminates Rote Commands

Polytel Computer Products' Keyport 300 is a 300-key programmable input device for the home, office, and school. Available for the Apple II series, the Commodore 64, and the IBM PC or PC XT, Keyport uses interchangeable overlays known as Keyware. These overlays organize the commands associated with, for instance, a spreadsheet in such a fashion that anyone, regardless of computer expertise, can use the program immediately. The need to learn a command language is eliminated.

With the Keyware overlays, Keyport translates commands into languages the computer understands. It uses single

keystrokes, and the command outlines are written in plain English.

A library of preprogrammed Keyware overlays for spreadsheet, word-processing, and integrated programs is available. You can create custom overlays using Keyport's programmable keys.

Keyport 300 uses a membrane keyboard; it has no integrated circuits or moving parts. It measures 9½ by 12¾ inches. To use this system, you plug Keyport into the computer, load a Keyware disk, fit the program overlay onto Keyport, and begin programming.

A larger version of Keyport, the 717, which features 717 pro-

grammable keys, is available for the Apple only.

An Executive Keyport 300 package, complete with word-processing, spreadsheet, and

graphics demonstration overlays, is available for \$299. The

Keyport 717 with educational software begins at \$179. Contact Polytel Computer Products Corp., Suite 310, 1250 Oakmead Parkway, Sunnyvale, CA 94086. (408) 730-1347.

Circle 606 on inquiry card.



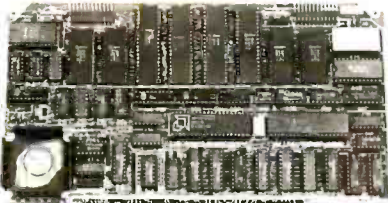
(continued)



INPUT/OUTPUT TECHNOLOGY, INC.

25327 Avenue Stanford, Unit 113, Valencia, CA 91355 • [805] 257-1000

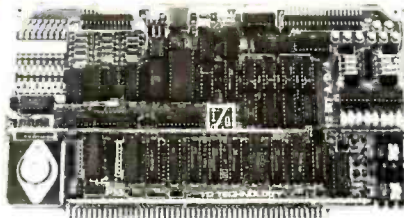
Uncompromising Additions to your S-100/IEEE-696 BUS



DUAL GPIB-488 INTERFACE BOARD

A Stand-Alone, Independently Controlled Dual Channel IEEE-488 I/O Processor. Interface Activity Modes for Controller-in-Charge, Controller Assigned or Terminal Bus Slave, and all Interface Functions are handled transparent to Host System CPU through an on-board CPU and DMA controller. User Friendly operation.

A&T, P/N 52748-800-102

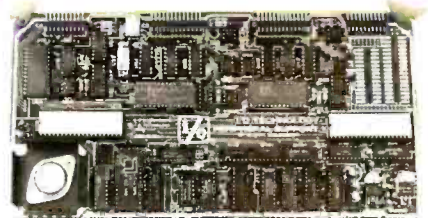


12-BIT A-D-A CONVERTER BOARD

B Channel A-D: 12 microsec. Conversion, 50KHz Sample Rate, Programmable Gains, Offset and Diff./Single Modes.

B Channel D-A: 2 microsec. Settling, Bipolar V or Unipolar I Output, Programmable Reference levels, Dual-Ported Channel Refresh RAM. **16/8-Bit Data Transfers** via I/O or Memory Mapped

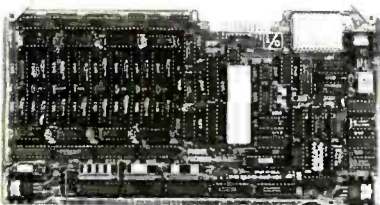
A&T, P/N 52748-900-101



PERIPHERAL SUPPORT BOARD

Two Serial SYNC/ASYNCR Ports with RS-232, TTL or Current Loop Outputs, three 8-Bit Parallel Ports, three Timers, Real Time Clock/Calendar and Response Programmable Interrupt Controller. Small Proto Area with +5 and $\pm 12v$.

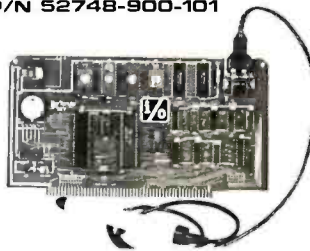
A&T, P/N 52748-150-101



RGB COLOR GRAPHICS BOARD

Programmable resolution up to 512 x 512 pixels with 4 local video planes and on-board graphics processor. Color mapper allows 16 colors from a palette of 4096. Light pen input. Plus more ...

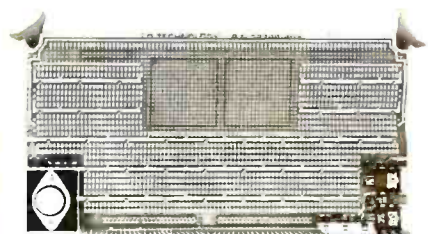
A&T, P/N 52748-300-101



BAR CODE PROCESSOR BOARD

The BarTender is a stand-alone I/O Processor that reads and prints most common Bar Codes. Includes bi-directional reading, wand interface, clock/calendar with battery. Extensive documentation and software.

A&T, 52748-500-101 Without Wand
A&T, 52748-500-201 With Wand



MULTI-PURPOSE PROTOTYPING KIT

Industrial Quality with Plated-Thru holes for Wire-Wrap or Solder projects. Complete with +5, $\pm 12v$ Regulators, Bus Bar, Filter Capacitors, and Manual.

P/N 52748-450 Circle 157 on inquiry card

ALSO AVAILABLE: MULTI-FUNCTION I/O BOARD, SMART PROTOTYPING KIT, 128Kx8/64Kx16 STATIC RAM MODULE

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

SagePaint Drawing Program



SagePaint is a color-graphics drawing program from Sage Computer.

Written in UCSD Pascal, it runs on a Sage II or IV computer enhanced by the Pluto graphics subsystem. The program uses a three-button mouse to draw eight-color graphics in 288- by 568-pixel resolution. Using the metaphor of pen and ink, the user can mix foreground and background colors to create a wider variety of

"paints" than the eight pure colors that are supplied.

The user can select functions from a menu of graphic icons displayed on screen. The program can draw brush strokes and thin lines, erase, fill an enclosed area, copy and modify rectangular areas of graphics, and enter text in one size.

SagePaint's price was not available at press date but was estimated to be about \$400 for the program itself and \$1000 for the source code.

For further information, direct your inquiries to Sage Computer, 4905 Energy Way, Reno, NV 89502. (702) 322-6868. Circle 607 on inquiry card.

Photo 1: SagePaint's color mixing palette. On the left-hand side of the screen, you can select functions from the icon menu.

Portable Drive for Notebook Computers

The Bullet, a mass-storage system for such notebook computers as the Radio Shack TRS-80 Model 100, the Olivetti M-10, and the NEC 8201, is produced and manufactured by Holmes Engineering. It plugs directly into the computer's RS-232C port and operates using menu-driven commands from the computer. Power is drawn from rechargeable batteries or from a battery charger/power transformer.

The Bullet uses thin wafer-type tape cassettes; each can store up to 64K bytes of data on its continuous loop. A ROM-based operating system gives the Bullet a rapid load/save response time: for example, a 10K-byte file can be saved and verified in about 40 seconds.

It's housed in a cabinet that complements the Model 100's color. The 3¼-pound Bullet measures 8 inches wide, 5½ inches deep, and 2½ inches high. With cables, wafer tape, manual, and battery charger/power transformer, the Bullet is \$369.95. Contact Holmes Engineering Inc., 5175 Green Pine Dr., Salt Lake City, UT 84107. (801) 261-5652. Circle 608 on inquiry card.

Intelligent Copier/Printer Uses 68000

The K-2 intelligent copier/printer from Kentek Information Systems has the ability to merge multiple fonts, customized logograms and signatures, and business graphics. It uses electrophotographic technology and is designed to print letter-quality text and graphics from virtually any host micro-computer.

Its on-board intelligence centers around a Motorola MC68000 microprocessor, supported by a 5¼-inch floppy disk. It can perform a variety of program control functions ranging from the selection of page sizes, print orientation, and fonts to the generation of highly complex vector graphics such as computer-aided designs, statistical symbols, line drawings, and technical diagrams.

The data stream of text and graphics can be fed from your computer to the K-2's on-board controller. In turn, the controller computes the corresponding all-points-addressable bit-map pattern for transfer to the LED array printing head, which is focused on an organic photoconductor belt. It yields a 240- by 240-pixel-per-inch image at a rate of 12 pages per minute.

The print engine uses a two-component dry toner that is heat and pressure fused.

Two paper cassettes are available to feed 16- to 64-pound bond, letterhead, transparencies, pressure-sensitive labels, perforated sheets, and envelopes. Paper sizes range from 5½ by 8½ inches to 8½ by 14 inches. Envelope sizes are 8¾ by 4¾ inches to 6½ by 3½ inches.

The K-2 supports character variables, including line density in standard text of 5, 5.33, 6, 8, and 24 lines per inch. Line spacing is available in single, double, triple, half, and one and a half. Character pitches include 10, 12, and 15 with or without

proportional spacing. All characters can be rotated.

Font selection and management is controlled by the host computer and limited only by the capacity of the floppy disk. Disks are capable of storing more than 30 fonts of 154 characters each.

Connections are through either an RS-232C or an RS-422 port. The K-2 supports three asynchronous protocols at concurrent levels. Pricing begins at less than \$10,000. Contact Kentek Information Systems Inc., Six Pearl Court, Allendale, NJ 07401. (201) 825-8500. Circle 609 on inquiry card.

(continued on page 431)



“Heaven Knows How I’d Keep Track of My Flock Without Infoscope.”



Before we got Infoscope, I frankly didn't know what to do with our church's personal computer. Now I don't know what I'd do without it. Infoscope lets me put virtually anything in our computer, and take anything out in whatever form I need. I can see how a business could use data management like that. But my "business" is my congregation — and I never knew my congregation so well before.

Wait till you see what we get out of Infoscope ...

“Our Computer Never Did So Much Before.”

I've got every church member in here. Names. Addresses. Children. Anniversaries. Pledges. Special needs. Volunteer projects. Infoscope makes it easy to enter information. If I make a mistake (no man is perfect), Infoscope suggests an alternative.



If I misspell a word, Infoscope suggests the right spelling. Politely, I might add. None of this SYNTAX ERROR business. I don't need scolding.

I Forget Anniversaries. Infoscope Doesn't.

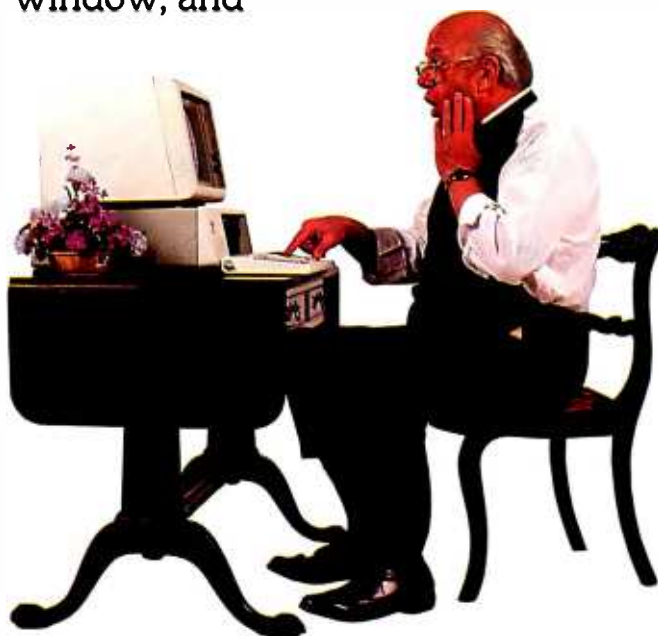
Once I've entered the data, I just ask Infoscope to pull out all anniversaries of our members for, say, January. Before I can blink my eyes, I've got it. I remember birthdays the same way. My congregation thinks it's wonderful, the kind of memory I have. It's hard to believe that pastors used to keep all this in their heads. Or, forgive me, but maybe they didn't ...

Building Fund Pledges Here. Contributions Here.

Anytime you want to compare data, Infoscope lets you create windows.



I can see our pledge list in one window, and

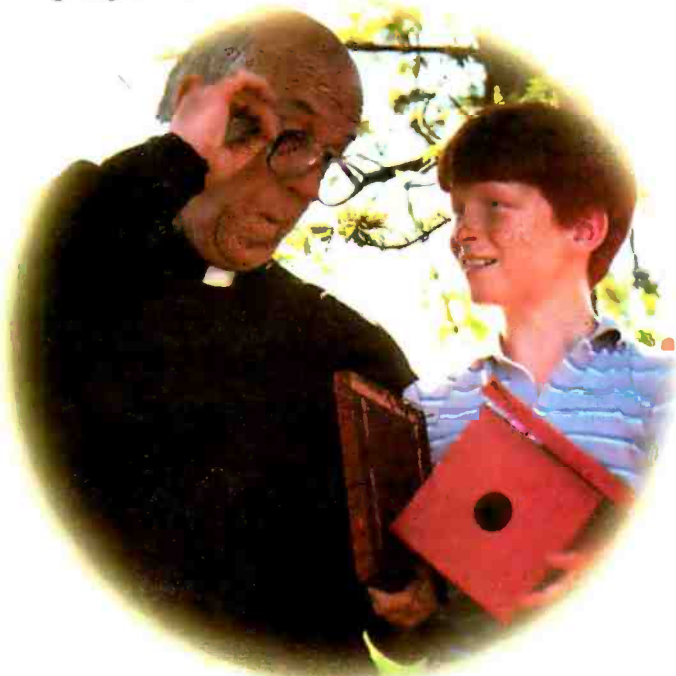


contributions in another. The only thing Infoscope doesn't know is that Bill Martin is late paying his pledge because Sue has been sick. That's my department.



I Can Create a Window for Everything.

For example, Vacation Bible School. In one window, I pull out and display all the volunteer teachers. In another, I scroll through last year's students. In another, all the class projects.

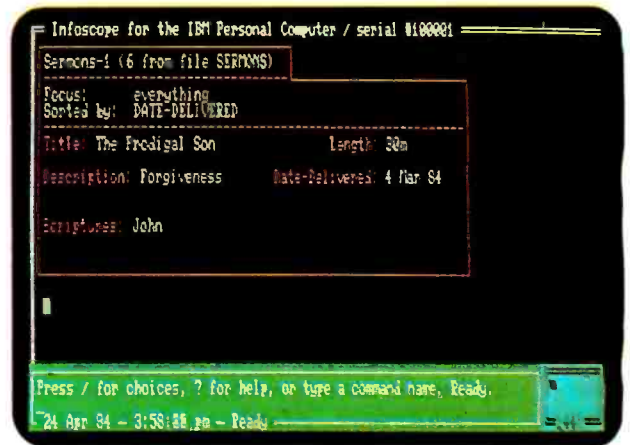


And so on. I can make each window as large as I want, and put it anywhere on the screen I want.



At Last, Our Computer Performs Miracles.

It just took the right program. With Infoscope, we can enter data ... sort it



... compare it in expanding movable windows ... even pull out data from a larger data base. No software ever did so much to make a microcomputer so valuable. I swear by — well, I appreciate very much what it does for me.



in scope™

* Infoscope operates on data in RAM, so it's 4 to 100 times faster than other information management programs. For a demonstration, see your retailer. Or, write for details:

MICROSTUF®

1000 Holcomb Woods Parkway / Roswell, Georgia 30076

Conducted by Steve Garcia

TI KEYBOARD FOR IBM PC?

Dear Steve:

Having seen the Texas Instruments PC keyboard (November 1988 BYTE, page 23) and seeing an IBM PC that actually had it, does the TI "turn out right" in designing it backward so it would be easier for the IBM PC to be adapted to work with the IBM PC? It is possible what would be involved in this conversion?
 Wm. Maurice
 Anheuser, AE

While it is probably possible to adapt the TI Professional Converter's keyboard to the IBM PC, it would require extensive changes to the IBM BIOS (basic input/output system) keyboard-interpretation routine and possibly some hardware changes—not an easy task.

Alternately, do you envision if you want to get a keyboard with a softer touch and more the well-worn feel of the IBM key and the return key in a more conventional location. I've had both in the market, but they make no attempt to duplicate the TI Professional's 27 keys, nor do they give you nearly 50% of them as provided for by Texas Corp., P.O. Box 14587, Dallas, TX 75214 (Houston Co., 2627 East River St., Minneapolis, MN 55423, and Cole Distributing, 4809 Cole Ave., Omaha, NE 68131). Advertised prices for these keyboards are in the \$200-\$300 range.

A cheaper alternative is to use one of the keyboard-emulation programs that modify the keyboard interpretation routine to change some of the key functions to your specifications. Some of these are Keyboard 2.0 from Texas Systems, 2950 West 48th St., Los Angeles, CA 90048; Magic Keyboard from Differentiate, Inc., 1451 Avenue, New York, NY 10020; ProKey from Swadlow, P.O. Box 4808, Seattle, WA 98107; and Keyboard II from Strategic Software, 2150 South West Ave., Los Angeles, CA 90007.

One or two of these options will meet your requirements, will cost less than adapting the TI keyboard.—Steve

CPM FROM APPLE II TO C-64

Dear Steve:

I have been searching for a way to transfer data from an Apple IIe disk to Commodore 64's diskette format. I want to use the Commodore 64 with a 2M cartridge and CPM 2.2. I have seen disk-format conversion utilities for other machines.

Douglas Yi
 Longmont, CO

I am not aware of a format converter that will change Apple II CPM disk files into the Commodore 64 format. The Commodore CPM implementation is new and has not yet gained widespread use.

Files can be transferred from one machine to the other by the use of serial ports and more-commodore-oriented software. The transfer can be accomplished either by means of a modem or by direct connection through a serial cable. The files are then extracted or structured as required.

Many Commodore software packages are available for such transfers. Consult the ads in BYTE or manufacturers' magazines for manufacturers.—Steve

QUESTIONS ON APPLE AND BASIC

Dear Steve:

I have an Apple IIe with two disk drives, a Commodore 64, and a Commodore 80. I'm, who is a good intermediate programmer or perhaps better a specialist in the programming of the computer?

Second, I have an IBM disk card in the case. How do I want to know if another card can be used in Slot 1 while the 80-volume card is in use? If so, which one or what type?

Finally, can the Gemini compiler library page 149 be used to compile microprogram programs?

Mike W. C. Blandford
 Camp Lejeune, NC

Your question is not providing time for your Apple IIe's overall use. The one best suits the your application, however, depends on the type of program. For example, if your program requires a lot of disk interaction, a 80M disk will greatly improve speed. If your program does a lot of reading, tracking the 80M disk will not be effective. A better microcomputer can result in speed increases of three to four times.

Apple Logic Business Systems (2119 North Green St., Woodstock, IL 60098, 815) will fit into the hardware if used (2795) which increases the processor capacity to 64K available RAM and the 80M disk, 145K and 128K (two memory boards) (2717, 1248, 1499) with software from the Institute of Data, Chicago Microware, 2121 South Lincoln Hwy., Suite 224, Chicago, IL 60606, (712) 642-6642) sells the Gemini, 198K, a multi-purpose expansion card with disk-oriented software (2459 95).

The book is also the auxiliary connector for Slot 1 for maximum compatibility with an

Apple IIe volume software. When one of the 80-volume card cards is plugged into the connector, a 198K connector module is used and enables the 80M (hard-copy) connector or software on any card plugged into Slot 1.

The Gemini connector for any other BASIC compiler converts a BASIC program into a machine-language program that executes faster.—Steve

MONOCHROME GRAPHICS ON A PC

Dear Steve:

I have an IBM PC with its monochrome display and printer-adaptor card. Unfortunately, I want to get the monochrome graphics output from my display without spending more than \$100.

I know that some vendors have introduced a simple interface circuit to enable the IBM monochrome display to be connected with the color graphics card to get the result.

Please let me if this method is technically and economically suitable. Will it do any harm to the monochrome display? Also, please describe in a future BYTE how such a circuit is built, if possible.

Marlene Lee
 Roselle, NJ

The IBM monochrome display is designed to work at a horizontal sync rate of 15.750 and a vertical scan rate of 50 Hz. The difference from the ATCC (National Television System Committee) norm is attributed by the graphics-video adapter to cause problems. IBM cards that operating the monochrome display than the graphics adapter will change the display. I have also heard of changed power supplies in these displays that operating this way.

For this reason, I don't recommend using the monochrome display with the color graphics adapter. Instead, I recommend that you buy an inexpensive monochrome monitor that follows ATCC standards, many of which are available from advertisements in BYTE for around \$100 that will give you a graphics display on the IBM monochrome display. The graphics adapter advantage that both monitors are available in your cabinet, so you can have the monitor that display of the monochrome display connect with the graphics video to the graphics display when using graphics. Programs such as Lotus 1-2-3 help the user with compatibility when both display systems are installed.

A pair of programs in the IBM BASIC manual (included)

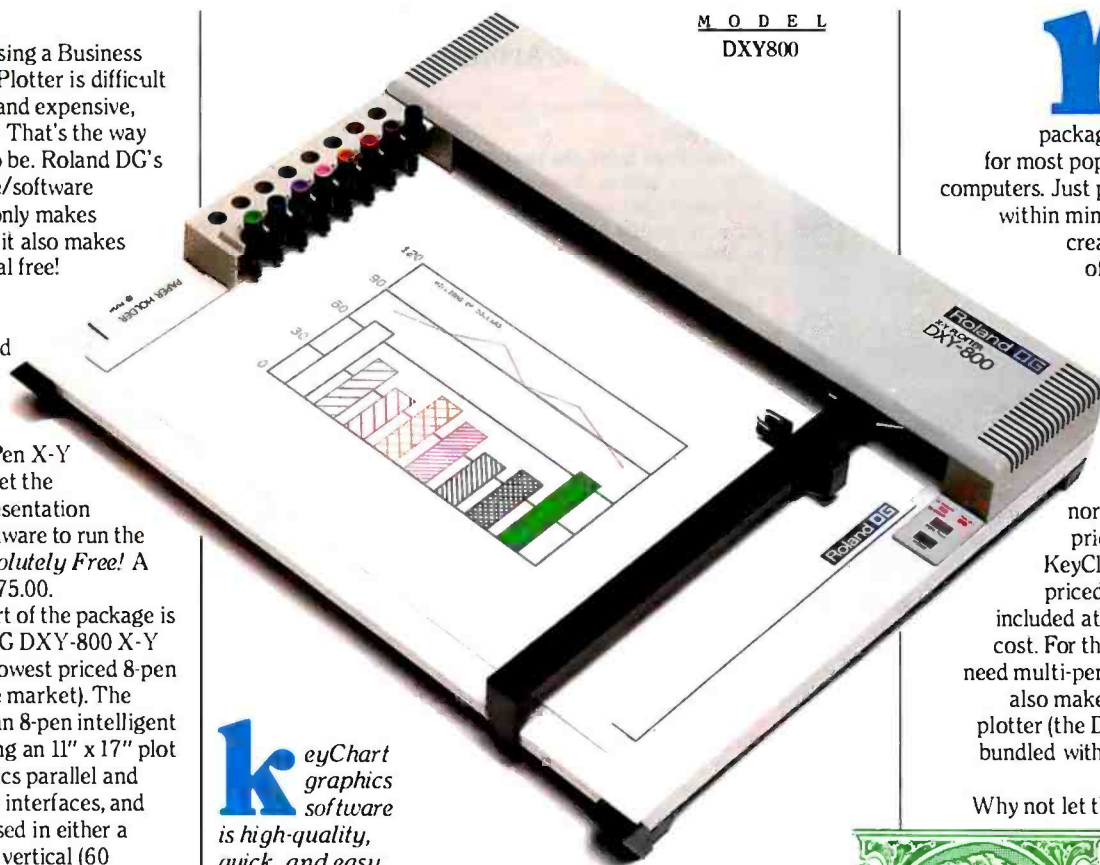
Free and Easy

Using a Business Plotter is difficult and expensive, right? Wrong! That's the way things used to be. Roland DG's new hardware/software package not only makes plotting easy, it also makes part of the deal free!

During the months of April, May and June with the purchase of a Roland DG DXY-800 8-Pen X-Y Plotter, you get the KeyChart Presentation Graphics Software to run the plotter—*Absolutely Free!* A savings of \$375.00.

At the heart of the package is the Roland DG DXY-800 X-Y Plotter, (the lowest priced 8-pen plotter on the market). The DXY-800 is an 8-pen intelligent plotter offering an 11" x 17" plot bed, Centronics parallel and RS-232 serial interfaces, and can also be used in either a horizontal or vertical (60 degree inclined) position, to conserve your desk-top space. Use regular paper or even acetate to produce overhead projection graphics.

Next add KeyChart, probably the quickest, and easiest software program for generating presentation-quality business graphics. You don't have to be a programmer to use KeyChart. It is completely menu-driven and can provide automatic default values for every characteristic. Load in your data from the keyboard, or from almost any electronic spreadsheet, including Lotus 1-2-3.



MODEL
DXY800

KeyChart graphics software is high-quality, quick, and easy.



Why not take the work out of your next business presentation?



Thanks to Roland DG, KeyChart can come to you for free.



Roland DG's DXY-800 KeyChart package is available for most popular personal computers. Just plug it in, and within minutes you'll be creating the kind of graphics you thought might take days of programming. All of this comes to you for the DXY-800's normal low retail price of \$995.00. KeyChart, normally priced at \$375.00 is included at no additional cost. For those who don't need multi-pens, Roland DG also makes a single pen plotter (the DXY-101), also bundled with KeyChart for only \$750.00. Why not let the Roland DG

graphics system improve the quality of your business presentations? But you'd better

hurry, this kind of free and easy dealing isn't going to last forever, just until June 30th. For a dealer near you contact: Roland DG, 7200 Dominion Circle, Los Angeles, CA 90040, (213) 685-5141.

KeyChart is a trademark of SoftKey Software Products Inc. Lotus and 1-2-3 are trademarks of Lotus Development Corp.

Roland DG

ERG/68000 MINI-SYSTEMS

- Full IEEE 696/S100 Compatibility

HARDWARE OPTIONS

- 8MHz, 10 MHz, or 12 MHz
68000/68010 CPU
- 68451 Memory Management
- Hardware Floating Point
- Multiple Port Intelligent I/O
- 64K/128K Static RAM (70 nsec)
- 256K/512K/1MB Dynamic RAM (150 nsec)
- Graphics-Digital Graphics
CAT-1600
- DMA Disk Interface
- SMD Disk Interface
- ¼" or ½" Tape Backup
- 5¼" or 8" Floppy Disk Drives
- 5MB-474MB Hard Disk Drives
- 7/10/20 Slot Back Plane
- 20 or 30A Power Supply
- Desk Top or Rack Mount Encl.

SOFTWARE OPTIONS

- 68KFORTH¹ Systems Language
- CP/M-68K²O/S with C, 68K-BASIC¹,
68KFORTH¹, FORTRAN 77, EM80
Emulator, Whitesmiths' C, PASCAL
- IDRIS³ O/S with C, PASCAL,
FORTRAN 77, 68K-BASIC¹, CIS
COBOL⁴, INFORMIX⁵ Relational
DBMS
- UNIX⁶ SYS V O/S with C, PASCAL,
FORTRAN 77, BASIC, RM COBOL⁷,
ADA⁸, INFORMIX⁵, Relational DBMS
- VED 68K Screen Editor
- Motorola's MACSBUG and FFP
Package

Trademark ¹ERG, ²Digital Research,
³Whitesmiths, ⁴Micro Focus, ⁵RDS,
Inc., ⁶Bell Labs, ⁷Ryan McFarland,
⁸U.S. DoD

30 Day Delivery - OEM Discounts



since 1974

Empirical Research Group, Inc.
P.O. Box 1176
Milton, WA 98354
(206) 872-7665

ASK BYTE

(Appendix I, page 8) switch the output back and forth between monitors. A more versatile program, VMODE by Ray Duncan, was published in the September 1983 issue of *Soft talk for the IBM PC* (page 178).—Steve

REPLACING THE APPLE II KEYBOARD

Dear Steve,

I have three questions I would like answered. What do I have to do to replace the Apple II keyboard? Can I use an Apple-compatible disk drive on an IBM PC? What can I build or buy to allow me to access the game I/O port as a plug-in socket from outside the Apple II cabinet?

DAVID A. FONG
San Jose, CA

The Apple II keyboard plugs into a socket on the motherboard. A replacement keyboard can be added simply by plugging its cable into this socket. Several keyboards are available for the Apple II. Some feature preprogrammed functions, single-keystroke commands, uppercase and lowercase, and a full numeric keypad. Consult the ads in BYTE or an Apple-related magazine for further information.

The Apple II disk drives are quite different from the IBM PC disk drives even though they both use 5¼-inch disks. Apple uses a software approach to control many of the disk-drive functions; the PC uses on-board hardware. Many of the functions required by the PC drives are missing from the Apple drives. They are incompatible.

An extension socket can be made from a piece of flat cable, a 16-pin plug, and a socket to bring the connection outside the computer. A zero insertion-force socket facilitates the insertion and removal of accessories. One company featuring several such products (\$16.95 to \$34.95) is Happ Electronics Inc., 4640 Island View, Oshkosh, WI 54901. (414) 231-5128.—Steve

C-64 VIDEO SIGNALS

Dear Steve,

I recently began a project to transform my Commodore 64 into a portable unit. I have a used case and monitor originally designed for an Osborne I system. Since the Osborne monitor requires horizontal and vertical synchronizing signals along with an input video signal. I need to convert the composite output from the VIC II chip to the component signals so I can see a display. Is there a simple solution to my dilemma?

GREGG PEELE
Greensboro, NC

A circuit to separate the horizontal and vertical synchronizing signals from the composite video signal from your Commodore 64 is known as a sync separator. A suitable circuit was presented in the January 6, 1982 issue of EDN. "Sync Separator Provides Speed, Accuracy" by Bradley Albing (page 207) describes a method to obtain the desired signals.—Steve

APPLE SOFTWARE ON S-100

Dear Steve,

I'm currently running CP/M on my CompuPro 20-slot S-100 mainframe using Advance Micro Digital's Supernet S-100 single-board computer with an 8-inch Qume Data Track double disk drive, a TeleVideo 925 terminal, and an Epson MX-80 printer. My problem is that the company I work for has its software written for the Apple II: some is standard DOS, and some is Apple/CP/M.

Is there an S-100 board that can be added to my system along with an Apple disk drive that would permit the direct use of this Apple software or the ability to read the Apple/CP/M programs onto my CP/M 8-inch disks and run them on my equipment?

If I use Modem7 to transfer the Apple/CP/M files to my 8-inch S-100 system, will those programs execute acceptably or must I modify the program files to make them work? They are all written in BASIC, with which I'm somewhat familiar.

Also, do you know of a computer (desktop or portable) that can run Apple, IBM, and CP/M software interchangeably?

VERNE CAREY
Windom, MN

I am not aware of an S-100 board that will allow direct reading of Apple software. Since the instruction sets for the two processors are greatly different, there is no benefit.

As for transferring Apple/CP/M files to the S-100, Modem7 works fine. There should be few, if any, changes required, since the BASICs for each system are comparable. A direct serial connection can be used if the two systems are in close proximity. Otherwise, a modem must be used.

If you have an IBM PC and a lot of money, you can run Apple, CP/M-80, and IBM software on the same machine. The Quadram Quadlink card will handle the Applesoft programs, and the Trump Card from Sweet Micro Systems or the Baby Blue card from Xedex will run CP/M-80 programs on the PC. For further information, contact Quadram Corporation, 4357 Park Dr., Norcross, GA 33093, (404) 923-6666; Sweet Micro Systems, 50 Freeway Dr., Cranston, RI 02920, (401) 461-0530; and Xedex Corporation, 222 Route 59, Suffern, NY 10901, (914) 368-0353.—Steve

ROBOT EYES

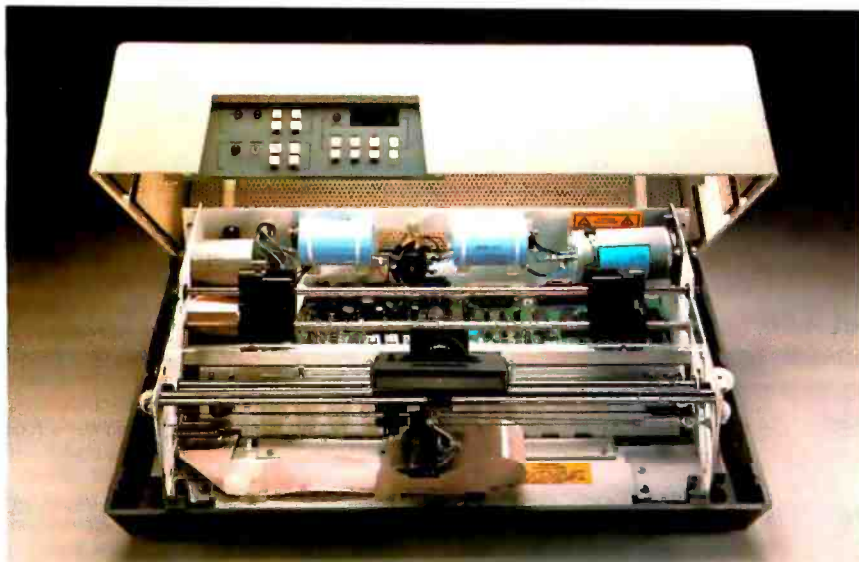
Dear Steve,

I am presently designing a robot and want to give it electronic eyes for recognition and data retrieval. In your series, "Build the Micro D-Cam Solid-State Video Camera" (September and October 1983), you describe a unit using a RAM chip. In this series you did not mention how the lens was mounted. I would like to know how you did this. I would also like to know how to make this unit work with three others. These four units could have a dedicated 1802 processor that would give out only information that was requested from it or that the 1802's pro-

(continued)

HIGH PERFORMANCE

IT'S WHAT'S UNDER THE HOOD THAT COUNTS



Take a close look under the hood of a Datasouth printer. Inspect for loose parts, cheap fittings. Search for things that show more concern for speed on the assembly line than the communications line.

You won't find them. Instead you'll find the source of the Datasouth reputation: design, engineering and materials dedicated exclusively to *high performance* value.

Now look closer.

MORE THAN THE HUM OF ITS PARTS

Count the moving parts in a Datasouth printer. You won't find many. Most of those are dedicated to transporting the printhead and the paper from point to point with optimum speed and accuracy, while the rest of the printer sits quietly with the motionless authority of a Stonehenge.

And thinks.

Under the hood of every Datasouth printer is a highly intelligent microprocessor. Its sophisticated brainwork eliminates the need for many parts still common in other printers, and optimizes carriage and paper travel so the printhead intelligently follows the shortest path from one printable character to the next. So more work gets done with less strain on the machinery.

MODULAR MAINTENANCE

Datasouth design simplicity assures easy maintenance. All control electronics are on a single printed circuit board. The 9 wire printhead is rated at over 500 million characters, and is easily replaced in minutes.

Everything that matters is easy to reach, right there under the hood. Even the cartridge ribbon, rated at 3 to 4 million characters, snaps into place in seconds.

JUST TURN THE KEY

Datasouth printers are easily driven by virtually any mini or microcomputer. The fully instrumented dashboard allows the user to program up to 50 different applications features at the touch of a few buttons. Meanwhile, the digital readout shows everything from programming prompts to line count.

TAKE YOUR CHOICE

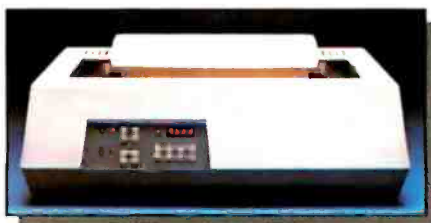
Datasouth reliability comes in two high performance models. The DS180 is a legendary workhorse that delivers crisp data quality printing at 180 CPS. The new multimode DS220 cruises at 220 CPS for high speed data printing and at 40 CPS for letter quality word processing. Both models print precision dot-addressable graphics.

If you have a high performance printing need, Datasouth has a high performance printer to fill it.

DRIVE ONE TO WORK TODAY

Both the DS180 and the DS220 are on display at more dealer showrooms every day, including one near you. So go take a hard look at the kind of hard copy you get from high performance Datasouth printers.

See what *really* counts when you compare printers.



datasouth

H I G H P E R F O R M A N C E M A T R I X P R I N T E R S

Find Datasouth Printers At
Participating **ComputerLand**® Stores
And Other Fine Dealers.

Circle 98 on Inquiry card.

AVAILABLE NATIONWIDE
THROUGH OUR NETWORK OF
SALES AND SERVICE DISTRIBUTORS
CALL TOLL FREE:
1-800-222-4528

www.americanradiohistory.com

Datasouth Computer Corporation
Box 240947 · Charlotte, NC 28224
704/523-8500 · Telex 6843018 DASOU UW

AUGUST 1984 · BYTE 57

gram demanded to be on the data lines. The processor is to communicate strictly parallel and must collect data from all four units and process it before any information can be obtained. It is to run and store this information until requested from another processor in the robot system.

I would also like to know why you chose a 16-millimeter lens for this project. Can an 8mm movie camera or a 35mm still camera lens be used with a better result?

Finally, do you know of any way to increase the resolution of the unit?

CHOIS BLACKWELL JR.
Waco, TX

I don't see any reason why you can't use the Micro D-Cam as robot eyes. The binary characteristic of the image produced might limit its ability to recognize objects in cases where tonal gradations are important, but this can be circumvented to a large extent by techni-

ques described in the articles if you have time enough to take the several pictures needed. If you want to use a dedicated processor instead of the Apple or IBM PC, you will need to write control software for it. The program should be modeled after the Apple program listed on pages 512 to 538 of the October 1983 BYTE. If you want to use four cameras for special vision properties, the same program could be modified to control them all and read the images in sequence. Further processing will depend on your specific application.

The output from the Micro D-Cam's IS32 sensor chip is serial, primarily because the chip is organized as a 64K by 1-bit memory array. Part 2 of the article shows how to convert this to a parallel data stream.

The selection of a lens for the camera also depends on the application. A lens for a 16mm movie camera was chosen as one that provides a standard mount, a "C" mount in this case, and has a focal length short enough to provide a usable field of view. Remember that the field of view and magnification are determined by the lens focal length, not the type of camera it was made for. The longer the focal length, the higher the magnification and the smaller the field of view for a given sensor size. Lenses designed for 8mm or 35mm cameras could also be used, since the sensing element is about the width of an 8mm film frame and much smaller than 35mm film.

If you want to mount your own lenses, buy short extension tubes (the kind sold at photography stores for close-ups) and attach them to your robot for use as lens mounts. The lenses then screw or bayonet into the mounts. The resolution of the element is close to the resolution limit of most inexpensive lenses, so the decision you make must achieve a good balance between magnification and field of view. High magnification (longer focal length) will allow your robot to see a little bit of an object very clearly; a short focal length will allow it to see more but with less detail.—Steve

8-INCH DISKS FOR APPLE II

Dear Steve,

I have an Apple II and two 8-inch disk drives (Pertec type FD400). I want to connect both drives to the computer. I would be pleased if you would let me know how to do so.

MARC KLEYN
Merchtem, Belgium

Converting 8-inch disk drives to run on your Apple II is quite involved since a different disk-controller card is required. Many of the disk functions of the Apple are implemented in software rather than hardware, thus the controller card is relatively simple. The 8-inch drives have on-board circuitry that handles these functions, and the controller must provide the proper interface.

Advanced Computer Products (1310B East Edinger, Santa Ana, CA 92705, (800) 854-8230) sells the Vista A800 8-inch Disk Controller Card for the Apple II. It uses all the standard Apple DOS commands except INIT.

(continued)

What do you get when you cross 1200 baud, free on-line time, and extra features at a price Hayes can't match?

Data Rate?

The MultiModem gives you a choice—either 1200 or 300 bits per second. So you can go on-line with the information utilities. Check out bulletin boards. Dial into corporate mainframes. Swap files with friends.

On-Line Time?

With the MultiModem you get CompuServe's DemoPak, a free two-hour demonstration of their service, and up to seven more free hours if you subscribe. You also get a \$50 credit towards NewsNet's business newsletter service.

Features & Price?

Of course, the MultiModem gives you automatic dial, answer, and disconnect. Gives you the Hayes-compatibility you need to support popular communications software programs like Crosstalk, Data Capture, our own MultiCom PC, and dozens of others. Gives you a two-year warranty, tops in the industry.

But Better?

Yes. The MultiModem gives you features the Hayes Smartmodem 1200™ can't match. Features like dial-tone and busy-signal detection for more accurate dialing and redialing. Like a battery-backed memory for six phone numbers. All at a retail price of just \$549—compared to \$699 for the Smartmodem.

What do you get? The new MultiModem, from Multi-Tech Systems. Isn't this the answer you've been looking for?

For the name of your local distributor, write Multi-Tech Systems, Inc., 82 Second Avenue S.E., New Brighton, MN 55112. Or call us at (612) 631-3550.

MultiModem.



MultiTech Systems

The right answer every time.

Trademarks—MultiModem, MultiCom PC, Multi-Tech Systems, Inc.—CompuServe, CompuServe Information Services, an H & R Block company—NewsNet, NewsNet, Inc.—Crosstalk, MicroStar, Inc.—Data Capture, Southwestern Software—Smartmodem: Hayes Microcomputer Products, Inc.

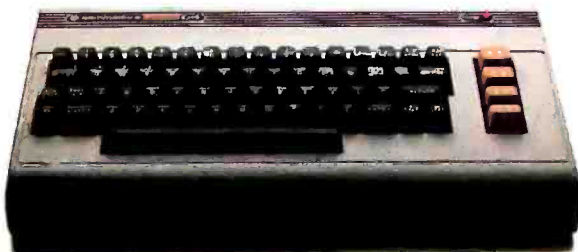
HOW TO BECOME COMPUTER LITERATE.

FEATURES	COMMODORE 64™	APPLE IIe™	IBM PC jr™	ATARI 800XL™
Price*	\$219	\$699	\$669	\$299
Built-in Memory	64K	64K	64K	64K
Typewriter Keyboard	YES (66 Keys)	YES (62 Keys)	"CHICKLET" (62 Keys)	YES (61 Keys)
Upper/Lower Case	YES	YES	YES	YES
Programmable Function Keys	YES	NO	YES	NO
AUDIO				
Polyphonic Tones	YES	NO	YES	YES
Music Synthesizer	YES	NO	NO	NO
Hi-Fi Output	YES	NO	YES	YES
VIDEO				
TV Output	YES	EXTRA COST	EXTRA COST	YES
Video Monitor Output	YES	YES	EXTRA COST	YES
INPUT/OUTPUT				
Intelligent I/O Bus	YES	NO	NO	YES
RS-232 Communications	YES**	EXTRA COST	YES**	EXTRA COST
"Smart" Peripherals	YES	NO	NO	YES

*Prices shown are common retail and may vary slightly in different markets.
**Requires an adapter to operate.

First you need the right input. Like \$219. That's what the Commodore 64™ costs. It's about one third the price of the Apple IIe™ or the IBM® PCjr.™ And 64K. That's how much memory the Commodore 64 has. It's also how much memory Apple IIe and the IBM PCjr have. This computer lesson is brought to you as a public service by Commodore (certainly not by Apple or IBM), the only computer company that can afford to show you a chart like the one above.

But what you can't see above are the



thousands of software programs that make the Commodore 64 fully capable of doing anything any "triple the price" computer can do; for fun or profit, for every member of the family; anything from soccer to spread sheets to space exploration.

Because the Commodore is so affordable, you can load up on Commodore peripherals. Like a disk drive, a printer or a telephone modem. All together they cost just a tad more than an IBM PCjr by itself. With no peripherals.

No wonder Commodore sells more computers than Apple and IBM combined.

commodore
COMPUTERS
IT'S NOT HOW LITTLE IT COSTS,
IT'S HOW MUCH YOU GET.

"I just found the ideal solution to my telecomputing problems. And it's right here inside my IBM® PC. *Plus* I got a free bonus to boot!"



Hayes Smartmodem 1200B™ and Smartcom II™ software.

The complete, easy-to-use plug-in telecomputing system for the IBM® PC and compatibles.



Looking for just the right telecomputing system for your PC? Hayes has it! Smartmodem 1200B and Smartcom II communications software. The most reliable and easy to use modem and software for your IBM PC or compatible computer. At a great single-package value for you. And when you buy now, you'll also receive a valuable free offer. From Hayes, the telecomputing leader.

Smartmodem 1200B. Your PC's telephone.

Everything you need to communicate-computer to computer-is on one, convenient plug-in board. Smartmodem 1200B easily slides into an expansion slot of your PC (your dealer can install it in minutes). You're ready to send and receive information at up to 1200 bps. For speedy, economical transmission to personal computers, data bases and information services throughout North America.

So what could make communications easier? Smartcom II software, designed by Hayes specifically for Smartmodem and your PC!

Smartcom II. Your Smartmodem's software.

Smartcom II maximizes the outstanding capabilities of Smartmodem 1200B. At the same time, it minimizes your effort.

Thanks to Smartcom II's menu-driven ease, the first time out you'll be creating messages, sending and storing them to disk. Simultaneously! And when you're on the receiving end, your PC will do all the work, completely unattended.

Circle 141 on inquiry card.

Smartmodem 1200B and Smartcom II are trademarks of Hayes Microcomputer Products, Inc.

IBM is a registered trademark of International Business Machines Corp.

*Trademarks of COMPAQ Computer Corporation, Corona Data Systems, TeleVideo Systems, Inc., Columbia Data Products, Inc., and Direct, Inc.

CompuServe Information Service is a registered trademark of CompuServe, Inc., an H&R Block Company.

Dow Jones News/Retrieval is a registered trademark of Dow Jones & Company, Inc.

OAG EE is a registered trademark of the Official Airline Guides, Inc.

THE SOURCE, AMERICA'S INFORMATION UTILITY is a service mark of Source Telecomputing Corporation, a subsidiary of The Reader's Digest Association, Inc.

©1984 Hayes Microcomputer Products, Inc.

Smartcom II stores frequently called numbers and parameters for lengthy log-on sequences. So calling another system requires just a few quick keystrokes. And if you ever need it, on-line "help" is right there at your fingertips.

A complete, plug-in telecomputing system for 9 popular PC models!

Whatever your PC model, Hayes has the definitive connection! Smartmodem 1200B and Smartcom II are compatible with the: IBM PC, PC XT and PC Portable, COMPAQ and COMPAQ Plus, Corona, Tele-video Portable, Columbia VIP and Direct IPC 1000.*

Free introductory subscriptions. Free access time.

Smartcom II comes with more "built-in" benefits, as well. Your Hayes telecomputing system includes introductory subscriptions and access time to several leading information services!

Sample a wide variety of practical services from CompuServe,® OAG EE® (Official Airline Guide), Dow Jones News/Retrieval®, and THE SOURCE,™ AMERICA'S INFORMATION UTILITY.™ A value of up to \$200, free!

Act now through August 31! Get an additional \$69 value free.

Act right away, and you'll receive a free introductory subscription to CompuServe's Executive Information Service. For accurate, up-to-the-minute investment information, as well as news, home shopping, travel, education services and more! Direct from CompuServe to your PC screen!

And we'll also send you a complimentary copy of *Free Software for the IBM PC*, a practical resource book that tells you how to access and download more than 600 varied software programs to your PC, with the help of your Hayes Smartmodem. And Hayes offers you this valuable guide free, when you purchase a Smartmodem 1200B/Smartcom II telecomputing package!

But remember. To take advantage of these great bonuses, you need to get moving fast!

Get on-line with the telecomputing leader.

See your computer dealer right away! And plug in to the exciting world of telecomputing. With Smartmodem 1200B and Smartcom II. A smart buy for your IBM PC or PC compatible!

Hayes



**Save this coupon! It's your ticket
to a \$69 value from Hayes.
Offer good through August 31, 1984.**

To receive your free introductory subscription to CompuServe's Executive Information Service, and your complimentary copy of *Free Software for the IBM PC*. Complete this coupon and mail direct to Hayes with your Product Registration Card (inside your Smartmodem 1200B and Smartcom II package).

Name _____

Address _____

City _____

State _____

Zip _____

Date of Purchase _____

Place of Purchase _____

**Mail to: Hayes Microcomputer Products, Inc., Dept. 1200B,
5923 Peachtree Industrial Blvd., Norcross, Georgia 30092.**

The introductory offer for CompuServe's Executive Information Service includes a free subscription plus \$15 worth of free connect time.



PREVENT THE DISASTER OF HEAD CRASH AND DROPOUT.

The war against dust and dirt never ends. So before you boot-up your equipment, and everytime you replace a cassette, disk or drive filter, be sure to use Dust-Off II; it counteracts dust, grit and lint. Otherwise you're flirting with costly dropouts, head crashes and downtime.

Dust-Off II is most effective when used with Stat-Off II. Stat-Off II neutralizes dust-holding static electricity while Dust-Off II blasts loose dust away. There's also the Dual Extender and Mini-Vac for vacuuming dust out of hard-to-reach places.

Photographic professionals have used Dust-Off brand products consistently on their delicate lenses and expensive cameras for over ten years. They know it's the safe, dry, efficient way to contaminant-free cleaning.



Cleaning not provided by liquid cleaners.

Dust-Off II's remarkable pinpoint accuracy zeros in on the precise area being dusted. And you have total control—everything from a gentle breeze for



Stat-Off II neutralizes dust-holding static electricity from media and machines.

delicate computer mechanisms to a heavy blast for grimy dirt.

Don't let contamination disrupt your computer operation. Stock upon Dust-Off II—the advanced dry cleaning system, at your local computer or office supply dealer.

Or send \$1.00 (for postage and handling) for a 3 oz. trial size and literature today.



Dust-Off II

The safe dry cleaning system

Falcon Safety Products, Inc., 1065 Bristol Road, Mountainside, NJ 07092

The latter has been improved and enhanced in a different format. A high-speed DMA (direct memory access) data rate of 1 micro-second per byte is provided, and it is compatible with DOS 3.3, Pascal 1.1, and CP/M 2.2 (with optional Z80 card). The A800 sells for \$299.95.—Steve

PUNCH-CARD READER

Dear Steve,

I would like information on how to construct a mark sense punch-card reader or a source from which I could purchase one at a reasonable price.

I believe that card input would be more accurate for data entry than punching a set of keys. Also, keyboard entry is a large waste of "on time" for a system.

STEPHEN MIZGALA
New York, NY

Punch cards are an excellent way of feeding data to a computer if you can find them all punched with the correct data. After you've had the pleasure of punching a few hundred cards and checking them for errors before submitting them to the computer, I'm sure you'll never again want to sit at a terminal typing in data and correcting it as you go.

Seriously, though, if you want a card reader, used units are sometimes available on the surplus market. I found one listed for \$34.50 in the H&R March 1984 catalog. The catalog number is TM20K917, and the address is H&R Corporation, 401 East Erie Ave., Philadelphia, PA 19134.

If punched tape turns you on, you can get a punch and a reader from John H. Meshna Inc., 19 Allerton St., Lynn, MA 01904. The catalog numbers are SPL 339A and LBXB1. The punch interfaces with an IBM Selectric typewriter that you can get for about the price of an inexpensive computer.—Steve

IBM PC MEMORY SEGMENTS

Dear Steve,

All the material I've read regarding memory segmentation for the IBM PC states that each physical segment can be up to 64K bytes long. However, the sample device driver for an in-storage disk that is listed in the back of the DOS 2.0 manual for the IBM PC defines a 180K-byte virtual-disk area contiguous to the code segment. The program is initialized with the CS, ES, and DS registers all pointing to the code segment, and the virtual-disk area appears to be addressed using the "based and indexed addressing" mode. How does this work?

CURTIS L. JEWS
Gaithersburg, MD

First, to make the answer to your question a little easier to understand, let's review the memory-addressing method used in the IBM PC.

The PC uses the 8088 processor, which has the capability of addressing four segments of memory at the same time by putting the start-
(continued)

This is THE PASCAL COMPILER You've Been Hearing About



VERSION 2.0

"It's almost certainly better than IBM's Pascal for the PC... Recommended."

Jerry Pournelle
Byte, May 1984

\$49.95

"If you don't have CP/M [for your Apple], Turbo Pascal is reason enough to buy it."

Cary Hara
Softalk Apple, May 1984

"If you have the slightest interest in Pascal... buy it."
Bruce Webster, Softalk IBM, March, 1984

And Now It's Even Better Than You've Heard!

- Windowing (IBM PC, XT, jr. or true compatibles)
- Color, Sound and Graphics Support (IBM PC, XT, jr. or true compatibles)
- Optional 8087 Support (available at an additional charge)
- Automatic Overlays
- A Full-Screen Editor that's even better than ever
- Full Heap Management—via dispose procedure
- Full Support of Operating System Facilities
- No license fees. You can sell the programs you write with Turbo Pascal without extra cost.

Yes. We still include Microcalc... the sample spreadsheet written with Turbo Pascal. You can study the source code to learn how a spreadsheet is written... it's right on the disk.* And, if you're running Turbo Pascal with the 8087 option, you'll never have seen a spreadsheet calculate this fast before!

*Except Commodore 64 CP/M.

Order Your Copy of TURBO PASCAL® VERSION 2.0 Today

For VISA and MasterCard orders call toll free:
In California:

1-800-227-2400 x968
1-800-772-2666 x968

(lines open 24 hrs, 7 days a week)

Dealer & Distributor Inquiries Welcome 408-438-8400

Choose One (please add \$5.00 for shipping and handling for U.S. orders. Shipped UPS)

- ___ Turbo Pascal 2.0 \$49.95 + \$5.00
- ___ Turbo Pascal with 8087 support \$89.95 + \$5.00
- ___ Update (1.0 to 2.0) Must be accompanied by the original master \$29.95 + \$5.00
- ___ Update (1.0 to 8087) Must be accompanied by the original master \$69.95 + \$5.00

Check ___ Money Order ___
VISA ___ MasterCard ___
Card #: _____
Exp. date: _____



Borland International
4113 Scotts Valley Drive
Scotts Valley, California 95066
TELEX: 172373

My system is: 8 bit ___ 16 bit ___
Operating System: CP/M 80 ___
CP/M 86 ___ MS DOS ___ PC DOS ___

Computer: _____
Disk Format: _____
Please be sure model number & format are correct.

Name: _____

Address: _____

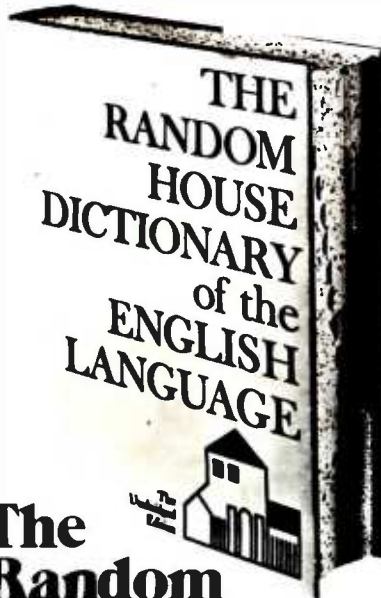
City/State/Zip: _____

Telephone: _____

California residents add 6% sales tax. Outside U.S.A. add \$15.00 (If outside of U.S.A. payment must be by bank draft payable in the U.S. and in U.S. dollars.) Sorry, no C.O.D. or Purchase Orders. D15

Less for Your Money

If you do word processing on your personal computer, you probably know that there are many programs for sale to help you with your spelling. But the biggest spelling error you'll ever make is paying too much for your spelling correction software. The Random House ProofReader gives you less for your money — less trouble, that is, and fewer spelling errors. The Random House ProofReader is based on the world famous Random House Dictionary. It contains up to 80,000 words, depending on your disk capacity. You can add new words with the touch of a key. It shows you the error and the sentence it's in. It instantly suggests corrections. It even re-checks your corrections. And it costs half as much as other programs with far less power. The Random House ProofReader is compatible with all CP/M 2.2[®], MS-DOS[®] and IBM Personal Computer[®] systems.



The Random House Proof Reader \$50

For orders or information, see your local dealer or call (617) 967-4541. Master card and VISA accepted. Or write Wang Electronic Publishing, One Industrial Ave., Lowell, MA 01851. Please enclose \$50 and specify your computer model, disk size and memory.

Random House and the House design are registered trademarks of Random House, Inc. CP/M is a registered trademark of Digital Research, Inc. IBM and IBM Personal Computer are registered trademarks of International Business Machines, Inc. MS-DOS is a registered trademark of Microsoft, Inc.

ASK BYTE

ing address of each segment in one of the segment registers. The four segments can start at any 20-bit address whose last 4 bits are zero, or in other words, on a paragraph boundary. Thus, a 20-bit address is specified completely by multiplying the contents of a 16-bit segment register by 16 and adding the offset into the segment as defined by the program. The multiplication isn't the programmer's job; it results from the hardware design that loads the segment registers in the high 16 bits of the 20-bit address register before the offset is added.

Each segment can be up to 64K bytes long. The usual arrangement is to put the program code in the segment designated by the CS register and the data in the segment starting at the address in the DS register. If a stack is required, it is defined by the SS register, and the ES register can be used for data in addition to the DS segment. The ES register is usually used to identify the segment of the destination address in string moves. These are used in the virtual-disk program to transfer data to the virtual disk.

Now we get to the workings of the addressing used in the DOS 2.0 virtual-disk program. The segment definition at the beginning of the vdisk procedure (line 69) sets the CS, DS, and ES registers to the same address, as you say. Equally significant, it does not define a stack segment. The result is that the constants and variables defined in the beginning of the program will be stored in the body of the program rather than in the virtual-disk storage area, and it also tells the assembler that we want to use the stack area defined by DOS. These segment definitions are, however, temporary. They get changed as soon as we want to address an area outside the program segment.

Notice that around line 100, variables named VDISK_PTR and START_SEC are defined. These are used to point to the beginning of the virtual-disk area, and their values are changed as required to put data into the virtual-disk area without overwriting files. To see how this is done, we can follow part of the procedure for writing a file.

First, on entering the program by requesting a write operation, a jump to the procedure OUTPUT will occur. This routine determines how many sectors are to be written and the address of the starting sector, and it calls another routine called SECTOR_WRITE. This routine in turn calls CALC_ADDR to get the beginning address of the sector to be saved and loads this into the ES register. An offset address is then loaded into the DI register to make the complete ES:DI destination address for a string move. The DS and SI registers are also set in this routine to point to an area called the DTA (data-transfer area), which contains the data to be saved to the virtual disk.

While this explanation leaves out a lot of detail about how this program uses variable segment boundaries on the fly to make use of large blocks of memory, I hope it will help you understand the program. As you can see from the description above, the general procedure is to use an area in the code segment

to calculate segment addresses for data-storage areas as needed and load these into the ES or DS registers as appropriate. The DI and SI registers are used as described above for string moves, but for other types of storage or retrieval operations, any of the general-purpose registers can be used to hold the offset address.—Steve

PROJECT MANAGEMENT

Dear Steve,

Do you know anyone who offers O-GERT for the IBM PC? Reportedly, this software (code-size equivalent to about 10,000 IBM cards) was produced on the basis of work done by Alan B. Pritsker and can be used for personnel management, hardware-project management, etc., similar to PERT.

F. R. CAPPELLETTI
Washington, DC

A survey of several current application-software listings reveals no mention of the use of O-GERT on an IBM PC.

However, a number of software publishers offer other project and resource-management programs that can run on the PC under a wide variety of system configurations (operating systems, memory, display, storage, etc.). These include

Data*Easy Software
877 Bounty Dr. #EE203
Foster City, CA 94404
(415) 571-8100

Harvard Software Inc.
Software Park
Harvard, MA 01451
(617) 456-3400

McClintok Corporation
9655 South Dixie Hwy. #305
Miami, FL 33156
(305) 666-1300

Earth Data Corporation
POB 13168
Richmond, VA 23225
(804) 231-0300

Morgan Computing Co.
10400 North Central Expwy. #210
Dallas, TX 75231
(214) 739-5895

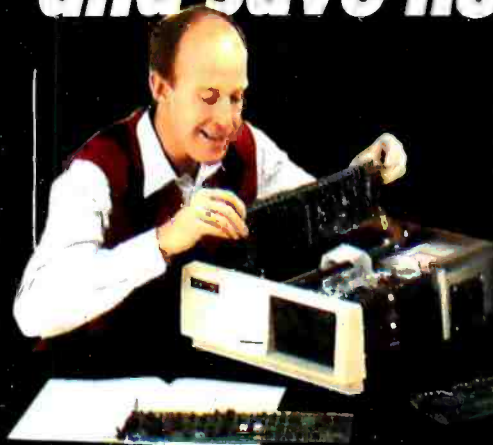
Aha Inc.
1475 Rodriguez St.
Santa Cruz, CA 95063
(408) 475-8705

SoftCorp Inc.
#L244, 2304 State Rd. #580
Clearwater, FL 33575
(813) 799-3984

Peachtree Software
3445 Peachtree Rd. N.E.
Atlanta, GA 30326
(404) 239-3000

(continued)

Build your own IBM PC compatible and save hundreds of dollars.



Heath proudly announces the NEW HS-151 Desktop and HS-161 Portable computers.

One of the world's largest software libraries has IBM's name on it. Now you can run that software on Heath's new IBM PC compatible computers, available in easy-to-build kits.

Can you build one of these computers? 85% of our first-time customers ask the same question. And the answer is 100% yes. You can.

In fact, you *should* build one. You'll save a lot of money while learning about computers in general and the Heath PC's in particular.

Build confidence... and your new computer...one step at a time. Two main circuit boards come to you pre-assembled and factory-tested. So that you can build the three other boards, we include a test soldering board plus helpful soldering instructions to make sure you get it right. Our instruction manuals are easy to understand, thorough and packed with cogent illustrations. And once it's built, the computer guides you

through a full range of included disk-based diagnostics.

Expert advice is only a phone call away, should you need it. You'll reach a trained consultant whose specialty is talking sense, not jargon.

We'll do whatever's necessary to make our pledge come true: "We Won't Let You Fail." Our entire business depends on that simple promise.

Experience a little wonder and a lot of pride. Save money, too, by building the highest quality personal computer. The Heath PC's have 128K RAM standard (expandable to 640K), a professional keyboard, dual 360K disk drives and optional Winchester. These machines are truly complete. Both are color capable and MS-DOS is included.

Check out the Heath PC computers today. IBM compatibility means they'll run the most popular software. And, with the money saved by building a kit, think of all the peripherals and software you can buy!

HS-151 Desktop PC with standard floppy disk drive or optional hard disk.

CIRCLE READER SERVICE CARD. Get more information on the most rewarding personal computers. The HS-151 Desktop PC and HS-161 Portable PC.

*MS is a registered trademark of Microsoft Corporation.

For computing on the go... the HS-161 Portable.



The HS-161 has the same features as the HS-151. Amber Monitor included. Convenient keyboard folds up, two disk drives fold down.



Heathkit®
Heath
Company

A subsidiary of Zenith Radio Corporation

CP-230

Quala
23026 Frisca Dr.
Valencia, CA 91355
(805) 255-2922

Primavera Systems
29 Bala Ave. #224
Bala-Cynwyd, PA 19004
(215) 667-8600

Scitor Corporation

710 Lakeway #290
Sunnyvale, CA 94086
(408) 730-0400

In addition, you may be interested in a few *BYTE* articles dealing with *PERT* and *CPM*: "Programming *PERT* in *BASIC*" by Steven Zimmerman and Leo M. Conrad, May 1982, page 465 and "Programming the Critical-Path Method in *BASIC*" by Steven Zimmerman and Leo M. Conrad, July 1982, page 378.—Steve

CARRIER-CURRENT MODEM

Dear Steve,

I am in the process of building your power-line carrier-current modem (August 1983, page 36). I have had no problems except locating a few of the components listed in the schematics. If possible, would you supply me the part number and manufacturers for the following components: 0.22- μ F, 600-V capacitor (line-coupling capacitor) and fused capacitor (line-to-line coupling).

FRED MATHEWS JR.
Las Vegas, NV

In this day and age of microelectronics, finding high-voltage capacitors is becoming more difficult. Few computer or electronics supply houses carry the 600-V capacitors used in my article on carrier-current modems. However, any electronics supply house that handles radio or television components will surely have the 0.22- μ F, 600-V capacitor. A typical part number for such a capacitor is Sprague 6PS-22 (orange drop-dipped tubular).

The fused capacitor is exactly what it implies, a capacitor with a series fuse to provide protection in case of capacitor failure. Since the current through the capacitor is small, any low-value (1-amp) fuse will suffice.—Steve

TELETYPE PARTS

Dear Steve,

I have an old TDR33 Teletype (an ASR33 with a paper-tape punch/reader). The tape reader has a few parts missing, and the feed wheel is broken. Is there any place to get parts for these old machines?

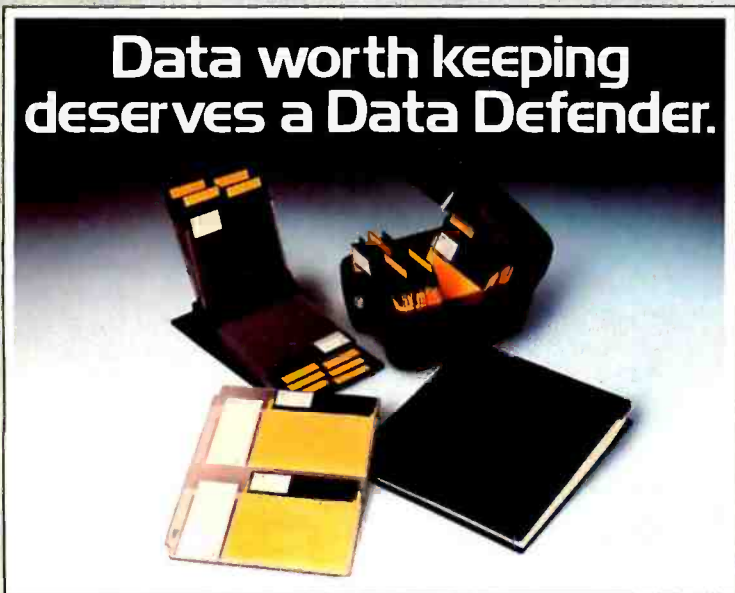
DOUGLAS COOK
Exeter, NH

Amateur-radio operators used Teletypes for radioteletype transmission long before their application to personal computers. While solid-state units are now more popular, there is still some interest in the older units.

A scan through a recent amateur-radio magazine revealed the company Typetronics, POB 8873, Ft. Lauderdale, FL 33310. A self-addressed, stamped envelope will bring a list of parts, supplies, and gears.

Also, Teletype parts may be available from Morris Precision Parts Co., POB 157, Morris Plains, NJ 07950, (201) 993-9669.—Steve ■

IN "ASK BYTE," Steve Ciarcia answers questions on any area of microcomputing. The most representative questions received each month will be answered and published. Do you have a nagging problem? Send your inquiry to
Ask BYTE
do Steve Ciarcia
POB 582
Glastonbury, CT 06033
Due to the high volume of inquiries, personal replies cannot be given. All letters and photographs become the property of Steve Ciarcia and cannot be returned. Be sure to include "Ask BYTE" in the address.



Data Defenders by Ring King. They're the finest quality protection you can buy for the information you have stored on 5¼" mini-diskettes and printout.

The Ring King 070 Tray holds 70 mini-diskettes in a tough copolymer shell with security lock. The Ring King Flip File II binder holds 20 mini-diskettes and converts to a desktop index. Ring King Looseleaf Files are punched to fit standard 3-

ring binders. Ring King Data Binders hold up to 8" of 9½" x 11" or 14¾" x 11" unburst printout.

Ask for Ring King Data Defenders at your computer supply dealer. Or send for our free, full-color catalog of computer support products. Write Ring King Visibles, Inc., 2210 Second Avenue, P.O. Box 599, Muscatine, Iowa 52761. For customer service, phone (800) 553-9647, in Iowa (319) 263-8144.

DATA DEFENDER™



CLUBS & NEWSLETTERS

● MODUS OPERANDI

MODUS, the Modula-2 Users Association, first met in Zürich, Switzerland, as part of the 8th International Conference on Programming Languages and Program Development. It is made up of a nucleus of institutional and corporate charter members that includes the ETH Institut für Informatik (Zürich), Volition Systems Inc. (Del Mar, California), the Modula Research Institute (Provo, Utah), and Logtech Inc. (Palo Alto, California, and Appels, Switzerland). MODUS plans to produce a quarterly newsletter, *Modula-2 News*. Although the association has offices in Zürich, contact MODUS, c/o the Pacific Systems Group, POB 51778, Palo Alto, CA 94303.

● EPSONS IN BRITAIN

The **HX-20/OX-10** (International) Users Group, specializing in information about Epson products, enables members from 25 countries to exchange information on peripherals and software via its monthly newsletter. Members are offered introductory prices on items premiered in the newsletter and can further benefit from educational articles, program listings, and free software bonuses. Members can also exchange programs and ideas via an electronic mail facility, the Closed-User Group Network, on Telecom Gold. In addition, the group provides consultants who, for a moderate fee, give demonstrations to Epson end-users. Contact Terence L. Ronson, HX-20/OX-10 (International) Users Group, 25 Sawyers Lane, Drayton Bridge Rd., London W13 0JP, England.

● HEATH USERS IN LEHIGH VALLEY

The Lehigh Valley Heath Users Group (LVHUG) welcomes all Heath/Zenith users to join the newly formed club. The meetings are informal gatherings held at Lehigh University at 1 p.m. on the last Saturday of every month. Upcoming plans include selection

of club officers and determination of dues to cover postage of a monthly newsletter, which is presently distributed at the meetings. The newsletter covers minutes of the last meeting, goals of the club, and suggested future presentations. An exchange column is planned for members who wish to exchange their equipment. At this time, no dues have been set. Call Carol Bloch for details at (215) 770-4640, or contact James Batug, LVHUG, 1425 North Broad St., Allentown, PA 18104, (215) 770-5993.

● CLASSROOM CREATIVITY

Creative Word Processing in the Classroom is for educators who want to explore the use of computers in developing children's reading and writing skills. The three annual editions—fall, winter, and spring—have color-coded sections relevant to administrators, librarians, and teachers of kindergarten through grade 12. Lessons, discussions of hardware and software, and articles on educational theory are written by educators with experience in several computer-assisted creative-writing projects. A subscription is \$9 a year. Write to *Creative Word Processing in the Classroom*, Suite 365, 2210 Wilshire Blvd., Santa Monica, CA 90403.

● LEGAL REVIEW

The Computer Law Newsletter, a publication from Delphi Data of Riverside, California, is a concise review of legal issues in the rapidly changing software industry. It reviews current cases and offers suggestions about protecting computer software, acquiring rights to software, and marketing software. A subscrip-

tion to the bimonthly publication is \$96 for one year. Access is available via modem at no extra charge. For details, contact Clyde Sparks, 3425 Meadowview Dr., Riverside, CA 92503, (714) 689-7408.

● A LEGACY FOR JUNIORS

The first bulletin-board service (BBS) for use exclusively by owners or potential owners of the IBM PCjr is open 24 hours a day at (402) 466-8114. Legacy Technologies Ltd. of Lincoln, Nebraska, is offering the public service as a forum for the exchange of technical and general information about the PCjr. Both technical and nontechnical users can communicate with other users, dealers, and distributors. Questions can be answered by Legacy engineers within 24 hours. Contact Greg Bréhn, Legacy Technologies Ltd., 4817 North 56th St., Lincoln, NE 68504, (800) 228-7257; in Nebraska, (402) 466-8108.

● MAC NEWS OF SAN DIEGO

The San Diego Macintosh Users Group meets on the fourth Wednesday of every month. Membership is free, but to receive the monthly newsletter, San Diego Mac News, you must pay a subscription fee of \$15. The newsletter is prepared and produced using a Macintosh. Columns include the Chairman's Corner, Editor's Note, Minutes, and a Gallery. Articles, drawings, letters, or other contributions related to the Apple Macintosh or Lisa are welcome. For further details, contact the San Diego Macintosh Users Group, POB 12561, La Jolla, CA 92037.

● **FREE ADVICE FOR USER GROUPS.** A monthly help column is available to all user

groups for the price of the postage. The columnist offers help for frustrated users and guarantees a reply on questions about CP/M, Pascal, UNIX, XENIX, WordStar, MailMerge, programming techniques, and criteria for selecting software and microcomputers. For details, write B Bhavivrat, Land of the Blind, Route 1, Box 318, Moundsville, WV 26041.

● MAC SUPPORTS THE COMMUNITY

The founder of Club Mac offers a free Macintosh communications program, a monthly newsletter, access to an on-line idea exchange, and a professionally staffed help line. Current or prospective Macintosh owners, software or peripheral vendors, Mac artists, and other interested persons can join by sending \$35 in annual dues to Club Mac, 735 Walnut, Boulder, CO 80302, (303) 449-5533.

● FIND OUT HOW

The Computer Analyst & Programmers Association (CAPA) consists of professional people working with computer hardware and software. Practical guidance is submitted by members to improve programming languages, operating systems, system documentation, and input/output (I/O) devices. The focus is on CP/M, MP/M, MS-DOS operating systems, BASIC, Pascal, FORTH, and hardware-interfacing capability. For information, send a self-addressed stamped envelope to CAPA, POB 5762, Rockford, IL 61125-0762.

● CO-OP ITEMS FOR EPSONS

The National Epson OX-10 Users Group (EUG) produces a bimonthly newsletter that lists items that can be bought at a discount by members, contains numbers of public BBSs for the Epson OX-10 that span the continental U.S., and provides news and comments on topics of interest to Epson users. The

(continued)

.....
CLUBS & NEWSLETTERS is a forum for letting BYTE readers know what is happening in the microcomputing community. Emphasis is given to electronic bulletin-board services, club-sponsored classes, community-help projects, field trips, and other activities outside of routine meetings. Of course, we will continue to list new clubs, their addresses and contact persons, and other information of interest. To list events on schedule, we must receive your information at least four months in advance. Send information to *BYTE, Clubs & Newsletters*, POB 372, Hancock, NH 03449.

EMACS™ FOR UNIX,™ MS-DOS™ & VMS™

UniPress
Product
UPDATE

You can now run the famed Gosling EMACS on your VAX, Sun, Pyramid, Cyb, Callan, Masscomp, Integrated Solutions, Apple Lisa, Pixel, Charles River Data, Perkin Elmer, Dual, Momentum, Cadmus, Tandy Model 16, NCR Tower, Fortune, Apollo, HP9000 and the list goes on!

UniPress Gosling EMACS: The famous multi-window full-screen editor. Edit several files at once. Interprocess communication on UNIX and VMS. Extensible via macros and the built-in compiled MLISP language.

UniPress Gosling EMACS: The ultimate programmer's tool: C, Pascal and MLISP language assist. EMACS manages execution of Unix makefiles, and automatically points to lines containing errors in the source code. Keys can be bound as desired, macros can be named, customized MLISP routines can supplement the many included packages, and much more!

UniPress Gosling EMACS: Use EMACS as your session manager—Divide your screen into a "shell window" to run commands, and one or more source file windows.

UniPress Gosling EMACS: Runs under Unix 4.1/4.2, System III/IV and Version 7. VMS and MS-DOS too!

PRICES: UNIX: \$395/Binary; \$995/Source
VMS: \$2500/Binary; \$7000/Source
MS-DOS: \$375/Binary; \$995/Source
(Requires at least 384K)

Call us with your hardware type.

ALSO NEW! MINIMACS—Special efficiency-conscious EMACS for Unix. Runs on a wide range of hardware types.

MINIMACS: Faster and smaller version of the famed Gosling Emacs. Its features include full screen editing, multiple windows allowing several files to be edited simultaneously, full EMACS keybindings, macro capability and many more powerful Emacs features, such as command output being directed to a window.

MINIMACS: Minimizes your resource load and is much smaller than the vi editor.

Price: \$375/Binary; \$795/Source

UNIPRESS OFFERS A FULL LINE OF SOFTWARE FOR UNIX, VMS AND MS-DOS.

Lattice®C compilers to the 8086-family; both native and cross. Write programs on your mainframe for execution on the IBM-PC, etc. (Cross compilers for UNIX and VMS.)

Window Shell: Multiple windows on any CRT!

Q-CALC • Lex • Phact • /RDB • The Menu System • UniCalc
• Full UNIX System V Operating System for the Apple Lisa
• and much more powerful software.

Call or write for more information.

UniPress Software, Inc.

2025 Lincoln Highway, Edison, NJ 08817
201-985-8000 • Order Desk: 800-222-0550 (outside NJ)
Telex: 709418
Mastercard and Visa

EMACS and MINIMACS are trademarks of UniPress Software, Inc. • Unix is a trademark of Bell Laboratories • VMS is a trademark of Digital Equipment Corp. • MS-DOS is a trademark of Microsoft
• Lattice C and UniCalc are registered trademarks of Lattice Inc.
• IBM-PC is a trademark of IBM.

CLUBS & NEWSLETTERS

membership dues are \$25 per user; \$15 per student user. For information, contact EUG, Box 1076, Lemont, PA 16851. (814) 237-5511.

● **LIBRARY MICROCOMPUTER DATABASES.** The Public Library Association Task Force on the uses of microcomputers in public libraries is compiling national and regional databases of library microcomputer users. For details, contact Phil Clark, 216 South 4th Ave., Highland Park, NJ 08904.

● **6809 PEOPLE UNITE**
People with an interest in MC6809 machine code and the 6809's hardware applications can join a user group that is based in England but welcomes an international audience. The bimonthly newsletter will cost £75 and will feature software and hardware sections, an assembly-language course for updates, advertisements, letters, and articles of interest to 6809 enthusiasts. For details, contact Paul Hill, 28 Woburn Rd., Launceston, Cornwall PL15 7HH, England.

● **HERO ROBOTS ORGANIZE**
The Hero Resource Exchange is an organization for the benefit of Hero I owners to exchange information, programs, and ideas about their robots. For details, contact Walter Glod Jr., 10802 Condrey Ridge Court, Richmond, VA 23236.

● **EVENS AND ODDS OF SECAUG.** The South East Connecticut Apple Users Group (SECAUG) meets at 7:30 p.m. every month. In odd-numbered months, the group meets every third Thursday at the Groton Public Library; in even-numbered months, it meets every third Tuesday at the Mohegan Community College in Norwich. Special-interest groups include DOS, machine language, and BASIC programming. The group maintains a library of public-domain software in disk format and produces a monthly newsletter, *Statements*, a subscription to which is included in the \$20 annual membership fee. For details, contact Warren Nordgren, 42 Terry Rd., Gales Ferry, CT 06335. (203) 464-9372.

● **MALDEN CATHOLIC HS ACTIVITY.** Students at the Malden Catholic High School and members of the Malden Catholic Computer Club produce the *MC Microcomputer News* six times during the school year. Although the focus is on Radio Shack's TRS-80 Models III and 4, the newsletter also covers Apple Logo, BASIC programming tips, printer information, a glossary, and suggested periodical readings. Readers are encouraged to contribute comments and criticism. Newsletter exchanges are welcome. For further details, contact *MC Microcomputer News*, Malden Catholic High School, 99 Crystal St., Malden, MA 02148.

● **SOFTWARE LAW UPDATE**
The coverage of *Software Protection*, a monthly publication, includes international developments and software-licensing law relevant for software vendors, users, and legal advisors. The expanding editorial board is international. A sample copy is \$5; a year's subscription is \$72; and \$90 covers airmail outside the US. For further information, contact Law & Technology Press, 1112 Ocean Dr. #201, Manhattan Beach, CA 90266.

● **BILINGUAL MEDICAL JOURNAL.** *Micromed*, devoted to practical applications of microcomputers in medicine, is a nonprofit, independent group that produces a monthly newsletter in English and Italian. Exchanges with other newsletters are welcome. The \$10 membership fee outside Italy covers the cost of printing and mailing. For details, contact Francesco Di Girolamo, V.le della Rimembranza, 25, 66034 Lanciano, Italy.

● **EPSON USERS UNITE**
An international Epson users group provides access to a remote BBS throughout the country. The 32-page monthly newsletter, *EpsonConnection*, will contain information on forming regional groups for Epson users. The annual fee is \$24. For details, contact Carolyn McCarty, *EpsonConnection*, POB 14027, Detroit, MI 48214. (313) 822-0090. ■

WHY INVEST \$90 IN MODULA-2? BECAUSE YOU'RE COMPETING WITH PEOPLE WHO BELIEVE THE BEST PROGRAMMING METHOD IS THE ONE THEY ALREADY KNOW.

Whoever decided to make the switch from Roman numerals to a more efficient notation for doing arithmetic should be a hero. His friends probably reacted as if he'd asked them to learn a *whole new language*. We think you'll see the parallel with Modula-2, especially after you try it.

Niklaus Wirth, creator of Modula-2, asserts that Modula-2 is an abstract tool for the construction of computing machinery. "In my opinion, the term *programming language* is ill chosen and misleading. *Program notation* would be eminently more appropriate."

We're not proposing that you learn a "new language." That would be like arguing the merits of English versus French. But it does make sense to avail yourself of the most efficient known technology for controlling computing machinery—while your competition is left in the dark ages.

Compared to Modula-2, whatever program notation you're now using is like doing your arithmetic in Roman Numerals.

In this limited space, we won't try to prove that Modula-2 is *the best available competitive tool for the serious computer entrepreneur*. "Such matters," according to Frank Herbert (*DUNE*), "can only be tested in the crucible of survival, not in the play of symbols."

The question is, for \$90, can you afford not to test our claim? No other company in history has made it as easy for you to do business. Our entire object-program licensing agreement is on this page. So put some distance between yourself and those who believe the best programming method is the one they already know.

MODULA-2 COMPILERS FOR IBM PCs, MACINTOSH, LISA AND IS—\$90

Modula-2 compiler and interpreter with enhanced, bit-mapped graphics, interrupts, and extended memory support are supplied on diskette for Apple's Lisa, Macintosh and II computers; IBM's PC, XT and compatibles (MS-DOS 2.0); and others soon to be announced, including 68000 systems under UNIX. Documentation is on diskette. Compiler and library sources are available under separate license.

PASCAL-TO-MODULA-2 CONVERTER—\$100

Invaluable to all who have Pascal investments, or whose Pascal programs generate too much code to run on the Apple IIs, it will run on any of the mentioned systems.

MODULA-2 ACCELERATOR CARDS FOR IBM AND APPLE—\$245

If you don't want to waste the memory and go to a full, compiled Modula-2, our accelerator cards increase execution speed of our modified Modula-2 interpreters by a factor of four. Accelerators are available for the Apple IIs, and the IBM PC, XT and compatibles.

THE IDEAL MODULA-2 ENGINE

We'd love to introduce you to the Lilith. It's a workstation computer with bit-map graphics, three-button mouse and a bit-slice processor. The Lilith was designed by the original Modula-2 team at the Swiss Federal Institute of Technology (ETH) as the ideal Modula-2 engine. Over 200 have been placed into academic and research environments. Now Modula Corporation makes a commercial version for your more demanding problems. Just call 800/LILITH2 to hear about customer benchmark reports.

OBJECT PROGRAM LICENSE

Join us in a commitment to personal integrity. Our prices are fair. Unlike program license agreements you can't help but violate, we've tried *reTHINKing* a few

things. Perhaps we can start a trend that makes violation of another's intellectual property *unfashionable*. Without all the "whereas" and "herewith" language, here's our attempt to transmute integrity into the entrepreneurial bloodstream:

You are to treat the information we send you as if were a book, with the exception that you are granted the right to make backup copies. Simple, Poincaré logic! In the spirit of the "book" analogy, you are free to take your book to another house (or computer) with you. This, of course, means someone at your own house (or computer) cannot simultaneously read it. Similarly, you can loan your book to a friend. But there can be no possibility you can read it at the same time. You may sell your book, only if the new owner agrees to these same conditions (which means a copy of this agreement, signed by the new owner, must be sent to us). Finally, just as in a book, it lacks integrity to substitute your name for the name of the legitimate author.

As for our warranties. Defective software may be returned within thirty days for replacement. But just like any other sell-help book, its value to you is what you make of it. No matter how badly it damages your life, or that of your customers, we're not obligated to do anything whatsoever about it.

Now, it's time to play "How'd-you-like-to-see-something-really-scary?" When you send us your check or credit card authorization, enclose this page (or a copy) with an original signature. Violate this agreement of integrity, and you'll get a doozer of a course in integrity at the claws of our attorneys; and they'll tell your mother.

MODULA
CORPORATION
reTHINK

950 N. University Ave., Provo, UT 84604
801/375-7400 or 800/LILITH2

In addition to information on the Lilith,

- Please send me the Modula-2 Compiler for \$90 for the IBM PC or XT, or the Apple IIs, Lisa or the Macintosh.
 Please send me the Pascal-to-Modula-2 Converter of \$100 for the IBM PC or XT, or the Apple IIs, Lisa or the Macintosh.
 Please send me the Modula-2 Accelerator of \$245 for the Apple II or the IBM PC or XT. (Note: You must also have ordered the modified compiler below.)
 Please send me the Modula-2 Compiler, for use with the accelerator or at \$40.

Utah resident's include 6% sales tax.
 \$10 handling and shipping is included for all orders over \$_____ Total amount enclosed/authorized.

My signature below, besides being a possible credit card authorization, indicates my agreement to all the above terms.

- My check is enclosed
 Please bill my VISA MASTERCARD

Card number	Expiration
Signature	Date
Real name	Title
Company	Phone
Address	
City	State ZIP

**Somebody
has to be better
than everybody
else.**

It's inevitable.
Somebody is always more determined.
Works harder. And winds up on top.
Take Dysan, for instance.
We were the ones who helped
develop the first 5¼" flexible diskette.
And while everybody else was trying
to figure out how to make them, we
were busy making them better.
With superior materials. A special
lubricant and jacket liner that extend
diskette life.
Unique manufacturing techniques.
Like our burnishing process that helps
eliminate read/write errors.
And an almost fanatical corporate
commitment to quality.
What does all this mean to you?

Every Dysan diskette you buy will
record and retain all your data all the
time. For as long as you own the diskette
and treat it right.

Dysan.

We're not just like everybody else.

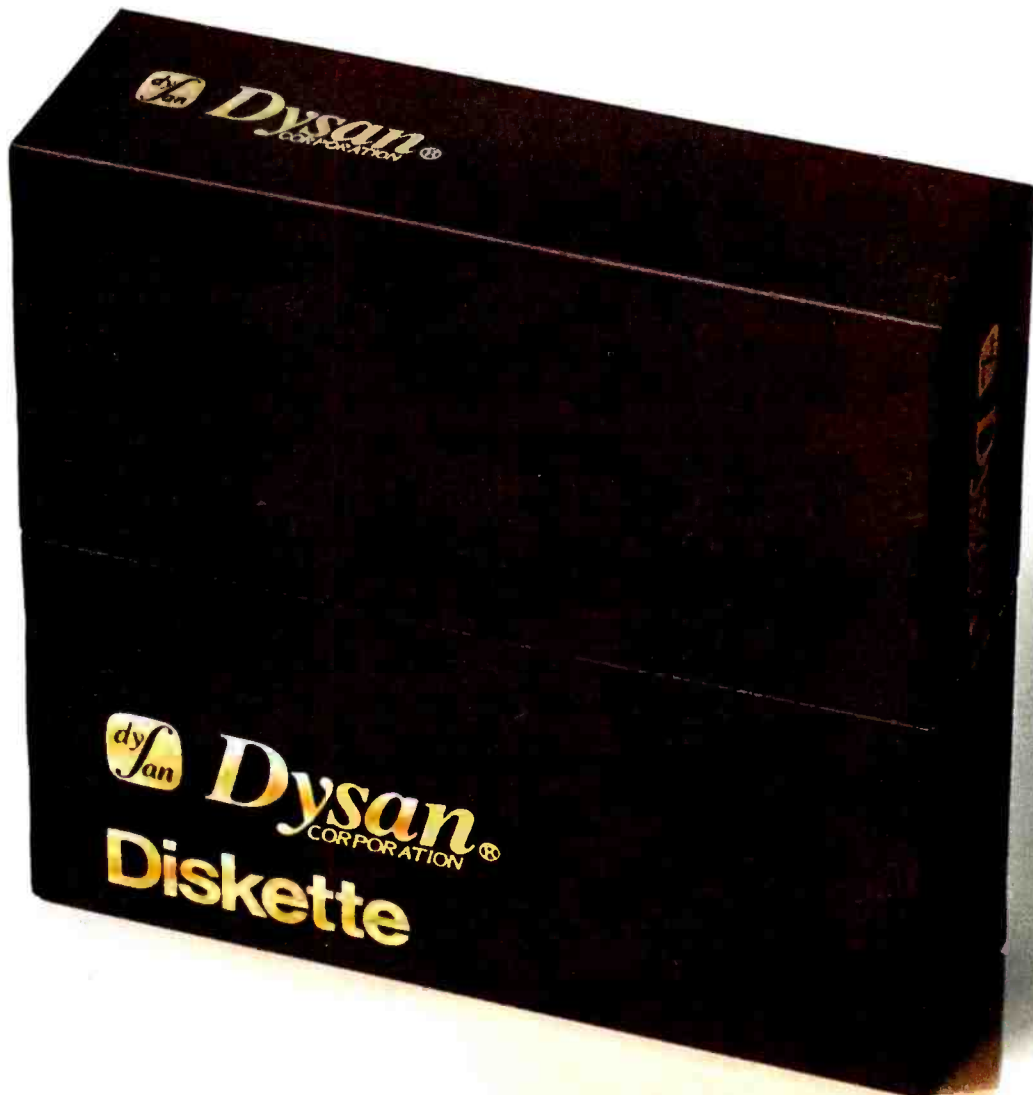
Dysan 5¼" and 8" flexible diskettes
are available at your computer products
dealer.

Call toll free for the name of the
Dysan dealer nearest you. (800) 551-9000.

Dysan Corporation, 5201 Patrick
Henry Drive, P.O. Box 58053, Santa Clara,
CA 95050, (408) 988-3472.

Dysan[®]

Circle 116 on inquiry card.



CONDOR jr.

Data Management Software



Condor's IBM™ PC-compatible file management software is one of the easiest and most complete MENU assisted file managers today, and for just \$195.

Would you buy a file manager that can't add two numbers? Of course you wouldn't. PFS FILE™ contains no arithmetic capability and can't even balance a checkbook!

Condor jr. offers all the benefits of PFS FILE™ **plus** the ability to easily balance your checkbook, total your purchase orders, average grades and even monitor your tax deductible expenses. This is in addition to your normal mailing list and other file management tasks. Unlike PFS FILE™, Condor jr. also offers **report writing** at no additional cost.

Condor jr. allows you to upgrade to Condor3 and save money as your needs grow. You can move to a fully relational database without redoing your system. A \$195 discount off Condor3 also makes it easier.

Since Condor has years of data management experience — we have a proven growth path for you. Condor jr. has been especially designed for the first time user. Not surprisingly, it is designed directly from Condor 3 — a fully relational database that is being used in over 100,000 businesses today.

To find out more about Condor jr. and the demonstration-pack software, see your personal computer dealer, or call **1-800-221-8479** (in Michigan call

0-313-769-3992 collect) for the dealer nearest you.

IBM is the registered trademark of International Business Machines Corp.
PFSFile is the registered trademark of Software Publishing Corp.

Circle 77 on inquiry card.

 **condor**
2051 South State Street Ann Arbor, MI. 48104 313-769-3988

PROGRAMMING
IN MODULA-2
Niklaus Wirth
Springer-Verlag
New York: 1983
176 pages. \$16.95

THE ELEMENTS OF
FRIENDLY SOFTWARE
DESIGN
Paul Heckel
Warner Books
New York: 1984
224 pages. \$8.95

THE ABC'S OF
DEVELOPING SOFTWARE
Sheldon D. Softky
ABC Press
of Silicon Valley
Menlo Park, CA: 1983
144 pages. \$13.95

THE PROGRAMMER'S
CP/M HANDBOOK
Andy Johnson-Laird
Osborne/McGraw-Hill
Berkeley, CA: 1983
500 pages. \$21.95

PROGRAMMING IN MODULA-2
Reviewed by David D. Clark



User friendliness is one approach discussed in a review of two books on software design this month.

By now, everyone has heard about Niklaus Wirth's new language, Modula-2. You've probably also heard that it will be the programming language of choice in the near future, replacing Pascal and preferred over Ada. For these predictions to come true, however, people have to learn the language. Niklaus Wirth's book, *Programming in Modula-2*, is designed to teach programmers the fundamentals of the language.

Professor Wirth describes the rationale behind the development of Modula-2 in the book's preface:

In 1977, a research project with the goal to design a computer system (hardware and software) in an integrated approach, was launched at the Institut für

Informatik of ETH Zürich. This system (later to be called Lilith) was to be programmed in a single high-level language, which therefore had to satisfy the requirements of high-level system design as well as those of low-level programming of parts that closely interact with the given hardware. Modula-2 emerged from careful design deliberations as a language that includes all aspects of Pascal and extends them with the important module concept and those of multiprogramming. Since its syntax was more in line with that of Modula than with Pascal's, the chosen name was Modula-2.

The text of the book was prepared in camera-ready form using a Lilith mini-computer and printed with a laser printer. All of the programs to format

the text, control, and interface to the printer were also written in Modula-2 on a Lilith.

STRUCTURE

The book is divided into five parts followed by the technical Modula-2 report (mentioned later in this review in more detail), two appendixes, and an index. The first nine chapters describe the basic concepts of variables, expressions, statements, and simple data types. Although the preface states that the book is intended for persons with some knowledge of programming, in several instances it goes into detailed discussions of very elementary concepts, explaining, for example, that the order in which statements are executed affects the outcome of a calculation.

The next five chapters explore the concept of the sub-program or procedure. This second part starts with an explanation about breaking

down a large problem into simple parts, which can be further subdivided. It is this process of stepwise refinement, of yielding simple tasks that can be implemented in single procedures, that is the power in any programming language. The reader is also introduced to the ideas of locality or scope, recursion as a programming strategy, and the methods of transferring parameters and results to and from procedures.

The third logical division of the text begins with chapter 15 and covers the concepts of data type and structure. In a general sense, the purpose of computer programs is to perform some useful transformation on some piece of

(continued)

data. Using an appropriate data structure facilitates the implementation of a program from such a transformation. One of the great strengths of Pascal, and now Modula-2, is the richness of this capability. This section of the text describes the data-structuring facilities clearly and completely.

OVERVIEW

The first 22 chapters can be skimmed by an experienced Pascal programmer with little chance of missing anything important. Modula-2 has several changes in syntax from Pascal, usually well-designed extensions and refinements. With the exception of some interesting examples, though, we've seen it before.

The really interesting stuff begins with the exposition of modules in chapter 23. Modules, familiar to people already acquainted with UCSD Pascal UNIT or Pascal Plus's ENVELOPE, provide a means of grouping related tasks into

separately compiled pieces for inclusion in libraries. This capability to logically group related procedures further enhances the process of stepwise refinement.

After presenting the module in various forms, the book provides examples for the implementation of common tasks such as character input/output (I/O) from video terminals and file stores. As with the C programming language, I/O is not explicitly provided for by the language. This is because it is such a hardware-dependent activity. To be complete, each implementation should provide a library of modules containing procedures and data types to perform the functions required.

The chapter on screen-oriented input and output is one of the most interesting in the book. It presents definition modules for line-drawing primitives, a mouse handler, and a window handler. As an aside, the Lilith minicomputer, on which Modula-2 was the systems' pro-

gramming language, has a high-resolution, bit-mapped display that is perfect for graphics-intensive applications.

DETAILS

In demonstrating the use of the line-drawing primitives, Professor Wirth returns to an example presented in one of his previous books, *Algorithms + Data Structure = Programs* (Prentice-Hall, 1976). The program generates a Sierpinski curve. This program was used to illustrate recursive techniques in the older book. The algorithm employs four mutually recursive procedures (A, B, C, and D).

The program in the older book, which was written in Pascal, would not compile because some of the procedures had not been previously declared. To remedy the situation, Pascal provides a FORWARD statement. The situation in Modula-2 is slightly different: all objects at the same scope level are known to

(continued)



POWER THAT WON'T QUIT!

DC-AC CONVERTER: #PS400 199⁰⁰

Great for mobile computer applications.
Sinewave output.
3 separate grounded outlets.
110V @ 4A output.
12 VDC input
All loads up to 400W combined (IE computer, printer, monitor).
Filtered + Bypassed.

Make Your Portable Computer Truly Portable.

POWER BASE: #B400 199⁰⁰

Provides uninterruptable power source for converter.
Gives up to 30 min. backup if power fails.
No power on switching time.
Continuous on line operation.
Status indicators.
Auxiliary battery input.
Fan cooled.

UNINTERRUPTABLE PS: #UPS400 299⁰⁰

Combines DC-AC converter with power base to make an uninterruptable power supply for your computer system. Will run 3 loads up to 400W. Measures just 6"x 9"x 12".

10MB 499⁰⁰

COMPLETE #TD10
(INTERNAL MOUNT)

HD Backup • May be used like a 10MB Floppy!
Single File Access • Inexpensive Removeable Media
Auto Loading • Streaming Tape Mode
Installs in a single 1/2 high 5 1/4" floppy slot
Optional Standalone package!
Low Power consumption + 12v @ .5avg, + 5v @ .5avg
For IBM, Apple², Atari¹, and many others.

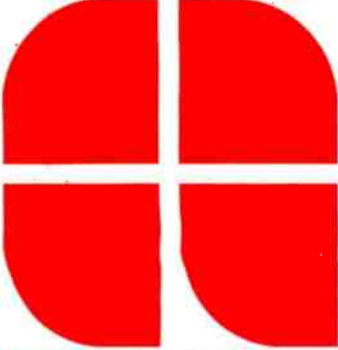
THE MOST COST EFFECTIVE MEMORY YET!

- (1) Cabinet, Cables, PS #KIT 99.00
- (2) Requires Special Controller #UDC 99.00
- (3) Requires Expansion Box

INFORMATION & ORDERS (209) 295-4014

PS400	199.00	NAME _____
B400	199.00	COMPANY _____
UPS400	299.00	ADDRESS _____
TD10	499.00	CITY, STATE, ZIP _____
KIT	99.00	CHECK <input type="checkbox"/> American Express <input type="checkbox"/> MasterCard <input type="checkbox"/> VISA <input type="checkbox"/>
UDC	99.00	CARD# _____ EXP. DATE _____ Signature _____

INTERSTAR CORP. CIA, COD. COMPANY P.O. (OAC)
Box 2008
Pioneer, CA 95666



DEALERS:
WE BUY
OVERSTOCKED
MERCHANDISE

GenTech

COMPUTERS

ALTOS
586-20 (8086, 512K, 5 Users, XENIX/RT, 20 MB Hard Disk & 1 Floppy) \$Call
986-40 (9 Users, 42 MB) \$Call

COLUMBIA
1600-1 (128K, 2 Drives) \$Call
1600-4 (10 MB Hard Disk) \$Call
1600-VP (Portable) \$Call



COMPUPRO All Models \$Call
CDRONA Desktop & Portable PC's \$Call
DIRECT PC (128K, 2 Drives, 12" Amber) \$2425

EAGLE
PC-Plus 2/PC-Plus XL \$Call
Spirit-2/Spirit-XL \$Call
Turbo-XL (8086, 256K, 10 MB) \$3995

FRANKLIN
CX Series (NEW! Apple DDS, MS-DDS, CP/M) \$Call
ACE 1200 DMS (6502/280B, 2 Drives, WordStar, MailMerge, ACE Calc) \$Call

ACE 1200 DMS 10 Pkge (10 MB Hard Disk) \$2449
FUJITSU MICRO 16S (8086/280A) \$Call

INTECTEC
HeadStart VPU 512 (280A/8086, 512K) \$Call
HeadStart VPU 1000 (1 MB RAM) \$Call

NEC
PC-8201A (w/ 16K RAM) \$479
PC-8801A (280A, 64K, 2 Drives, 12" Monitor, WordStar, MailMerge, Multiplan, NBASEC) \$1199

PC-8801-16 (Optional 8086 w/ MS-DDS) \$Call
SANYO
MBC 550-2 (8088, 128K, 1 DSDD Drive (360K), WordStar, CalcStar, EasyWriter) \$Call

MBC 555-2 (550-2 Plus 1 Add. Drive, Mailmerge, Spellstar & Infostar) \$Call

Double-Sided Drive Systems Available Now!
SEEQUA Chameleon (IBM Compatible) \$Call

SWP Micro Computer Products
Co-Power-88 Board (8088 w/ 256K) \$Call
For **KAYPRO 2, 4 & 10** \$Call

For **MORROW DESIGNS** Micro Decision. \$Call
TAVA IBM Look-Alike (128K, 2 Drives) \$1945

TELEVIDEO
1605 (8088, 128K, 2 Drives, DDS 2.0) \$Call
TPC-II (Portable Version of Above) \$Call

TITAN TECHNOLOGIES
DX-PC (8088 w/ 192K) For **EPSON QX-10** \$Call
VISUAL Commuter (IBM Compatible Portable) \$Call

FOR IBM-PC & COMPAQ

AST RESEARCH INC.
MEGA PLUS II (64K, Ser & Clk) \$269
SIX PACK PLUS (64K, Ser/Par, Clk) \$269
COMBD PLUS (64K, Ser/Par, Clk) \$269
I/O PLUS II (SerialPort, Clock/Cal) \$119

****OPTIONS****
Each 64K Increment Is \$60 Installed.
Serial/Parallel/Game Port. \$45

QUADRAM
EXPANDED DUABDARD (S.P. Clock, Game) \$279 384K \$529
64K \$279 384K

QUAD 512+ (SerialPort, Maximum 512K) \$389
64K \$239 256K

QUADCOLDR I (Video Board) \$199
QUADLINK (6502 w/ 64K) \$479

MICROFAZER
Parallel/Parallel \$239
16K \$139 64K \$185 128K \$239
Serial/Serial, Serial/Parl, Par/Serial \$239
8K \$145 16K \$155 64K \$209

AMDEK MAI Board (128K, 640 x 400) \$389
CCS SuperVision (132 Column) \$489
HERCULES Graphics Board (720 x 348) \$339
INTEL 8087 Math Co-Processor \$249

KEYTRONIC IBM Keyboard (5150) \$189
MA SYSTEMS PC Peacock (RGB & Composite, ParallelPort) \$269
MICROLOG Baby Blue II (Z80B, 64K, Parallel & Serial Ports, Clock/Calendar) \$539
PARADISE SYSTEMS Multi-Display Card \$409
PLANTRONICS ColorPlus \$Call
RANA 2.5 MB Disk Drive w/ Controller. \$Call
STB SYSTEMS Graphix Plus \$269
TANON TM 100-2 (DSDD Disk Drive) \$199
TEAC FD-55B (DSDD Thinline Drive) \$175
TECMAR Graphics Master (640 x 400 RGB) \$519
The Captain (w/ DK) \$259
1st Mate (w/ DK) \$229

FOR APPLE II/IIe, Franklin ACE

ALS CP/M Card \$279
Smarter II (80 Column Card) \$129
DIGITAL RESEARCH CP/M Gold Card w/ 64K \$339
FOURTH DIMENSION 16K RAM Card \$55
80 Column Card w/ 64K (IIe Only) \$129
INTERACT. STRU. PKASD Universal. \$125
KOALA TECH. Koala Pad \$85
MA SYSTEMS Omnigraph \$79
MICROSOFT Premium Softcard (IIe) \$279
Softcard (Apple/Franklin) \$229
MICROTEK Dumping-16. \$149
ORANGE MICRO Grappler+ \$109
Buffered Grappler+ (16K) \$169
PCP Applicard 6 MHZ \$249
RANA Elite I \$249
Elite II/Elite III \$349/\$429
TG Paddles. \$10
TRANSEND ASID \$125

HARD DISK

CORVUS
Omnidrive: 11 MB \$1949
Transporter \$399 Printer Server. \$789
Network Mirror \$759 The Bank \$1749

DAVONG (Universal External)
10 MB \$1925 21 MB \$2645



GREAT LAKES
10 MB Internal For IBM \$1059
23 MB External (w/ Controller) \$1799

QCS
10/20 MB (w/5 MB Cartridge Back-Up) \$2995/\$3495

TALLGRASS
12 MB External w/ Tape Back-Up. \$2799
20 MB External w/ Tape Back-Up. \$3149
TANON TM 5112 (10 MB External) \$1449

TECMAR
Removable Cartridge Winchester in PC (5 MB) \$1529
10 MB w/ 5 MB Cartridge in Chassis \$3149
THOUGHT WORKS for SANYO: 10 MB. \$1875
XCOMP 16 MB External (For IBM, Apple, Kaypro & Morrow Designs) \$1749

CALL FOR PRICES ON CONTROL DATA, DATAMAC, FRANKLIN, QUADRAM, RANA, SYSGEN

DOT MATRIX PRINTERS

ANADEX
DP 9625B (60 CPS NLD) \$1199
DP 6500 (500 CPS, 15" Carriage) \$2375
C-ITOH Prowriter I 8510 AP \$329
DATASOUTH DS-180 \$1149



EPSON
LQ-1500 \$1149 RX-100 \$509
RX-80 \$279 RX-80 F/T \$329
FX-80 \$459 FX-100 \$689

FLORIDA DATA (600 CPS, 4 Fonts) \$2995
INFO RUNNER Riteman Plus \$279

NEC
P2 Pinwriter (180 CPS, 10" Carriage) \$649
P3 Pinwriter (180 CPS, 15" Carriage) \$879

OKI/ATA
ML 92 \$Call ML 93 \$Call
ML 84(P) \$Call Pacemark. \$Call

MANNESMANN TALLY
MT 160L \$599 MT 180L \$789
PANASONIC KX-P1090/1091. \$289/\$339
SMITH CORONA D-200 (120 CPS, NLD 17 x 16) \$459
STAR MICRONICS
Gemini 10X \$285 Gemini 15X \$389
Delta 10 \$409 Delta 15 \$549
Radix 10 \$589 Radix 15 \$699
TEXAS INSTRUMENTS
850 RD. \$489 855 RD. \$759
TOSHIBA
P1340 \$789 P1350/1351 \$Call
TRANSTAR T315 Color Printer. \$449

LETTER QUALITY PRINTERS

ABATI LQ-20 (18 CPS, 15" Carriage) \$385
BROTHER/OLYNAX
DX-15 (13 CPS, Diablo Compat.) \$449
HR-25/HR-35 \$Call
COMREX ComRiter II (5K Buffer) \$449
ComRiter III (23 CPS, 15" Carriage) \$709
DAISYWRITER 2000 EXP (48K Buffer) \$985
DIABLO
620 API \$799 630 ECS/IBM \$2049
IBM 6100 (17 CPS, Diablo Compat.) \$Call
NEC
2030 \$685 2050 \$815
3530 \$1275 3550 \$1595
7710 \$1725 7730 \$1725
OLYMPIA Compact RD/2 \$459/\$429
ESW 3000 (50 CPS, 15" Carriage) \$1379
QUADRAM Quadjet (Ink Jet Printer) \$759
QUME Sprint 1140/1155 \$1299/\$1479
SILVER-REEO
EXP 500/550 \$409/\$519
EXP 770 (35 CPS, 15" Carriage) \$899
STAR MICRONICS PowerType (18 CPS) \$339
TRANSTAR T120/T130. \$409/\$569

PLOTTERS

AMDEK DXY-100/Amplot II \$609/\$879
ENTER COMPUTERS
Sweet-P \$Call Six Shooter. \$859
HOUSTON INSTRUMENTS
DMP-40-2 \$779 DMP-29 \$1849
DMP-41 \$2399 DMP-42 \$2399
PANASONIC VP-6801A \$1349
ROLAND DXY-101/DXY-800 \$539/\$709
STROBE Model 200/Model 260 \$529/\$689

MONITORS

AMDEK
Video 300/300A/310A \$135/\$145/\$159
Color I+ \$269 Color II+ \$419
Color III+ \$379 Color IV \$709
MONITECH 9"1/2" Green \$85/\$95
PRINCETON GRAPHICS HX-12 \$489
SR-12 (690 x 480) \$639
Max-12 (12" Amber, TTL) \$185
QUADRAM Quadscreen (17" 968 x 512) \$1439

ROLAND
MB-121G \$135 MB-121A \$145
MB-122G \$155 MB-122A \$165
CB-141 \$279 CC-141 \$559
SAKATA SC-100/SC-300 \$259/\$699



TAXAN
KG-12N \$109 KG-12N/LY \$119
210 (380 x 262) \$259 420 (640 x 262) \$439
USI Pi-2/Pi-3 \$Call

ZENITH
ZVM-123A \$99 ZVM-122A \$105
ZVM-135 (13", RGB/Composite, 640 x 240) \$459

TERMINALS

ESPRIT
Esprit I \$Call Esprit II \$499
Esprit III \$Call ESP-6310 \$589
LIBERTY Freedom 110/200 \$Call
QUME 102/102A \$535/\$549
103/108 \$849/\$549
TELEVIDEO 914/924 \$519/\$675
950/970 \$Call
Personal Terminal \$419
w/ 300 Baud Modem. \$528



VISUAL 50/55 \$559/\$699
WYSE
WY-50 \$519 WY-75 \$619
WY-100 \$659 WY-300 \$995
ZENITH
Z-29 \$649 Z-49 \$Call
ZTX-10 \$329 ZTX-11 \$389

MODEMS

ANCHOR
Mark VII \$109 Mark XII. \$265
HAYES
Micromodem IIe (w/ SmartCom I) \$245
Smartmodem 300/1200. \$219/\$499
Smartmodem 1200B (IBM) \$439

NOVATION
Access 1-2-3 \$419
J-Cat (Auto Orig/Answer, 300 Baud) \$99
Apple Cat II (300 Baud) \$225
212 Apple Cat II (1200 Baud) \$399
103 Smart Cat (300 Baud) \$169
103/212 Smart Cat (1200 Baud) \$399

TRANSEND (Formerly SSM)
Modemcard w/ Source (For Apple) \$239
PC Modem Card 1200 (For IBM) \$419

U.S. ROBOTICS
Password (1200 Baud) \$315
Auto Dial 212A \$449

SOFTWARE

ASHTON-TATE dBase III/III. \$Call
LOTUS 1-2-3/Symphony. \$319/\$Call
MBSI, STAR Accounting Software \$Call
MICROPRO WordStar Pro Pack (IBM) \$399
MICROIM R-Base 4000 \$309
MICROSOFT Multiplan \$129
PSI WordPlus-PC w/ BOSS \$349
SATELLITE SOFTWARE WordPerfect \$259
SOFTWARE SYSTEMS Multimate \$319
SORCIM SuperCalc 3 \$239

MISCELLANEOUS

SINGLE-SIDED DISKETTES
3M. \$23 Dysan \$29
Maxell \$26 Verbatim. \$23

DOUBLE-SIDED DISKETTES
3M. \$30 Dysan \$38
Maxell \$37 Verbatim. \$31

SURGE PROTECTORS
EPD: Lemon/Orange \$45/\$99
ULTIMA \$39

FOR COMMODORE-64
CARD CD Card?+ G. \$69
ORANGE MICRD Grappler CD. \$99

HOUSTON INSTRUMENTS
DT-11 Digitizer (1-Button Cursor) \$719
DT-114 Digitizer (4-Button Cursor) \$779
INTERACTIVE STRUCTURES Shufflebuffer 32K \$219
RANA 1000 Disk Drive w/ DDS (For Atari) \$269

CUSTOMER SERVICE

401-781-0020

ORDERS ONLY

800-843-4302

150 Broadway, Suite 2212, N.Y., NY 10038
Money Order, Cashier's Chk, Personal Chk (3 Weeks To Clear).
Add 3% MC/VISA. 5% AMEX Charge. Add 2% On COD Orders.
APO Orders Add 6%. Add 3% For Net Terms.
All Returned Non-Defective Merchandise Are Subject To
20% Restocking Charge.
GenTech Reserves the Right to Change Advertised Prices.



Circle 13 on inquiry card.

one another. This is the only example I could find in the book that even indirectly addresses the relaxed declaration sequence accepted by Modula-2. One of the improvements in the syntax of language relative to Pascal is that it allows for declarations of constants, types, variables, and procedures to be declared in an arbitrary order in arbitrary locations, within the same scope level. Such syntax allows global variables to be declared right in front of the group of procedures that uses them. Although this fact can be determined from close examination of the formal syntax (in my case, by recourse to someone who is already an expert in the language), I think this new syntactical feature should have been explicitly mentioned.

The fifth division of the text consists of three chapters that cover language facilities for system programming and other low-level tasks. When Pascal was created, it was originally intended only

to teach good programming practices. Because it was so easy to write reliable, structured programs in Pascal, several extensions of it were created to enable it to handle systems-level programming. The UCSD project, for example, wrote the entire operating system in its extended version. In order to access the underlying hardware, programmers resorted to tricks to get the job done. Because of such practices, programs written in one variant often were not portable to implementations using a slightly different version.

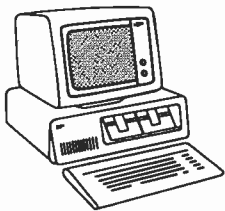
As stated in the preface, a major objective in the design of Modula-2 was creating a general-purpose programming language that could also program low-level tasks. The topics discussed in the fifth division of the book include multiprogramming, concurrency, coroutines, peripheral interfacing, and interrupts. While unleashing the programmer on these low-level facilities, an attempt is made to instill a sense of solid, sound,

conservative design when using them. These language features enable the programmer to greatly damage the system and should be used cautiously and deliberately. This part of the book is the most terse, possibly by design. My advice is, if you don't understand what the text is discussing, don't even attempt to use the facilities described.

Following the main body of the text is the "Report on the Programming Language Modula-2." This document is the technical reference mentioned earlier that describes the language. It defines the standard language, at least until national standards committees create new ones. While a book review need not comment on the technical merits of a language definition, a few comments on its presentation are in order. In this case, the most obvious observation is that it is understandable. The 25-page document clearly specifies the syntax and semantics of the language. It is remark-

(continued)

Developing microprocessor software? Check out this exciting duo!



Your IBM-PC + Our μ -Series™ software =

A low-cost development system that handles most popular types ranging from 8-bit controllers to full 32-bit architectures

Relocating Macro Assemblers	
AZ8 Z8 Asm	\$225
AB04X 8048/41A Asm	\$225
AB085 8080/85 Asm	\$225
A6801 6800/01 Asm	\$225
A6809 6809 Asm	\$225
A6502 6502 Asm	\$225
AT7000 TMS7000 Asm	\$225
A16032 INS16032 Asm	\$295 (Q3 B4)
AZ80 Z80/NSC800 Asm	\$225
AB051 8051/52/44A Asm	\$225
AB086 8086-80286 Asm	\$235 (Q2 B4)
A6805 6805/14605 Asm	\$225
A68K 68000/10 Asm	\$295
AT99 TMS9900/95 Asm	\$225
A1802 1802-1806 Asm	\$225
Utilities	
XLINK Universal linker needed by all μ -Series assemblers/compilers	\$225
XLIB Universal librarian usable with all μ -Series assemblers/compilers	\$175
Documentation only	
IPM-00012A(MS-DOS) Generic assembler, linker & librarian	\$35
CPU-ADD(XX) CPU-dependent addendum (specify CPU)	\$5
Packages	
XLINK + any 3 assemblers including documentation	\$575
XLINK + XLIB + any 5 assemblers including documentation	\$775

Product Summary

Assemblers: • Machine instruction syntax is compatible with the chip-manufacturers assemblers • Execute as single programs • Generate absolute or relocatable code • 132 significant characters in symbols • Nested "include" files • Self-explanatory error-messages • Unlimited number of relocatable segments • 32-bit arithmetic • Single precision IEEE floating point constants • Optional local symbols in the object code • Powerful recursive macro facility • Multiple object modules from a single source file • Cross-reference option and numerous list-control directives • Conditional assembly • Unified operation and documentation.

XLINK: • Relocates 8, 16 and 32-bit operands • Full support for 8086-type segmentation • Output in "standard" formats: Intel-hex, Motorola-S, TI, Millenium/Tektronix, RCA and a special format with symbols • Automatic library search for compilers • Single-line link command, or a multiple-line command made with interactive control of all loading parameters • Command file option • Prompts for missing parameters • Optional load-maps and cross-references • Type-check on public/external declarations • Range-check on relocatable objects • Help-command, directory-list and informative error-messages.

XLIB: • Supports creation and/or maintenance of object code libraries • Lists/Deletes/Moves/Updates/Renames or appends object modules • Lists or renames segments, externals or entries • Command structure and error-messages analogous with XLINK.

Documentation: • Generic 100-page manual in a ring binder • Lots of examples on how to use the "standard" as well as the unique features • 4-30 pages of CPU-dependent information delivered with each assembler.

Requirements: • Any PC-DOS/MS-DOS - based machine • 170 K or more user memory • Serial port for down-load to target system, PROM-programmer or emulator.



IAR SYSTEMS AB
Box 23051, S-750 23 UPPSALA, Sweden
Telephone: +46 18 14 43 14
Telex: 76147 UPTRADE S

US DISTRIBUTOR:
WESTICO
25 Van Zant Street · Norwalk, CT 06855
(203) 853-6880 · Telex: 643-788

COMPUTERS and more. . .

Member: BBB
S.D. Chamber of Commerce
NOMDA

is your place to buy for SELECTION, SERVICE and SAVINGS.

We know that your needs are not the same as everyone's, so we don't treat you "just like every one else."
Your needs are special. That's why **COMPUTERS and more. . .** is your place to buy for. . .



"Tomorrow's Technology at Prices You Can Afford Today"

COMPUTERS

IBM	CORONA
256K PC w/2 1750	DeskTop w/2 Drives 2099
PC w/10 Meg & 1-320 2495	Portable w/2 Drives 2099
PC w/2-320K & 10 Meg 3195	Models w/ Hard Disk CALL
Extended Warranty	New Models CALL
Available on All Models	CONVERGENT TECH
APPLE	WorkSlate 995
Hot New IIC 1150	MicroPrinter 229
MAC - All Models CALL	Comport 149
LISA - All Models CALL	NEC
Apple IIE 750	8201A (Portable) 489
FRANKLIN	APC-H01 2095
New CX-2 Portable 1295	APC-H02 CALL
New CX-2C Portable 1595	APC-H03 CALL
Ace 1000 699	APC-H04 2659
OMS System	TAVA
w/Monitor 1395	PC w/Monochrome
Ace Pro Plus 995	Monitor 1899
TELEVIDEO	PC w/Color Monitor 1959
Model 1605H 3795	ZENITH
Model 1605E 298	DeskTop 151-21 2159
Model TPC II 2399	DeskTop 151-22 2495
Model 803H 3379	Portable 161-21 2349
Model 804 3399	Portable 161-22 2639
Extended Warranty	CALL FOR PRICES ON:
Available on All Models	KAYPRO • SHARP •
COLUMBIA	COMPAQ • EAGLE •
1600-1 2295	OTRONO • NOVELLE •
1600-4 3299	NORTHSTAR • ALTOS •
VP Portable 2349	DEC • EPSON •
	SANYO • ATARI •

ACCESSORIES

IBM	AST 6-Pack 265
Hercules Color Card 199	Quad Link 469
StarLink by DRI 1295	PC Saver 39
KeyTronic 5151 - 5151 Jr. 209	TG Joystick 44
Bi-Graphics I 459	64K Ram Chips CALL
Bi-Graphics II 229	CALL FOR PRICE LIST!!
Smart Cable by I.Q. 64	APPLE
Jr. Extender by Falcon CALL	Disc Washer Carri 199
UltraPak by TSENG 489	PrinterFace by P.P. 64
UltraRam by TSENG 191	GraphicCard by P.P. 79
Multi-Display by P.S. 399	Z-80 Card 69
Plantronics Color Plus 389	Touch Pad by Koala 84
Orchid Blossom 299	MicroSoft Acces. CALL
Orchid PCnet 389	Grappler Plus 109
Orchid Combo CALL	Videx 80 Col w/Sft Switch 179
	Wesper Full Graphics System Saver FAN 67

WE'VE EXPANDED TO A NEW LOCATION TO SERVE YOU BETTER



1 Year Warranty Available

TO ORDER: Phone orders invited using Visa, MasterCard, or bank wire transfers. Visa, MC NO SERVICE CHARGE. Mail orders may send charge card number (include expiration date), cashiers check, money order, or personal check (allow 10 business days for personal or company checks to clear). Please add 3% (\$5.00 minimum) for UPS shipping, handling, and insurance. All equipment is in factory cartons with manufacturer warranty. Opened products not returnable. Restocking fee for returned merchandise. Equipment subject to price change and availability. Retail prices differ from mail order prices. Calif. residents add 6% State Tax. Company and school P.O.'s accepted on approval. IBM & Apple are registered trademarks.

* On All Pre-paid Cash Orders In Cont. U.S.

PRINTERS

JUKI	TOSHIBA
6100 18 Cps 419	P 1351 Parallel 1589
Tractor 109	P 1351 Serial 1589
Cut-Sheet Feeder 529	P 1340 Parallel 789
EPSON	P 1340 Serial 789
FX-100 CALL	MANN-TALLY
FX-80 - 80 F/T CALL	Spirit 294
LQ-1500 ON SALE!	1601 539
ABATI	160-L 619
LQ-20 Parallel 389	180-1 769
LQ-20 Serial 429	180-L 849
DAISYWRITER	420-1-123 2369
Daisy 2000 w/48 CALL	420L-111 1939
K Buf. CALL	440-1-112 1995
Tractor for Daisy 2000 CALL	440L-112 2199
Cut-Sheet Feeder CALL	PKu-1P 539
QUADRAM	PKu-3P 629
QuadJet 695	STAR
IBM Kit 19	STX-80 139
Apple Kit 49	Gemini 10X 269
NEC	Gemini 15X 379
New! Pinwriter 2 CALL	Delta20 389
New! Pinwriter 3 CALL	Delta-15 569
2030-Parallel 679	Radix-10 579
2050-Parallel 889	Radix-15 639
3510-RS232 1299	Power Type 389
3515-RS232 1299	OKIDATA
3530-Parallel 1279	MicroLine 84 P CALL
3550-Parallel 1599	MicroLine 92 P CALL
Extended Warranties CALL	Pacemark 2350 P CALL
	Pacemark 2410 P CALL

FREE * SHIPPING

"MODEMS"

HAYES	RIXON
II C Compatible w/Sft 259	R 103J ASYNC 229
MicroModem Ite 229	PC 212A IBM Internal 429
SmartModem 1200B (IBM) 399	PC 212A-WA 499
SmartModem 300 RS232 219	w/ASYNC Port 499
SmartModem 1200-RS232 539	R 212A-1 RS232 429
ChronoGraph RS232 199	NOVATION
U.S. ROBOTICS	Access 1-2-3 399
IBM PC Modem 369	J.Cat 99
Password 300/1200 357	103 Smart Cat 189
VEN-TEL	212 Auto Cat 397
1200 Plus 384	Appie-Cat II 229

DISK DRIVES

FLOPPY DRIVES	HARD DISK
Full High 320K 209	10 Meg Internal 995
Slim Line 320K 199	QuarterMaster ON SALE!
Apple Compatible 159	10 Meg External 1095
FUJI DISKETTES	15 Meg External CALL
SS DD 22	Bernoulli by Iomega 2799
DS DD 27	QUADRAM • TECMAR •
	CONTROL DATA

SOFTWARE

FOR PC & XT	APPLE
O2 by Fox & Geller 299	dBase III by Ash Tate 419
Quick Code 219	Friday by Aston-Tate 199
FrameWork by 269	Bottom Line Strategist 269
dBase III 419	C Dex Packages (each) 39
Friday 199	CPA Modules I thru 4 (each) 174
Please by Hayes CALL	O2 by Fox & Geller 319
SmartCom II 87	Graphox 197
MayDay by Teletex 174	Sales Edge 174
Symphony by Lotus 104	Format Ite 64
Upgrades for 1-2-3 27	Knoware 27
DESQ CALL	Master Type 64
Inves. Anyl. by Dow Jones 249	Micro Pro CALL
Market Analyzer 219	Micro Soft CALL
Market Manager 65	PFS: Access Ite 49
PFS: Access 89	PFS: File II 84
PFS: Write 89	PFS: File Ite 84
PFS: Report 84	The Handlers (all) 149
Bankstreet Writer 47	Terrapin Logo 99
EasyWriter II by IUS 269	VersaForm 259
CorrectStar by MicroPro 134 267	BPI GL 267
VolksWriter DeLux 198	P e Writer by Hayden 97
R-Base by MicroRim 319	Personna Pearl 194
WordStar ON SALE!	Dow Jones CALL
MBSI Real World CALL	Lock Smith 78
T.I.M. 329	Zork-I, II or III (each) 26
VersaForm 279	Deadline 33
Ask Micro (each) 389	Flight Simulator II 37
	Jack Report 74

MONITORS

Roland DG 121-G 139	Quadscreen w/Card 1650
Roland DG 121-A 249	Zenith 131 319
Roland CB-141 319	Zenith 135 487
Roland CC-141 595	Zenith 122 109
Taxan 420 449	Amdek 100 159
Taxan Amber 119	Amdek Color IV-T 597
Taxan 415 499	NEC JC 1215 269
RGB-80 col Ite 139	NEC JC 1216 397
RGB Card Ite 89	Format II 119
Quadchrome 559	ODEN 37

TERMINALS call

SERVICE

WE OFFER EXTENDED WARRANTIES ON ALL OF OUR PRODUCTS. OUR EXPERIENCED TECHNICIANS ARE HERE FOR YOU!



COMPUTERS and more.

8625 Commercial Dr., La Mesa, CA 92041



1-800-433-9449



For CA, HI and Alaska (619) 291-1442

NO SERVICE CHARGE FOR CREDIT CARDS
NATIONAL LEASING AVAILABLE

P.O.'S ACCEPTED
ON APPROVAL

able that so powerful a language can be described so concisely. It is also in marked contrast to the technical description of some other languages, notably COBOL, PL/I, and Ada.

DRAWBACKS

The book does have some flaws. It seems ironic that the creator of such beautiful languages as Pascal and Modula-2 should use one of the most unattractive programming styles I have ever seen. Indentation is shallow (often less than one character per level) and hard to follow in some of the longer examples. There is a tendency to cram several statements onto the same line. The use of proportional spacing in the listings is bothersome. Because different letters occupy varying widths in the listings, corresponding letters in consecutive lines do not always line up. This can be particularly annoying when character arrays are padded with blanks: there is simply no way of knowing how

many blanks to use.

The listings in this book do, however, have one advantage over the Pascal listings presented in Professor Wirth's previous books. The presentation listings that appear in typeset text and regular listings as produced by common printers are the same. One typeface is used for all program tokens instead of reserved words in bold, identifiers and operators in italics, and surrounding text in Roman. This makes it easier to write about the language and programs written in it.

Another slightly annoying property of the book is the level of presentation. It tries to be all things to all programmers. By presenting many very basic concepts of programming in general, it is probably too terse for the beginner to learn how to program without additional instruction. All the detail for beginners just slows down the experienced programmer. Such a person can skip large sections of the text, thereby possibly

missing important details. I think Professor Wirth should have directed his presentation to the more experienced audience because at this stage in the life of Modula-2, very few persons will learn it as their first programming language. Instruction for the beginner can be provided by tutorial books that will appear as the popularity of the language increases, just as they did for BASIC and Pascal.

Possibly the most disconcerting thing about this book is its index. Although it appears complete, it is hard to use. Printed in a two-column format, scanning it in alphabetical order means looking at an entry in the first column, checking the same line in the second column, moving down one line, checking the first column, and so on. It's not easy to break the habit of looking straight down the list when searching hurriedly. Such an index is a handicap in a book intended as a reference.

(continued)

BYTE CONNECTION, INC.

presents **BOTTOM LINE** Prices:
CALL (714) 778-6496

PERSONAL COMPUTERS

IBM PC 256k, color card, monitor, 2 slimline drives	\$ 2389.00
CORONA 128k, color card, monitor, 2 slimline drives	\$ 1995.00
TAVA PC 128k, color card, monitor, 2 slimline drives	\$ 1895.00
IBM XT, 128k, color card & Accounting pkg, AP, AR, PR	\$ 5255.00
MEMOTECH 64k, parallel and game ports, TV/Monitor adapter	\$ 595.00
ALTOS-586 512k, 20mb HD, 1mb FD, 6 Ser. ports, Altos-II terminal	\$ 7695.00
ALTOS-586 512k, 40mb HD, 1mb FD, 6 Ser. ports, Altos II terminal	\$ 8695.00

PRINTERS

EPSON RX 80FT	\$ 350.00	OKIDATA MICROLINE 84P	\$ 979.00
EPSON RX 80	\$ 270.00	OKIDATA MICROLINE 84S	\$ 1079.00
EPSON FX 80	\$ 499.00	OKIDATA MICROLINE 82	\$ 315.00
EPSON FX 100	\$ 699.00	OKIDATA MICROLINE 92	\$ 445.00
JUKI 6100 Letter qual.	\$ 489.00	OKIDATA MICROLINE 93	\$ 689.00

MODEMS

U.S. ROBOTICS 300	\$ 189.00	U.S. ROBOTICS PASSWORD 1200	\$ 340.00
U.S. ROBOTICS 1200	\$ 440.00	SMARTMODEM 1200	\$ 470.00

TERMINAL/MONITORS

TELEVIDEO 914	\$ 575.00	AMDEK 300G green	\$ 139.00
TELEVIDEO 924	\$ 675.00	AMDEK 300A amber	\$ 139.00
TELEVIDEO 950	\$ 880.00	TAXAN amber	\$ 139.00
TELEVIDEO 970	\$ 1045.00	TAXAN RGB III	\$ 499.00
AMDEK 310A amber	\$ 179.00	PGS HX12 Hi-res color	\$ 499.00

SOFTWARE

WORDSTAR	\$ 299.00	FRIDAY	\$ 249.00
EASYWRITER II	\$ 269.00	FINAL WORD	\$ 269.00
PERSONAL PEARL	\$ 269.00	QUICK CODE	\$ 259.00
LOTUS 1-2-3	\$ 395.00	SIDEWAYS	\$ 54.00
MULTIPLAN	\$ 225.00	DBASE II	\$ 489.00

DISK DRIVES & SUCH

TANDON TM100-2 IBM comp.	\$ 225.00	5 1/4 OS, DO 10 diskettes/box	\$ 29.95
TANDON 10mb. w/control	\$ 1395.00	6 PACK-6 function to 384k	\$ 269.95
TANDON 25mb. w/control	\$ 1995.00	S TB Graphic plus	\$ 399.00

Store Hours: Monday-Saturday 9:00 am - 5:00 pm

Prices reflect 3% to 5% cash discount. Product shipped in factory cartons with manufacturer's warranty.

Please add \$8.00 per order for UPS shipping. Prices & availability subject to change without notice.

All returned merchandise subject to a 20% restocking fee. Prices good in U.S. only.

Prices reflected in this section are lower than franchise stores

Send cashier's check or money order . . . Personal checks acceptable.



Introducing a pocketful of miracles.

It's the new BASF Qualimetric™ 3.5" Micro FlexyDisk®. Its name is a lot bigger than its size, and a lot smaller than its capacity—one astounding megabyte. Our new Micro fits into more than shirt pockets. It fits into several of the hottest new small portable personal computers—like Apple™ Computer's new Macintosh™ and Lisa™ 2 and Hewlett-Packard's HP-150 Touchscreen PC.

The Qualimetric part is what makes our Micro FlexyDisk different from the others that will inevitably follow. It indicates a new standard in design, production, inspection, and testing. This standard enables us to warranty the Micro for a lifetime.*

No more, no less. In addition, we certify that each bit of every byte on or between every track on each Micro FlexyDisk is

*Contact BASF for a copy of our warranty.

Circle 32 on inquiry card.

100% error-free. That's because we know, while each Micro FlexyDisk may only cost a couple of bucks, the hours and brain cells you put into it are priceless.

For those occasions when you need more than a pocketful of miracles, we provide a handy and virtually earthquake-proof 5-pack. It's sized to slip easily into your briefcase, handbag, or backpack.

For a plethora of technical details about our new Micro FlexyDisk and even more important information on where to buy it, call toll-free.

1-800-343-4600.



PRAISE

On a more positive note, this book covers almost all of the facilities of the language quite well. Professor Wirth infuses his exposition with the importance of stepwise refinement, the choice of appropriate data structures, and the separation of related tasks into isolated modules. In many cases, the programming examples given are quite interesting. The book seems to have been prepared carefully: I didn't notice one typographical error. To top it off, the book is reasonably priced, something quite rare in computer science books. And finally, this is an important book. It contains the report on Modula-2 and thus defines the standard language. As the language becomes more popular, it will serve as the arbiter of what constitutes a correct implementation. Simply, this book can help you resolve questions regarding the legality of syntax and recognition of nonstandard, nonportable use concerning Modula-2.

THE ELEMENTS OF FRIENDLY SOFTWARE DESIGN

THE ABC'S OF DEVELOPING SOFTWARE

Reviewed by Chris H. Pappas

A tension exists between two opposing software-design theories. One school of thought maintains that an efficient program must be structured, modular, and easily maintained. The other approach focuses on and caters to the needs of the user.

I have just finished reading two texts on software development. The first book is *The Elements of Friendly Software Design* by Paul Heckel and the second is *The ABC's of Developing Software* by Sheldon D. Softky. Both are written for beginning to experienced programmers. I see, as do the authors, that these two approaches are not mutually exclusive, even though both texts represent opposite ends of the spectrum. The

amount of space Heckel devotes to program-design structure in his book is similar in length to the space Softky devotes to user friendliness.

THE FRIENDLY WAY

The information in *The Elements of Friendly Software Design* is both entertaining and instructional. The major thrust of the text indicates that software design, if approached from the user's point of view, is the most recent addition in the field of communications crafts. Precursors include literature, theater, music, film, and other art forms.

Significant examples are included that support user friendliness: quotes from famous movie directors, authors, inventors, painters, and other people whose livelihood revolves around communications. Heckel suggests that software engineers go beyond proper program syntax and structure and concern themselves with addressing user needs.

(continued)

DISK COPYING SERVICE

Fast • Reliable • Low Cost

If you produce software, ALF's disk copying service is the quick, convenient answer to your duplication needs. Fifty copies or thousands, standard or copy-protected formats, just disks or a whole package—call ALF. Consider:

- **FAST.** Most orders are shipped in a week or less. Prompt service on custom printing, too.
- **LOW COST.** Set-up charges start at \$10, copy protection set-up at \$25. Copying charges are 30¢ to 40¢ per side (see blank disk prices at right). No extra charge per copy for protected formats.
- **CONVENIENT.** We offer label application, shrink packaging, heat sealing, and other services. Need custom printed labels and sleeves? We can handle it and much more. We have vinyl folders, binders with slip cases, 3-hole vinyl disk pages, and disk mailers in stock—and can custom print them for packaging in a hurry.
- **TOP QUALITY.** We start with the finest disks available. Your choice of 3M, Memorex, Verbatim, or other major brands—or you can supply your own blank disks. Every disk we copy is verified bit by bit and guaranteed 100% flawless.
- **RELIABLE.** ALF designs and manufactures copying equipment that other copying services and software publishers rely on every day. Our complete understanding of duplication technology assures you of the finest reproduction available—and has since 1980.

We're eager to meet your duplication and packaging needs. Give us a call today!

BLANK DISKS

ALF buys large quantities of top quality, bulk packaged disks for our disk copying service. We avoid the expense of fancy printing and labeling—and can pass these savings on to you! The disks listed below are 5¼", soft sector, double density, unlabeled, with hub reinforcement ring. Call for information on other disks, too.

3M	call for details
MEMOREX	\$146 per 100 SINGLE SIDED
	\$180 per 100 DOUBLE SIDED
VERBATIM	\$150 per 100 SINGLE SIDED
	\$192 per 100 DOUBLE SIDED

- Without sleeves:*
add \$2.50 shipping per 100.
- With tyvek sleeves:*
add \$7 plus \$2.50 shipping per 100.
- Packed in boxes of 10 with tyvek sleeves:*
add \$15 plus \$3.00 shipping per 100.

ALF To order, call 1-800-321-4668. Inside Colorado & customer service: 1-303-234-0871.
ALF Products Inc. 1315F Nelson St. Denver, CO 80215

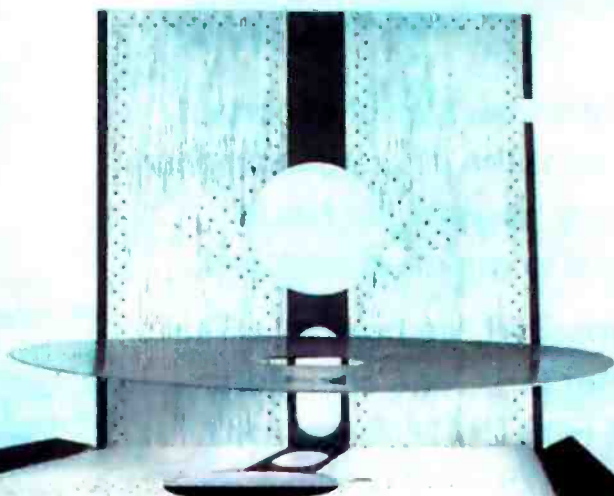
BASF QUALIMETRIC™ FLEXYDISKS® BUILT FOR ETERNITY - WARRANTED FOR A LIFETIME.

BASF Qualimetric FlexyDisks® offer you more...an extraordinary new lifetime warranty. The BASF Qualimetric standard is a dramatic new international standard of quality in magnetic media...insurance that your most vital information will be secure for tomorrow when you enter it on BASF FlexyDisks today.*

We can offer this warranty with complete confidence because the Qualimetric standard reflects a continuing BASF commitment to perfection...a process which begins with materials selection and inspection, and continues through coating, polishing, lubricating, testing, and 100% error-free certification. Built into our FlexyDisk jacket is a unique two-piece liner. This BASF feature traps damaging debris away from the media surface, and creates extra space in the head access area, insuring optimum media-to-head alignment. The result is a lifetime of outstanding performance.

When your information must be secure for the future, look for the distinctive BASF package with the Qualimetric seal. Call 800-343-4600 for the name of your nearest supplier.

Circle 33 on inquiry card.



BASF
FlexyDisk



ENTER TOMORROW ON BASF TODAY



BASF

*Contact BASF for warranty details. © 1982, BASF Systems Corporation, Bedford, MA

BASIC COMPILER

SuperSoft[®] Language Library

For PC DOS[®], MS DOS,
CP/M-86[®], and others



A programmer's most important software tool is the language compiler or interpreter he uses. He has to depend on it to work and work well.

At SuperSoft, we believe it. That's why we offer three fine compilers: SuperSoft FORTRAN, SuperSoft BASIC, and SuperSoft C, that answer the programmer's need for rock solid, dependable performance on 16 bit systems.



Compatible with Microsoft BASIC

The SuperSoft BASIC compiler, available under CP/M-86 and MS DOS, is compatible with Microsoft* BASIC and follows the ANSI standard.

Greater accuracy with BCD math routines

If you have used other languages without BCD math, you know how disconcerting decimal round off errors can be. For example:

With IBM PC* BASIC	With SuperSoft BASIC with BCD math
10 A=.99	10 A=.99
20 PRINT A	20 PRINT A
30 END	30 END
Output: .9899999	Output: .99

As you can see, SuperSoft BASIC with BCD provides greater assurance in applications where accuracy is critical.

SuperSoft's BASIC is a true native code compiler, not an intermediate code interpreter. It is a superset of standard BASIC, supporting numerous extensions to the language. Important features include:

- Four variable types: Integer, String, and Single and Double Precision Floating Point (13 digit)
- Full PRINT USING for formatted output
- Long variable names
- Error trapping
- Matrices with up to 32 dimensions
- Boolean operators OR, AND, NOT, XOR, EQV, IMP
- Supports random and sequential disk files with a complete set of file manipulation statements
- No run time license fee

Requires: 128K memory
BASIC compiler: \$300.00

For CP/M-86[®], MS DOS, and PC DOS

*SuperSoft BASIC is compatible with Microsoft BASIC interpreter and IBM PC BASIC. Due to version differences and inherent differences in compilers and interpreters some minor variations may be found. Machine dependent commands may not be supported. The vast majority of programs will run with no changes.

FORTRAN

SuperSoft FORTRAN is the answer to the growing need for a high quality FORTRAN compiler running under CP/M-86 and IBM PC DOS. It has major advantages over other FORTRAN compilers for the 8086. For example, consider the benchmark program used to test the IBM FORTRAN in *InfoWorld*, p. 44, Oct. 25, 1982. (While the differential listed will not be the same for all benchmark programs, we feel it is a good indication of the quality of our compiler.) Results are as follows:

IBM FORTRAN: 38.0 Seconds
SuperSoft FORTRAN 2.8 Seconds

In its first release SuperSoft FORTRAN offers the following outstanding features:

1. Full ANSI 66 standard FORTRAN with important extensions
2. Standard data types, double precision, varying string length, complex numbers
3. Free format input and free format string output
4. Compact object code and run time support
5. Special functions include string functions, dynamic allocation, time/date, and video access
6. Debug support: subscript checking, good runtime messages
7. Full IEEE floating point
8. Full 8087 support available as option (\$50.00).
9. Ratfor preprocessor available as option (\$100.00).

Program developers:

SuperSoft's family of FORTRAN compilers means you can write your programs once and they will run under CP/M-80, CP/M-86, and MS DOS. This lets you get your applications running fast no matter what the environment.

SuperSoft FORTRAN: available NOW and working great!

Requires: 128K with CP/M-86 or MS DOS,
32K with CP/M-80
 FORTRAN: \$425.00 (in each environment)
 8087 Support: \$ 50.00
 Ratfor: \$100.00

For CP/M-86®, MS DOS, IBM PC DOS®, and CP/M-80®

In conjunction with SuperSoft, SuperSoft FORTRAN was developed by Small Systems Services, Urbana, IL, a leader in FORTRAN development.

Japanese Distributor:
 ASR Corporation International, TBL Building, 7th Floor,
 1-19-9 Toranomon, Minato-Ku, Tokyo 105, Japan
 Tel 1031-5025550. Telex 222-5650 ASRTYO J

European Distributor:
 SuperSoft International Ltd., 51 The Pantiles,
 Tunbridge Wells, Kent, England TN2 5TE
 Tel 0892-45433 Telex 95441 Micro-G

Microsoft is a trademark of Microsoft Corporation
 IBM PC is a trademark of International Business Machines Corporation

C Compiler

In 1982 SuperSoft helped C programmers around the world move their applications from 8 to 16 bit operating systems with the first C compiler under CP/M-86, PC DOS, and MS DOS.

Today there are several C compilers on the market, and you can look at them all. But if you want a C that's fully portable, syntactically compatible with UNIX version 7 C, rigorously tested, fast in both compilation and execution, packed with more library functions than any other, and produces a very highly optimized assembly code... then you'll find only one. The SuperSoft C compiler.

Professional Quality

SuperSoft started working on C over three years ago, and the work has never stopped. While others were struggling to put in features, SuperSoft was refining and polishing... adding the quality professionals depend on.

Thoroughly Tested

SuperSoft C has been tested with hundreds of commercial application programs. And all this testing has paid off... with a compiler that's highly reliable in every phase of operation.

Portable

SuperSoft C is now available in most operating systems environments. Since we don't sell operating systems, we can support them all. And as new operating systems become popular, SuperSoft C will be there.

Packed with Library Functions

SuperSoft now has the most complete set of library functions available. All provided with source code.

Thorough User Manual

The new user manual is extensive—jammed with thorough explanations to help you every step of the way. And our technical hotline can help answer any additional questions.

For CP/M-80 CP/M-86 MS DOS & PC DOS
 SuperSoft C: \$350.00

SuperSoft®

FIRST IN SOFTWARE TECHNOLOGY

P.O. Box 1628 Champaign, IL 61820

(217) 359-2112 Telex 270365

CP/M and CP/M-86 are registered trademarks of Digital Research
 UNIX is a trademark of Bell Laboratories

GREAT PRICES! GREAT SERVICE!

If you're looking for a great deal on business software, 800-Software is hard to beat. We became one of America's largest software marketers by offering great prices—and a lot more.

Here are some of the reasons to buy from 800-SOFTWARE:

■ **LOW DISCOUNT PRICES.** Generally 40-50% off suggested list price.

■ **FAST DELIVERY.** Our giant inventory makes this possible. (We can provide overnight delivery!)

■ **FREE TECHNICAL SUPPORT.**

Call our helpful and patient experts.

■ **RELIABILITY AND REPUTATION.**

Some of our best customers are America's biggest corporations, including IBM, Hewlett-Packard, G.E. and Honeywell. Also, we fully guarantee every product we sell against defects.

■ **EASY TERMS.** We accept purchase orders from qualified organizations.

CHECK OUT THESE INCREDIBLE SOFTWARE PRICES:

AMDEK™ MONITORS	CALL	MICROSOFT® WORD	
AST 6-PACK PLUS™	CALL	W/MOUSE	\$359
CROSSTALK™	\$105	MULTIMATE™	\$299
dBASE II/III™	CALL	MULTIPLAN™	\$149
EASYWRITER II SYSTEM™	\$195	NORTON UTILITIES™	\$ 59
4-POINT GRAPHICS™	\$129	PFS: FILE/GRAPH/ WRITE/REPORT™	\$ 85
FRAMEWORK™	CALL	QUICKCODE™	CALL
HAYES SMARTMODEMS™	CALL	RBASE 4000™	\$329
HERCULES GRAPHIC CARD™	CALL	SUPERCALC® 2	\$159
INFOSTAR™	CALL	SUPERCALC® 3	\$219
IUS ACCOUNTING MODULES™	\$299	WORDSTAR®	CALL
LOTUS 1-2-3/ SYMPHONY™	CALL	WORDSTAR® PRO. PAK	CALL
MAXELL™ OR MEMOREX™ DISKETTES	CALL	VOLKSWRITER DELUXE™	\$179
		PLUS MUCH, MUCH MORE!	

800-SOFTWARE IS READY TO SERVE YOU.

TO ORDER CALL TOLL-FREE: 800-227-4587 OR 415-644-3611

- Dealer inquiries welcome.
- Quantity discounts available through our National Accounts Program.
- Purchase orders accepted. Please call in advance.
- Call for shipping charges. Overnight delivery available.
- We do not add surcharge for credit card purchases.
- Prices may change. Above prices are for IBM-PC and compatibles.
- International orders welcome: TELEX #751743 800-SOFTWARE UD
- Compuserve Key Word "GO-EH".

CA residents add sales tax.
©Copyright 800-SOFTWARE 1984



800-SOFTWARE

940 Dwight Way, Berkeley, CA 94710

BOOK REVIEWS

In the second chapter, "Our Counter-productive Instincts," the author points out that software engineers are primarily concerned with the logic in a program. Not enough time is devoted to the visual aspects of the program: How does it look to the user? Throughout the book the words create visual images that link thoughts with experience; Heckel believes that this use of familiarity is critical for successful software design.

If computers are to be accepted by the general population, Heckel declares, it is the job of software engineers to make the first experience a positive one. For instance, to design a word processor for a secretary, try to emulate a typewriter. Make the new user feel at ease and not intimidated by the product. With a positive, familiar approach, it is maintained, you can then lead the user on gradually to the more advanced features of the package.

"How to Design Software that People Will Want to Use" is a section that contains many aspects to ponder in friendly software design. For instance, "Most software is run by confused users acting on incorrect and incomplete information, doing things the designer never expected." How true! Judgmental commands, such as "Illegal Command," simply increase a user's defensiveness. Use empathy, not superiority. Give the user control. Involve the user. Orient the user to the world. In a word processor, the designer can not only show users the page they're typing on but can also tell them which document, page, line, and position is in use. Avoid frustrating the user. Don't bore them or go over their heads. Allow for help menus but don't make them automatically invoked. Put yourself in the user's place. To be a competent software engineer, you must know the medium's capabilities well. Be willing to rewrite. Don't expect to get it right at the first effort.

A LOGICAL APPROACH

If you're on a software-development team that isn't doing as well as it might, then Softky's *The ABC's of Developing Software* presents a totally different view of program design. The text describes how to design and implement a major software project.

The example used throughout this

(continued)

THE FORTH SOURCE™

MVP-FORTH

Stable - Transportable - Public Domain - Tools
 You need two primary features in a software development package... a stable operating system and the ability to move programs easily and quickly to a variety of computers. MVP-FORTH gives you both these features and many extras. This public domain product includes an editor, FORTH assembler, tools, utilities and the vocabulary for the best selling book "Starting FORTH". The Programmer's Kit provides a complete FORTH for a number of computers. Other MVP-FORTH products will simplify the development of your applications.

MVP Books - A Series

- Volume 1, All about FORTH** by Haydon. MVP-FORTH glossary with cross references to fig-FORTH, Starting FORTH and FORTH-79 Standard. 2nd Ed. \$25
- Volume 2, MVP-FORTH Assembly Source Code.** Includes CP/M®, IBM-PC®, and APPLE® listing for kernel \$20
- Volume 3, Floating Point Glossary** by Springer \$10
- Volume 4, Expert System** with source code by Park \$25
- Volume 5, File Management System** with interrupt security by Moreton \$25

MVP-FORTH Software - A Transportable FORTH

- MVP-FORTH Programmer's Kit** including disk, documentation, Volumes 1 & 2 of MVP-FORTH Series (All About FORTH, 2nd Ed. & Assembly Source Code), and Starting FORTH. Specify CP/M, CP/M 86, CP/M+, APPLE, IBM PC, MS-DOS, Osborne, Kaypro, H89/Z89, Z100, TI-PC, MicroDecisions, Northstar, Compupro, Cromenco, DEC Rainbow, NEC 8201, TRS-80/100 \$150
- MVP-FORTH Cross Compiler** for CP/M Programmer's Kit. Generates headerless code for ROM or target CPU \$300
- MVP-FORTH Meta Compiler** for CP/M Programmer's kit. Use for applications on CP/M based computer. Includes public domain source \$150
- MVP-FORTH Fast Floating Point** Includes 9511 math chip on board with disks, documentation and enhanced virtual MVP-FORTH for Apple II, II+, and IIE. \$450
- MVP-FORTH Programming Aids** for CP/M, IBM or APPLE Programmer's Kit. Extremely useful tool for decompiling, callfinding, and translating. \$200
- MVP-FORTH PADS (Professional Application Development System)** for IBM PC, XT or PCjr or Apple II, II+ or IIE. An integrated system for customizing your FORTH programs and applications. The editor includes a bi-directional string search and is a word processor specially designed for fast development. PADS has almost triple the compile speed of most FORTH's and provides fast debugging techniques. Minimum size target systems are easy with or without heads. Virtual overlays can be compiled in object code. PADS is a true professional development system. Specify Computer. \$500
- MVP-FORTH Floating Point & Matrix Math** for IBM or Apple \$85
- MVP-FORTH Graphics Extension** for IBM or Apple \$65
- MVP-FORTH MS-DOS file interface** for IBM PC PADS \$80
- MVP-FORTH Expert System** for development of knowledge-based programs for Apple, IBM, or CP/M. \$100

FORTH CROSS COMPILERS Allow extending, modifying and compiling for speed and memory savings, can also produce ROMable code. Specify CP/M, 8086, 68000, IBM, Z80, or Apple II, II+ \$300

FORTH COMPUTER

- Jupiter Ace** \$150

Ordering Information: Check, Money Order (payable to MOUNTAIN VIEW PRESS, INC.), VISA, MasterCard, American Express. COD's \$5 extra. Minimum order \$15. No billing or unpaid PO's. California residents add sales tax. Shipping costs in US included in price. Foreign orders, pay in US funds on US bank, include for handling and shipping by Air: \$5 for each item under \$25, \$10 for each item between \$25 and \$99 and \$20 for each item over \$100. All prices and products subject to change or withdrawal without notice. Single system and/or single user license agreement required on some products.

FORTH DISKS

FORTH with editor, assembler, and manual.

- APPLE** by MM, 83 \$100
- APPLE** by Kuntze \$90
- ATARI®** valFORTH \$60
- CP/M®** by MM, 83 \$100
- HP-85** by Lange \$90
- HP-75** by Cassidy \$150
- IBM-PC®** by LM, 83 \$100
- NOVA** by CCI 8" DS/DD \$175
- Z80** by LM, 83 \$100
- 8086/88** by LM, 83 \$100
- 68000** by LM, 83 \$250
- VIC FORTH** by HES, VIC20 cartridge \$50
- C64** by HES Commodore 64 cartridge \$60
- Timex** by HW \$25

Enhanced FORTH with: F-Floating Point, G-Graphics, T-Tutorial, S-Stand Alone, M-Math Chip Support, MT-Multi-Tasking, X-Other Extras, 79-FORTH-79, 83-FORTH-83

- APPLE** by MM, F, G, & 83 \$180
- ATARI** by PNS, F, G, & X \$90
- CP/M** by MM, F & 83 \$140
- Apple, GraFORTH** by I \$75
- Multi-Tasking FORTH** by SL, CP/M, X & 79 \$395
- TRS-80/II or III** by MMS F, X, & 79 \$130
- Timex** by FD, tape G, X, & 79 \$45
- Victor 9000** by DE, G, X \$150
- C64** by ParSec. MVP, F, 79, G & X \$96
- FDOS** for Atari FORTH's \$40
- Extensions for LM** Specify IBM, Z80, or 8086
 - Software Floating Point \$100
 - 8087 Support (IBM-PC or 8086) \$100
 - 9511 Support (Z80 or 8086) \$100
 - Color Graphics (IBM-PC) \$100
 - Data Base Management \$200
- fig-FORTH Programming Aids** for decompiling, callfinding, and translating. CP/M, IBM-PC, Z80, or Apple \$200

FORTH MANUALS, GUIDES & DOCUMENTS

- ALL ABOUT FORTH** by Haydon. See above. \$25
- FORTH Encyclopedia** by Derick & Baker \$25
- The Complete FORTH** by Winfield \$16
- Understanding FORTH** by Reymann \$3
- FORTH Fundamentals, Vol. 1** by McCabe \$16
- FORTH Fundamentals, Vol. II** by McCabe \$13
- FORTH Tools, Vol.1** by Anderson & Tracy \$20
- Beginning FORTH** by Chirlian \$17
- FORTH Encyclopedia Pocket Guide** \$7
- And So FORTH** by Huang. A college level text. \$25
- FORTH Programming** by Scanlon \$17
- FORTH on the ATARI** by E. Floegel \$8
- Starting FORTH** by Brodie. Best instructional manual available. (soft cover) \$18
- Starting FORTH** (hard cover) \$23
- 68000 fig-Forth** with assembler \$20
- Jupiter ACE Manual** by Vickers \$15
- Installation Manual for fig-FORTH,** \$15
- 1980 FORML Proc.** \$25
- 1981 FORML Proc 2 Vol** \$40
- 1982 FORML Proc.** \$25
- 1981 Rochester FORTH Proc.** \$25
- 1982 Rochester FORTH Proc.** \$25
- 1983 Rochester FORTH Proc.** \$25
- A Bibliography of FORTH References, 1st. Ed.** \$15
- The Journal of FORTH Application & Research**
 - Vol. 1, No. 1 \$20
 - Vol. 1, No. 2 \$20
- A FORTH Primer** \$25
- Threaded Interpretive Languages** \$23
- Systems Guide to fig-FORTH** \$25
- Invitation to FORTH** \$20
- PDP-11 User Man.** \$20
- FORTH-83 Standard** \$15
- FORTH-79 Standard** \$15
- FORTH-79 Standard Conversion** \$10
- Tiny Pascal fig-FORTH** \$10
- NOVA fig-FORTH** by CCI Source Listing \$25
- NOVA** by CCI User's Manual \$25

Source Listings of fig-FORTH, for specific CPU's and computers. The Installation Manual is required for implementation. Each \$15

- 1802 6502 6800 AlphaMicro
- 8080 8086/88 9900 APPLE II
- PACE 6809 NOVA PDP-11/LSI-11
- 68000 Eclipse VAX Z80 IBM

MOUNTAIN VIEW PRESS, INC.

PO BOX 4656

MOUNTAIN VIEW, CA 94040

(415) 961-4103

PROTECT YOUR ...

APPLE



The APPLE-CENTER model 12 protects your Apple from theft and unauthorized use. All metal construction, the APPLE-CENTER is available with or without fan and surge protection. Works with Apple's DUODISK.

IBM



The EMBLEM, for the IBM PC, protects both the keyboard and the computer. Foam lined keyboard tray flips up for complete security. Also available with surge protection.

PRINTERS & MORE



The SECURITY CORNERS will protect most printers, hard disks, stereos, test equipment, and other computers.

Available from your dealer or order direct.

DOSS INDUSTRIES

1224 Mariposa, San Francisco, CA 94107
415-861-2223

BOOK REVIEWS

The two authors occasionally agree.

book concerns the development of a software package that will simulate power-regeneration capabilities of energy sources placed strategically throughout California. The energy input is to come from solar cells, turbines, windmills, waste-burning systems, and tidal-wave energy generation occurring over varying seasonal conditions for a period lasting two years.

Due to the immensity of the project, the author calls for tremendous initial development to ensure that the project is successful, affordable, and delivered on time.

The process begins with a solid proposal, explaining in full detail what the project is all about, even suggesting people who should be hired. Because the software will be used and repaired by the people on hand, it is important to keep them in mind when the design is started. Here's where Softky states, agreeing with Heckel's point of user friendliness, "the simulation will be operable by staff who are not professionally trained programmers or software engineers."

Several interesting and upsetting statistics are woven throughout. One is that during the development life of any software project, the developer can expect a 30 percent turnover in staff. Softky stresses that a good initial problem design includes time to bring new engineers on board and train them to the point where they can be productive. If this happens late in the development phase, this training period can take six months.

The author points out that software developers must use the same system the customer owns. This could require some retraining of the developers. Also, because the software engineers cost so much, it makes sense to have terminals and printers for them all. Softky illustrates how to organize and structure the entire project and includes an excellent problem description using Program Definition Language (PDL).

Unlike Heckel, Softky sees the program controlled by data, control, input, output, and control logic, or sequential files. Excellent discussions center on

data-management systems (DMS). Some programs are designed to free the software engineer from worrying about any links between the program and the system's peripheral devices.

The ABC's of Developing Software contains informative guidance for the software-development phase. This includes the realization that as time slips, so does the quality of the entire project because important steps, such as keeping the documentation up to date, are bypassed. Quality monitoring is an on-going process.

Softky states, "User's needs are so pervasive that they ought to affect the list of requirements. It is important to always remember that most software isn't operated by people who built it, and as a result, some of it must exist to 'hold the user's hand.' It also happens that the design effort can turn up hard spots, those places where the user could easily make a wrong decision. Conscientious designers then include virtual requirements, which lead to improvements in design solely for the user's benefit." Here again, we find direct agreement between the two authors.

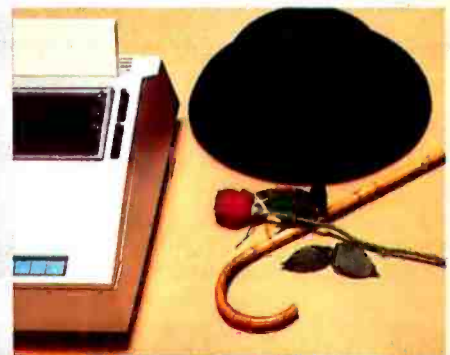
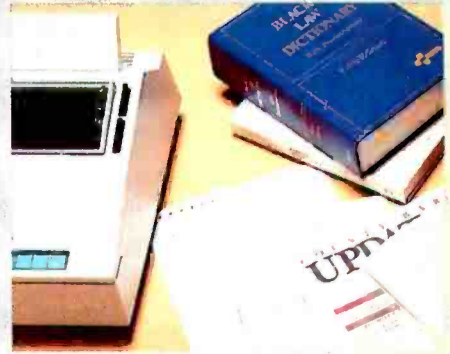
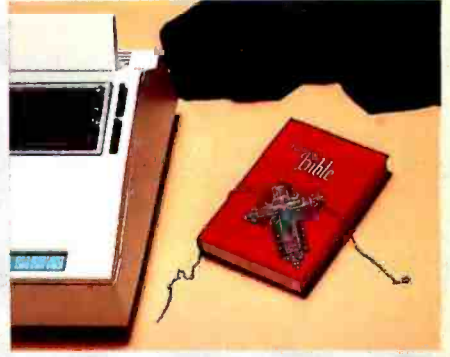
Softky stresses closely organized structured design, ranging from the high-level, broad design down to the detailed subprograms. He mentions the needs for good design-test plans and the usefulness of well-written software-maintenance and user's manuals.

The last step Softky mentions is integrating and testing the software. This is where the efforts of many subgroups come together under the master control program. Debugging occurs during the walk-through where the engineers, senior programmers, and the systems analysts have all done their parts; what hopefully emerges is a useful, well-documented, efficient, reliable, and on-time software package.

What I gained from Heckel's book will affect the way I program from now on. What I gained from Softky's text is an appreciation and respect for upper management. After you've read both books, you'll have a handy combination. You'll have the knowledge to correctly define, structure, code, and implement a software design, combined with the craftiness of a car salesman and the empathy of a psychiatrist.

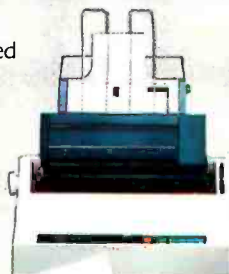
(continued)

WE ALL AGREE



We can't think of anyone who isn't better off with A DX-15 DAISY WHEEL PRINTER.

Auto Cut Sheet Feed (option)



Tractor Feed (option)



Keyboard (option)

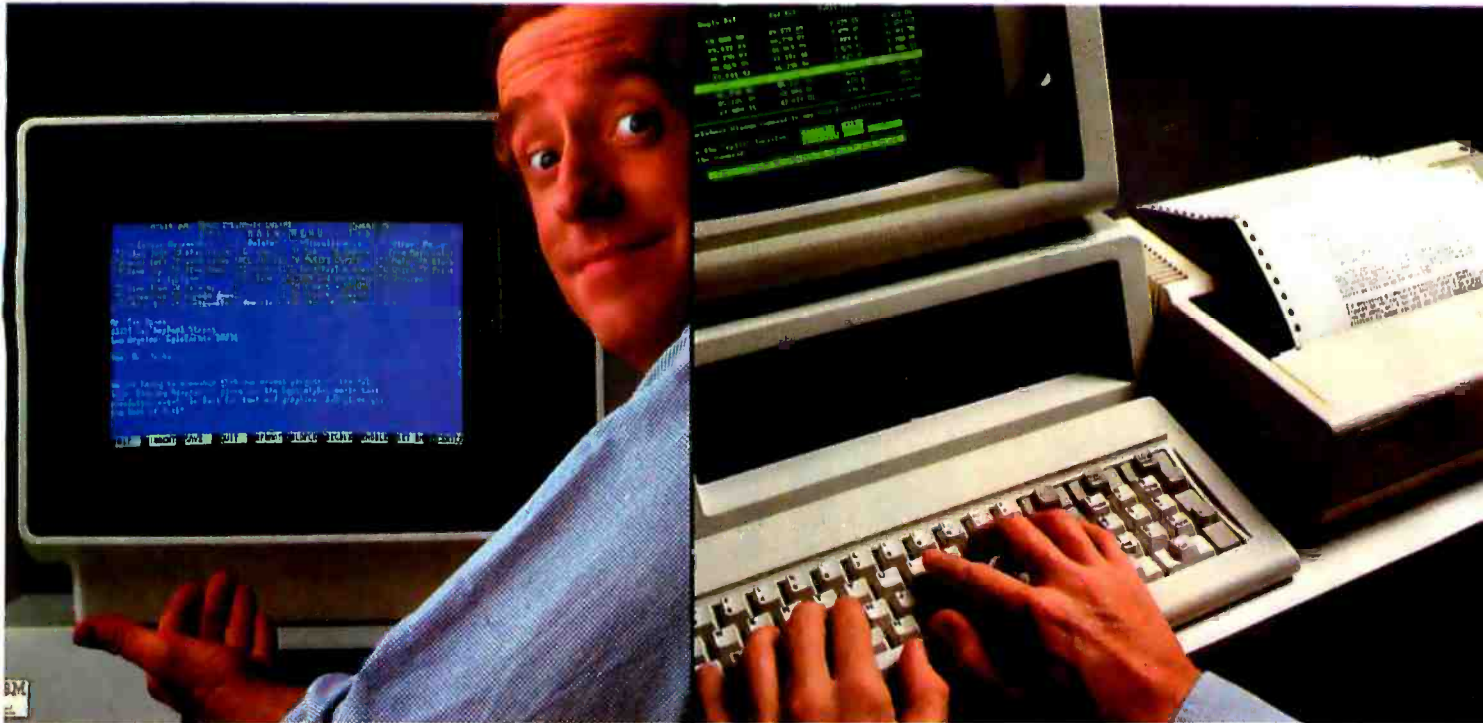


Dynax's DX-15. And if you want the kind of printer that lives in the fast lane, the DX-15 is your printer. It does it all, certainly all that far more expensive models can do. The DX-15 offers you some important options like Keyboard, Tractor Feed and Auto Cut Sheet Feed. Not only that, the DX-15 is a very durable unit, be it for business, home or word processing applications. And who says a great printer has to be expensive? Not us! What we say is you'll be dumbfounded when your dealer tells you just how inexpensive the DX-15 happens to be. Give him a call or drop by. Dynax's DX-15 says it ALL. Circle 115 on inquiry card.

DynaxTM, Inc.

6070 Rickenbacker Road,
City of Commerce, CA 90040,
213-727-1227

Only one company can show you so many And it isn't IBM.



Monochrome text. Color graphics. Even a new super display adapter that provides the Best of Both, on one board.

Connect your PC to peripherals like a modem or printer, with the added efficiency of print spooling.

IBM today sets the standard in personal computers.

But what happens when you want to expand your PC's capability to something beyond standard?

That's when you have to look beyond IBM. To the one company that offers the widest range of products to make your PC work more powerfully, more efficiently.

Persyst.

Display adapters. Persyst introduces a significant technical advance.

Now Persyst redefines the basic utility of display adapters for IBM personal computers.

Our BoB™ super display adapter provides the sharpest text resolution ever as well as brilliant color graph-

ics—the Best of Both—on one board. Plus a unique option that lets you design and download custom programmable character sets.

Meanwhile, for great basic performance, we also offer PC/Monochrome™ and PC/Color Graphics™ display adapters engineered to deliver the same quality as IBM's own standard adapters.

Only Persyst offers you so much choice.

Memory and multifunction boards. Persyst has the most flexible ways to expand your PC.

Here again, Persyst offers a unique array of products to expand your PC beyond the IBM standard.

Want the most capable one-slot multifunction packages available?

Choose either Time Spectrum™ with up to 512K, or Time Spectrum™ SB384 with up to 384K RAM. Other functions include a bidirectional parallel port and async serial ports to link your PC with printers, modems and instrumentation. Calendar clock. Game port. Plus, Wait-Less Printing™ print spooling and Insta-Drive™ RAM disk software.

Want to expand function without adding memory?

Our Timeport™ gives you a calendar clock, bidirectional parallel port and two async serial ports, as well as capability for ROM and static

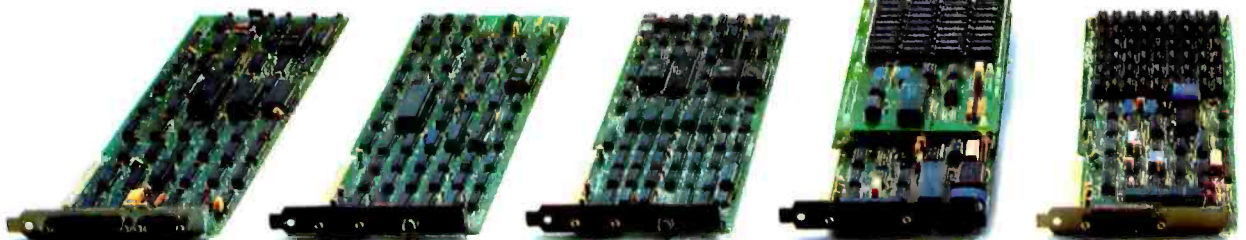
PC/MONOCROME DISPLAY ADAPTER

PC/ COLOR GRAPHICS DISPLAY ADAPTER

BoB SUPER DISPLAY ADAPTER

TIME SPECTRUM WITH RAMPAK™

TIME SPECTRUM SB384



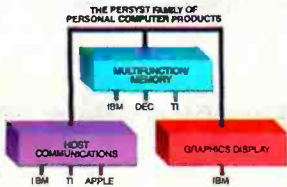
ways to expand the power of your IBM PC.



17664	3-88-83	12:80p
568	2-82-84	7:22p
133	1-81-88	12:88a
4	2-16-84	1:34p
273	2-16-84	3:49a
631	2-16-84	3:56a
288	2-22-84	11:24a
172	2-24-84	5:46p
615	2-24-84	5:58p
563	3-81-84	2:25p
1018	3-82-84	9:86a
311296 bytes free		

Memory expansion to let your PC utilize the most sophisticated software.

Productivity features like a calendar clock to date and time stamp your files automatically.



RAM. Uniport™ offers a calendar clock and bidirectional parallel port. And our Async Card™ provides two async serial ports.

You can even add synchronous communications to your PC with our Multiple Protocol Communications™ (MPC) controller.

Quality and documentation. Persyst support is built into every product.

All Persyst expansion products include one important extra benefit—Persyst quality.

Each board is fully burned in. Completely system tested. And backed by a limited one-year warranty.*

What's more, award-winning Persyst documentation makes using any Persyst product simple.

Expand all the way from an IBM desktop PC to an IBM intelligent workstation. You can only do it with Persyst.

Persyst is the only resource that offers display adapters. Multi-

function and memory boards. And micro to mainframe communications.

The most complete selection of innovative, technically advanced expansion products to meet your needs today. And tomorrow.

Persyst dealers are ready to serve you. For the one nearest you, call (714) 660-1010.

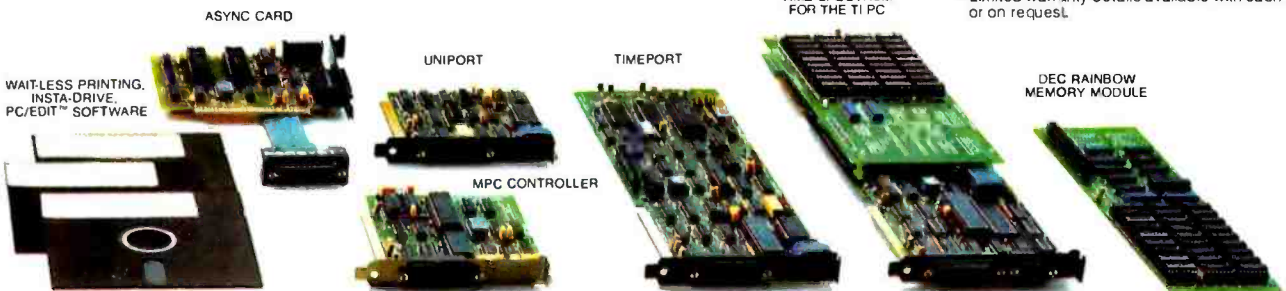
Persyst Products, Personal Systems Technology, 17862 Fitch, Irvine, CA 92714. Telephone: (714) 660-1010. Telex: 467864.



"You can only do it with Persyst."

IBM is a registered trademark of International Business Machines Corporation. Rainbow and DEC are registered trademarks of Digital Equipment Corporation. TI is a registered trademark of Texas Instruments Corporation.

*Limited warranty details available with each product or on request.



Circle 351 for Dealer inquiries. Circle 352 for End-User inquiries.

Multi-function RS-232 Transfer Switches

MFJ-1240
\$79.95
Choice of
8 models



Multi-function RS-232 transfer switches let you switch your computer among printers, modems, terminals, any RS-232 peripherals; monitor data/line failure, protect data lines from surges, and use as null modem for less cost than a switch alone.

Switches 10 lines (2, 3, 4, 5, 6, 8, 11, 15, 17, 20). LED data/line indicators monitor lines 2, 3, 4, 5, 6, 8, 20. Metal oxide varistors protect data lines 2, 3 from voltage spikes and surges. Push button reverses transmit-receive lines (2, 3). PC board eliminates wiring, crosstalk, line interference. Connects any one input to any one output.

Model	Price	In	Out	Model	Price	In	Out
MFJ-1240	\$79.95	1	2	MFJ-1244	\$139.95	3	3
MFJ-1241	\$99.95	2	2	MFJ-1245	\$169.95	3	5
MFJ-1242	\$119.95	2	3	MFJ-1246	\$199.95	5	5
MFJ-1243	\$119.95	1	4	MFJ-1247	\$99.95	1	2

switches 20 lines

AC Power Centers

MFJ-1108
\$99.95

MFJ-1108, \$99.95. Add convenience, prevent data loss, head bounce, equipment damage. Relay latches power off during power transients. Multi-filters isolate equipment, eliminate interaction, noise, hash. MOVs suppress spikes, surges. 3 isolated, switched socketpairs. One unswitched for clock, etc. Lighted power, reset switch. Pop-out fuse. 3 wire, 6 ft. cord. 15A, 125V, 1875 watts. Aluminum case. Black. 18x2 1/4x2 in. MFJ-1107, \$79.95. Like 1108 less relay. 8 sockets, 2 unswitched. MFJ-1109, \$129.95. Like 1107 but intelligent. Switch on device plugged into control socket and everything else turns on. Others available.



Acoustic/Direct Coupled Modem



Use with any
phone anywhere **\$129.95**
MFJ-1233

MFJ-1233 Acoustic/Direct Coupled 300 baud modem. Versatile. Use with virtually any phone, anywhere. Use battery or 110 VAC. Direct connect mode: Plug between handset and base. Use with single or multi-line phones. Acoustic coupled mode: Use with phones without modular plugs. Quality muffs give good acoustic coupling, isolates external noise for reliable data transfer. Originate/answer. Self test. Carrier detect, ON LEDs. RS-232, TTL compatible. Reliable single chip modem. Crystal controlled. Aluminum cabinet. 9x1 1/2x4 in. Other models available.

Order from MFJ and try it. If not delighted, return within 30 days for refund (less shipping).

One year unconditional guarantee.

Order yours today. Call toll free 800-647-1800. Charge VISA, MC. Or mail check, money order. Add \$4.00 each for shipping and handling.

CALL TOLL FREE ... 800-647-1800

Call 601-323-5869 in MS, outside continental USA.

**MFJ ENTERPRISES
INCORPORATED**

921 Louisville Road, Starkville, MS 39759

BOOK REVIEWS

THE PROGRAMMER'S CP/M HANDBOOK

Reviewed by Wayne W. Shearer Jr.

If you write assembly-language programs for CP/M systems, this book is for you. I could end this review right here and not receive any complaints from anyone who reads *The Programmer's CP/M Handbook*. The author, Andy Johnson-Laird, has provided the long-awaited definitive book on CP/M programming. Explanations of each function are explicit, filled with examples, and are the most complete I've seen about CP/M in print.

TO THE POINT

The first sentence of chapter 1 explains the author's direction and purpose: "This book is a sequel to the *Osborne CP/M User Guide* by Thom Hogan" (Osborne/McGraw-Hill, 1982). The first chapter outlines the contents of the book, the notation used in its examples, the mnemonics and languages in the program listings, and the type of reader for whom the book is written. And make no mistake, this is not a beginner's book. In chapter 4, a couple of paragraphs are devoted to each built-in command in the console command processor (CCP), and that's it. The book is for serious programmers who write applications, utilities, and systems for CP/M.

AMPLE COMMENT

Without a doubt, *The Programmer's CP/M Handbook* provides the best explanation of the CP/M file structure and disk interfacing that I have found. A full chapter explains the file structure in CP/M. The file control block (FCB) is described byte by byte—in English, not computerese. And I believe that I now actually understand the disk-definition tables and disk-parameter blocks used in the CP/M basic input/output system (BIOS). I won't say the book is easy reading, but the explanations are about as clear as you can muster in assembly-language programming, and all explanations are accompanied by heavily commented program listings.

One chapter is devoted to the basic disk operating system (BDOS) and another to the BIOS. Each call to the BDOS is discussed, including a short section on each, titled "Notes," that warns of common mistakes, misunder-

standings, and pitfalls that await the CP/M programmer. The same is done for the BIOS calls. Character input/output (I/O) is given the full treatment, untangling the difference between logical and physical devices and providing in-depth explanations of such mundane subjects as serial and parallel interfacing. The chapter ends with a sample BIOS listing. No, this isn't the same stripped-down BIOS that's been appearing in the back of the *CP/M Alteration Guide* for years; it's a well-documented, full-blown BIOS that the author has developed and tested himself. This could be the first assembly-language program that I've seen with more lines of comment than code.

But Johnson-Laird isn't satisfied with expanding the CP/M manuals. He describes enhancements that can be added to the BIOS to correct deficiencies in CP/M and to expand the features and facilities available. Programmers can learn to customize a CP/M BIOS configuration and implement an enhanced BIOS. These enhancements fall into two groups—expanded I/O facilities and improved error handling. Each group is given its own chapter. Adding I/O redirection, interrupt-driven input, serial protocols, terminal function keys, date and time, and device-configuration blocks are covered in one chapter. This may sound like a lot, but the chapter ends with a listing of an enhanced BIOS with over 4500 lines of source code. By an admittedly rough estimate, I figure the comment lines outnumber the source code lines by about 3 to 1. If you can't understand this listing, you weren't paying attention. All programmers should be so kind.

DEBUGGING

The next chapter describes CP/M's error handling. Obviously, this didn't take long. The author describes methods of detecting and correcting hardware errors. The goal is to build a CP/M that reduces the possibility of losing data. The result of this effort is a CP/M where the message "BDOS ERROR" seldom appears.

The chapter titled "Debugging a New CP/M System" should be lifted in its entirety and included in Digital Research's documentation for CP/M—with appropriate compensation to its author, of

(continued)

Powerful CP/M® Software.

For Apple, Osborne, Kaypro, Rainbow, NEC, Epson, Heath, Xerox and others.

Back to School Special!

Now only **\$29⁹⁵** each!

EXTRA MANUALS NOW AVAILABLE, ONLY \$14.95 EACH!

NEVADA COBOL™

When we introduced Nevada COBOL in 1979, it was loaded with innovations. Today's, Edition 2.1 is even better!

- Extremely Compact. You can compile and execute up to 2500 statements in 32K RAM, 4000 statements in 48K, etc.
- It's based upon the ANSI-74 standards with level 2 features such as compound conditionals and full CALL CANCEL.
- You get a diskette, 165-page manual with lots of examples and 16 complete COBOL source code programs.

Also available: COBOL Application Packages, Book 1 \$9.95

NEVADA PASCAL™

This newest addition to the 8-bit Nevada product line has many advanced features:

- 14-digit precision, BCD Math, no round-off errors with decimal arithmetic for business and floating point + 63 - 64 for scientific.
- A very nice TRACE style debugging.
- Arrays up to 8 dimensions and 64K strings.
- External procedures and functions with dynamic auto-loading.
- One-step compile, no assembly or link required.
- No limits on size of procedure, nesting levels, recursion.
- Requires 60K RAM and one disk drive with at least 90K storage.
- You get a 184-page manual and diskette rev. 4.1.

NEVADA FORTRAN™

FORTRAN IV based upon ANSI-66 standards with some 1977 level features.

- IF . . THEN . . ELSE constructs.
- A very nice TRACE style debugging.
- 150 English language error messages.
- You get a diskette, including an 8080 assembler and Nevada FORTRAN rev 3.2, 214-page manual and five sample programs. Requires 48K RAM.

NEVADA BASIC™

This interpreter has a built-in full-screen editor.

- Single- and Multi-line functions.
- BCD Math—no round-off errors.
- Full Matrix operations.
- Requires 48K RAM.
- You get 220-page manual and diskette rev. 2.5.

NEVADA EDIT™

A full-screen video display text editor rev. 3.1 designed specifically to create COBOL, PASCAL and FORTRAN programs.

- See the review in May 1983 Microcomputing.

NEVADA PILOT™

See review in January 1983 MICROCOMPUTING.

- You get a diskette rev. 6.1, 131-page manual and ten useful sample programs.



This is a limited time offer, so order yours today!

ELLIS COMPUTING, INC

3917 Noriega Street
San Francisco, CA 94122

Phone (415) 753-0186

The CP/M Operating System, an 8080, 8085 or Z-80 microprocessor, and 32K RAM are required, unless stated otherwise above.

Diskette format:

8" SSSD (Standard CP/M IBM 3740)

5 1/4" Diskette for:

- Apple CP/M
- DEC VT 180
- DEC Rainbow
- Epson QX-10
- Heath Hard Sector (Z-89)
- Heath Soft Sector (Z-90, Z-100)
- IBM-PC (Requires Z-80, CP/M-80 card)
- Kaypro Double Density (NCR)
- Micropolis Mod II
- NEC PC 8001

- North Star Double Density
- North Star Single Density
- Osborne Single Density
- Sanyo 1000, 1050
- Superbrain DD DOS 3.X (512 byte sec)
- Televideo
- TRS-80 Model I Base 0 mapper
- Xerox 820 Single Density

Satisfaction is guaranteed—or your money back. If for any reason you're not completely satisfied, just return the package—in good condition—within 15 days and we'll refund your money.

Please send me: Software Packages

COBOL FORTRAN EDIT PASCAL BASIC PILOT

Send my order for _____ packages @ \$29.95 each Total _____

COBOL Applications Package @ \$9.95 each Total _____

Please send extra manuals:

COBOL FORTRAN EDIT PASCAL BASIC PILOT

_____ EXTRA manuals @ \$14.95 each Total _____

California deliveries add 6% or 6.5% sales tax

Shipping and Handling Fees: Add \$4.00 for the first package or manual and \$2.00 each additional. **Overseas:** Add \$15.00 for first package or manual and \$5.00 each additional.

Checks must be in U.S. Dollars and drawn on a U.S. Bank.

Check enclosed COD if COD add \$4.00

MasterCard

VISA

TOTAL _____

Card # _____ Exp. _____

Signature _____

Ship to: Name _____

Street _____

City/ST/Zip _____

CP/M is a registered trademark of Digital Research, Inc. Microsoft is a registered trademark of Microsoft Corp. TRS-80 is a registered trademark of Tandy Corp. Apple II is a trademark of Apple Computer, Inc. Osborne is a registered trademark of Osborne Computer Corp. Xerox 820 is a trademark of Xerox Corp. Kaypro is a trademark of Non-linear Sys. Health/Zenith is a trademark of Health Corp. IBM is a registered trademark of International Business Machines Corp. Nevada BASIC, Nevada COBOL, Nevada FORTRAN, Nevada PILOT, Nevada EDIT, Nevada PASCAL, and Ellis Computing are trademarks of Ellis Computing, Inc. © 1984 Ellis Computing, Inc.

OFFER EXPIRES 9-30-84



SAVE MORE THAN EVER ON...

3M Scotch® DISKETTES

AND OTHER COMPUTER NEEDS!

**LIFETIME WARRANTY!**

3M BULK DISKETTES AT TREMENDOUS SAVINGS!

These are genuine 3M diskettes with a lifetime warranty. But they are bulk packed in cartons of 50 with separate white Tyvec envelopes. No identification labels, write protect tabs or cartons are provided! A great buy for volume users.

\$155 ea.	← 5 1/4" SSDD	\$197 ea.	
			→ 5 1/4" DSDD
	Qty. 50		Qty. 50

5 1/4" SSDD-96TPI	\$2.15	5 1/4" DSDD-96TPI	\$2.70
-------------------	-------	--------	-------------------	-------	--------

All have reinforced hub.
SOFT SECTOR ONLY!
(for IBM, APPLE, KAYPRO, DEC and about 99% of all computers.)
Must be ordered in multiples of 50!

BOXED 3M DISKETTES WITH ALL THE TRIMMINGS!

Factory-fresh 3M packaging with envelopes, 3M logo labels, ID labels and write-protect tabs.

\$169 ea.	← 5 1/4" SSDD	\$223 ea.	
			→ 5 1/4" DSDD
	Qty. 20		Qty. 20

5 1/4" SSDD-96TPI	.....	\$2.60	8" SSDD	.....	\$2.05
5 1/4" DSDD-96TPI	.....	\$3.25	8" DSDD	.....	\$2.50
			8" DSDD	.....	\$3.10

Minimum order of 20 diskettes. Additional diskettes in multiples of 10.

3M HEADCLEANING KITS

Stop swearing and start cleaning. This non-abrasive cleaning kit has everything you need for thirty applications.

\$23.00 • \$1.50 Shpng.

SAVE MONEY WITH A CLEAN COMPUTER! INTRODUCING MINI-VAC



Most computer malfunctions are caused by dust. MINI-VAC is ideal for cleaning keyboards, screens, drives and printers. (Great for photo equipment, too!) Equipped with an easy-empty bag, two directional wands and two fine-brush nozzles. Don't compute without it. (Requires 9-volt battery which is not included.)

\$21.95 • \$3.00 Shpng.

AT LAST: A DISK DRIVE DIAGNOSTICS SYSTEM THAT WORKS!

The Dymek Recording Interchange Diagnostic (RID) is a professional, but easy to use, drive diagnostic disk. It tests drive speed, radial position, hysteresis, write function, erase crosstalk, signal-to-noise and clamping. In short, it's a professional's system that will help you keep your machine in prime condition...and avoid the evils of data loss.



\$29.95 • \$1.50 Shpng.

MEDIA-MATE 50: A REVOLUTION IN DISKETTE STORAGE

Every once in a while, someone takes the simple...and makes it elegant. This unit holds 50 5 1/4" diskettes, has grooves for easy stacking, nipples to keep diskettes from slipping in the case and several other features. We like it.

\$10.95 • \$2.00 Shpng.



DISKETTE 70 STORAGE: STILL A GREAT BUY

Dust-free storage for 70 5 1/4" diskettes. Six dividers included. An excellent value.

\$14.95 • \$3.00 Shpng.

PRINTER RIBBONS AT BARGAIN PRICES.

EPSON MX-70/80	.....	\$3.58	25 Shpng.
EPSON MX-100	.....	\$6.99	25 Shpng.
Okidata Micro 84	.....	\$3.66	25 Shpng.
Diablo 630 Mylar	.....	\$2.60	25 Shpng.
Diablo 630 Nylon	.....	\$2.93	25 Shpng.
Okidata Micro 83	.....	\$1.48	25 Shpng.



DISK CADDIES

...the original flip-up disk holder for 10 diskettes.

5 1/4" **\$165** ea. Beige or grey only.
+ .20 Shpng.

Shipping: 5 1/4" DISKETTES—Add \$3.00 per 100 or fewer diskettes. 8" DISKETTES—Add \$4.00 per 100 or fewer diskettes. OTHER ITEMS Add shipping charges as shown in addition to diskette shipping charges. Payment: VISA and Mastercard accepted. COD orders only, add \$3.00 handling charges. Taxes: Illinois residents, please add 8% sales tax.

WE WILL BEAT ANY NATIONALLY ADVERTISED PRICE ON THE SAME PRODUCTS AND QUANTITIES!

Nationwide: 1-800-621-6827
Illinois: 1-312-944-2788

Hours: 9AM - 5PM Central Time

Minimum Order: \$35.00

course. This section covers troubleshooting the CP/M BIOS from basic debugging techniques (called "the Orville Wright approach") to the use of extensive built-in debugging code (listings included, naturally). Page after page is filled with checklists of potential problems and possible remedies. Detailed techniques for testing I/O, disk, and interrupt routines are provided, as those areas are especially hard to debug because they are very hardware dependent. The use of pass counters, error trapping, and a discussion of bringing up the bootstrap loader are all covered.

The final chapter provides expanded utilities for the system. A major change is made here: the author switches from assembly language to BDS C. While I have not yet used C, the program listings and examples are clear enough to follow the logic of the utilities and debugging aids described. In fact, these utilities looked so good that I am now in the market for a C compiler. I just can't resist changing data rates, hiding files from the directory, reassigning I/O devices at will, and changing serial protocols as needed. With the understanding of CP/M that I gained after reading this book, I can already think of a few new utilities that I just might develop.

This book has been needed by the CP/M community for some time now. The fact that it was written by someone as talented and knowledgeable as Johnson-Laird is a pleasant surprise. I recommend this handbook to anyone who desires an intimate and serious understanding of CP/M. I assure you that it will become a valuable but tattered addition to your technical literature, as you open it repeatedly to glean yet another fact from its pages. ■

.....
David D. Clark (246 South Fraser St. #2, State College, PA 16801) is a postdoctoral research scholar in the chemistry department of Pennsylvania State University.

Chris H. Pappas is a professor of computer science at Broome Community College, Binghamton, New York, and is currently writing a book on APL.

Wayne W. Shearer Jr. (1143 South University Blvd., Denver, CO 80210) is general manager of Shearer Associates, a consulting firm based in Denver.

DISK WORLD!, Inc.
SUITE 4808
30 EAST HURON STREET
CHICAGO, ILLINOIS 60611

Authorized Distributor
Information Processing Products



NEW 128K COMMODORE - 80 COLUMN

COMPUTER SYSTEM SALE!

HOME • BUSINESS • WORD PROCESSING

\$1195⁰⁰

(If ordered before 9/1/84 only \$1095)

List Price \$4008.95

LOOK AT ALL YOU GET FOR ONLY \$1195

- | | LIST PRICE |
|--|---------------|
| • B128 COMMODORE 128K 80 COLUMN COMPUTER | 995.00 |
| • 8050 DUAL DISK DRIVE (over 1 million bytes) | 1795.00 |
| * 4023 · 100 CPS · 80 COLUMN BIDIRECTIONAL PRINTER | 499.00 |
| • 12" HI RESOLUTION 80 COLUMN GREEN OR AMBER MONITOR | 249.00 |
| • SUPER SCRIPT 80 COLUMN PROFESSIONAL WORDPROCESSOR | 149.50 |
| • SUPER BASE PROFESSIONAL DATA BASE | 149.50 |
| • BOX OF 10 LORAN LIFETIME GUARANTEED DISKS | 49.95 |
| • 1100 SHEETS FANFOLD PAPER | 19.95 |
| • ALL CABLES NEEDED FOR INTERFACING | <u>102.05</u> |

TOTAL LIST PRICE	4008.95	SALE PRICE
		\$1195.00

Printer replacement options (replace the 4023 with the following at these sale prices)

	LIST	SALE
* Olympia Executive Letter Quality Serial Printer/Typewriter	849.00	499.00
* Comstar Hi-Speed 160 CPS 15½" Serial-Business Printer	779.00	449.00

Plus You Can Order These Business Programs At Sale Prices

	LIST	SALE		LIST	SALE
ACCOUNTS RECEIVABLE	149.95	99.00	INVENTORY	149.95	99.00
ACCOUNTS PAYABLE	149.95	99.00	GENERAL LEDGER	149.95	99.00
PAYROLL	149.95	99.00			

15 DAY FREE TRIAL We give you 15 days to try out this SUPER SYSTEM PACKAGE!! If it doesn't meet your expectations, just send it back to use prepaid and we will refund your purchase price!!

90 DAY IMMEDIATE REPLACEMENT WARRANTY If any of the SUPER SYSTEM PACKAGE equipment or programs fail due to faulty workmanship or material we will replace it IMMEDIATELY at no charge!!

Add \$50.00 for shipping and handling!!
 \$100.00 for Canada, Puerto Rico, Hawaii orders.
 WE DO NOT EXPORT TO OTHER COUNTRIES.
 Enclose Cashiers Check, Money Order or Personal Check.
 Allow 14 days for delivery. 2 to 7 days for phone orders. 1 day
 express mail! Canada orders must be in U.S. dollars. We
 accept Visa and MasterCard. We ship C.O.D. to U.S. addresses
 only.

PROTECTO
ENTERPRIZES (WE LOVE OUR CUSTOMERS)
 BOX 550, BARRINGTON, ILLINOIS 60010
 Phone 312/382-5244 to order

E·V·E·N·T Q·U·E·U·E

August 1984

● C. UNIX COURSES

Courses in C Language and UNIX. Concord, MA. Somers Point, NJ, and College Park, MD. Three five-day courses are offered: "C Programming Workshop," "Advanced C Topics Seminar," and "UNIX Workshop." Contact Joan Hall, Plum Hall Inc., 1 Spruce Ave., Cardiff, NJ 08232. (609) 927-3770. August

● DATABASE SEMINARS

SoftwareBanc Seminars, various sites in the U.S. and Canada. Such seminars as "Problem Solving with 1-2-3," "dBASE II," and "Exploring UNIX" are planned. Contact SoftwareBanc Inc., 661 Massachusetts Ave., Arlington, MA 02174. (800) 451-2502; in Massachusetts, (617) 641-1241. August

● DBM SEMINARS

Digital Consulting Associates Classes and Seminars, various sites in the U.S. Seminars and classes on information centers, database administration, and other microcomputer topics. Contact Digital Consulting Associates Inc., 339 Salem St., Wakefield, MA 01880. (617) 246-4850. August

● ENGINEERING SUMMER

CONFERENCES. Chrysler Center, North Campus, University of Michigan, Ann Arbor. Topics include aerospace, chemical, electrical, nuclear, marine, metallurgical, mechanical/automotive, industrial, and computer, information, and control engineering. Fees range from \$450 to \$1000, depending on course length. Contact Engineering Summer Conferences, 200 Chrysler Center—North Campus, University of Michigan, Ann Arbor, MI 48109. (313) 764-8490. August

● WORKSHOPS FOR

EDUCATORS. Compuworkshops Computer Seminars for Educators, various locations in California. Among the seminars offered are "Computer Literacy

for Educators" and "How to Set Up a Computer-Based Education Program in Your School or District." Each course is \$50. Contact Kompukids of Seal Beach, Rossmoor Shopping Center, 12385 Seal Beach Blvd., Seal Beach, CA 90740. (213) 430-7226; in West Los Angeles, (213) 473-8002; in Tarzana, (213) 343-4008; and in Rancho Bernardo/San Diego, (619) 451-1742. August

● DEC SEMINARS

Technical and Management Seminars for Professionals, various sites in the U.S. Subject areas: system-performance management, networking, personal computing, applications design and programming, real-time applications design, and management development. On-site seminars can be arranged. Contact Educational Services, Seminar Programs BUO/E58, Digital Equipment Corp., 12 Crosby Dr., Bedford, MA 01730. (617) 276-4949. August–September

● EFFICIENT COMPUTING

TECHNIQUES. Microcomputers: Techniques for Improving Your Computer Efficiency, Valley Inn and Tavern, Waterville Valley, NH. Four intensive two-day seminars: "Microcomputers: Programming in BASIC," "Introduction to VisiCalc," "Micro Database Applications," and "Engineering and Management Applications." Tuition is \$495, or \$679 with meals and lodging. Contact New Hampshire College, Resource Center, 2500 North River Rd., Manchester, NH 03104. (603) 668-2211, ext. 175. August–September

● MANAGERIAL SEMINARS

Computer Competence Seminars, Boston University Metropolitan College, Boston, MA. A series of hands-on presentations tailored for managers who know

little or nothing about computers and for those who wish to sharpen their computing skills. On the docket are "PCs for Improving Financial Analysis and Decision Support," "dBASE II," and many others. Fees range from \$225 to \$595. In-house programs can be organized. Contact Joan Merrick, University Seminar Center, Suite 415, 850 Boylston St., Chestnut Hill, MA 02167. (617) 738-5020. August–September

● RAINBOW SEMINARS

All-Hands-On, Boston, MA, Chicago, IL, New York City, and San Francisco, CA. A series of applications seminars featuring the DEC Rainbow 100. Contact Carol Ericson, BUO/E50, Educational Services, Digital Equipment Corp., 12 Crosby Dr., Bedford, MA 01730. (617) 276-4572. August–September

● PROFESSIONAL EDUCATION

Seminars from the Institute for Professional Education, various sites in the U.S. Programs in statistics, management, simulation and modeling, personal computers, and computer science. Contact the Institute for Professional Education, POB 756, Arlington, VA 22216. (703) 527-8700. August–December

● COMPUTERS IN ENGINEERING

The 1984 ASME International Computers in Engineering Conference and Exhibit, Hilton Hotel, Las Vegas, NV. More than 60 panel discussions and paper sessions. Product exhibits. Contact American Society of Mechanical Engineers, 345 East 47th St., New York, NY 10017. (212) 705-7100. August 12–16

● MICROS & VOC EDUCATION

Microcomputers and High Technology in Vocational Education Conference, Vocational Studies Center, University of Wisconsin,

Madison. Concurrent sessions, formal classes, presentations, speeches, and videotaped programs. Preregistration fee is \$55, or \$65 at the door. Contact Dr. Judith Rodenstein, 964 Educational Sciences Building, University of Wisconsin, 1025 West Johnson St., Madison, WI 53706. (608) 263-4367. August 13–16

● COMPUTERS AND BIOLOGY

The Fourth Annual Notre Dame Short Course Series: Computers in Biology, University of Notre Dame, Notre Dame, IN. Three concurrent short courses: "Computers in Bioeducation," "Microcomputers in Classroom and Laboratory," and "Computerized Data Analysis in Biological Research." Technical expertise is not required. Tuition is \$450. Contact Theodore J. Crovello, Biocomputing Short Course Coordinator, Department of Biology, University of Notre Dame, Notre Dame, IN 46556. (219) 239-7496. August 13–17

● COMPUTING IN SCHOOLS

The Third Annual Harvard Institute on Computing in Schools, Harvard Graduate School of Education, Cambridge, MA. Designed for educators and administrators. Software demonstrations and group discussions will be featured. Prior computer experience not required. Contact Institute on Computing in Schools, Programs in Professional Education, Harvard Graduate School of Education, 339 Gutman Library, Cambridge, MA 02138. (617) 495-3572. August 13-17

● PROGRAM COMPUTER

GAMES. Programming Games on Computers, Salzburg Inn, Stowe, VT. Presented by Monty Newborn and David Levy, computer-game experts, this course is designed to show you how to program a computer to play chess, bridge, othello, checkers, and blackjack. Ability

(continued)

WE DRESSED OUR UNIX* SOFTWARE FOR YOUR IBM PC/XT



Try it Risk FREE — the first AT&T-licensed UNIX implementation for the IBM PC/XT. Shipping since August 1983, Venix/86 is the popular choice among knowledgeable UNIX users and developers. Here's why!

Multi-User Capability...

Share the same PC, disk, and printer with up to three users! Simply plug in a CRT and run.

Multi-Tasking...

Edit a file, print a report, run a spelling check, format a diskette...all at the same time.

Berkeley Enhancements...

Including vi, termcap, more and the c shell.

Real-Time Extensions

With semaphores, raw and asynchronous I/O, priority, shared data, I/O page addressing.

Quad-Screen Windowing...

Featuring four unique and powerful windows.

MS-DOS Partitioning...

Keep your DOS files and programs!

Lean and Clean...

192K RAM, 3.5 Mbytes on disk. Proven reliability.

Applications...

Networking, word processors, database managers, spreadsheets, menu interfaces.

One Source with Unisource...

Unisource is the leading publisher and developer of UNIX software for the IBM PC/XT and compatibles, DEC Professional 350, Rainbow, Micro-11, PDP-11, VAX series, and NCR computers. All our packages are fully documented and supported by our 800 user hotline. Call for a complete information kit or to arrange your 30-day Risk FREE Trial of Venix/86. Unisource Software Corp. Department 4109
71 Bent St., Cambridge, MA 02141.
Telex 92-1401/COMPUMART CAM
CALL 617-491-1264

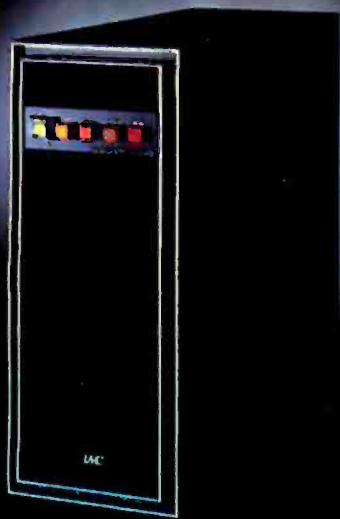


*UNIX is a trademark of AT&T Technologies, Inc.
Venix/86 implementation by VenturCom, Inc.

Circle 313 on inquiry card.



**Getting UNIX Software
Down to Business**



LMC's 32-Bit Virtual Memory MegaMicro Is The-State-Of-The-Art UNIX Microcomputer

LMC's 32-bit MegaMicro provides mainframe or super-minicomputer performance at prices competitive with today's far less powerful 8- and 16-bit microcomputers. This is made possible by use of the next generation of logic chips—the National Semiconductor 16000-series. LMC MegaMicros incorporate: the NS16032 central processing unit which has true 32-bit internal logic and internal data path configured on the IEEE 796 multibus; demand-paged virtual memory implemented in hardware; and hardware 64-bit double-precision floating-point arithmetic.

The LMC MegaMicro is supplied with HCR's UNITY* which is a full implementation of UNIX** and includes the Berkeley 4.1 enhancements to take advantage of demand-paged virtual memory. Also included are C and FORTRAN. Typical multi-user systems with 33 megs. of fast (30 ms. average access time) winchester disk storage, a half meg. of RAM, virtual memory, hardware floating-point arithmetic, UNIX, C, and FORTRAN 77 are available for \$20,000 (and even less with quantity or OEM discounts).

* UNITY is a Trademark of Human Computing Resources.
** UNIX is a Trademark of Bell Laboratories.

LMC MegaMicros The Logical Alternative™

LMC

The Logical MicroComputer Company
4200 W. Diversey, Chicago, IL 60639 (312) 282.9667



A member of The Marmon Group of companies

EVENT QUEUE

to program in BASIC, FORTRAN, or Pascal is advised. The fee is \$550. Contact Dr. Monty Newborn, 4874 Westmount Ave., Westmount, Quebec H3Y 1Y1, Canada, or call (514) 481-1766. August 13-17

● **COMPUTERS, GRAPHICS, AND BUILDING.** Computers/ Graphics in the Building Process—BP '84. Embarcadero Center, Hyatt Regency San Francisco, CA. Exhibit of equipment and services, tutorials, and technical sessions exploring the theme "The Building Process in Transition." Contact Conference Director, BP '84, Suite 333, 2033 M St. NW, Washington, DC 20036. (202) 775-9556. August 19-23

● **ADA COURSE—** Hands-On Programming in Ada. Washington, DC. Upon completion students will be able to design, code, and test Ada programs in an interactive environment. Enrollment is limited to individuals with programming experience in at least one high-level language. The fee is \$875. Contact Continuing Engineering Education, George Washington University, Washington, DC 20052. (800) 424-9773; in the District of Columbia. (202) 676-6106. August 20-24

● **PROGRAM COMPUTER GAMES.** Programming Games on Computers. Salzburg Inn, Stowe, VT. See August 13-17. August 20-24

● **HAMFEST/COMPUTERFEST** The Central Pennsylvania Repeater Association Eleventh Annual Hamfest/Computerfest. Hershey, PA. Indoor dealer and flea-market areas. Registration is \$3. Children and spouses free. Contact Timothy R. Fanus, WB3DNA, 6140 Chambers Hill Rd., Harrisburg, PA 17111. (717) 564-0897 (noon to 8 p.m.). August 26

● **INFO CENTER CONFERENCE** Information Center Conference and Exposition. Sheraton Boston and Hynes Auditorium, Boston, MA. More than 60 educational sessions on hardware, software, and organizational topics of interest to information-center managers will be featured. Contact Warren/Weingarten Publications. 38

Chauncy St., Boston, MA 02111. (617) 542-0146. August 26-30

● **PCB TECHNICAL SEMINAR** The 1984 Printed Circuit Fabrication Technical Seminar. Boston, MA. Contact Donna Esposito, PMS Industries, 625 Sims Industrial Blvd., Alpharetta, GA 30201. (404) 475-1818. August 27-29

● **ADA WORKSHOP** Workshop in Ada. Atlanta, GA. This course combines lectures with laboratory sessions and emphasizes the design and implementation of Ada programs. Programming experience with FORTRAN, PL/I, Jovial, Pascal, C, or another high-level language required. Fee: \$900. Contact Elaine Hadden Nicholas, Department of Continuing Education, Georgia Institute of Technology, Atlanta, GA 30332-0385. (404) 894-2547. August 27-30

● **EUROMICRO** The Tenth Annual Euromicro Symposium—Euromicro 84. Copenhagen, Denmark. One of the largest European computer events, Euromicro features speeches, tutorials, and technical sessions. Also featured will be the annual Euromouse contest in which robotic mice zip through a maze, racing against time and foreign competitors. Contact Euromicro, p/a TH Twente, Department INF, Room A306, POB 217, 7500 AE Enschede, The Netherlands; tel: (31) (53) 338799; Telex: 44200 THES. August 27-30

September 1984

● **COURSES FROM ICS** Courses from Integrated Computer Systems, various sites throughout the U.S. Among the courses offered are "Computer Network Design and Protocols" and "Data Communications." Fees are generally \$895. Contact Integrated Computer Systems, 6305 Arizona Place, POB 45405, Los Angeles, CA 90045. (800) 421-8166; in California, (800) 352-8251 or (213) 417-8888. September-October

● **ERGONOMICS CONFERENCE** World Conference on Ergonomics in Computer Systems, various sites throughout the U.S.

(continued)

With Microfazer, you could be doing this...



While your printer is doing this.



Your personal computer works fast. Except when you're printing. Then it doesn't work at all. And when your computer's not working you're stuck waiting. But with Microfazer there's no more waiting. Microfazer is the print buffer that frees your computer. So you can compute and print at the same time.

Compute while you print

Microfazer stores data from your computer, then sends it to the printer at an appropriate speed. Because Microfazer remembers exactly what your printer

needs, you and the computer can get back to business fast. This makes Microfazer perfect for any buffer task: word processing, complicated graphics, you name it.

But Microfazer remembers more...

Microfazer remembers to give you the hardware features you're looking for in a print buffer. Features that include memory expansion to 512K.

(Parallel-to-Parallel version), RESET, PAUSE, and COPY functions. Plus a choice of serial or parallel interfaces (or combinations of both) for your data transmission requirements.

The perfect system buffer

Microfazer goes with printers and plotters to make it the perfect buffer for all your system needs.

And Microfazer's price makes it perfect, too.

MICROFAZER BY QUADRAM™

So stop waiting on your printer. Get Microfazer and compute while you print. Microfazer. The buffer that remembers it all.



©Copyright 1984 Quadram Corporation. All rights reserved.

Circle 260 on inquiry card.

4355 International Blvd./Norcross, Ga. 30093
(404) 923-6666/TWX 810-766-4915 (QUADRAM NCRS)
International Offices
Chevco Computing • 6581 Kitimat Road # 14
Mississauga, Ontario, Canada L5N-2X5 • 416-821-7600

floppy disk drives



TANDON TM 100-2 FULLY IBM PC COMPATIBLE
CALL FOR QUANTITY PRICING

\$209

½ HT. DISK DRIVES TOP NAMES
SOUTH'S LARGEST SUPPLY • DEALER INQUIRIES INVITED . . .

\$179

networking/protocol conversion



PC Turbo by ORCHID

80186 Co-processor Board • Speeds Up PC 5 Times

IRMA "STILL A BEAUTY"
REPLACES 3278's WITH PC's /IRMALINE

PCterminal LOW-COST Terminal W/Built-in LAN & Processors
Serial and Parallel Ports • Four Extra Open Slots

BLUE LYNX 5251/3276 EMULATOR

FORTE DATA 3278/3279 Emulator w/SIII, Graphics Capability

printers



AMDEK AMPLLOT II Supports LOTUS 1-2-3 Graphics **\$799**
Houst. Inst. Plotters & Digitizer CALL!

DOT MATRIX

EPSON FX80 & 100 (160 cps) . . . Best Price!

EPSON RX80 & 100 . . . Best Price!

EPSON LQ 1500 NEW! Letter Quality in a Dot Matrix . . . Best Price!

ProWriter C-ITOH **\$339**

Prism Color IBM's Choice for LESS, 132 Col (200 cps) Color Graphics **\$1495**

OKIDATA 92&93 Opt IBM Proms 160 cps . . . Best Price!

OKIDATA ML84 200 cps . . . Best Price!

OKIDATA 2410 Pacemark (350 cps) . . . Best Price!

TOSHIBA P-1351 & 1340 . . . Best Price!

GEMINI Full Line of StarMicronic Printers . . . Starting At **\$285**

T.I. 855 24 WIRE PIN HEAD, NOW IN STOCK! . . . Best Price!

NEC P2 & P3 180 cps . . . Best Price!

DIABLO P38 (400 CPS) **\$1695**

LETTER QUALITY

NEC SPINWRITERS 2050, 3550 & 7730 . . . Best Price!

DIABLO 620, 630 630 ECS . . . Best Price!

C-ITOH Starwriter (40 cps) Printmaster (55 cps) **\$1055/\$1455**

QUME SPRINT 11/40 PLUS SPRINT 11/55 PLUS . . . Best Price!

LQ Feeders Great Cut Sheet Feeders for NEC 3550 & C-ITOH Starwriter . . . SAVE!

micro modems

HAYES SMARTMODEM 300, 1200 & 1200B . . . CALL!

NOVATION MICRO MODEMS, W/Access 1-2-3; Internal w/Crosstalk XVI . . . Starting at **\$99**

RIXON 1200-4800 BAUD • IBM PC Compatible . . . CALL!

Signalman Mark XII 300-1200 Direct Connect **\$259**

Advertised cash prices subject to change without notice.

Atlanta, Charlotte, Washington D.C., Tampa, Ft. Lauderdale, Orlando, Louisville

SNA & BISYNC • 3780, 5251, 3274

hard disks

Peachtree Peripherals P-10 Industry's Best Buy • 10 Meg/F. Auto Boot • Runs W/Out Ext. Power Internal or External Installation

SYSGEN 10 & 20 MEG/F W/Streamer Tape, also IMAGE Streamer Backup for Your IBM XT . . . CALL!

INFAX Bernoulli Box • Double Drives 10 MEG Removable Cartridges . . . CALL!

DAVONG 10 MEG/F IBM 15, 21, 35 Available • Ext. . . CALL!

"MacIntosh" Hard Disk by Tecmar . . . CALL!

ALL NAME BRANDS AVAILABLE NOW! BEST PRICES!! IF YOU DON'T SEE IT— . . . CALL!

multi-cards



#1-384K 64-384K • Clock Ser & Par Pts Ram Disk • Spooler • Opt Game Pt . . . Best Price!

#1 MultiCard Max: 8 Func (64-512K) W/Opt. Game Pt. . . Best Price!

#1 I/O Card Ser. Clk. Spooler Ram Disk (Opt 2nd Ser. Par & Game) . . . Best Price!

QUADBOARD New Version 64-384K . . . Best Price!

CAPTAIN 64-384K by Tecmar . . . **\$269**

SEATTLE RAM + 3 0-256K • Ser • Par Flash Disk • Clk • Spooler . . . **\$199**

J-RAM II 512K Multifunction . . . Best Price!

PROFIT Systems 64-512K RAM Plus & Elite **\$299/\$680**

BABY BLUE II 64-256K • 2808 • Par • 2 Ser • Clk RAMdisk • Spooler • Extra Software . . . Best Price!

PC Blossom ORCHID's 6-Pak Clone with Optional PCnet Piggy Back . . . starting at **\$275**

MAYNARD SANOSTAR Floppy & Hard Disk Controller Cards . . . Best Price!

Grappler Apple Parallel Interface . . . CALL!
Quadram eRAM80 Apple 80 Col. 64K RAM Card . . . CALL!
Microtek Apple Dumping & Parallel Interface . . . CALL!
Premium Softcard IIe Apple . . . CALL!

graphic cards



HERCULES Monochrome Graphics Supports LOTUS 1-2-3 . . . CALL!

PLANTRONICS Color+ Biplaner, Super Hi/Res With Color Magic . . . CALL!

Graphics Master Tecmar Color & Mono Graphics Supporting Lotus . . . Low Price!

QUADCOLOR I & II . . . CALL!

ULTRA PAK Graphics • Serial Port(s) • Par. Port Expand. RAM (384K) • Opt. Color & Floppy Cont. . . CALL!

STB Graphics Plus Color & Mono Graphic • Par. Port RAM Disk • Spooler • Lite Pen Port • Opt. Clk/Cal . . . CALL!

Multigraph 132 Col in Mono W/Graphics 720h x 350v Color Graphics to 640h x 400v • Opt. Par. Port . . . **\$375**

Apple and the Apple logo are registered trademarks of Apple Computer, Inc. IBM and the IBM logo are registered trademarks of International Business Machines Corporation. Micro Mart is a registered trademark of Micro Mart Inc.



software

MICROSOFT PROJECT

- ACCOUNTING**
- IUS** IBM A.R., A.P., G.L., Inventory, Order Entry, Payroll Starting at **\$299**
 - Peachtree Accounting** A.R., A.P., G.L., Payroll Job Cost, Inv., Order Proc. **CALL!**
- MISCELLANEOUS**
- Dow Jones** IBM Entire Line Now W/Full Acct., Comm. & Sales Plan. Complementing Fine S.tk. Mkt. Pkg. **CALL!**
 - Open Access** Spreadsheet, 3-D Graphics, Word Processor, Time Manager & Comm. in One Pkg. **\$299**
 - Decision Manager** IBM All New Integrated Software by Peachtree **CALL!**
 - VisiOn** Applications manager Calc • Word • Graph • Query IBM **CALL!**
 - QUICKCODE/dGRAPH/dUtil** IBM **CALL!**
 - Lattice C-Compiler** IBM Version 2.1 Supports One Meg RAM on PC **\$299**
 - MICROSOFT COMPILERS** IBM **CALL!**
 - DIGITAL RESEARCH COMPILERS** **CALL!**
 - Norton Utilities** A must for Every IBM PC **\$59**
 - ProKey 3.0** Rosesoft IBM **\$95**
 - Copy II PC** **\$35**
 - ATI Training** IBM Critics Choice Software Tutorials **\$49**
 - Set-FX PLUS** IBM Epson FX Series Control Pkg. **\$45**
 - PC Paint Brush** IBM Amazing Mouse Driven Graphics W/Screen Dump Utility. **\$129**
 - Chart-Master/Sign-Master** IBM **CALL!**
 - "CAD Systems"** IBM Best Selection Available of Computer Aided Design Graphics. **CALL!**
 - ENERGRAPHICS** IBM Hot New Graphics Package **\$269**

New for the Macintosh

- Habadex** Apple New Style Data Base for your Macintosh. **CALL!**
- Microsoft** Apple Chart • File • Basic. **CALL!**

IBM etc. chips

- INTEL** High Speed Math Coprocessor **\$175**
 - 64K RAMCHIPS** **\$55/\$159**
- (64K-9 Chip/Upgrade Kit) (192K-27 Chip/Upgrade Kit)
CALL FOR QUOTE ON QUANTITY CHIP PURCHASES

monitors & crt's

- PGS-MAX 12** Amber • Runs off IBM Mono Card • 720h x 350v **Best Price!**
- PGS SR-12** 690x480 • Non-Interlaced Mode RGB W/HiRes Text, W/Dual Scan Cd **Best Price!**
- PGS-HX 12** IBM HiRes 690 Dot RGB **Best Price!**
- QUADCHROME** HiRes RGB **Best Price!**
- AMDEK COLOR II+** **\$399**
- AMDEK COLOR IV** IBM 720 Dot **\$549**
- AMDEK 300 A/300G** IBM 12" **\$149/\$139**
- AMDEK 310A** Amber 12" Improved Alternate to IBM Green Screen IBM **\$185**
- Wyse Terminals** Wy 300, 100, 75, 60, 50 Entire Line In Stock **Best Price!**

WORD PROCESSING

- MultiMate** IBM 3.22 "WANG" Style Word Processor with Spelling Checker & All New Tutorial **\$289**
- SAMNA II & III** IBM Deluxe Word Processing at Best Pricing W/WJo Mouse • Fourth Generation Word Processor • Use Up to 8 Windows **CALL!**
- Microsoft Word** **CALL!**
- VOLKSWRITER DELUXE** IBM **\$189**
- WordStar ProPack** IBM Now W/Free Tutor! CorrectStar, MailMerge. **CALL!**
- WordPerfect by SSI** IBM * Available Now by Popular Demand **\$299**
- Easy Writer II** IBM Systems Include Speller & Mailer. **CALL!**
- Peach Text 5000** IBM Personal Productivity Series. **\$179**

DATA BASE

- HARVARD PROJECT MANAGER** IBM **CALL!**
- Day Flo** IBM Super new data base **CALL!**
- R:base 4000 or 6000** Report Writer & Clout Microrim Starts at **\$329**
- Power-base** IBM GMS Systems • Combination of Relational & Hierarchical Data Base **CALL!**
- Knowledge Man** IBM Ver. 1.06 Now Available for this Highly Acclaimed Data Base **\$295**
- dBasell & III** IBM Ashton Tate • Standard plus New "C" Language **CALL!**
- Infoscope** IBM Critically acclaimed data base **CALL!**

SPREADSHEET

- MultiPlan** Microsoft • New Low Pricing IBM **CALL!**
- SuperCalc 3** IBM Superior Graphics to LOTUS **CALL!**

COMMUNICATIONS

- CROSSTALK XVI** IBM Microstuf **CALL!**
- SMARTCOM II** IBM Hayes **\$99**

miscellaneous

- Keytronics 5151** New Improved **CALL!**
 - MOUSE** Optical Type LOTUS & VisiOn Compatible By Mouse Systems **\$209**
 - CURTIS** Monitor Pedestal Keyboard Extension Cable, Monitor Extension Cable **CALL!**
 - MICROFAZER** (8K 128K) Stack Spooler Starting At **\$139**
 - BACK UP Power Supply** 200/425/625 Watts **CALL!**
 - ISOBAR** Surge Protectors • With Great Filtering Via Isolated Outlet Pairing • 4 & 8 Plug Starting at **\$55**
- Circle 206 on inquiry card.

ORDERS ONLY
1-800-241-8149
Monday Friday 9 00 AM 7 00 PM Saturday 9 00 AM 5 00 PM

MICRO MART
TECHNOLOGY CORPORATE CAMPUS
3159 Campus Drive • Norcross, GA 30071

For Information 1-404-449-8089
Technical Support 1-404-446-3836
Telex 880497

What a performance! Seven new data acquisition and control boards for your IBM PC.™

Encore!
Encore!

Data Translation has done it again. Our first two analog and digital I/O boards for IBM personal computers received rave reviews.

So we extended our product line to seven ... starting at \$295 for quantity purchasers.

While most of the personal computer world focused on home and office applications, we lifted the curtain on two other key areas. Laboratory data acquisition and industrial control.

Now, no matter what you need for your IBM PC, we have it. Each board is a complete data acquisition and control system. With A/D, D/A, digital I/O, and a programmable clock. You simply choose the board offering the speed and resolution you need most. Just plug it into your PC's backplane and it's showtime.

With on-board intelligence, all seven are software compatible and supported by Data

Translation's PCLAB software package.

Data Translation is playing the leading role in personal computer data acquisition and control. Find out how we can help your performance today.

VISA and MasterCard accepted.
Call (617)
481-3700



Price (U.S. \$)	Class	Model	Resolution (bits)		Speed (kHz)	A/D		D/A		Digital I/O Channels	Programmable Clock
			No. of Channels	Speed (kHz)		Resolution (bits)	No. of Channels				
295 (OEM) 495	Low Cost	DT2808	10	16SE	3.3	8	2	10	16	yes	
1195	General Purpose	DT2801	12	16SE or 8DI	13.7	12		16			
1345	High Speed	DT2801-A	↓	↓	27.5			33			
2170	High Resolution	DT2801/5716	16	8DI	2.5			16			
1295	Low Level	DT2805	12	↓	13.7						
2270	Low Level, High Resolution	DT2805/5716	16	↓	2.5						
1695	Simultaneous S/H	DT2818	12	4	27.5			33			

NOTES: 1. PCLAB software supports all models.
2. Programmable gain is standard for all DT2801 and DT2805 models.
3. Screw terminal and signal conditioning panels available for connection of all I/O signals.

DATA TRANSLATION

World Headquarters: Data Translation, Inc., 100 Locke Dr., Marlboro, MA 01752 (617) 481-3700 Tlx 951 646
European Headquarters: Data Translation Ltd., 430 Ball Rd., Slough, Berkshire SL1 6BB England (06286) 3412
Tlx 849852
In Canada: (416) 625-1907.

IBM PC is a registered trademark of IBM.

EVENT QUEUE

and Europe. Ergonomic experts and computer professionals and users will exchange information and observations. Contact Computer Psychology Inc., 54 East Main St., POB 16, Mendham, NJ 07945. (201) 543-9009. In Europe, Telefonaktiebolaget LM Ericsson, LM Ericssons väg 4-8, S-12625 Stockholm, Sweden; tel: (8) 7190000. *September-October*

● HIGH-TECH TUTORIALS Tutorial Short Courses from Hellman Associates, London, England, and various sites in the U.S. Among the courses offered are "VLSI Design," "Digital Control," and "Error Correction." Fees are generally \$895. Contact Hellman Associates Inc., Suite 300, 299 California Ave., Palo Alto, CA 94306. (415) 328-4091. *September-October*

● MEDICAL COMPUTER SEMINAR. Medical Computer Weekends, various sites throughout the U.S. For cardiologists, internists, and primary-care physicians. Focus on the role of the multipurpose medical office computer. Seminars qualify for 13 hours CME Category I credit. Contact International Medical Education Corp., 64 Inverness Dr. E, Englewood, CO 80112. (800) 525-8651; in Colorado. (303) 790-8445. *September-October*

● SEMINARS FOR PROFESSIONALS. Professional Development Seminars, various sites throughout the U.S. Topic areas: data communications, database management, EDP operations, microcomputers, software engineering, CAD/CAM, personal computers, IBM mainframes, office automation, management, and administration. Fees range from \$195 to \$1095. Contact Institute for Advanced Technology, 6003 Executive Blvd., Rockville, MD 20852. (800) 638-6590; in Maryland. (301) 468-8576. *September-October*

● CONTINUING ENGINEERING EDUCATION, George Washington University. Continuing Engineering Education, Washington, DC. For a schedule, contact George Harrison, Continuing Engineering Education, George Washington University, Washington, DC 20052. (800) 424-9773; in the District of Columbia. (202) 676-6106. *September-November*

● SHOWS IN GERMANY Chip Microcomputer Weeks, various sites throughout West Germany. Microcomputer products, trends, and applications will be demonstrated. Sponsored by Chip, a leading German computer magazine. Contact Network GmbH, An der Friedenseiche 10, D-3050 Wunstorf 2, Bundesrepublik Deutschland (West Germany); tel: (0 50 33) 10 56; Telex: 92 45 45. In England, Network Events Ltd., Printers Mews, Market Hill, Buckingham MK18 11X, England; tel: (02 80) 81 52 26; Telex: 83111. *September-November*

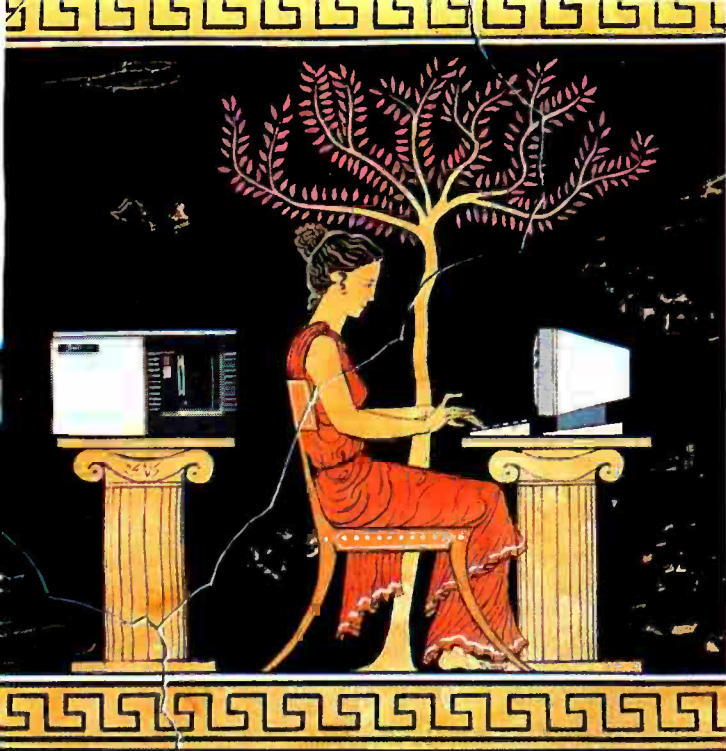
● INTEL WORKSHOPS Microcomputer Workshops, various sites throughout the U.S. and Canada. Intel, the semiconductor memory manufacturer, is offering more than 20 workshops on microprocessor applications. A brochure is available. Contact Customer Training, Intel Corp., 27 Industrial Ave., Chelmsford, MA 01824-3688. (617) 256-1374. *September-December*

● IBM SYSTEMS SHOW The IBM System User Show, Olympia 2, London, England. Covers the full spectrum of IBM mainframes, minicomputers, and microcomputers. A focus on business. Contact EMAP International Exhibitions Ltd., 8 Herbal Hill, London EC1R 5JB, England; tel: 01 837 3699. *September 3-5*

● AI IN EUROPE The Sixth European Conference on Artificial Intelligence, Pisa, Italy. Covers programming languages, expert systems, natural-language processing, robotics, and computer vision. Tutorials. Contact the Programme Chairman, Institute of Educational Technology, Open University, Walton Hall, Milton Keynes MK7 6AA, England. In Italy, Stefano A. Cerri, Dipartimento di Informatica, Università di Pisa, Corso Italia, 40, Pisa 56100, Italy; tel: Pisa 40862/3/4; Telex: CNUCE 500371. *September 5-7*

● SOFTWARE ONLY The Second Annual National Software Show, Convention Center, Anaheim, CA. An exposition and conference devoted solely to microcom-

(continued)



ZeusTM

The Ideal Computer is No Longer a Myth.



Zeus V.I.P.C.

Ideal Solutions. Finally... a truly complete family of computers and peripherals extensive enough to please even the toughest customers. The Zeus MultiUser MultiProcessor Computers, Personal Computers, and peripherals, from OSM.TM

Value and Compatibility Above All. As diverse as they are, every Zeus computer boasts the same family traits. Impressive power and speed, combined with high reliability. Forward-looking, easy-to-use features. And expandability you can afford. All for a surprisingly low initial cost.

Zeus MultiUsers Let You Share The Power. With a Zeus MultiUser

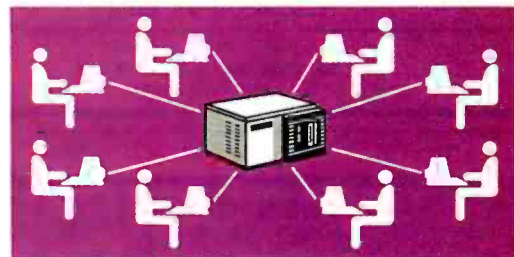
system, you buy only one computer for all your computer users. As many as 32 employees can work on the system at the same time, from their own desks—even when they're using separate software, or calling up different files and data. When you're ready to expand, just plug in additional terminals,

modems or printers where you need them.

The cost? One of the lowest costs per-workstation of any computing system. Zeus Multi-User systems are specifically designed to suit a wide range of needs. You can select the number of workstations you want, the amount of hard-disk storage you need (up to 70,000 pages worth), and many other customizing features.

Zeus Personal Computers. Simplicity and Sophistication.

The Zeus V.I.P.C., one of the three IBM[®]-compatibles in the Zeus family, is the only single-user computer that can offer you the security of a built-in back-up storage system. It protects you from inadvertently losing your valuable data by copying it onto a high-capacity, high-speed cartridge tape. And every Zeus Personal Computer gives you the major advantage of twice as much memory as the IBM PC,



Zeus MultiUsers support 2 to 32 workstations simultaneously.

for less cost.

Call OSM Marketing Services today for the name of your local Zeus representative: **(800) 538-5120 outside California, or (415) 961-8680.**

Zeus. The Ideal Solution to Your Real Needs.

OSMTM Computer Corporation

Zeus Computers and Peripherals
OSM Computer Corporation
665 Clyde Avenue
Mountain View, California 94043
(800) 538-5120 outside California
(415) 961-8680
TWX 910-379-5003

© OSM Computer Corporation

OSM and Zeus are trademarks of OSM Computer Corporation. IBM is a registered trademark of International Business Machines Corporation. Specifications subject to change without notice.

EVENT QUEUE

DUMP/RESTORE-XT
Can Help You Avoid Disaster!



When's the last time you backed up your hard disk? Are you flirting with disaster? The School of Hard Knocks proves that when you're least expecting it, head crashes, electrical outages, and system failures occur when sufficient backups have not been made.

Up until now, you've had to buy add-on hardware to accomplish this necessary task, outlaying hundreds of dollars. But now, there's **DUMP/RESTORE-XT**! Using your own floppy disk drive and our backup program, you can backup your hard disk in about 30 minutes*.

DUMP/RESTORE-XT spans diskettes, too! So, if your diskette runs out of room, don't panic... just insert another diskette and press ESC to continue. Full positive and negative wildcard selections are supported.

DUMP/RESTORE-XT is modeled after **FAST DUMP/RESTORE**, which was designed for CP/M systems. We have over 1,500 copies of this program in use world-wide. Our track record speaks for itself. Our hundreds of satisfied users speak for us.

*Depending on volume of data.

Suggested retail: \$90. MasterCard and Visa accepted. Dealer inquiries welcome.



24000 Telegraph Road
 Southfield, Michigan 48034 USA
 (313) 352-2345

puter software. Contact Raging Bear Productions Inc., Suite 175, 21 Tama Vista Dr., Corte Madera, CA 94925. (800) 732-2300; in California. (415) 924-1194. *September 5-7*

including computers, graphics, and networks. Contact Electronic Conventions Management, 8110 Airport Blvd., Los Angeles, CA 90045. (213) 772-2965. *September 11-13*

● **COMPUTER INTERFACING FOR SCIENCE**. Personal Computing and STD Computer Interfacing for Scientific Instrument Automation. Washington, DC. A hands-on workshop costing \$395. Contact Dr. Linda Leffel, C.E.C., Virginia Polytechnic Institute and State University, Blacksburg, VA 24061. (703) 961-4848. *September 6-8*

● **UNIX EXPOSITION**
 UNIX Systems Expo/84. Convention Center, Los Angeles, CA. More than 200 exhibits of UNIX-related products and services, as well as presentations and panel discussions. Contact Computer Faire Inc., 181 Wells Ave., Newton, MA 02159. (617) 965-8350. *September 11-14*

● **COMPUTERS IN COMMONWEALTH**, Halifax Computer and Office Automation Show. Metro Centre, Halifax, Nova Scotia, Canada. Contact Industrial Trade Shows, 20 Butterick Rd., Toronto, Ontario M8W 3Z8, Canada. (416) 252-7791. *September 6-8*

● **EUROPEAN COMPUTER GRAPHICS**. Eurographics '84—The Fifth Annual European Computer Graphics Congress. Copenhagen, Denmark. A congress with an international lineup of speakers and product exhibits. Contact Kenness International, 1 Park Ave., New York, NY 10016. (800) 235-6400; in New York. (212) 684-2010. *September 12-14*

● **BYTE SHOW**
 The BYTE Computer Show. Brooks Hall, San Francisco, CA. Seminars, conferences, and displays of interest to BYTE and *Popular Computing* subscribers. Contact The Interface Group, 300 First Ave., Needham, MA 02194. (800) 325-3330; in Massachusetts. (617) 449-6600. *September 6-9*

● **INTRO TO DATA COMMUNICATIONS**. Introduction to Data Communications. Atlanta, GA. An overview of data-communications terminology, technology, hardware, and software. Participants will learn to design a batch data-collection system and estimate the response time of a multipoint circuit. Fee: \$72.5. Contact Elaine Hadden Nicholas, Department of Continuing Education, Georgia Institute of Technology, Atlanta, GA 30332-0385. (404) 894-2547. *September 12-14*

● **FUTURE DBMS**
 Fourth Generation Data Management Software. Washington, DC. Topics include user-friendly DBMS, applications generators, data dictionaries/directories, database designers, and decision-support systems. Registration fee: \$650. Contact Software Institute of America Inc., 8 Windsor St., Andover, MA 01810. (617) 470-3880. *September 10-11*

● **SOFTWARE EXPO**
 The Fifth Annual Software/Expo. Hyatt Regency, Chicago, IL. A conference and exposition. Contact Software/Expo, Suite 205, 2400 East Devon Ave., Des Plaines, IL 60018. (312) 299-3131. *September 12-14*

● **MOTION CONTROL SEMINAR**. Electronic Motion Control Seminar. Boston, MA. Sponsored by the Electronic Motion Control Association. Contact EMCA Headquarters, Suite 1200, 230 North Michigan Ave., Chicago, IL 60601. (312) 372-9800. *September 10-11*

● **TECHNOLOGY FOR DISABLED**. Computer Technology for the Handicapped. Raddison South Hotel, Minneapolis, MN. A national conference and exhibit for special education, rehabilitation, and medical professionals. Presentations and workshops. Registration is \$150 before September 1; \$175 after. Admission to the exhibit floor only is \$3. Contact Closing the Gap, (continued)

● **ELECTRONICS SHOWS**
 Midcon/84 and Mini/Micro Southwest-84. Dallas, TX. Concurrent conferences exploring practical applications and the state of the art of electronics.

ONE STOP SHOP
for SERVICE,
SAVINGS, and SATISFACTION
 Call for August Specials!!

PRINTERS

Brother HR-15	419
Epson FX-100	679
FX-80	459
RX-80 FT	389
Gemini 10X	259
15X	379
NEC 3550	1795
2030	Call
Okidata 92P	439
g3P	747
Prowriter	349
HP Ink Jet	469
Quadjet Color Ink	629

MONITORS

Amdek 310 A	159
300	135
Princeton HX 12	479
Sakata SC100 Color	259
Taxan Amber	119
Vision 3	449
Zenith 123 12" Green	95
122 12" Amber	95
135 13" Color	459

MODEMS

Hayes 1200	469
1200B	389
MM //e	229
300 baud	199
Novation Apple Cat 2	259
Smart Cat +	379
Promodem 1200	349
Signalmark Mark I	81
Mark X	210
XI	269
VolksModem 300baud	59

IBM

PC 64K
 2-Drives, Controller
 Color & Monochrome,
 Parallel Port
 \$2195

IBM XT \$3795
 Call for Special Deals!

MONTH'S SPECIALS

Brother HR-15 ... \$375
 Gemini 10X ... \$259
 Gemini 15X ... \$379
 Word w/Mouse ... \$269
 Slim Line Drive
 Apple/IBM ... \$189
 Videx Ultraterm ... \$179

apple

NEW ARRIVAL!!
MACINTOSH...\$2995
 //e and //c
 64K CPU, 2 Drives,
 Controller, 80-Col
 S SAVE \$

IBM PRODUCTS

Tandon TM 100-2	219
Panasonic 320K	179
Teac 55B 320K	179
STB Graphix Plus II	329
RIO+	259
Super RIO	279
Microsoft Multiplan	179
Lotus 1-2-3	289
AST 6 Pak	269
Mega+	269
Quadboard EX 6K	219
Hercules Graphics Card	369
Dbase II	289
Ascl Express Pro	129

APPLE PRODUCTS

Micro Sci A2 Drives	189
Rana Elite I	219
Teac Drive	210
Chinon Drive	179
Videx 80 col w/softswitch	189
Ultraterm	179
Grapplet+	119
Grapplet Work-alike	59
Buffered 16K	99
16K Ram	50
System Saver Fan	69
Microsoft Palm //e	279
Softcard CPM	229
Multiplan	179
MAC Multiplan	139
Basic	109
Apricorn Serial Card	69
Chalkboard Power Pad	63
Z-80 Card	59
Ascl Express Professional	89
Maxell S/S	24
D/S	35

WE SUPPORT THESE FINE SYSTEMS:
 Altos, Apple, Columbia, Compaq
 Corona, DEC, Epson, IBM, KayPro,
 Sanyo, TeleVideo, Zenith, and many
 more.

NO CLUB FEE
 PRICES SUBJECT TO CHANGE WITHOUT NOTICE.
 CASH PRICE!

8/84

Computer Price Club

714 841-6160

16783 Beach Blvd.
 Huntington Beach, CA 92647

MasterCard
 VISA

new
**The CONCEPT AVT+
In a word: capability.**



THE CONCEPT AVT+ DISPLAY TERMINAL

ANSI standard conformance, DEC software compatibility, eight pages of memory, 80/132 columns, windowing, multiple computer connections...and a full range of practical ergonomic features. Capabilities which enable all terminal users to maximize their productivity and explore their creativity. Only from Human Designed Systems.

Introducing the new concept AVT+ display terminal from Human Designed Systems. Simply the smartest interactive display terminal available today. And at a very competitive price.

It starts with ANSI standard (X3.64-1979) conformance and DEC software compatibility, and incorporates superior human design features, advanced functionality and highest quality construction. A commitment to quality that is reflected in each of the individual components.

The concept AVT+ keyboard is ergonomically designed for optimum operator comfort, incorporating a VT100-style numeric pad for DEC software compatibility. And it builds on those human design features with a range of capabilities that make the concept AVT+ an ideal choice for smart terminal users.

The concept AVT+ offers up to eight pages of display memory that eliminates unnecessary

*Quantity one DEC and VT are trademarks of Digital Equipment Corporation.

\$1295*

hardcopy printouts and provides a powerful tool for applications requiring multiple formats and storage of large volumes of text; non-volatile memory that enables users to permanently configure a terminal for their needs or applications, windowing that allows

users to create individual displays within display memory, programmable function keys which transmit data and/or execute terminal commands; up to three additional communications ports for connection to other peripherals and computers;

flexible user networking and functionality for use in a wide range of different applications, including multiple computer connections; and much more.

The new concept AVT+ More to offer at its price for terminal users than any other terminal available today.

human designed systems, inc.

3440 Market Street, Philadelphia, PA 19104
215-382-5000 Circle 148 on inquiry card.

Human Designed Systems. We're redefining terminal performance.

Atlanta — (404) 391-9763; Boston — (617) 449-6446; Chicago — (312) 825-2960; Dallas — (214) 437-1888; Delaware — Infocon: (302) 239-2942; Denver — (303) 469-1953; Hawaii — Gray Associates: (808) 261-3751; Houston — (713) 952-1403; Los Angeles — (213) 410-9454; Northern New Jersey — Infocon: (201) 624-1372; New York City Area — Infocon: (212) 689-8833; New York State — Naco Electronic: Rochester: (716) 223-4490; Syracuse: (315) 699-2651; San Francisco — (415) 692-4184; Washington, DC — International Systems Marketing: (301) 279-5775; Argentina — Itron SA: (01) 774-9349; Australia — Computer Clear Pty. Ltd.: (02) 241 3385; Belgium — BELCOMP: 091-31.52.22; Canada — CAIL Systems: Toronto: (416) 362-1063; Denmark — ADCOM Data ApS: 1-19 44 66; Finland — Evumatic: 0 594 141; France — Walton: (1) 226 06 90; Japan — Ampere: 03 (365) 0825; Singapore — DTS Singapore: (65) 33-88-566; Switzerland — Mitek ag: 01/461 22 52; United Kingdom — Shandell Systems Ltd.: 02407-2027; Venezuela — H. Blohm SA: 2 541.21.22; West Germany — COMKO Computersysteme gmbh: 0221-48 30 51. DISTRIBUTORSHIP INQUIRIES INVITED.





THE INCOMPLETE WORKS OF INFOCOM, INC.

Incomplete, yes. But it's not just because we're always bringing out new stories in the Infocom interactive fiction collection. Nor is it simply due to the fact that with all the writing and re-writing, honing and perfecting that we put into every one of our stories, our work is seemingly never done.

The real reason is: an Infocom work of fiction can never be complete until you become a part of it.

You see, as hard as we work at perfecting our stories, we always leave out one essential element—the main character. And that's where you enter in.

Once you've got Infocom's interactive fiction in your computer, you experience something akin to waking up inside a novel. You find yourself at the center of an exciting plot that continually challenges you with surprising twists, unique characters (many of whom possess extraordinarily developed personalities), and original, logical, often hilarious puzzles. Communication is carried on in the same way as it is in a novel—in prose. And interaction is easy—you type in full English sentences.

But there is this key difference between our tales and conventional novels: Infocom's interactive fiction is active, not passive. The course of events is shaped by the actions you choose to take. And you enjoy enormous freedom in your choice of actions—you have hundreds, even thousands of alternatives at every step. In fact, an Infocom interactive story is roughly the length of a short novel in content, but because you're actively engaged in the plot, your adventure can last for weeks and months.

In other words, only you can complete the works of Infocom, Inc. Because they're stories that grow out of your imagination.

Find out what it's like to get inside a story. Get one from Infocom. Because with Infocom's interactive fiction, there's room for you on every disk.

INFOCOM™

Infocom, Inc., 55 Wheeler Street, Cambridge, MA 02138

For your: Apple II, Atari, Commodore 64, CP/M8*, DECmate, DEC Rainbow, DEC RT-11, IBM PC* and PCjr, KAYPRO II, MS-DOS 2.0*, NEC APC, NEC PC-8000, Osborne, Tandy 2000, TI Professional, T199/4A, TRS-80 Models I and III.

*Use the IBM PC version for your Compaq, and the MS-DOS 2.0 version for your Wang or Mindset.

Circle 155 on inquiry card.

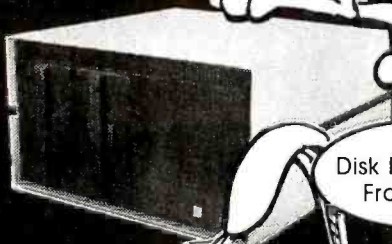
Main/Frames

Main/Frames

from
\$175

- 70 Models of Enclosures
- Assembled and tested
- Quasi-Coax Motherboards
- Power Supply
- Card cage and guides
- Fan, line, cord, fuse, power & reset switches

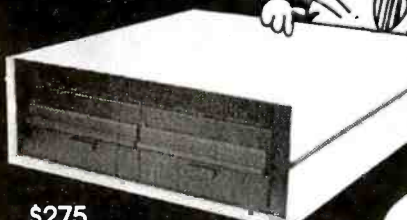
Wow!
70 Models!



\$499

8" Floppy Main/Frame

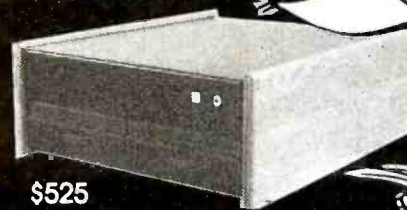
Disk Enclosures
From \$100



\$275

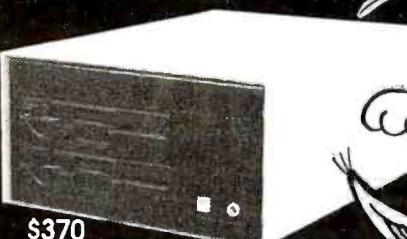
8" Disc Enclosure

MORE BANG
FOR THE BUCK



\$525

Phase/80 8" Floppy Main/Frame



\$370

Slim Line 8" Floppy Main/Frame

32 Page
Free Fakt
Pakt Catalog

Write or call for our
brochure which includes our
application note:
"Making micros, better than
any ol' box computer"

INTEGRAND

8620 Roosevelt Ave. • Visalia, CA 93291
209/651-1203

We accept BankAmericard/Visa
and MasterCard

EVENT QUEUE

POB 68, Henderson, MN 56044,
(612) 665-6573 or (612)
341-8299. *September 13-16*

● **GULF COAST COMPUTING**
The Heart of Texas Computer
Show, Bayfront Plaza, Corpus
Christi. Seminars and displays.
Contact Heart of Texas Com-
puter Show, POB 12094, San
Antonio, TX 78212. (512)
681-2248. *September 14-16*

● **PEOPLE AND COMPUTERS**
The 1984 SME World Congress
on Human Aspects of Automa-
tion. Hotel du Parc, Montreal,
Quebec, Canada. Contact Soci-
ety of Manufacturing Engineers,
One SME Dr., POB 930, Dear-
born, MI 48121. (313) 271-1500,
ext. 369. *September 16-19*

● **COMPUTERS AND MODERN
WORLD, COMPCON Fall '84.**
Hyatt Regency Crystal City, Ar-
lington, VA. Tutorials, panels,
demonstrations, sessions, and
papers will explore the theme
"Small Computer (R)Evolution."
Contact COMPCON Fall '84,
IEEE Computer Society, POB
639, Silver Spring, MD 20901.
(301) 589-8142. *September 16-20*

● **MEDICINE, BIOLOGY,
ENGINEERING.** The Thirty-
Seventh Annual Conference on
Engineering in Medicine and
Biology, Los Angeles Hilton, Los
Angeles, CA. Papers, short
courses, and scientific and com-
mercial exhibits will be featured.
Contact The Alliance for
Engineering in Medicine and
Biology, Suite 402, 4405 East-
West Highway, Bethesda, MD
20814. (301) 657-4142.
September 17-19

● **NETWORK COMPONENTS
COURSE.** Data Communications
Network Components, Atlanta,
GA. Covers the use, operation,
application, and acquisition pro-
cedures for 25 major communi-
cations components. Fee: \$750.
Contact Elaine Hadden Nicho-
las, Department of Continuing
Education, Georgia Institute of
Technology, Atlanta, GA
30332-0385. (404) 894-2547.
September 17-19

● **ADA WORKSHOP**
Future Ada Environment
Workshop, Miramar Hotel By-
the-Sea, Santa Barbara, CA.
Workshops, addresses, presenta-
tions, working groups, and
discussions. Registration: \$400

to \$700 depending on room
choice. Contact ACM AdaTEC
Future Ada Environment
Workshop, TRW R2/1134, One
Space Park, Redondo Beach, CA
90278, or register directly with
Carolyn Gannon, GRC, POB
6770, Santa Barbara, CA 93160.
September 17-20

● **KENTUCKIANA EXHIBITION**
CompuFest '84, Commonwealth
Convention Center, Louisville,
KY. Computer consultant serv-
ices and approximately 100
hardware, software, peripheral,
and word-processing system
vendors will man exhibits.
Technical sessions will be
offered. A full day's worth of
seminars costs \$15. Registration
fee is \$2. Contact the Kentucky
Society of CPAs, 310 West Liber-
ty St., Louisville, KY 40202,
(502) 589-9239. *September 18-20*

● **OFFICE PRODUCTS**
IN OK CITY, The First Annual
Southwest Office Products Show,
Oklahoma City, OK. Contact
SWOPS, POB 950, Norman, OK
73070, (405) 329-3660 or (918)
587-9550. *September 18-20*

● **ADA WORKSHOP**
Workshop in Ada, Atlanta, GA.
See August 27-30.
September 18-21

● **PARISIAN COMPUTING**
The Thirty-Fifth SICOB—Inter-
national Exhibition of Data Pro-
cessing, Teleprocessing, Com-
munication, Office Procedures,
and Office Systems, CNIT, Paris-
La Défense, Paris, France. Micro-
processing and videotex will be
major highlights of the exhibi-
tion. International visitors pre-
senting their passports will have
a special reception room. Some
of the congresses and confer-
ences will feature simultaneous
interpretation in English and
French. Contact International
Trade Exhibitions in France, 8
West 40th St., New York, NY
10018, (212) 869-1720.
September 19-28

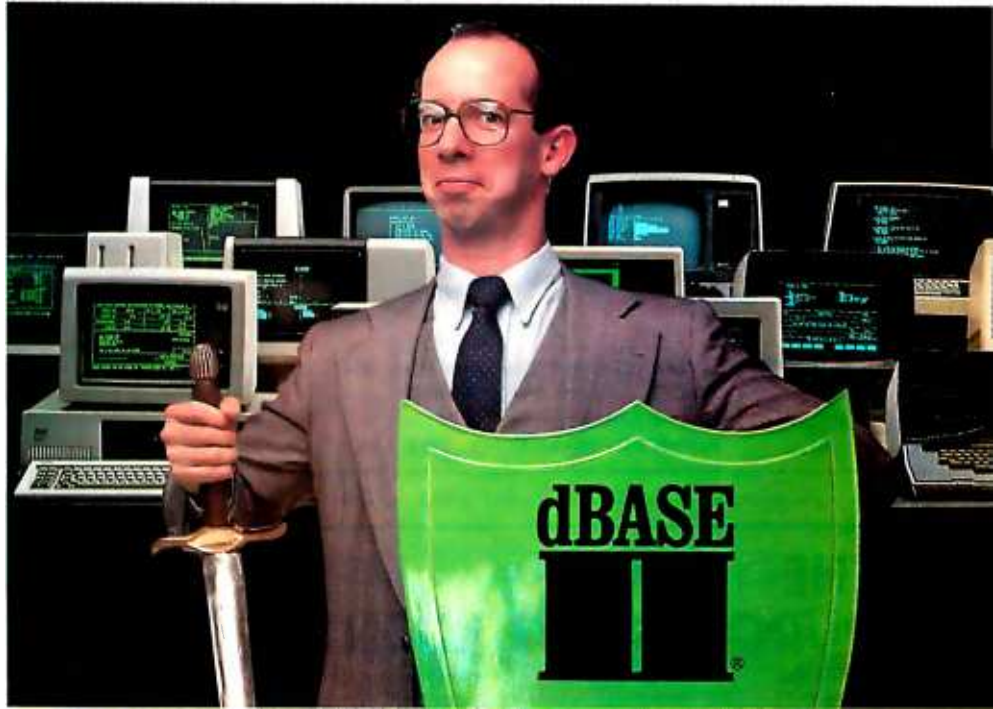
● **EDUCATIONAL CONFERENCE**
The First North Carolina Educa-
tional Microcomputer Con-
ference, Benton Convention
Center and Hyatt Hotel,
Winston-Salem, Educational ses-
sions, hands-on workshops, and
product displays. A network of
various computers will be set
up. Contact Jeanette Gann, NC

(continued)

Self-dFENSE™ for EDP managers.

The micro invasion has begun. And, chances are, you've now got a lot of different people in a lot of different departments using a lot of different micros.

Now there's a way for you to control and maximize the benefits of all the different micros in your domain.



Fight back with dBASE II.®

dBASE II is the relational database management system from Ashton-Tate that enables you to manage your micro-based corporate data resources with the high level of consistency and sophistication you've enjoyed with mainframe and minicomputer systems.

Armed with dBASE II and the dBASE II RunTime™ program development module, you can write programs which will enable micro users in each department to "do their own thing" while creating complete database consistency throughout the company.

dBASE II is a powerful, flexible way for you to effectively manage the micro proliferation.

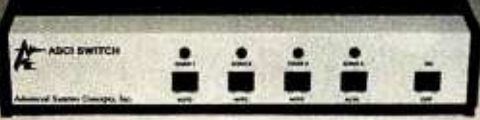
Help is here.

If you'd like to know more about how dBASE II and RunTime can help you win the micro management battle, contact Ashton-Tate today. 10150 West Jefferson Boulevard, Culver City, CA 90230. (800) 437-4329, ext. 212. In Colorado (303) 799-4900. In the U.K. (0908) 568866.

ASHTON · TATE ™

dBASE II is a registered trademark and RunTime is a trademark of Ashton-Tate.
Suggested retail price for dBASE II is \$700.
© Ashton-Tate 1984

Peripheral Networking Now



Buy ASCII Intelligent Port Expanders

- Eliminate Manual Switching by Remote Control
- Improve Productivity and Reliability
- Share Printers, Modems or Plotters
- Expand Computers or Terminals
- Use Matrix Switching for Multiple Transmission or Security
- Supports Polling and Queuing

INSTANT COMPATIBILITY with new computer devices and MAJOR OEM PRODUCTS:

Altos — Burroughs — Data General — DEC
H.P. — IBM — NCR — Northstar — Victor
and other key manufacturers.

Call 213-793-8979 to EXPAND YOUR SYSTEMS TODAY.



Advanced Systems Concepts Inc.
4.35 N. Lake Ave., Dept. B8
Pasadena, CA 91101
800-824-7080 Telex: 701 215

EVENT QUEUE

Regional Education Center, POB 21889, Greensboro, NC 27420, (919) 379-5764. *September 20-21*

● **PROJECT MANAGEMENT SEMINAR.** Software for Project Management and Estimating, Los Angeles, CA. Fee: \$425. Contact CIP Information Services Inc., 1105-F Spring St., Silver Spring, MD 20910, (301) 589-7933. *September 20-21*

● **DOCUMENTATION METHODS** How to Document a Computer System. Holiday Inn—Thomas Circle, Washington, DC, and Hyatt Cherry Hill, Cherry Hill, NJ. A series of documentation procedures will be presented. The fee is \$155. Contact Technical Communications Associates, Suite 210, 1250 Oakmead Parkway, Sunnyvale, CA 94086, (800) 227-3800, ext. 977; in California, (408) 737-2665. *September 21 and September 24, respectively*

● **PACIFIC COAST FAIR** The Fifth Annual Pacific Coast Computer Fair, Robson Square Media Centre, Vancouver, British Columbia, Canada. This event features exhibits, user-group displays, and more than two dozen speakers. Workshops, presentations, and panels will discuss the Apple Macintosh, MS-DOS, software and hardware marketing, publishing, Modula-2, and graphics. Admission is \$4 per day. Contact Pacific Coast Computer Fair Association, POB 80866, South Burnaby, British Columbia V5H 3Y1, Canada. (604) 581-6877. *September 22-23*

● **GRAPHICS STANDARD COURSE.** Introduction to GKS. Hyatt Regency Hotel, Austin, TX. A course on the Graphics Kernel System (GKS) standard. The fee is \$495. Contact Nova Graphics International Corp., 1015 Bee Cave Woods, Austin, TX 78746, (512) 327-9300. *September 24-25*

● **ASIAN COMPUTER SHOW** The Fifth South East Asia Regional Computer Conference and Exhibition and Hong Kong Computer 84, Hong Kong Exhibition Centre, China Resources Building, Wanchai, Hong Kong. Contact Cahners Exposition Group, 7315 Wisconsin Ave., POB 70007, Washington, DC 20088, (301) 657-3090. *September 24-27*

● **OFFICE AUTOMATION IN OTTAWA.** The Seventh Annual Ottawa Computer and Office Automation Show, Lansdowne Park, Ottawa, Ontario, Canada. Contact Industrial Trade Shows, 20 Butterick Rd., Toronto, Ontario M8W 3Z8, Canada, (416) 252-7791. *September 26-27*

● **COMPUTERS, COMMUNICATIONS, AND CONTROL** Eurocon 84—The Sixth European Conference on Electrotechnics, Brighton, England. A conference that seeks to identify the impact of computer-based technology on communications and control. Contact Manager, Conference Services, Institution of Electrical Engineers, Savoy Place, London WC2R 0BL, England; tel: 01-240 1871, ext. 222; Telex: 261176. *September 26-28*

● **MID-ATLANTIC SHOW** The Fifth Annual Mid-Atlantic Computer Show and Office Equipment Exposition, Convention Center, Washington, DC. Contact CompuShows Inc., POB 3315, Annapolis, MD 21403, (800) 368-2066; Annapolis, (301) 263-8044; Baltimore, 269-7694; District of Columbia, 261-1047. *September 27-30*

October 1984

● **TECHNOLOGY FOR DISABLED.** Discovery '84: Technology for Disabled Persons, Chicago, IL. Presentations, demonstrations, and exhibits on computers, technological products, and services for disabled persons. Before September 1, registration is \$125; after, it's \$175. Contact Office of Continuing Education, University of Wisconsin-Stout, Menomonie, WI 54751, (800) 457-8688; in Wisconsin, (800) 227-8688. *October 1-3*

● **INFO/MANAGEMENT CONFERENCE.** Information Management Exposition and Conference: Info 84, Coliseum and Sheraton Centre Hotel, New York City. Contact Banner & Greif Ltd., 110 East 42nd St., New York, NY 10017, (212) 687-7730. *October 1-4*

● **NORTHWEST ELECTRONICS SHOW.** Northcon/84 and Mini/ *(continued)*

THE PURCHASING AGENT

COMPUTERS

Alpha Micro 1000 WF	6,193
Altos 586-20 w/10term.	5,725
586-40 w/10term.	7,063
986-40 w/10term.	8,403
58000 12	10,068
CompuPro Godbout™	
Sys. 816A RAM 17"	4,378
Sys. 816A RAM 21"	4,489
Sys. 816AH*	6,283
Sys. 816C*	6,482
Sys. 816CH*	8,224
Sys. 816D*	9,402
Sys. 816F (CPU 286)*	12,737
Completely Assembled	
M-Drive-H	1,100
Pragmatic 20 meg., 8"	2,590
Pragmatic 40 meg., 8"	4,656
Columbia Sys., 2-320K	2,244
Sys., 12 meg.	3,393
Sys., portable	2,130
Molecular SM 8, 10 meg.	1,900
Molecular 16X, 30 meg.	12,593
NEC APC-403	2,999
APC-412 Graphics	618
Special Softpacks	747
APC-426, 10 meg.	2,172
8201 portable	619
8801A, System	CALL
Northstar Advantage	
w/Dual Floppies	1,976
w/5meg	3,299
w/15 meg	3,886
Onyx 8001 MU 20, 255K	10,454
8002 MU 20, 512K	14,338
5001 MU 21 meg.	6,813
Sanyo 555, w/2-160K	1,100
Sanyo 555-2, w/2-320K	1,375
Tava	CALL
TeleVideo TS-1605 PC	2,356
TPC-1, port.	1,643
TPC-2, port.	2,356

COMPUTERS

Zenith ZF-110-22	2,685
ZW-110-32	4,176
IBM PC Compatibles	
ZF-151-22	2,565
ZF A-161-22	2,553
ZW-151-2	3,912

HARD DISKS

Corvus 12 meg. w/int.	2,299
Clavong 5 meg. Univ.	1,525
32 meg. Univ.	3,040
Iomega 10 meg.	2,091
Mountain Computer	
10 meg. internal	1,701
35 meg. external	3,484
Talgrass 12 meg. w/tape	2,670
20 meg. w/tape	3,097
35 meg. w/tape	4,337

IBM & PERIPHERALS

IBM PC 64K mono, 2-360K	2,950
Keytronics 5150 keyboard	189
5151 keyboard	239

MODEMS

Hayes 1200	499
US Robotics Password	349

MONITORS

Amdel Color IV A	1,007
Color IV T	780
NEC 1410 RGB	780
Princeton RGB w/cable	485

PRINTERS

Anadex 9625B, parallel	1,150
Brother, DX-15P	439
C. Holt F10-55	1,250
Dataproducs B 300-4	5,921
Datasouth DS-220	1,366

PRINTERS

Diablo 630 API	1,615
Fujitsu 830, 80 cps	CALL
IDS Prism 132, w/color	1,465
Juki 100	487
Juki 2010	718
NEC 2010	1,586
3550	569
7710	1,729
Okidata	
Printronix P300	5,300
Qantex 7065	1,575
Qume 11140 w/interlace	1,395
Tally 160L, w/tractor	764
180L, w/tractor	1,323
Texas Instr. T1810 basic	842
T1855	795
Toshiba P-1340	1,499
P-1350	1,099
P-1351	408
Transar 120 Por S	

PLOTTERS/DIGITIZERS

Hitachi HGG-2222	3,170
Houston Instr., DMP 29	1,776
DMP 40	771
DMP 41	2,321
DMP 42	2,321
DMP 52	3,484
Hi-Pad	783
Strobe M 100	461

TERMINALS

DEC VT100	1,528
Freedom 200	580
Hazeltine Espr/II	520
Qume OVT102A	542
OVT103A	661
Televideo 924	713
925	715
950	905
Wyse WY-50	539

CALL FOR YOUR PRICE ON ANY OF OUR 7,000 OTHER PRODUCTS.

Since 1980



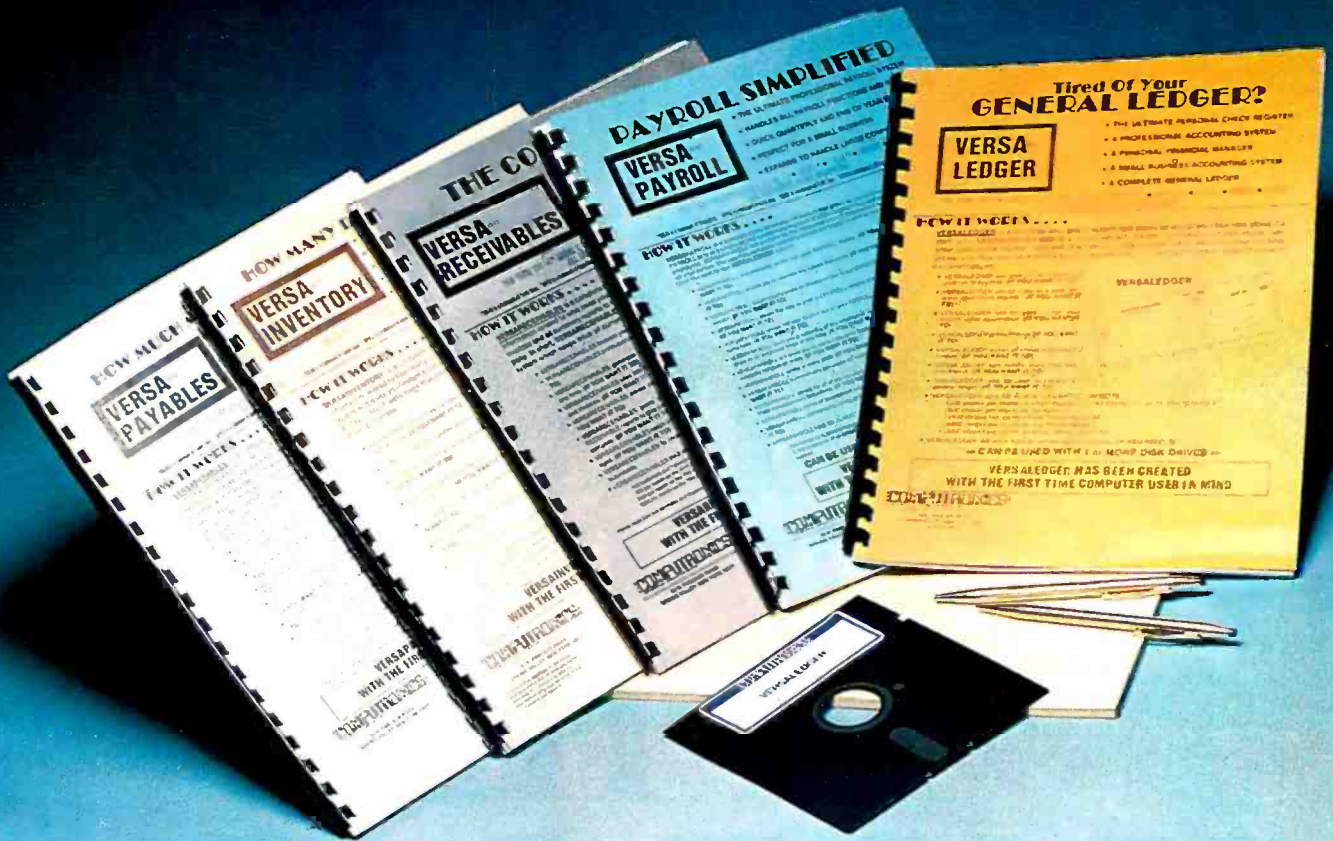
THE PURCHASING AGENT, INC.

2444 Old Middlefield Way, Suite J
Mountain View, CA 94043
(415) 964-8222

B-84-8

Introducing the Most Powerful Business Software Ever!

TRS-80™ (Model I, II, III, or 16) • APPLE™ • IBM™ • OSBORNE™ • CP/M™ • XEROX™



The VERSABUSINESS™ Series

Each VERSABUSINESS module can be purchased and used independently, or can be linked in any combination to form a complete, coordinated business system.

VERSARECEIVABLES™

\$99.95

VERSARECEIVABLES™ is a complete menu-driven accounts receivable, invoicing, and monthly statement-generating system. It keeps track of all information related to who owes you or your company money, and can provide automatic billing for past due accounts. VERSARECEIVABLES™ prints all necessary statements, invoices, and summary reports and can be linked with VERSALEDGER II™ and VERSAINVENTORY™.

VERSAPAYABLES™

\$99.95

VERSAPAYABLES™ is designed to keep track of current and aged payables, keeping you in touch with all information regarding how much money your company owes, and to whom. VERSAPAYABLES™ maintains a complete record on each vendor, prints checks, check registers, vouchers, transaction reports, aged payables reports, vendor reports, and more. With VERSAPAYABLES™, you can even let your computer automatically select which vouchers are to be paid.

VERSAPAYROLL™

\$99.95

VERSAPAYROLL™ is a powerful and sophisticated, but easy to use payroll system that keeps track of all government-required payroll information. Complete employee records are maintained, and all necessary payroll calculations are performed automatically, with totals displayed on screen for operator approval. A payroll can be run totally, automatically, or the operator can intervene to prevent a check from being printed, or to alter information on it. If desired, totals may be posted to the VERSALEDGER II™ system.

VERSAINVENTORY™

\$99.95

VERSAINVENTORY™ is a complete inventory control system that gives you instant access to data on any item. VERSAINVENTORY™ keeps track of all information related to what items are in stock, out of stock, on backorder, etc., stores sales and pricing data, alerts you when an item falls below a preset reorder point, and allows you to enter and print invoices directly or to link with the VERSARECEIVABLES™ system. VERSAINVENTORY™ prints all needed inventory listings, reports of items below reorder point, inventory value reports, period and year-to-date sales reports, price lists, inventory checklists, etc.

VERSALEDGER II™

\$149.95

VERSALEDGER II™ is a complete accounting system that grows as your business grows. VERSALEDGER II™ can be used as a simple personal checkbook register, expanded to a small business bookkeeping system or developed into a large corporate general ledger system **without any additional software.**

- VERSALEDGER II™ gives you almost unlimited storage capacity (300 to 10,000 entries per month, depending on the system),
- stores all check and general ledger information forever,
- prints tractor-feed checks,
- handles multiple checkbooks and general ledgers,
- prints 17 customized accounting reports including check registers, balance sheets, income statements, transaction reports, account listings, etc.

VERSALEDGER II™ comes with a professionally-written 160 page manual designed for first-time users. The VERSALEDGER II™ manual will help you become quickly familiar with VERSALEDGER II™, using complete sample data files supplied on diskette and more than 50 pages of sample printouts.

SATISFACTION GUARANTEED!

Every VERSABUSINESS™ module is guaranteed to outperform all other competitive systems, and at a fraction of their cost. If you are not satisfied with any VERSABUSINESS™ module, you may return it within 30 days for a refund. Manuals for any VERSABUSINESS™ module may be purchased for \$25 each, credited toward a later purchase of that module.

To Order:

Write or call Toll-free (800) 431-2818
(N.Y.S. residents call 914-425-1535)

* add \$3 for shipping in UPS areas

* add \$5 to CANADA or MEXICO

* add \$4 for C.O.D. or non-UPS areas

* add proper postage elsewhere

DEALER INQUIRIES WELCOME

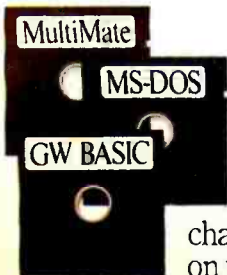
All prices and specifications subject to change / Delivery subject to availability.

COMPUTRONICS

50 N. PASCACK ROAD, SPRING VALLEY, N.Y. 10977

* TRS-80 is a trademark of the Radio Shack Division of Tandy Corp. • APPLE is a trademark of Apple Corp. • IBM is a trademark of IBM Corp. • OSBORNE is a trademark of Osborne Corp. • CP/M is a trademark of Digital Research • XEROX is a trademark of Xerox Corp.

HOW
TO RUN
THE
WORLD.



Without software you're nowhere.

That's why the Corona PC runs virtually everything. Word Star,¹ dBASE II,² Lotus 1-2-3^{3*}. Thousands of packages in all. But we didn't stop there.

We give you 60% better graphics than IBM[®] (640x325 pixels). So your pie charts look tastier. We doubled the memory: 128K memory expandable to 512K on the main board. For power that won't quit. And we bundle software. For instant productivity right out of the box. All at a price about 20% less than IBM's.

The Corona PC. Once you can run the world, running your business looks easy. In North America, call 1-800-621-6746 for the Authorized Corona Dealer near you. In Holland, call 020-03240-18111. There are over 1600 dealers worldwide. And their job is to help. Service by Xerox.



THE CORONA PC

©Corona Data Systems 1984. 1. TM Micropro Corp. 2. TM Ashton-Tate. 3. TM Lotus Development Corp. *HTS driver needed for graphics only.

High performance to cost ratio...

Programming Chips?

Projects develop profitably with development hardware/software from GTEK.



MODEL 7956
(with RS232 option) \$1099.
MODEL 7956 (stand alone) \$ 879.
GTEK's outstanding Gang Programmer with intelligent algorithm can copy 8 EPROMS at a time! This unit is used in a production environment when programming a large number of chips is required. It will program all popular chips on the market through the 27512 EPROMS. It also supports the Intel 2764A & 27128A chips. It will also program single chip processors.

MODEL 7228 - \$549
This model has all the features of Model 7128, plus *Intelligent Programming Algorithms*. It supports the newest devices available through 512Kbits; programs 6x as fast as standard algorithms. Programs the 2764 in one minute! Supports Intel 2764A & 27128A chips. Supports Tektronics, Intel, Motorola and other formats.

EPROM & PAL

PROGRAMMERS

—These features are standard from GTEK—

Compatible with all RS232 serial interface ports • Auto select baud rate • With or without handshaking • Bidirectional Xon/Xoff • CTS/DTR supported • Read pin compatible ROMS • No personality modules • Intel, Motorola, MCS86 Hex formats • Split facility for 16 bit data paths • Read, program, formatted list commands • Interrupt driven — program and verify real time while sending data • Program single byte, block, or whole EPROM • Intelligent diagnostics discern bad and/or erasable EPROM • Verify erasure and compare commands • Busy light • Complete with Textool zero insertion force socket and integral 120 VAC power (240 VAC/50Hz available) •



MODEL 7324 - \$1199

This unit has a built-in compiler. The Model 7324 programs all MMI, National and TI 20 and 24 pin PALs. Has non-volatile memory. It operates stand alone or via RS232.

MODEL 7128 - \$429
This model has the highest performance-to-price-ratio of any unit. *This is GTEK's most popular unit!* It supports the newest devices available through 256Kbits.

MODEL 7316 Pal Programmer \$ 599
Programs Series 20 PALs. Built-in PALASM compiler.

DEVICES SUPPORTED

by GTEK's EPROM Programmers

NMOS		CMOS		EEPROM		MPU'S		
2758	2764A	2508	68764	27C16	5213	12816A	8748	8741H
2716	27128	2516	8755	27C16H	5213H	12817A	8748H	8744
2732	27128A	2532	5133	27C32H	52B13		8749H	8751
2732A	27256	2564	5143	27C64	X2816		8741	68705
2764	27512	68766		27C256	48016		8742H	

UTILITY PACKAGES

GTEK's PGX Utility Packages will allow you to specify a range of addresses to send to the programmer, verify erasure and/or set the EPROM type. The PGX Utility Package includes GHEX, a utility used to generate an Intel HEX file.

PALX Utility Package — for use with GTEK's Pal Programmers — allows transfer of PALASM® source file or ASCII HEX object code file. Both utility packages are available for CPM,® MSDOS,® PCDOS,® ISIS® and TRSDOS® operating systems. Call for pricing.

AVOCET CROSS ASSEMBLERS

These assemblers are available to handle the 8748, 8751, 28, 6502, 68X and other microprocessors. They are available for CPM and MSDOS computers. When ordering, please specify processor and computer types.

ACCESSORIES

Model 7128-L1, L2, L2A	XASM (for MSDOS)	\$250.
Model 7128-24 (OEM Quantity) \$259.	UV Eraser DE-4	\$ 80.
Model 7128-24	RS232 Cables	\$ 30.
Cross Assemblers	8751 Adapter	\$174.
SIM48 Simulator	8755 Adapter	\$135.
PGX Utilities	48 Family Adapter	\$ 98.
PALX	68705 Adapter	Call for pricing



Development Hardware/Software
P.O. Box 289, Waveland, MS 39576
601/467-8048
. INC.

GTEK, PALASM, CPM, MSDOS, PCDOS, ISIS, and TRSDOS are all registered trademarks.

EVENT QUEUE

Micro Northwest-84, Seattle, WA. Among the topics are automation, CAD/CAM, local area networks, and personal computing. Contact Electronic Conventions Management Inc., 8110 Airport Blvd., Los Angeles, CA 90045. (213) 772-2965. October 2-4

● GLOBAL INFO/MANAGEMENT CONGRESS. The Sixteenth Annual International Information Management Congress. Hyatt Regency Hotel, Singapore, Republic of Singapore. Seminars, displays, and more than 30 conference sessions. Contact IMC Infomatics '84, POB 34404, Bethesda, MD 20817. (301) 983-0604. October 2-4

● ADA WORKSHOP
Workshop in Ada, Atlanta, GA. See August 27-30. October 2-5

● PC EXPO
PC-World Exposition, Market Hall, Dallas, TX. Contact Mitch Hall Associates, POB 860, Westwood, MA 02090. (617) 329-8090. October 3-5

● MOTION CONTROL SEMINAR. Electronic Motion Control Seminar, Philadelphia, PA. Contact Electronic Motion Control Association, Suite 1200, 230 North Michigan Ave., Chicago, IL 60601. (312) 372-9800. October 8-9

● VIRGINIA IS FOR COMPUTERS. The Tidewater Ninth Annual Computer Fair, Radio Amateur Hamfest/Electronic Flea Market, Virginia Beach Pavilion, Virginia Beach, VA. Dealers, a giant flea market, displays, and forums. Advanced tickets are \$4; at the door, \$5. Contact Jim Harrison, 1234 Little Bay Ave., Norfolk, VA 23503. (804) 587-1695. October 8-9

● ANNUAL CONFERENCE OF ACM. ACM 1984 Annual Conference, Hilton Hotel, San Francisco, CA. Papers, sessions, and panel discussions will address the theme "The Fifth Generation Challenge." Contact Association for Computing Machinery, 11 West 42nd St., New York, NY 10036. (212) 869-7440. October 8-10

● NETWORK CONFERENCE
The Ninth Conference on Local Computer Networks, Minne-

apolis, MN. Papers, conference sessions, and tutorials. The theme is "Local Computer Networks—The Exploding Marketplace." Contact Ninth Conference on Local Networks, c/o Harvey Freeman, Architectural Technology Corp., POB 24344, Minneapolis, MN 55424. October 8-10

● INFO SYSTEMS CONFERENCE and EXPO. INTECH—The Integrated Information Technology Conference and Exposition, Convention Center, Dallas, TX. Seminars, sessions, and panels addressing total information systems integration. Contact National Trade Productions Inc., 9418 Annapolis Rd., Lanham, MD 20706. (800) 638-8510; in Maryland, (301) 459-8383. October 9-11

● SOUTHWEST COMPUTING
The Third Annual Southwest Computer Conference, Convention Center, Tulsa, OK. A business and industry event featuring more than 50 seminars as well as 250 exhibits. Contact SWCC, POB 950, Norman, OK 73070. (405) 329-3660 or (918) 587-9550. October 9-11

● MID-WEST ELECTRONICS
The Mid-America Electronics Convention—MAECON/84, St. Louis, MO. Exhibits, seminars, tutorials, and symposia. Contact Electronic Representatives Association, 20 East Huron St., Chicago, IL 60611. (312) 649-1333. October 10-11

● NETWORKS EXPLORED
LocalNet '84, Sheraton Harbor Island Hotel, San Diego, CA. Speakers, papers, and exhibitions will look at local network technology and the effects of office automation. Contact Online Conferences Inc., Suite 1190, 2 Penn Plaza, New York, NY 10121. (212) 279-8890. October 10-12

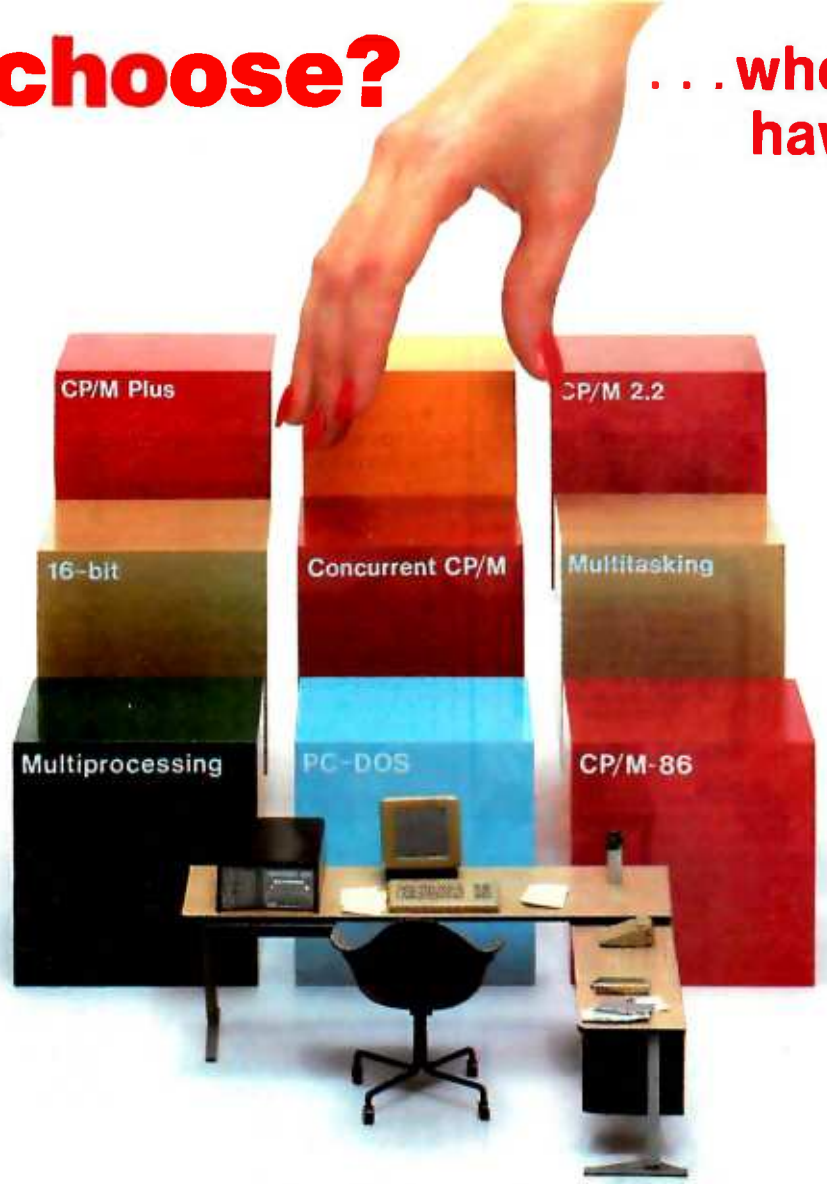
● PROJECT MANAGEMENT SEMINAR. Software for Project Management and Estimating, Washington, DC. See September 20-21. October 11-12

● COMPUTERS IN SUNSHINE
Great Southern Computer Show, Centroplex Expo Centre, Orlando, FL. Seminars and exhibits of hardware, software, peripheral

(continued)

Why choose?

... when you can have them all.



Introducing Concurrent CP/M with PC Mode* for DISCOVERY Multiprocessor Networks

Selecting the right blend of hardware and software for your computing needs can be a monumental challenge. Action Computer Enterprise, pioneer in the field of microcomputer multiprocessing, makes choosing easy. Scoring another innovative first, we have brought Concurrent CP/M with PC Mode to our full range of DISCOVERY Supermicros. This new multitasking enhancement to our already powerful multiprocessing operating system provides the capability to network multiple IBM PC

compatible workstations without sacrificing the ability to run your business in a true multi-user environment. And of course, the DISCOVERY can utilize the full complement of CP/M-80 and CP/M-86 based software including many fine multi-user applications. If total flexibility is what your business needs, pick the system that offers all the choices... DISCOVERY.

Take Action Today!
 Call Toll Free: **1-800-821-6596.**
 (In California, it's **1-818-351-5451.**)



DISCOVERY... The Ultimate Solution.

DISCOVERY is a trademark of Action Computer Enterprises, Inc. CP/M, CP/M Plus, CP/M-86 and Concurrent CP/M are trademarks or registered trademarks of Digital Research, Inc. IBM PC and PC-DOS are trademarks of IBM Corporation.

ACE Action Computer Enterprise
 The Multiprocessing Company

Corporate Headquarters: 430 N. Halstead St., Pasadena, CA 91107 USA TWX 910-588-1201 ACTION PSD

In Europe: ACE (Europe), B.V., Paradijslaan 42, 5611 KP Eindhoven, The Netherlands Tel. (004) 045-2658 TLX: 51767 ACE E NL
 In Asia: ACE (Asia), G/F, Lee Wah Mansion, 171-177 Hollywood Road, Hong Kong Tel. 5-441692 or 5-442310 TLX: 75332 PACIC HX

Serviced nationwide by Bell & Howell Company

Circle 9 for Dealer inquiries. Circle 10 for End-User inquiries. * IBM PC compatible mode.

The Software Toolworks presents:
THE COMPUTER CHEF™ SERIES

The Computer Chef Series includes Computer Chef and Best of Wok Talk, \$29.95 each, and What's for Dinner, \$19.95. The programs store, scale and help choose from over 300 available recipes or from those you've entered. The Computer Chef Series from your local retailer or The Software Toolworks, 15233 Ventura Blvd., Suite 1118, Sherman Oaks, CA 91403 (818) 986-4885.

© 1984 Software Toolworks. All rights reserved.

NOT ANOTHER BLACK BOX

A Software Implementation within Your Product Hardware

If you manufacture a computer system or a computer based product, allow it to EMULATE/COMMUNICATE by installing one or more of Systems Strategies "C" Language based communication packages.

- 3270 SNA/SDLC Emulation
- 3270 BSC Emulation
- 2780/3780/HASP Emulation
- X.25 Levels 1, 2, 3 Communication

You can purchase these "C" Language packages with source code and license to distribute in your hardware product. Each package is available either "Port it Yourself" with instruction manual and training or ported to your hardware by Systems Strategies' communications staff.

**Systems Strategies/Advanced Technology Division
Specialists in Data Communications Software**



Systems Strategies Inc.
225 West 34th Street
New York, New York 10001
(212) 279-8400

EVENT QUEUE

als. and accessories. Contact Great Southern Computer Shows, POB 655, Jacksonville, FL 32201. (904) 356-1044. *October 11-13*

● **GOLDEN STATE EXPO**
Computer Expo and PC Faire. Cal Expo, Sacramento, CA. Contact Computer Expo & PC Show, Suite 395, 2020 Hurley Way, Sacramento, CA 95825. (916) 924-9351. *October 11-14*

● **EDUCATIONAL COMPUTER FAIR**. Fourth Annual Educational Computer Fair, Cleveland, OH. Contact Educational Computer Consortium of Ohio, 4777 Farnhurst Rd., Cleveland, OH 44124. (216) 291-5225. *October 12-13*

● **LONE STAR COMPUTING**
The Second Annual Heart of Texas Computer Show. Convention Center, San Antonio, TX. Exhibits of computers, games, robots, and other high-tech products. Contact Heart of Texas Computer Show, POB 12094, San Antonio, TX 78212. (512) 681-2248. *October 12-14*

● **COMPUTERS IN LABORATORY**. Laboratory Computer Interfacing. McGill University, Montreal, Quebec, Canada. Two short courses, "Computers in the Laboratory" and "Laboratory Computer Interfacing," are offered. Contact Dr. Eric Salin, Department of Chemistry, McGill University, Montreal, Quebec H3A 2K6. (514) 392-5784. *October 13-14*

● **FUTURE OF VIDEO DISC**
The Second International Conference on the Future of Optical Memories, Videodiscs, and Compact Disks to the Year 2000. Loew's Summit Hotel, New York City. Speakers and demonstrations. The fee is \$795. Contact Technology Opportunity Conference, POB 14817, San Francisco, CA 94114-0817. (415) 626-1133. *October 15-17*

● **UNIX INSIDE AND OUT**
UNIX Operating System Exposition and Conference. Sheraton Centre Hotel and Marina Exposition Complex, New York City. Seminars, social functions, and 350 exhibition booths. Contact National Expositions Co. Inc., 14 West 40th St., New York, NY 10018. (212) 391-9111. *October 16-18*

● **OFFICE COMPUTERS**
The Sixth Annual Calgary Computer and Office Automation Show, Roundup Centre, Calgary, Alberta, Canada. Contact Industrial Trade Shows, 20 Butterick Rd., Toronto, Ontario M8W 3Z8, Canada. (416) 252-7791. *October 17-18*

● **COMPUTERS, COMMAND, CONTROL**. The Second Annual Symposium and Exhibition of AFCEA, Inn at Executive Park, Kansas City, MO. The theme for this year's symposium is "The Role of Knowledge-Based Systems in Command and Control." Panel discussions, paper presentations, and exhibits. Contact Armed Forces Communications and Electronics Association, POB 456, Leavenworth, KS 66048. (913) 651-7800. *October 17-19*

● **ASIS MEETING**
The Forty-Seventh Annual Meeting of American Society for Information Science, Franklin Plaza, Philadelphia, PA. This year's theme is "1984—Challenges to an Information Society." Contact 1984 ASIS Convention, The Automated Office, 3401 Market St., Philadelphia, PA 19104. *October 21-26*

● **HOOSIER COMPUTERFEST**
Indy/Con '84, Indiana Convention Center and Hoosier Dome, Indianapolis. The largest micro-computer/electronics exhibition and conference in the state. Contact Indy/Con, 5160 East 65th St., Indianapolis, IN 46220. (317) 842-3024. *October 23-24*

● **COMPUTERS IN CONSTRUCTION**. Computers in Construction. Atlanta, GA. Fee: \$425. For further details, contact CIP Information Services Inc., 1105-F Spring St., Silver Spring, MD 20910. (301) 589-7933. *October 25-26*

● **COMPUTERS IN ARTS**
Symposium on Small Computers in the Arts. University Hilton Hotel, Philadelphia, PA. Introductory and advanced courses in computer animation, music, graphics, interfaces, and legal issues complemented by talks, exhibits, research presentations, a computer art gallery, and film shows. Contact Symposium, POB 1954, Philadelphia, PA 19105. *October 25-28* ■

Formula-1 is your clever better-half.

AVAILABLE ON OCTOBER!
IBM PC COMPATIBLE
"MICROVOICE-16" IS
IN PREPARATION!

DISTRIBUTOR
& OEM
Inquiries Invited



Portable Computer

ALL-IN-ONE

Formula-1



Triple Actor

Development & Maintenance Tool
 Built-in-EP-ROM Programmer on CP/M basis for software development & maintenance.

Terminal
 Access to the host computer.

Portable Business Computer
 WordStar (MailMerge & SpellStar included), CalcStar, InfoStar SYSTEM (DataStar, ReportStar & FormSort included) are bundled to Formula-1.

You must be able to design more effective Information Management System by reasonable cost and small space. Formula-1 with bundled software packages will be a good assistant to solve many of your problems.



1. Small and All-In-One

This portable computer is a high-performance and composed of 2 disk drives of 5.25" two-sided double density, 5.5" CRT, Folding-Keyboard, Thermal Printer, EP-ROM Programmer, Serial & Parallel I/O Interface and expansion Floppy Disk Interface all packed in one case.



2. Built-In EP-ROM Programmer

You can write-in CP/M's HEX and COM files directly to EP-ROM and also can write-in EP-ROM's data directly to HEX file. EP-ROM-2716, 2732, 2764 and 27128 are available.



3. Acoustic Coupler FCP-300

You can build communication network system by connecting acoustic coupler and Formula-1 can be a terminal of office computers.



Computer System Engineering
MICROVOICE CORPORATION

Shinei Bldg., 8-5 Nishishinjuku 3-chome, Shinjuku-ku, Tokyo, 160 JAPAN Telephone: (03)377-1661 Telex: 2325279 MVOICE J

Introducing the new Project Scheduler 5000™

Help! The demands of managing a project have you frantically juggling people and resources. It's getting more complicated and you're about to drop the ball on profits and deadlines.

Successfully managing one project can be difficult. Successfully managing two or three projects can be overwhelming. But now, help is here for you. With Project Scheduler 5000 you can precisely forecast, schedule, control and track large projects easily and quickly. You can replace your frustration with a sense of self-satisfaction from a project well managed.

Main Frame Power — Personal Computer Simplicity

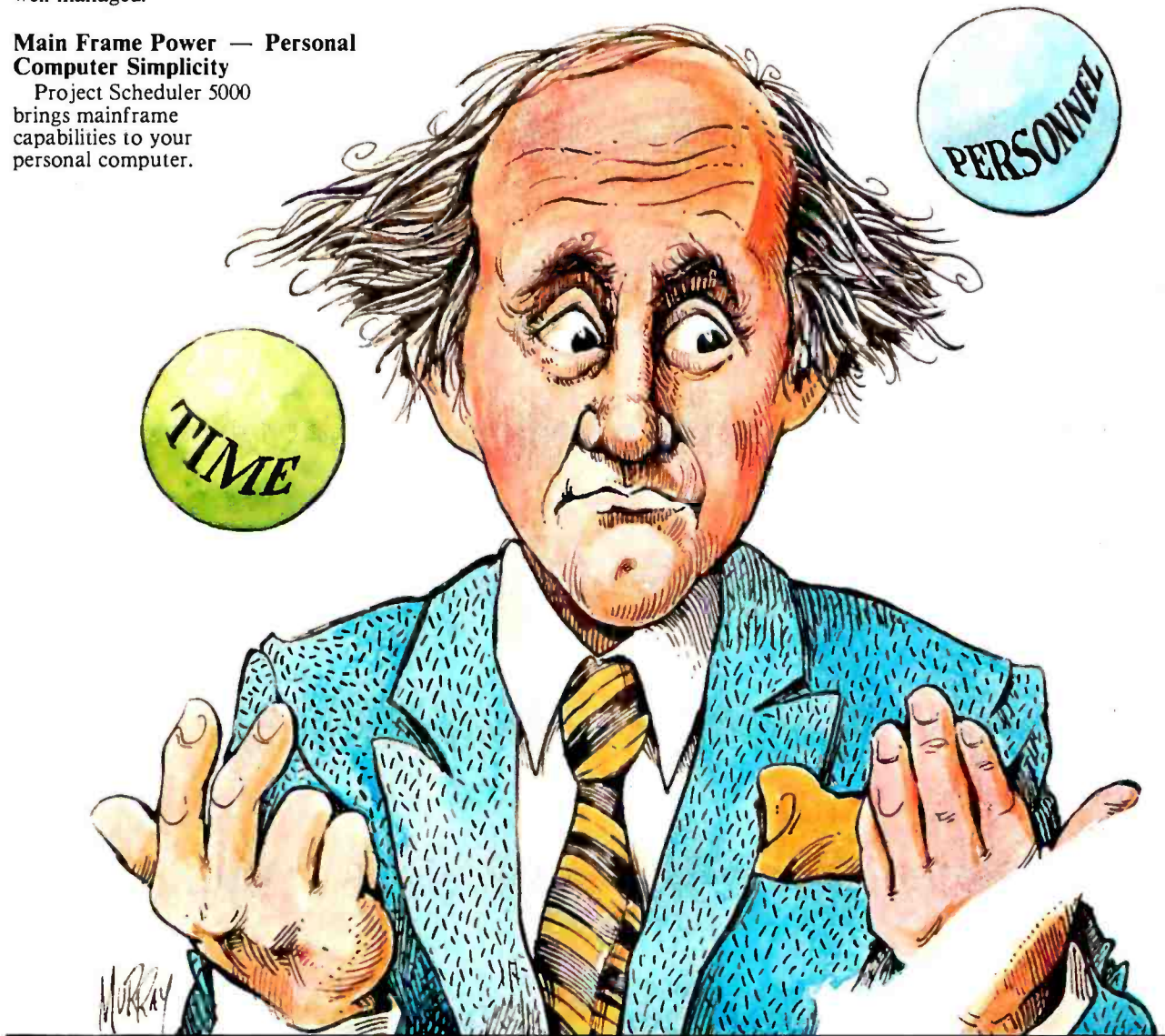
Project Scheduler 5000 brings mainframe capabilities to your personal computer.

This new generation in scheduling software makes possible what was, until now, only a dream: true interactive use and immediate response to changes and additions. You can schedule over 5000 activities spread over 10,000 time periods. What this means is that you can manage the largest projects with ease. While you probably don't need this power on a daily basis, it's nice to know that you have room to grow.

Interactive "What If" Capability

"What if" scenarios are an important source of information that allow you to make the best decision after trying the alternatives. Now you have time for this kind of in-depth planning, because updating and modifying are so simple with Project Scheduler 5000.

A scheduling package should do more than schedule. With Project Scheduler 5000 you never take the risk of making guesses instead of accurate decisions.



... the best solution to effective project management

On Time On Target

Project Scheduler 5000 gives you all the information you need when you need it. Instantly, you know the status of your project.



At a glance, unique plot symbols will let you know whether or not the project is on time and on target and if not, why. Meeting performance goals will become a habit.

Project Scheduler 5000 keeps you constantly informed through its partial complete capabilities. Partial complete status is displayed, reported and used to calculate "value earned".

Accurate Resource Assignment

Extensive resource categories allow you to schedule more efficiently. Using these categories, you can assign to an activity an almost limitless amount of resources. In addition, these resources can be assigned at any point within the activity timeline providing the accuracy you need to build realistic resource profiles by person, labor grade, or other types.

Integration Of Multiple Projects

Keeping track of how a resource is used from project to project can be extremely difficult. Not with Project Scheduler 5000. The program can combine projects to give you a complete overview of where and when resources are used. Graphic presentations can be condensed allowing you to visually compare multiple projects quickly and easily. Think of it! You can simultaneously manage several projects and be on time and meet or beat cost projections on each one.

Get The Picture Any Way You Want It

Hours, days, weeks, and months. You can select the resolution you need. In addition, you can break days into as many as 99 units to provide detailed shift or hour resolution. Get the big picture of your schedule on the screen or report by selecting a compressed format which displays up to 60 days, weeks or months of a project.

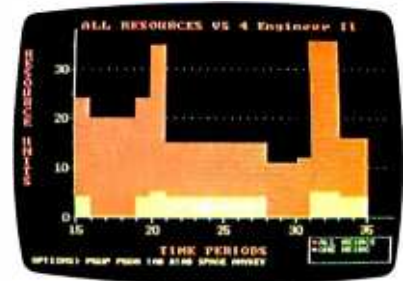
Fast Comprehensive Reporting

Communicating project information is no longer the time consuming task it used to be. An enhanced report generator synthesizes project information into reports on resource allocation, status, schedule and cost at both the project and the detailed activity level. You can interactively define special reports to give you all the detail you need. Reports and Gantt plots can be printed on hard copy or stored on disk for future use. Presentation quality graphics are available on a color plotter. Additionally, a spreadsheet interface provides labor and cost transfers for further analysis.

Integrated Graphics Power

Project Scheduler 5000 plus Graphics complements the outstanding scheduling and reporting features provided by Project Scheduler 5000. Using presentation quality financial line graphs, resource histograms, resource bar graphs and other high impact displays, Project Scheduler 5000 plus Graphics provides additional insight as you study in depth the effects of resource allocation, labor usage distribution and cost spreads.

With this control tool you can also track your original cost estimates against updated forecasts and expenditures. Project Scheduler 5000 plus Graphics will help eliminate the possibility that you'll overlook critical costs and deadlines.



Available for PC or MS DOS:

IBM PC or XT
TI Professional
Wang PC*
Grid Compass*
DEC Rainbow*

*Project Scheduler 5000 plus Graphics available 4th quarter 1984.



SCITOR

SCITOR CORPORATION
256 Gibraltar Drive
Sunnyvale, CA 94089
(408) 730-0400



IVAN POWELL '89

Features

FRAMEWORK
by Rik Iadrnicek, John Markoff, and Ezra Shapiro 121

THE 65816 MICROPROCESSOR.
PART I: SOFTWARE
by Steven P. Hendrix 125

CIRCUIT CELLAR FEEDBACK
by Steve Ciarcia 129

BENCHMARKING UNIX SYSTEMS
by David F. Hinnant 132

FORTH-83: EVOLUTION CONTINUES
by C. Kevin McCabe 137

THE 6502 MICROPROCESSOR has a history as brilliant as that of the Beatles or the Boston Celtics. Not just the heart and soul of a still-evolving line of Apple computers (see the May BYTE, page 276, for John Markoff's product description of the new Apple IIc), the 6502 has given life to personal computers made by Commodore, Ohio Scientific Instruments, and Atari, plus single-board computers by Rockwell and Synertek, two early second-source makers of the chip. After its invention in 1974 by a team of eight ex-Motorola employees working at a calculator-chip company called MOS Technology, the 6502 quickly became an engineering success owing to its compact instruction set, high clock speed, extended addressing modes, and memory-mapped I/O.

But what has become of the 6502 in the 16-bit microprocessor age? Is a CMOS 65C02 the end of the evolutionary ladder for this popular chip? This month, Steven P. Hendrix provides details on a recently announced 16-bit version of the venerable 6502, a microprocessor called the 65816 made by Western Design Inc. of Mesa, Arizona. Capable of addressing 16 megabytes of memory and running at clock speeds up to 10 MHz, the 65816 offers complete software compatibility with its 8-bit predecessors. It is rumored to be at the heart of a new Apple computer called the Apple IIx. Hendrix's examination of this enhanced microprocessor's software is part I of a two-part story that concludes next month with a detailed look at the hardware.

In the wake of our preview of Symphony comes a look at Ashton-Tate's Framework in a feature put together by our West Coast staff. Using an outline processor for its underlying structure, this integrated program uses frames instead of windows (will the next generation product use window frames?) and can peer through a frame into a dBASE II database presenting the data laid out in a table, so you don't have to create an arcane report form to view data. Our product description shows Framework to be a significant offering.

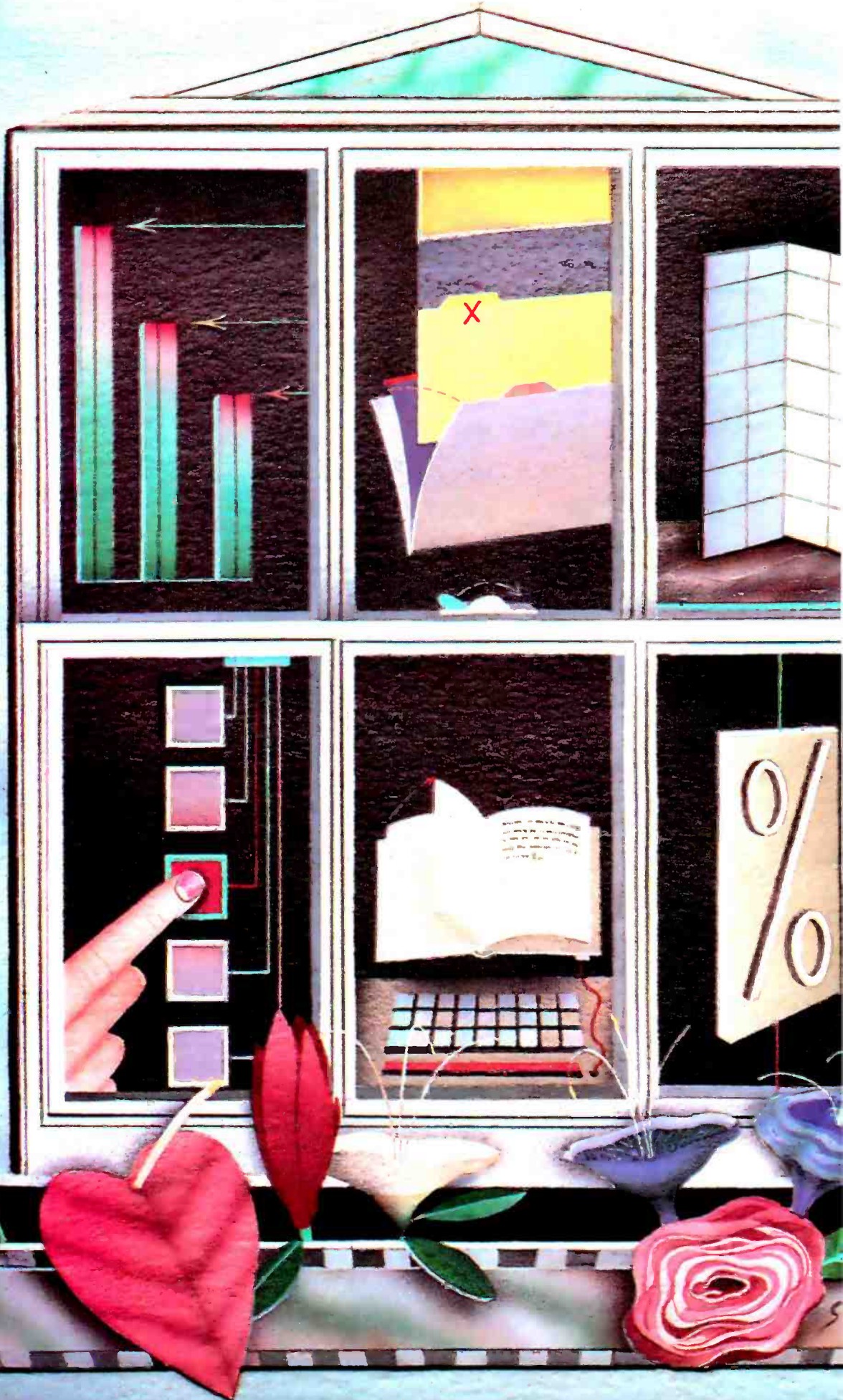
Since readers and editors alike have a minimum monthly requirement for benchmarks, this month we put UNIX through its paces on several mini- and microcomputers to time functions like performing disk reads and writes, making function calls, and finding prime numbers (using the infamous Sieve benchmark). David F. Hinnant's report may give you some insights into how UNIX works as well as information on how different versions perform.

The FORTH language community has more fodder for its debates on the merits of FORTH's different "official" versions now that FORTH-83 has been adopted by the FORTH Standards Committee. As author and committee member C. Kevin McCabe describes, FORTH-83 differs significantly from FORTH-79, even going so far as to redefine some FORTH keywords. Nevertheless, you can expect this newest version of FORTH to win substantial support from many threaded-code proponents.

The hazy days of summer prompt Steve Ciarcia to take a project-building break this month. He takes advantage of the respite to answer letters from readers about projects covered in past issues. Steve's answers can help to clarify those occasionally tricky problems that crop up when late-night soldering sessions make your eyes blur while reading a crucial part of a schematic. A new Circuit Cellar project returns to these pages next month.

Next month also brings articles on the 65816, disk coatings, and a fascinating analysis technique called cluster analysis, along with reports from the microcomputer frontier.

—G. Michael Vose, Senior Technical Editor, Features



FRAMEWORK

BY RIK JADRNICKEK,
JOHN MARKOFF, AND EZRA SHAPIRO

*Integrated software
that combines familiar features
within a novel structure*

Framework, a new program for the IBM Personal Computer (PC) and work-alikes, was developed by Forefront Corporation and is now being distributed by Ashton-Tate. This package has something for everyone. All the usual elements of integrated software packages—word processing, database management, financial modeling, business graphics, communications, and a macro language—are combined in a window environment built around an outline-processing system.

The result falls somewhere between the two most popular approaches to integration: Framework is neither a shell that enables independent applications to exchange data (as are Visi On and DESO), nor is it a "seamless" integrated program (like Ovation). Nevertheless, the logical structure of Framework provides an easy transition between text and data operations and the generation of coherent, seemingly continuous final reports.

Framework is designed to be self-contained, including as it does all the major business applications. However, it is also an operating environment: you can open a window to DOS (disk operating system) and run a program. When you're finished, you'll find yourself back in Framework. As

(continued)

Rik Jadrnicek, a BYTE contributing editor, is president of Micro Flow (POB 1147, Mill Valley, CA 94942), a microcomputing consulting firm.

Ezra Shapiro is BYTE's West Coast bureau chief. He can be reached at McGraw-Hill, 425 Battery St., San Francisco, CA 94111.

John Markoff is a senior technical editor at BYTE's West Coast bureau. He can be contacted at McGraw-Hill, 1000 Elwell Court, Palo Alto, CA 94303.

AT A GLANCE

Name

Framework

Type

Windowing integrated software package with macro command language

Applications Supported

Word processing, spreadsheet, database manager, business graphics, communications, and outline processing

Manufacturer

Ashton-Tate
10150 W. Jefferson Blvd.
Culver City, CA 90230
(213) 204-5570

Developer

Forefront Corp.
Mountain View, CA

Price

\$695

Language

C

Computers

IBM PC and compatibles with two 360K-byte floppy-disk drives and a minimum of 256K bytes of RAM

Audience

Business professionals



Photo 1: The Framework desktop in its initial state. Menus along the top edge can be accessed by holding down the control key and the first letter of the menu title.

Framework cannot control all the screen-handling routines employed by an external program; it may not be possible to run it within a partial-screen Framework window—the program itself might grab the whole screen. The basic DOS commands (CHKDSK, DIR, etc.), though, can be run in a small corner of the Framework display.

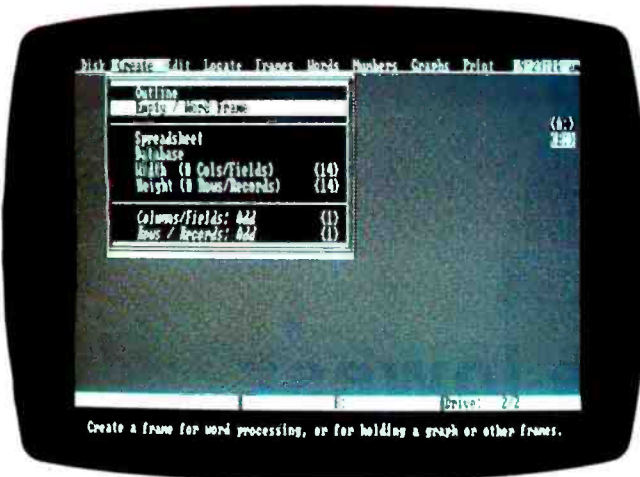
UNDERSTANDING FRAMES AND OUTLINES

The underlying principle of Framework is really quite simple. You create "frames" (roughly equivalent to subfiles appearing in separate windows on the screen) containing text, graphics, database, or spreadsheet data. Each frame can hold a maximum of 32,000 characters, but that is not a limitation on file size: the trick to using this product is to start seeing your data as smaller blocks that can be linked together when it comes time for output.

Framework's opening display consists of a blank central workspace (dubbed the "desktop"), a line of one-word menu titles across the top of the screen, and a status area at the bottom for various messages. You can pull down menus for operations that remain consistent throughout Framework (such as frame creation and on-screen formatting) by pointing to the appropriate title with the cursor. This menu line is always displayed, and you're never more than a couple of keystrokes away from accessing its commands. Most of your actual work is done in windows on the desktop: formulas and macro commands are usually entered and displayed in the status area. On-line help is available with the touch of a function key. This arrangement should be familiar to the users of spreadsheets or some of the newer word-processing packages.

Using the menus, you begin by first deciding whether you want to work on text, a database, a spreadsheet, or an outline (more on that later) and then opening a window on the screen. Suddenly, a box appears that's appropriate to its function (e.g., a spreadsheet frame set up with letters across the top to indicate columns and numbers down the left side to indicate rows). This window is the basic operational unit, the frame. Using the function keys, you can size it for your needs and drag it around the screen to a convenient position. It's initially untitled, but you can enter a name for it along its top border. With the plus-sign and minus-sign keys on the right edge of the cursor/numeric keypad, you can "zoom"

(2a)



(2b)



Photo 2: There are two ways to begin working with Framework: either start a brand new frame by selecting its type from the Create menu (2a) or call in an existing file from one of your disk drives by using the Disk menu (2b). The Disk menu also includes options for closing files and cleaning up the desktop.

in from the desktop to the frame title, in to the frame, and back out again. The bottommost zoom position blows up the frame to occupy the entire desktop. You can have a large collection of frames open on the desktop at any one time; you aren't required to close up and put away any of them until you're done. Though Framework is memory-bound—that is, it works entirely in available RAM (random-access read/write memory)—the program uses data-compression algorithms to temporarily squeeze open frames that haven't been used for a long time. While it's conceivable that you'll hit the upper limit of your system—by trying to recalculate an enormous spreadsheet, for example—it's unlikely that you'll have to close frames in order to continue to work. Warning messages signal if you push your luck.

Framework departs from other windowing environments in how it keeps track of frames: it ties them together in an outline that is essentially hierarchical. Frames are ordered as you would rank them in an indented outline. Though frames may be given the same weight and treated as independent files, all frames are not necessarily created equal; a frame can have one or many subframes, and those, in turn, can also have "descendants." In fact, you can open a new frame at any point within an existing frame or build a new frame around an old one. Even a frame title or a spreadsheet data cell can become an entire frame that you can zoom in to. Framework keeps an account of this structure by building an index of frame titles that looks like a standard outline.

You have two ways to deal with this system, and you can toggle between them with a few keystrokes. First, you can simply create frames one at a time and build the hierarchy as you go along. In this case, opening a view of Framework's outline processor is merely a method of providing yourself with a map of how you've organized your data. Using the second method, you can open an "outline frame," which is set up displaying a simple indented form, empty at the outset, into which you can enter short points that can then be used as frame titles. You don't have to open frames for every point if you don't want to, and it isn't necessary to put anything at all into an open frame on the desktop. Framework's power and flexibility become evident as you learn how to move back and forth between these two outline-processing modes.

Furthermore, you can use an outline frame to create just

(continued on page 370)

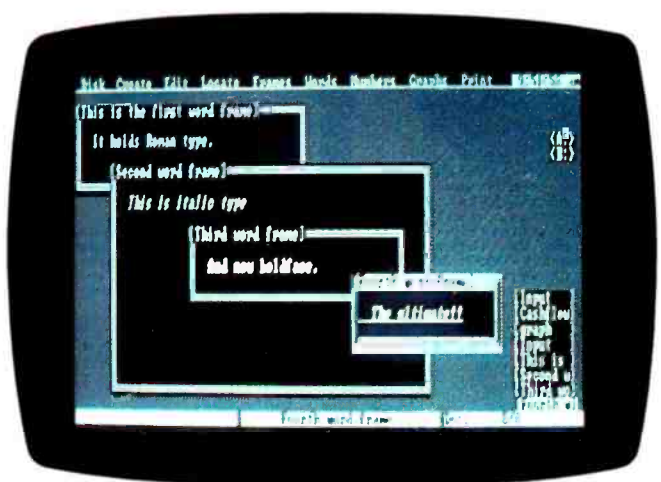


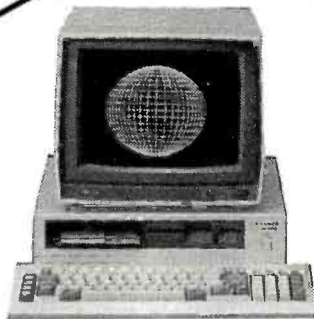
Photo 3: The stack of "trays" (bracketed titles) to the lower right shows all frames available on the desktop in the order in which they were created or opened.



Photo 4: Two simple spreadsheet examples and a graph generated from one of them. Were the graph to be zoomed to full-screen dimensions, it would appear in color.

#1 Rating
(Spreadsheet Configuration)
Auerbach's Index
"... a terrific machine"
Microcomputing May 1984
"... a great bargain"
Computers and Electronics May 1984

NOW 720K DRIVES



We have the lowest prices for Sanyo 550's*

*Our prices this month are at least \$10 less than any other bona-fide advertised price in this magazine for Sanyo 550/555's, the 360k-2's, and our new 720k-4's. Of course, low prices aren't the only reason we've sold more Sanyo 550's than any dealer in the United States. To find out why these "under \$1000" MS-DOS machines are the "hot" computers of 1984 call or write for our new 12-page brochure.

SANYO

FREE LG PRINTER



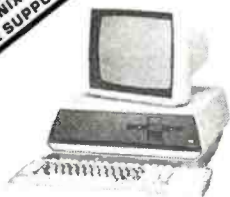
Special sale on "4-digit" Sanyo computers. All include dual drives, Disk, Wordstar, Colstor, Mailmerge, Spellstar and Infostar. Plus prices include a Sanyo 5000 letter quality printer (may be deducted for \$200 credit). The 1150's have dual 320K drives, the 1250's and 4050's feature 1.2 megabytes of formatted storage.

All Sanyo systems have a full one year warranty on the main board, 90 days on everything else, and can be serviced at over 50 service centers nationwide (quantities limited).

1150 w/CP/M	\$1499
1250 w/CP/M	\$1849
4050 w/CP/M-86	\$1999

ALTOS

XENIX
PHONE SUPPORT



From the lowest-priced dual-floppy multi-user systems to true 16-bit 10 MHz multi-user systems. Local service available via TRW. We will configure, test and install your systems for an additional charge (call for prices).

580-20	\$3629
580-40	\$5099
586-20	\$5925
586-40	\$7395
8000 Series	Call

Columbia

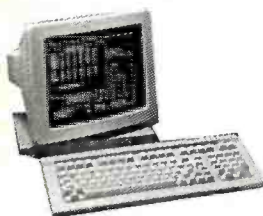
Compatible with IBM-PC's and your checkbook!



What are you looking for in a compatible system? If maximum compatibility, minimum prices, \$3000 worth of software, reliability and nationwide service are on your checklist you should consider buying a Columbia from Scottsdale Systems. Each system comes with MS-DOS, CP/M Calc, Fast Graphs, Home Acc'l Plus, Space Commanders, a tutorial and nationwide Bell and Howell service. (Prices for 1600 series include video card and keyboard).

V.P. (Portable)	\$1899	1600-1V	\$1899
Xtra 128K Installed	\$269	1600-4V (10mb)	\$3239

TERMINALS



Wyse 50 \$499
Also great prices on ADDS, other Wyse models, Televideo, Altos, Zenith and Qume terminals.

PLOTTERS

HI DMP-29	\$1795
HI DMP-40	\$745
HI DMP-41	\$2340

MODEMS

Password 300/1200	\$309
Hayes 1200	\$509
Hayes 300	\$209
Mark XII	\$249

NEC PC-8201A

\$449

Scottsdale Systems Ltd.

617 N. Scottsdale Road, Suite B, Scottsdale, Arizona 85257



(602) 941-5856



Call 8-5 Mon.-Fri.

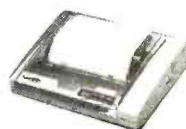


We participate in arbitration for business and customers through the Better Business Bureau of Maricopa County.

SERVICE/ORDERING

TELEMARKETING ONLY: If you plan to visit please call first for an appointment. Prices listed are for cash and include a 3% discount. We sell on a Net 30 basis to Fortune 1200 companies and universities. No C.O.D.'s or A.P.O.'s. P.O.'s add 2%. Visa, Mastercard add 3%. Az. residents add 6%. Prices subject to change, product subject to availability. Personal/company checks take 3 weeks to clear. All items listed are new with manufacturers warranty, 0-20% restocking fee for returned merchandise. Shipping extra-products are F.O.B. point of shipment. Software is not warranted for suitability. Registered trademarks: Televideo-Televideo Systems, Inc.; Unix-AT&T Technologies, Inc.

PRINTERS



Okidata 92	\$180 Off List
Okidata 93	\$350 Off
Plug n' Play	Free if you ask
Okidata 84	New Low Price
IDS/Data Prod	Call
Tally Spirit	\$298
Tally 160/L	\$599
Tally 180/L	\$777
Gemini 15X	\$140 Off
Toshiba 1351	\$1039
Radix	Call
Epson	Call

LETTER QUALITY

Juki 6100	\$418
Silver Reed 500	\$409
Silver Reed 550	\$498
Silver Reed 770	\$849
Diablo 630	\$1669
NEC 3530	\$1279
NEC 7710	\$1735
DTC 380Z	\$995

COLOR MONITORS

Princeton HX-12	\$489
Zenith ZVM-133	\$449
Amdel Color 1	\$274
Roland CB-141	\$319



GEMINI 10X

The best price on the best-selling Gemini 10X Directional - 120 c.p.s. printing - 80 or 132 columns in condensed mode. True descenders, bit graphics, and a 6 month warranty. Great prices on all other Star Products.

Gemini 10X \$258



THE

65816

MICROPROCESSOR

PART 1: SOFTWARE

An 8-/16-bit successor to the 6502

WITH SEMICONDUCTOR memory prices falling, microcomputer systems are boldly going where no micros have gone before. Systems with 64K-byte main memories are common, and those with a megabyte or more are just around the corner. Since such old 8-bit standbys as the 6502, 6800, and Z80 can directly address only 64K bytes, their days as the backbone of general-purpose systems may be numbered. Indeed, the increasing number of personal computers, like Apple and Atari, using bank switching and disk simulation to expand their semiconductor memory access shows the growing severity of the address-space pinch.

Designed to relieve the constraints of limited memory, a new branch of the

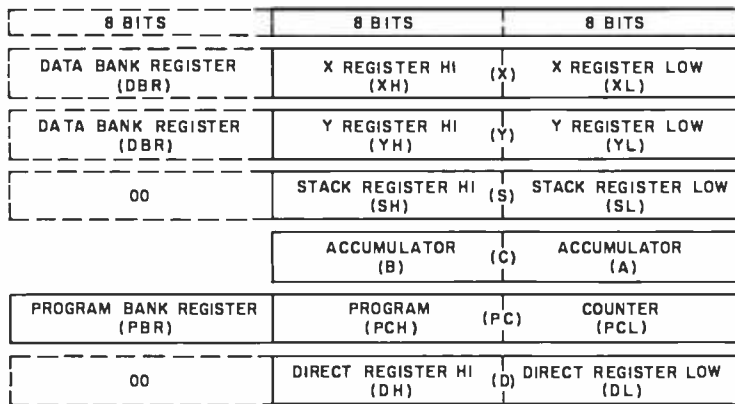
6502 family directly addresses up to 16 megabytes while bringing the simplicity and execution speed of this time-tested microprocessor to 16-bit systems. The main representative of this new group is the W65SC816, which I refer to hereafter as the 65816. In emulation mode, it is pin- and software-compatible with the 6502, and toggling a single flag bit converts it to a complete 16-bit processor. In part 1 of this article I cover

(continued)

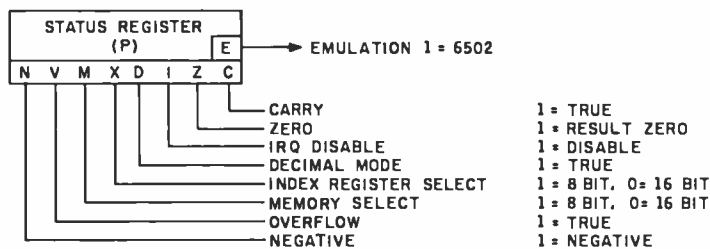
Steven P. Hendrix, an instructor pilot for the U.S. Air Force, has a B.S. in computer science and mathematics from the USAF Academy. He can be reached at Route 8, Box 81E, New Braunfels, TX 78130. His hobbies include computers and astronomy.

BY STEVEN P. HENDRIX

W65SC816 PROCESSOR PROGRAMMING MODEL



STATUS REGISTER CODING



PIN CONFIGURATION

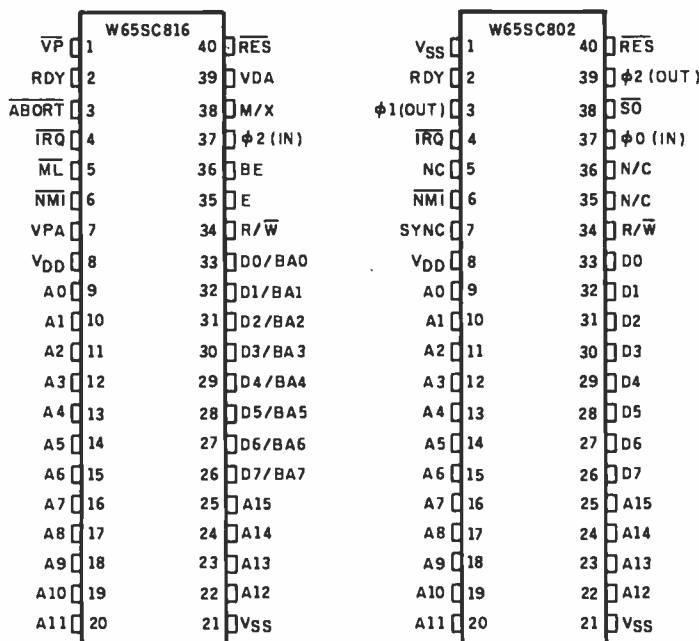


Figure 1: The programming model for the 65816 shows that the 6502's 8-bit registers have been expanded, the program counter extended, unused bits filled, and a new register (the direct register) added.

some of the software considerations for this processor. Next month, part 2 will address some hardware considerations. Throughout, the term "page" refers to a 256-byte memory area wherein individual location addresses differ in only the low-order 8 bits, just as for the 6502. "Bank" refers to a 64K-byte memory area with address locations that differ in the low-order 16 bits, with the upper 8 bits identical.

OVERVIEW

Figure 1 shows the programming model for the 65816. Close examination reveals the 6502 registers with extensions, plus one additional 16-bit register formerly not present (the direct register) and two 8-bit bank registers. The 8-bit registers of the 6502 have been extended to 16 bits, the 6502's 16-bit program counter has been effectively extended to 24 bits, and the previously unused bits in the status register have been filled (with an extra bit added). The accumulator and index registers still can be treated optionally as 8-bit registers by setting the appropriate status register bits. Except for the accumulator, the full 16-bit registers retain the original 8-bit names. Each half of each register uses the same original name, and they are distinguished from one another by an "H" or "L" suffix for the high- and low-order bytes, respectively. The 16-bit accumulator is newly designated as "C." The high- and low-order bytes of the accumulator are referred to as "B" and "A."

The six status register flags matching those of the 6502 retain the same meanings. The seventh 6502 flag, "B,"

(continued on page 385)

E = 1 (6502 Emulation)

00FFFE.F—IRQ/BRK	Hardware/Software
00FFFC.D—RESET	Hardware
00FFFA.B—NMI	Hardware
00FFF8.9—ABORT	Hardware
00FFF6.7—	—
00FFF4.5—COP	Software

E = 0 (16-Bit Operation)

00FFFE.F—IRQ	Hardware
00FFFC.D—RESET	Hardware
00FFFA.B—NMI	Hardware
00FFF8.9—ABORT	Hardware
00FFF6.7—BRK	Software
00FFF4.5—COP	Software

Figure 2: When the 65816 is not emulating a 6502, it has a separate vector that defines the software interrupt's location and relieves the routine from having to determine which type of interrupt invoked it.

YOUR PC CAN BE YOUR NEXT SMART TERMINAL.

SmarTerm software can make your personal computer a lot more intelligent than it really is.

Our terminal emulators have the features that do the job: Full keyboard emulation. Multiple setups. TTY mode. "Smart" softkeys. Printer support. Help screens. And a friendly user manual.

Built-in text and binary file transfer is powerful and simple to use, and does not require

any special host software. SmarTerm also features automatic file transfer and two different "error-free" protocols, including XMODEM.

There's a SmarTerm emulator that matches your needs: SmarTerm 100 for emulation of DEC VT100, VT102 and VT52. This program now features 132-column display mode support, using either horizontal scrolling or special 132-column video display boards. SmarTerm 125 includes all the features of SmarTerm 100, plus VT125 ReGIS graphic support. SmarTerm 400 for emulation of Data General Dasher D100, D200 and D400.

More than 10,000 customers have discovered just how smart their PCs can be with SmarTerm. We think you'll agree. Try it for 30 days with full refund privilege.



IN A WORLD OF CHANGE, THE SMART GET SMARTER™

Call today for more information.

Available through your local software dealer, or Persoft, Inc., 2740 Ski Lane, Madison, WI 53713. Phone (608) 273-6000. TELEX 759491.

SMARTERM is a trademark of Persoft, Inc. • DEC & VT are trademarks of Digital Equipment Corp. • Dasher is a trademark of Data General Corp. • IBM is a registered trademark of International Business Machines, Inc.

Circle 247 on inquiry card.



persoft

Introducing the first computer games that pay you to own them.



bc
BLUE CHIP SOFTWARE



Blue Chip Software is a registered trademark

We've helped Blue Chip make a million,



PLATO
The face of quality educational courseware.



Plato is a registered trademark of Control Data Publishing

Plato[®] courseware educate,

Thoughtware.
Expanding The Universe Of Learning



Thoughtware.

Thoughtware is a registered trademark of the Institute for Management Improvement

and Thoughtware[®] expand the universe of learning.

If you don't know us, you probably should.

The world's leading producers of quality software trust their software duplication to us. We're Allenbach Industries. We created the diskette duplication industry. So it is no surprise that the most respected names in software turn to us for their duplicating needs. We understand that your reputation lives or dies with every package sold. So does ours. That's why every step of the duplication process — from copy protection to labeling to package design and assembly — is supported by a complete staff of professionals. When your product leaves our facility, whether it be a duplicated diskette or the entire market-ready package, it's ready for your name.

Give us a call at (800) 854-1515* and discover how we can help you make a million.

*In California, call collect (619) 438-2258.

ALLENBACH
INDUSTRIES, INC.

2101 Las Palmas Drive • Carlsbad, California 92008 • 619-438-2258 • 800-854-1515
We Set the Standard in Software Duplication

Circle 15 on inquiry card.

© 1984 Allenbach Industries, Inc.

C·I·A·R·C·I·A'S C·I·R·C·U·I·T C·E·L·L·A·R

Circuit Cellar Feedback

Steve
answers
some letters
about past
projects

BY STEVE CIARCIA

One result of writing a design column like the Circuit Cellar is that it produces a lot of mail. While this might be a curse for some authors, I find that receiving many pounds of mail suggests that I'm doing something right.

Generally speaking, reader feedback comes in three forms. The first group includes general computer questions and interfacing problems. A selection of these questions is presented each month in "Ask BYTE."

The other two groups deal specifically with my articles or make project suggestions. There never has been a good vehicle for sharing this correspondence with you. I sometimes insert a few project-related questions in "Ask BYTE" when I think the answer has some broad educational value.

Unfortunately, because most of these project-specific letters are never published, I receive many of the same questions and have to answer them individually. For example, unless you wrote me directly or found it somewhere in BYTE, you probably wouldn't know that there is now an MPX-16 user's group (see page 398), that there is a PAL (phase alternating line) equivalent for the Texas Instruments NTSC (National Television System Committee) graphics chip used in EZ-Color,

or that an alternative 300-bps modem chip is available so that the ECM-103 can operate in Europe.

This month, rather than presenting a new project, I'll share some of these project-specific letters with some answers I've been mailing to other readers. The ones I've chosen are just a few of the hundreds I receive each month.

The letters I appreciate most are project ideas and general comments. Many readers take the time to describe their experiences building Circuit Cellar projects and enhancements they have made. While there has been no lack of article ideas on my part, it is hard to ignore a hundred letters asking for a 1200-bps modem or a voice-recognition interface.

Finally, with 450,000 technically educated readers, BYTE is one of the best sources of expertise in the U.S. Many of its readers chart the course of history rather than passively observe it.

I appreciate reader feedback and try not to take anything for granted. Many of today's inventions sound absurd at first disclosure, but, if you've developed a perpetual-motion machine, I'd like to know about it.

—Steve Ciarcia, Consulting Editor

RADIO SPEECH SYNTHESIS

Dear Steve,

I liked your article in the June 1983 BYTE ("Use ADPCM for Highly Intelligible Speech Synthesis," page 35). Could you please send me a new figure 7 (page 42) showing a 12-bit A/D converter in it?

I know the circuit sends out TTL-level parallel data: could you recommend a circuit addition that will let me send out this audio data in a serial bit stream? I may send this data over a short radio link (citizens band radio) to be received by a friend having a serial-to-parallel converter and then plug the converter into the circuit in figure 10 (page 49). It is a one-way data link. I might want to modulate this serial data stream and elevate the entire stream by

16, 32, or 40 kHz in an upper-carrier fashion and demodulate at the receiving end. Does this sound like FM carrier modulation?

STEVE ABRAITIS
Cleveland, OH

The 12-bit version of the circuit can be found in the applications notes on the ADPCM chip. Contact your local Oki sales representative.

I do not recommend using a serial radio link
(continued)

Steve Ciarcia (pronounced "see-ARE-see-ah") is an electronics engineer and computer consultant with experience in process control, digital design, nuclear instrumentation, and product development. He is the author of several books about electronics. You can write to him at POB 582, Glastonbury, CT 06033.

in the manner you describe. This is due to the sheer magnitude of the speed requirements involved. For example, for an 8-bit D/A converter with an 8-kHz sample speed, the data rate is 4K bytes/sec \times 11 bps(async) = 44 kbps min. For a 12-bit D/A converter with an 8-kHz sample speed, the data rate is 6K bytes/sec \times 11 bps(async) = 66 kbps.

You would need a carrier of twice the bit rate, a minimum of approximately 120 kHz, to send this data over the air. This, coupled with the signaling speed requirement, puts the system out of the reach of conventional citizens band transmission.—Steve

NEEDS DISK CONTROLLER

Dear Steve,

I used your book to build a Z80 computer. I am now starting on your Term-Mite ST smart terminal (January, page 37). Now I think I may have reached a dead end.

Do you know of a disk-controller circuit and monitor program that would work with this computer? I haven't seen any. If you can be of any help, I would really appreciate it.

H. G. WOODWARD
San Antonio, TX

My ZAP computer was designed to be software and peripheral compatible with the Digital Group computer system. Any peripheral that can run with the DG system can be used with the ZAP, once the bus signals are lined up. A disk controller and DOS (disk operating system) are available for the DG machine. The DG system is being supported by Aeon Electronics, Suite MSB, 1855 South Pearl, Denver, CO 80210, (303) 777-2366.

Because the ZAP uses a Z80, the TRS-80 disk controller could also be used as well as the Tarbell, Morrow, and Godbout boards. Use of the last three boards would mean setting up the ZAP bus to the S-100 standard, which would make many other S-100 boards available for your use.—Steve

WHERE'S THE TRANSFORMER?

Dear Steve,

I recently bought your fine book *Build Your Own Z80 Computer*. I want to construct the computer and have started to gather parts. So far, I cannot find the 10-V, 6-A transformer. Also, what prototyping board was used?

I enjoy your articles in BYTE. I would

like to see construction and other articles on the TI-99/4A. It is a good computer.

PAT ROBERTSON
Virginia Beach, VA

You can use a transformer with a higher current rating or with a slightly higher voltage output (11.6 or so). Keep in mind that this will strain the regulators a bit more, and they may have to be heat-sunk and cooled. A 10-V, 6-A transformer is a moderately rare item, but you can order the Stancor Model P-8655 from Sterling Electronics, POB 7790, Richmond, VA 23231. The cost is \$18.45 (shipping additional). This unit provides the desired specifications in a center-tapped configuration.

For the prototype board, you can use an S-100 card produced by Vector Electronic Company. These are carried by Jameco, Priority One Electronics, and many other companies that advertise in BYTE.

I have played around with the TI-99/4A and was frankly amazed at the power and completeness of its BASIC. The full-size keyboard was nicer to type on than the keyboards found on many inexpensive units today. I did not like the way TI used function keys to logically shift the keyboard characters, however. Although the 99/4A has been discontinued, I'll keep an eye on the mail to see if projects for this machine are warranted.—Steve

SIMPLIFY THE ZAP

Dear Steve,

I am studying your book *Build Your Own Z80 Computer*, and I have several questions.

Has the state of the art changed significantly since you wrote the book that would simplify your computer? Is there reading material that would give me more information? I've noticed a TMM2016, 2048 by 8-bit RAM (random-access read/write memory) that looks like an attractive replacement for the 2114, 1024 by 4-bit RAM. Can these be exchanged without modifications to the circuitry? Can you tie MCS0 and MCS1 together to access this replaced RAM?

I also have a question about the lead IORQ that feeds two NAND gates that determine whether a read or a write operation is to be performed (figure 4.24 on page 109). Shouldn't this lead be IORQ rather than IORQ, since a high when active control signal is desired to AND the respective NAND gate to generate a low out on IORD or IOWR?

Any help you can give me will be appreciated.

DAVE SCHAFER
Omaha, NE

Several new chips are available that would simplify the ZAP computer. However, one of the underlying concepts behind the computer and the book was to make the circuits understandable to novice builders. The use of LSI (large-scale integration) multifunction components would have made the building simpler but the understanding harder. This is why discrete SSI (small-scale integration) and MSI (medium-scale integration) components were used.

BYTE Books and Hayden Press offer many fine books on computer peripheral design. Many examples of circuits that employ LSI devices are found in these books.

The TMM2016 memory part could easily be used in place of two 2114 parts. No circuit modifications are necessary, except for the MCS0 and MCS1 lines. Tying these together would damage the decoder IC. Line MCS0 addresses the 2708 EPROM (erasable programmable read-only memory), which has an 8-bit data bus. Lines MCS1 and MCS2 each drive two 2114s. The 2114s have a 4-bit data bus, which is why two are driven together. The 2016 part, with its 8-bit bus, replaces two of the 2114s and is driven by either MCS1 or MCS2.

Your comment on the IORQ line is correct. The positive true signal is the one that should have been shown on the schematic. This same problem occurs on figure 4.26.—Steve

QUESTIONS ABOUT LINE CONDITIONING

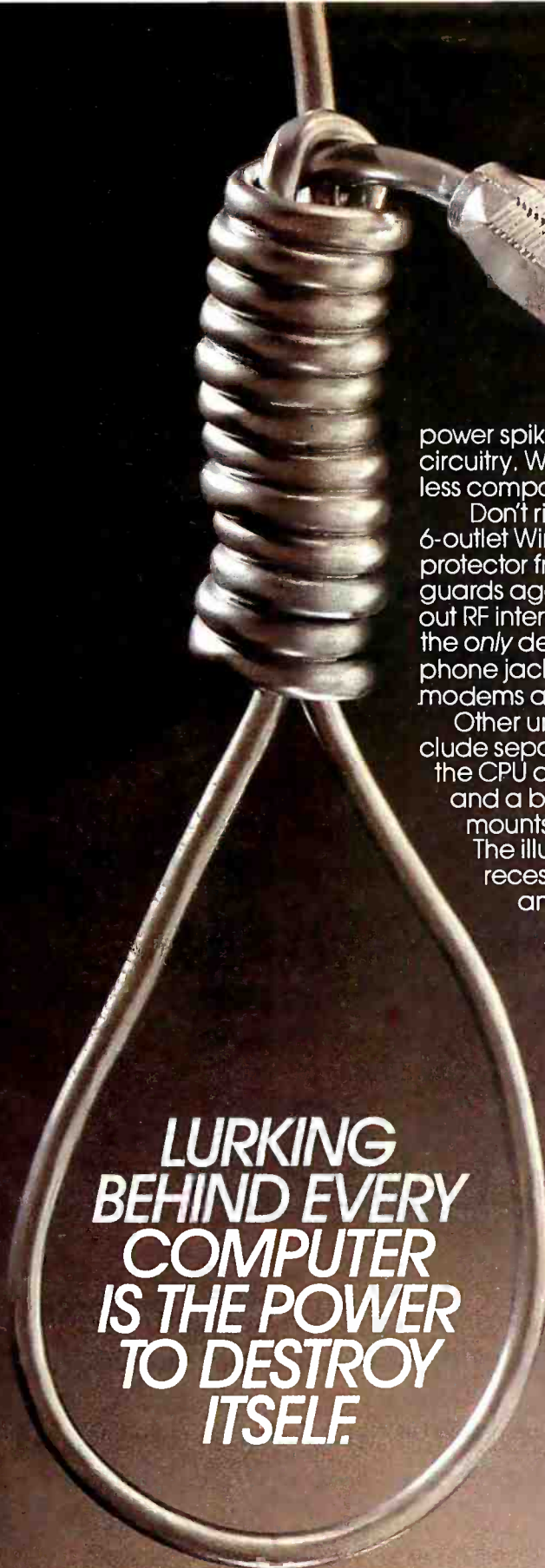
Dear Steve,

Thank you for the article on line conditioning ("Keep Power-Line Pollution Out of Your Computer") in the December 1983 BYTE (page 36). I've built an eight-outlet conditioned power bar with surge and EMI (electromagnetic interference) protection; I have three questions on this project.

Why are three MOVs required instead of two? Won't the function of the third be assumed by two acting together?

Radio Shack's EMI filter (part number 273-100) is rated only to 5A; to achieve a 10-A rating for the total system, I wired two of these units in parallel. Will this have any consequences on the EMI attenuation specs for the system?

(continued on page 392)



That power cord may look innocent. But it could suddenly turn against your PC.

It could, for example, hurt a power spike from static or lightning into its delicate circuitry. Wiping out its memory. Or destroying a defenseless component.

Don't risk it. Get a 6-outlet Wire Tree Plus™ surge protector from NETWORX™. It guards against spikes. Filters out RF interference. And it's the *only* device with two phone jacks to protect modems against surges.

Other unique features include separate switches for the CPU and peripherals and a bracket that

mounts under the front of the workstation.

The illuminated switches are easy to reach, and yet recessed, so you can't accidentally shut down power and lose data.

If you don't need 6 outlets, pick up our 4-outlet Wire Tree™. Or our single-outlet Wire Cube™ that's ideal for portable computers.

That'll take care of power surges. But what if your foot gets tangled in a power cord? Prevent this potential disaster with the Wire Away™. It stores up to four 18-gauge wires and ends the hazardous mess of dangling cords.

All our products are backed by a 5-year warranty. So when you shop for a PC, ask for NETWORX computer station accessories. And don't go home without them.

**LURKING
BEHIND EVERY
COMPUTER
IS THE POWER
TO DESTROY
ITSELF.**

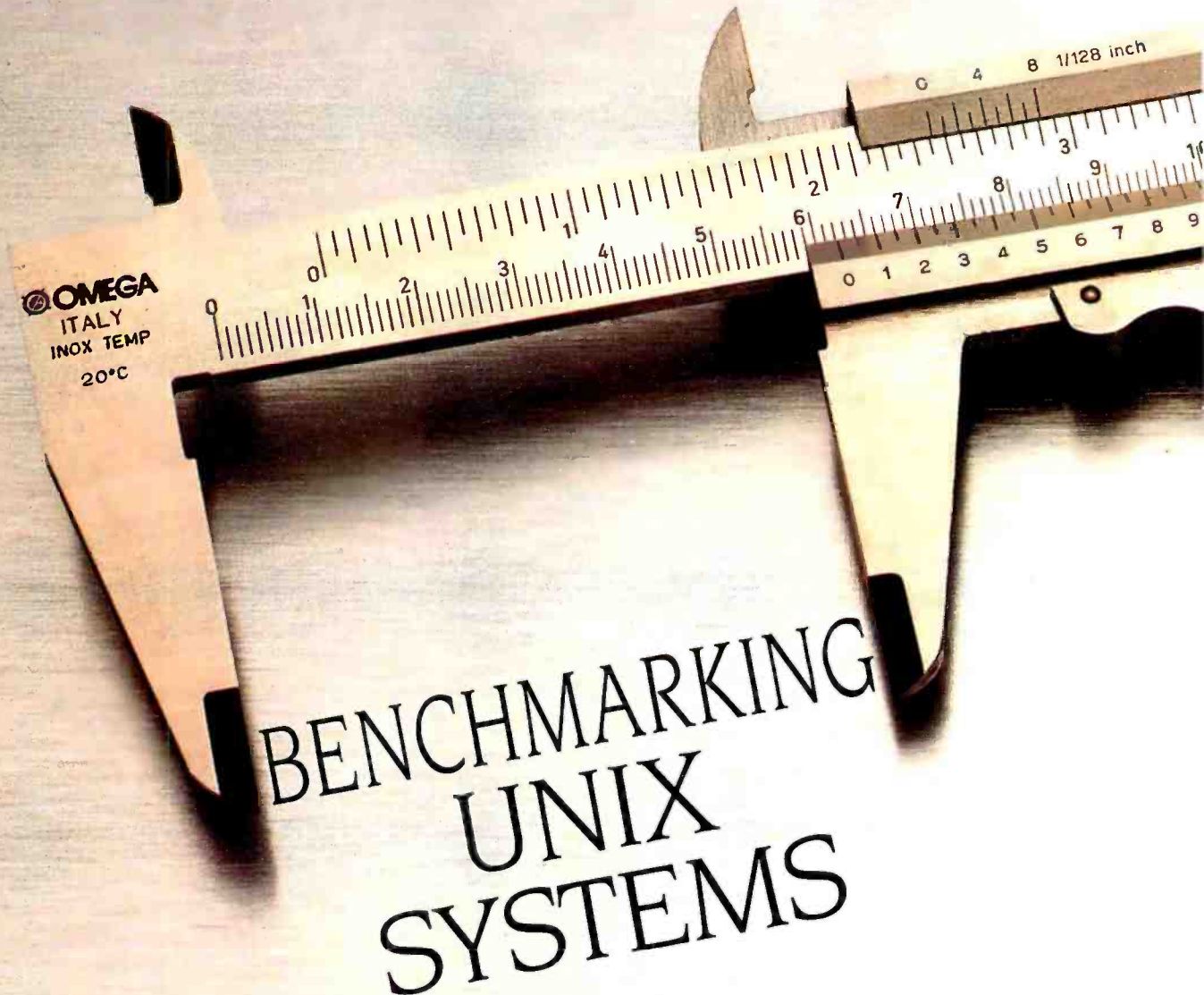


NETWORX™

Computer Station Accessories

Networx, Brooklyn, NY 11237-1587 (212) 821-7555

Circle 232 on inquiry card.



BENCHMARKING UNIX SYSTEMS

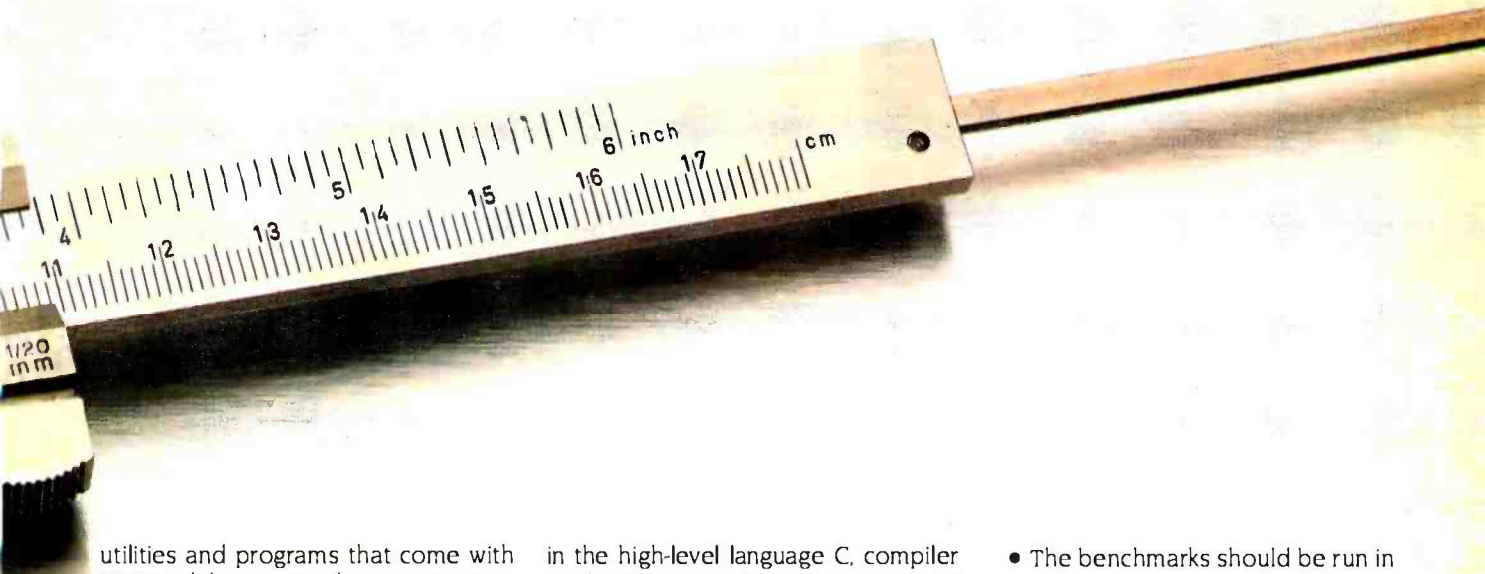
*UNIX performance
on microcomputers and minicomputers*

BY DAVID F. HINNANT

WITH THE ADVENT of inexpensive but powerful 16- and 32-bit microprocessors, the multiuser, multitasking UNIX operating system is available on many new microcomputers. Because UNIX is becoming a standard multiuser operating system, this article presents benchmarks for several microcomputer UNIX implementations and shows how they perform when compared to minicomputer versions of UNIX.

Almost every week, new versions of

UNIX for popular microcomputers or new UNIX-based microcomputers are being announced. They come from everyone from AT&T (UNIX was developed at Bell Laboratories) and IBM down to previously unknown companies who license UNIX from AT&T and then implement, or port, it for new hardware configurations. For some UNIX implementations on microcomputers, you need additional hardware (at least a hard-disk system for the megabytes of



utilities and programs that come with UNIX), while some implementations run by just inserting a disk and booting up the run-time operating system.

Quite a few releases of UNIX software are also available, including Version 6, Version 7, System III, and System V (AT&T's new standard) from Bell Labs; the 4.1 BSD and 4.2 BSD UNIX extensions from the University of California, Berkeley; XENIX, an enhanced UNIX Version 7 from Microsoft; VENIX, a finely tuned UNIX with real-time capabilities; Uniplus+, an enhanced UNIX System III from Unisoft; also, many systems claim to be "UNIX-like." Do all these UNIX implementations look and work alike? What do you look for in determining which is the better UNIX-based machine? Some will be faster than others because of hardware constraints, but how can you tell if you're getting the best system for your operating conditions? That's usually the bottom line. Enter the UNIX benchmarks.

Just what is a benchmark? For our purposes, a benchmark is a set of instructions that measures how well the hardware and software of a computer system perform together. Benchmarks can either exercise singular, specific functions of a compiler or operating system (e.g., *function-call* overhead or *system-call* overhead) or they can test the general performance of the machine by exercising a number of operations (e.g., looping, searching, etc.). In both cases, these timings are compared to results on other machines.

Benchmarking an operating system is much more complex than benchmarking a compiler. However, since UNIX and its language compilers are written

in the high-level language C, compiler implementation is just as important, as we will see. What should an operating-system benchmark do?

The purist approach tests only well-defined individual functions of the operating system (e.g., pipe implementation, disk throughput, system-call overhead, and context switching). This is difficult to do, as any program that exercises one particular operating-system function inadvertently includes statements that are not related to the function under scrutiny. We must reconcile ourselves to a benchmark that includes as little superfluous code as possible. Since this unwanted overhead varies from program to program, in most cases, the execution-time results cannot be manipulated in an arithmetic fashion to produce true timings of a particular operating-system function. They can, however, be compared to timings on other machines.

The practical approach tests overall system performance by performing many typical functions (e.g., sorts; compilations; and creating, listing, and deleting files) but in a controlled fashion. Again, these timings are compared with timings on other UNIX machines.

Both approaches have merit, and examples of both will be presented here.

SOME BENCHMARK GUIDELINES

Let's develop some guidelines for benchmarking operating systems in general and apply them specifically to UNIX. In order to benchmark any operating system, as many environmental variables as possible should be eliminated:

- The benchmarks should be run in a multiuser environment so that any normal operating-system overhead (e.g., context switching between processes and other operating-system housekeeping) is taken into account. (Most UNIX implementations offer a single-user mode as well as a multi-user mode.)
- The benchmarks should be taken more than once and averaged to compensate for any system-level background processes that repeatedly sleep awhile and work awhile. (A good UNIX example is the routine update that wakes up every 30 seconds and, among other things, flushes buffers and in-core tables to disk.)
- The benchmarks should be performed while the system is otherwise idle so that the timings are as true as possible. On microcomputers, even one additional user can distort benchmark results significantly; depending, of course, on what is being done.
- All available optimizations should be used. Implementations that take advantage of the hardware con-

(continued)

.....
David Hinnant (2017 Hunterfield Lane, Raleigh, NC 27609) holds a BS. degree in physics and is a UNIX systems programmer with ITT Telecom in Raleigh. He is coauthor of a book on UNIX microcomputers soon to be published by Robert J. Brady Co. His UNIX UUCP address is ...ucbvax!decvax!ittvax!itt!rahinnant. Machine-readable copies of the benchmark suite are available upon request to the UUCP address. Benchmark results from UNIX systems not mentioned in this article are welcome.

Listing 1: *The UNIX pipe benchmark.*

```

/*
 *          UNIX Operating System Implementation Test #1
 *
 * This program evaluates pipe efficiency and implementation.
 * Since pipes are commonly used in UNIX, pipe performance is often a
 * decisive factor in overall system performance, and says a lot about
 * the UNIX implementation. Here we test pipe implementation by
 * cramming 0.5 MB through a pipe as fast as possible.
 *
 * Instructions:
 *   Compile by:          cc -O -s -o pipes pipes.c
 *
 *   The -O option says to use the optimizer.
 *   The -s option says to strip the namelist from the
 *   object file after linking.
 *   The -o option says to place the object file in the file
 *   specified by the next argument.
 *
 * Time by:              /bin/time pipes
 *
 * Results:
 *   Since pipes usually use the disk as a buffer, real time is
 *   important, but can be misleading if the disk is very slow.
 *   Of greater importance here is the 'system' time, as it is
 *   a direct measurement of kernel efficiency. The 'user' time
 *   is of little importance.
 */

#define BLOCKS 1024

/* the buffer */
char buffer[512];
/* file descriptor for pipe */
int ffd[2];

main()
{
    /* want to test pipe implementation: not arithmetic */
    register int i;
    /* initialize the pipe */
    pipe(ffid);
    /* fork the child process */
    if (! fork() ) {
        /* parent process writes to pipe in 512 byte chunks */
        for (i = 0; i < BLOCKS; i++)
            if (write(ffid[1], buffer, 512) < 0)
                /* if there is a problem, say so */
                printf("Error in writing: i=%d\n", i);
        /* close the pipe when we're done */
        if (close(ffid[1]) != 0)
            printf("Error in parent closing\n");
    }
    else {
        /* close, since we aren't writing */
        if (close(ffid[1]) != 0)
            printf("Error in child closing\n");
        /* child process reads the pipe until EOF */
        for (i=1;
            if (read(ffid[0], buffer, 512) == 0) {
                break;
            }
        }
    }
}

```

figuration are generally better to begin with. If a compiler option for object-code optimization is available, it should be used. If the hardware can support fast (register in the case of C) variables, they should be used. In the benchmarks discussed here, all variables that can be of the register type will be declared as

such. In reality, the number of registers available for use by register variables varies widely because of hardware differences between microprocessors. Remember, our goal here is not to develop benchmarks that determine which UNIX machine is the best under a given set of requirements but to develop a general

set of benchmarks to aid the consumer in determining which hardware/software implementation gives the most performance for the money.

- The benchmarks should be *exactly* the same on all machines tested and portable enough to run on all the machines. Some may argue that if a particular software option is available, it should be used as an optimization is used (a binary-tree search function, for example). Keep in mind that extensions are not optimizations. Although the distinction can become cloudy, an extension is probably not used as routinely as an optimization.
- Some of the benchmarks developed should be able to exercise specific, known functions of operating-system and compiler implementation.
- The benchmarks developed should also contain tests of overall performance by simulating typical user activities. This should include executing background processes concurrently with foreground processes (if possible) to see how the system responds under a multitasking load.
- The benchmark timings should be made using a consistent and accurate method. A stopwatch just won't do. Fortunately, UNIX has a standard timing mechanism that reports elapsed (real) and processor times used by a process. The processor time is further divided into user and system times.

User time is the amount of time the process spent executing nonprivileged instructions (e.g., arithmetic calculations, sorting, searching, calling user-level functions, etc.).

System time is the time the process spent executing privileged (kernel) commands (i.e., system calls) plus some system-level overhead (e.g. context switching between processes).

The elapsed time is just that. And it is often not the sum of the user and system times. The majority of the missing time is spent waiting for I/O (input/output) operations to complete, waiting for a signal from another process, sleeping, or swapped out on disk while another program is running. It is unfortunate that in some implementations of UNIX the elapsed time reported by this timing mechanism is given only to the second. Thus, the sum of the system and user times can on occasion be greater

Table 1: The results of UNIX benchmarks for some common microcomputers and minicomputers. The table is sorted on the fastest execution (real) time for the shell benchmark in listing 6a.

System			Time in Seconds						
No.	Machine	Version	1. Pipe			2. System Call			3. Function Call
			real	user	sys	real	user	sys	real
1	VAX-11/780	4.1 BSD	3.2	0.1	1.2	4.8	1.4	4.0	1.0
2	Masscomp	Sys III+	5.7	0.0	2.8	6.3	0.4	5.8	0.9
3	Sun-2/120	4.2 BSD	7.6	0.1	3.7	6.8	1.1	5.6	0.8
4	VAX-11/750	4.1 BSD	4.6	0.2	2.1	7.0	0.9	6.2	1.7
5	PDP-11/70	2.8 BSD	8.1	0.0	3.4	8.0	0.2	7.5	1.0
6	Altos 986	XENIX	6.0	0.1	2.8	11.0	0.8	10.3	0.4
7	IBM PC XT	PC/IX	16.6	0.1	7.6	39.8	2.9	35.6	4.7
8	PDP-11/23	VENIX	30.0	0.1	9.5	24.0	3.2	20.4	3.3
9	IBM PC XT %	VENIX/86	18.0	0.1	7.3	20.5	2.3	17.8	2.8
10	SCI-1000 ~	Sys III+	9.3	0.0	3.1	26.2	0.7	24.2	1.2
11	Omnibyte	Idris *8:	32.0	0.1	30.4	21.3	2.5	18.4	1.7
12	TRS-80 16B	XENIX	8.0	0.1	3.4	15.0	1.5	12.7	1.4
13	PDP-11/23	V7	23.0	0.1	10.7	36.5	0.9	33.7	3.6
14	DEC Pro/350	VENIX	26.0	0.5	13.8	33.3	5.8	26.5	3.5
15	Apple Lisa	Sys III+	8.1	0.0	3.0	10.5	0.2	9.1	1.3

System			Time in Seconds												
No.	Machine	Version	4. Sieve			5a. Disk Write		5b. Disk Read		6a. Shell			7. Loop		
			real	user	sys	real		real		real	user	sys	real	user	sys
1	VAX-11/780	4.1 BSD	1.7	1.5	0.1	2.0		8.0		3.3	0.3	1.3	2.6	2.5	0.1
2	Masscomp	Sys III+	2.8	2.5	0.1	1.7		—		3.5	0.4	1.4	6.6	6.3	0.1
3	Sun-2/120	4.2 BSD	5.1	2.8	0.4	1.8		4.9		3.5	0.3	2.0	7.4	7.0	0.1
4	VAX-11/750	4.1 BSD	2.4	2.7	0.1	3.0		8.0		3.8	0.4	1.5	5.1	4.9	0.1
5	PDP-11/70	2.8 BSD	2.3	1.6	0.1	4.0		9.5		4.0	0.2	1.7	7.9	7.1	0.2
6	Altos 986	XENIX	3.3	3.0	0.0	3.5		7.3		7.0	0.4	1.6	13.3	13.0	0.1
7	IBM PC XT	PC/IX	8.2	7.8	0.3	11.6		20.7		8.5	1.1	3.2	32.2	31.5	0.3
8	PDP-11/23	VENIX	5.5	5.1	0.1	8.0		33.7		12.0	0.7	4.8	26.0	25.2	0.1
9	IBM PC XT %	VENIX/86	9.0	8.2	0.3	7.0		25.6		13.0	0.8	4.2	32.7	31.4	0.3
10	SCI-1000 ~	Sys III+	4.4	3.6	0.1	4.3		9.1		13.6	0.5	1.9	14.5	13.6	0.2
11	Omnibyte	Idris *8:	7.0	5.4	0.4	12.3		5		17.6	0.3	16.1	17.0	16.1	0.4
12	TRS-80 16B	XENIX	6.0	4.8	0.3	8.0		22.0		18.0	0.4	2.6	14.0	12.5	0.5
13	PDP-11/23	V7	5.8	5.3	0.1	22.0		32.7		20.4	0.8	8.5	27.4	25.9	0.3
14	DEC Pro/350	VENIX	6.3	5.1	0.1	7.7		28.0		27.0	0.8	4.7	26.7	25.3	0.1
15	Apple Lisa	Sys III+	6.1	5.3	0.1	20.8		44.5		37.6	0.4	3.2	14.0	12.0	0.2

+ Indicates UNIX System III plus some Berkeley enhancements.

• The benchmark in listing 1 had to be modified slightly to run under Idris 2.1, perhaps explaining the large times that resulted.

\$ Idris 2.1 is a Version 6-based UNIX system, and hence did not have the rand() system call. Thus, the benchmark could not be run.

- Unfortunately, this time was not available at the time of publication.

~ The SCI-1000 benchmarked was a preproduction 80186 system with debugging code in the kernel and compiler.

% For some reason, the C compiler optimizer caused the operating system to crash, so these results are with nonoptimized benchmarks.

System Configuration:

1 - 4-megabyte RAM, two 256-megabyte disk drives
 2 - 2-megabyte RAM, one 50-megabyte disk drive
 3 - 2-megabyte RAM, one 42-megabyte disk drive
 4 - 2-megabyte RAM, one 121-megabyte disk drive
 5 - 1.5-megabyte RAM, 400 megabytes of disk drives
 6 - 1-megabyte RAM, one 40-megabyte disk drive
 7 - 512K-byte RAM, one 10-megabyte disk drive
 8 - 256K-byte RAM, two 5-megabyte disk drives

9 - 512K-byte RAM, one 40-megabyte disk drive
 10 - 640K-byte RAM, one 10-megabyte disk drive
 11 - 384K-byte RAM, one 20-megabyte disk drive
 12 - 384K-byte RAM, one 15-megabyte disk drive
 13 - 256K-byte RAM, two 10-megabyte disk drives
 14 - 256K-byte RAM, one 5-megabyte disk drive
 15 - 1-megabyte RAM, one 5-megabyte disk drive

than the elapsed time.

This mechanism is the time command, which is invoked explicitly by

```
/bin/time filename
```

where filename is the program to be timed. Under UNIX, filename can be either an object file or a text file of shell commands. Of course, some overhead

is in the time command itself, since it has to start filename executing, but it is small and can be neglected because all our benchmarks will be timed this way. The results are compared to other UNIX machines timed in the same manner.

THE UNIX BENCHMARK SUITE

How can we apply these guidelines to

the UNIX operating system and its most important language, the C compiler? What should we test? That question can be answered by answering the question, "What does UNIX do most often?"

UNIX has a number of unique and powerful features that are used quite heavily. If implemented efficiently, these

(continued on page 400)

Apricot voted best in the world.* But you be the judge.

Of course, you'll have to visit your local Apricot dealer to confirm the experts' judgement first hand. But here's some preliminary evidence:

- A keyboard that includes special function keys, a numeric keypad, a built-in, software-accessible calculator, and dynamic, touch-sensitive keys that adapt to each program.
- Convenient, fit-in-your-pocket, 3½-inch disks that are 100 times more reliable than the older 5¼-inch style.
- A special, high-resolution (800x400 pixel) non-glare monitor.
- Full 16-bit internal architecture for faster program execution. (The Apricot runs most software written for the IBM PC.)
- Standard 256K RAM internal memory (upgradeable to 768K).
- RS-232 (V-24) serial port plus a synchronous and asynchronous parallel port.

The Apricot is available with a single disk drive, as you see it here with twin disk drives, with double-sided twin disks, or with a 5 Mbyte or 10 Mbyte Winchester disk drive. Prices range from \$2295 to \$4895. For more information, return the coupon or call 800/447-4700.



**Microcomputer of the Year and Business Microcomputer awards, British Microcomputing Awards Presentation.*

I'll be the judge. Send me the evidence.

Name _____

Address _____

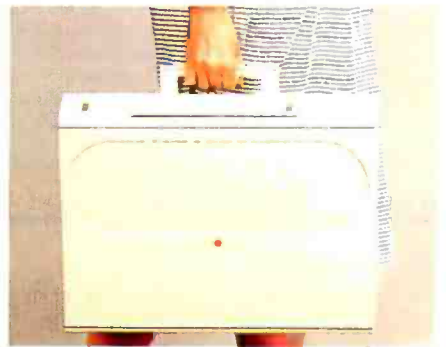
City _____

State _____ Zip _____

Primary use: business home



The unique MicroScreen™ serves as a calendar, clock, a built-in calculator, and a labelling device for special touch-sensitive keys.



You can carry the Apricot like a briefcase.



MAIL TO:
ACT (North America) Inc.
3375 Scott Blvd., Suite 342
Santa Clara, CA 95051

© 1984 ACT North America, Inc.

Circle 8 on inquiry card.

FORTH-83: EVOLUTION CONTINUES

BY C. KEVIN MCCABE

A new standard corrects some problems, but FORTH is still a language in flux

All FORTH words in this article, and in the tables, are in boldface type. Italics is used to designate numeric values that are treated in a specific way. Italicized terms in angle brackets (< >) are unspecified word names.

The evolution of FORTH from a radio-telescope control language to an acclaimed software tool can hardly be termed usual—or entirely peaceful. Perhaps because the language is attractive to software hackers, new versions of FORTH appear with a frequency quite unlike more established languages. Proponents of various dialects tend to splinter into groups, with heated debates over mono-addressing, threaded versus direct code, and other esoteric matters.

The latest standardization attempt may only add to a continuing controversy over which version is the “real” FORTH. FORTH-83, accepted almost un-

animously by the FORTH Standards Team, includes numerous differences from the earlier FORTH-79 standard. FORTH-79, in turn, differs greatly from FIG-FORTH, the public-domain version developed by the FORTH Interest Group (FIG), FORTH Inc.’s commercial versions of FORTH, and several earlier proposed standards. Major changes in virtually all areas almost insure that FORTH-79 programs will not be compatible with the new standard.

THE CHANGES

Eleven FORTH-79 “words” (named ex-
(continued))

C. Kevin McCabe (Lord, Bissell & Brook, 115 South LaSalle St., Chicago, IL 60603) is a trial attorney concentrating in aviation-disaster litigation. When not using his Exidy Sorcerer, Kaypro 4, or other homebrew systems, he enjoys flying, skydiving, writing, and hacking.

Table 1: FORTH-79 words not included in the FORTH-83 required word set.

FORTH-79 Word	Remarks
79-STANDARD	new word FORTH-83 fulfills same function
?	use equivalent sequence @ . instead
CONTEXT	moved to new system-extension word set
CURRENT	moved to new system-extension word set
EMPTY-BUFFERS	moved to controlled-reference word set
LIST	moved to controlled-reference word set
MOVE	moved to uncontrolled-reference word set
QUERY	moved to controlled-reference word set
SCR	moved to controlled-reference word set
U•	use UM• instead
U/MOD	use UM/MOD , but note floored division

ecution procedures) have been re-named or removed entirely from the standard's required word set (see table 1). Twenty new words have been added to the required word set. Major changes in FORTH-83 definitions affect integer arithmetic, control structures, relational operations, use of mass storage, stack manipulations, I/O (input/output), compilation of new definitions, and vocabulary usage. Required words that have undergone significant changes in definition are listed in table 3. Both the assembly-language and the double-number extension word sets have been revised, and a new system-extension word set has been added as an option; the additions and changes in meaning are shown in tables 4, 5, and 6.

FORTH-83 division operations use

"floored" integer arithmetic, with the quotient z rounded to the greatest integer less than or equal to z , i.e. toward negative infinity. This provides symmetry with respect to 0 on the number line but is incompatible with FORTH-79's simpler rounding toward 0. FORTH-83 division operations also are defined to force error conditions if a divisor is 0 or a quotient lies outside the permissible operand range.

The DO ... LOOP and DO ... +LOOP control structures have been revised considerably. For positive increments, termination of a FORTH-79 loop occurs when the new index value equals or exceeds the limit; for negative increments, +LOOP terminates only when the new index is less than (but not equal to) the limit. FORTH-79 loop pa-

rameters are also restricted to signed single-precision numbers.

Both characteristics have changed in FORTH-83. The new versions permit loop parameters to be any signed or unsigned single-precision value (values between -32.768 and 65.535; see table 7). FORTH-83 loops terminate when the index is incremented across the boundary between limit-1 and limit; code to detect the transition is easily implemented for any processor with an overflow bit. Use of the transition detection rather than FORTH-79's direct comparison means that a limit equal to the initial index will no longer terminate the loop after one pass; instead, the index is handled on a continuous "number circle" using 2's complement arithmetic.

(continued on page 412)

Table 2: Modifications to, and clarifications of, stack parameter manipulations under the proposed FORTH-83 standard. Stack diagrams show value(s) on the parameter stack before and after the execution or compilation of the indicated FORTH word. For an explanation of the abbreviations used for stack values, see table 7.

Word	Word Set	Stack Diagram(s)	D+	required and double	(wd1 wd2 - wd3)
!	required	(16b addr -)	D-	double	(wd1 wd2 - wd3)
#>	required	(32b - addr + n)	DEPTH	required	(- +n)
.	required	(w1 w2 - w3)	DROP	required	(16b -)
+	required	(w1 w2 - w3)	DUP	required	(16b - 16b 16b)
+!	required	(w1 addr -)	ELSE	required	(-)
.	required	(16b -)			(sys1 - sys2) (compiling)
-	required	(w1 w2 - w3)	FILL	required	(addr u 8b -)
-TRAILING	required	(addr + n1 - addr + n2)	I	required	(-w)
!+	required	(w1 - w2)	IF	required	(flag -)
!-	required	(w1 - w2)			(- sys) (compiling)
2!	double	(32b addr -)	J	required	(- w)
2+	required	(w1 - w2)	LOAD	required	(u -)
2-	required	(w1 - w2)	OR	required	(16b1 16b2 - 16b3)
2@	double	(addr - 32b)	OVER	required	(16b1 16b2 - 16b1 16b2 16b1)
2DROP	double	(32b -)	R>	required	(- 16b)
2DUP	double	(32b - 32b 32b)	R@	required	(- 16b)
2OVER	double	(32b1 32b2 - 32b1 32b2 32b1)	REPEAT	required	(-)
2ROT	double	(32b1 32b2 32b3 - 32b2 32b3 32b1)			(sys -) (compiling)
2SWAP	double	(32b1 32b2 - 32b2 32b1)	ROT	required	(16b1 16b2 16b3 - 16b2 16b3 16b1)
:	required	(-)	SPACES	required	(+ n -)
		(sys -) (compiling)	SWAP	required	(16b1 16b2 - 16b2 16b1)
>R	required	(16b)	THEN	required	(-)
@	required	(addr - 16b)			(sys -) (compiling)
ABS	required	(n - u)	TYPE	required	(addr + n -)
ALLOT	required	(w -)	UNTIL	required	(flag -)
AND	required	(16b1 16b2 - 16b3)			(sys -) (compiling)
BEGIN	required	(-)	WHILE	required	(flag -)
		(- sys) (compiling)			(sys1 - sys2) (compiling)
C!	required	(16b addr -)	XOR	required	(16b1 16b2 - 16b3)
C@	required	(addr - 8b )	|	required	(-)
CMOVE	required	(addr1 addr2 u -)			(-) (compiling)
CONVERT	required	(+d1 addr1 - +d2 addr2)	[COMPILE]	required	(-)
COUNT	required	(addr1 - addr2 + n )	|	required	(-) (compiling)

Announcing the WY-75.



Our new WY-75, VT-100* software-compatible terminal is specially fitted for use with your DEC* computer.

It offers a combination of features you can't find in any other VT-100 software-compatible terminal. Like a compact, ergonomic design. A finely sculpted, low-profile keyboard. And a swivel and tilt non-glare 14" screen, tailored with an 80/132 column format.

At a price of \$795, the WY-75 won't cost the shirt off your back.

Contact Wyse Technology for more information. And put your DEC on the best dressed list.

\$795

**VT-100 software
compatible and
dressed for success.**



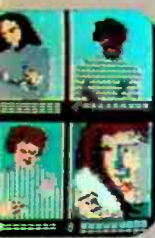
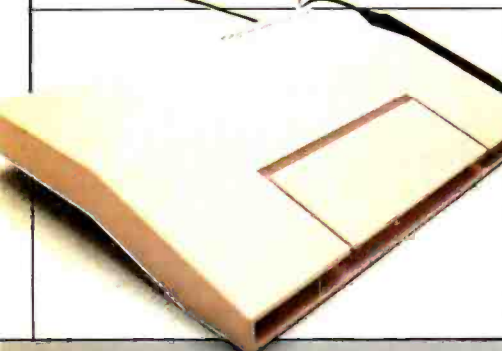
WYSE

Make the Wyse Decision.

Wyse Technology, 3040 N. First Street, San Jose, CA, 95134, 408/946-3075,
TLX 910-338-2251, Outside CA call toll free, 800/421-1058, in So. CA 213/340-2013.

*VT-100 and DEC are trademarks of Digital Equipment Corporation.

Turn your Apple professional color graphics



Our system lets you take an idea, draw it on the screen, manipulate the image electronically — even draw interactively with a colleague thousands of miles away — then save your concept on disk or dot matrix printer.

The Digital Paintbrush System is an exciting new way to use your Apple computer to increase your professional productivity. It's the first low-cost system to integrate sophisticated graphics, telecommunications, presentation and printout capabilities.

Draw automatically. Electronically.

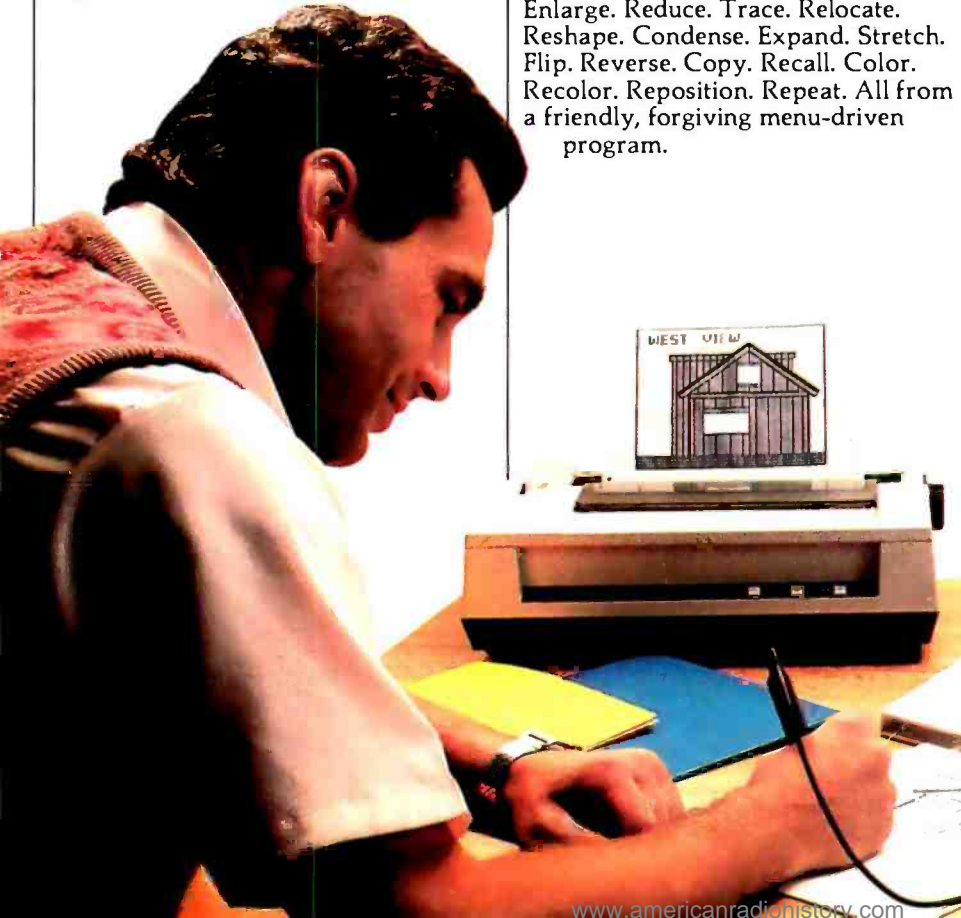
Our drawing device is as natural to use as a pencil. And our software helps anyone to be a talented artist. Lines snap taut, circles go perfectly round — even complex multi-point curves smooth themselves out. Erase electronically. Enlarge. Reduce. Trace. Relocate. Reshape. Condense. Expand. Stretch. Flip. Reverse. Copy. Recall. Color. Recolor. Reposition. Repeat. All from a friendly, forgiving menu-driven program.

Draw interactively. Coast-to-coast.



Communicate with your colleagues via the first real-time interactive drawing program ever. We've included a spare diskette you can send your associates. This will let you create drawings in real time over phone lines with a modem. Both of you can work on the same drawing, then save it on disk or dump to printer.

Apple IIe & II+ with 64K, one or two Disk Drives.



computer into a graphics workstation.

Create libraries of special purpose drawings or symbols.

Draw your own symbols or pictures you can later borrow or "grab" by computer. Re-use these images over and over.

You can customize your own drawings or symbol sets or you can order pre-drawn pictures and symbols.

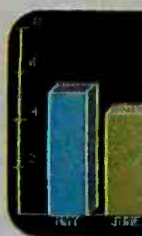
Enhance your drawing ability by

Move whole drawings or single elements at will.

The technical name is "image capture" but you'll call it incredible. Pick up any portion of your drawing and move it or create multiples. Expand or contract. And you are working with thousands of user-mixable color patterns including negative colors. Paint with 37 different brushes. And user-

Complete for only \$299.

The Digital Paintbrush System mimics the sophistication of graphics and CAD systems costing hundreds — even thousands more. Now you can put this powerful tool to work to produce illustrations, diagrams, flow charts, layouts, maps, business graphics, presentations, title slides, symbols, logos, training material and applications we



All images were created on The Digital Paintbrush System™ with an Apple IIe and II+.

mixing and matching images endlessly.

adjustable grids of any size make scaling exact. Trace and measure areas automatically. Use "micro" mode for the tiniest details.

Label with popular typesetting fonts from headline to text.

AaBbCcDd
AaBbCcDd

Use our built-in typesetting fonts or load in dozens of other fonts. (We're compatible with the Fontrix™ family). Mix in text or label your drawings at the touch of a button.

Convert screen graphics to printer hardcopy.

Our program lets you printout on 37 of the most popular dot matrix printers (upgradable to the coming color inkjet technology). Use 5 powers of magnification for both text or graphics.

Make personalized presentations.

Create and project your own "slides," change and adapt them quickly and easily for each client.

A strikingly effective sales tool.

haven't even thought of.

Available in finer computer stores everywhere. Or order toll free 1 800 874-1888 or in California 415 331-3022.



The Digital Paintbrush System™

THE COMPUTER
COLORWORKS

The Digital Paintbrush System is a registered trademark of The Computer Colorworks, a division of Jandel Corporation, 3030 Bridgeway, Sausalito, California 94965. Circle 338 on inquiry card.



IVAN POWELL 64

Modula-2

HISTORY AND GOALS OF MODULA-2 <i>by Niklaus Wirth</i>	145
TUTORIAL ON MODULA-2 <i>by Jürg Gutknecht</i>	157
LILITH AND MODULA-2 <i>by Richard Ohran</i>	181
AN INTRODUCTION TO MODULA-2 <i>by Robert J. Paul</i>	195
PASCAL, ADA, AND MODULA-2 <i>by David Coar</i>	215

A PIECE OF FOLK WISDOM on computer programs says, "Write two and throw the first one away." We all know that completing a program gives us insight into how we should have done it in the first place, as does subsequent real-world experience using it. The same is true of programming languages. Dr. Niklaus Wirth of the Institut für Informatik research institute of ETH (Switzerland's equivalent to MIT) invented Pascal in 1968—largely as a hypothetical language to teach programming—and had a working implementation by 1970. Wirth started on the design of Modula-2 in 1977, but only after he had written another language, Modula, and learned from it as well. (Modula was an experimental language concerned with multiprogramming; it contributed its name, syntax, and the concepts of multiprogramming and modules to Modula-2.)

After using Pascal for several years in academic and commercial situations, Wirth and many users of the language found shortcomings and defects in it, most notably its awkwardness when used for large programs, the many nonstandard extensions, and problems that occurred when a programmer wanted to use Pascal to manipulate the computer's memory and peripherals directly. Wirth was sensitive to the last criterion. In the preface to his book, *Programming in Modula-2* (Berlin: Springer-Verlag, 1982), Wirth says:

In 1977, a research project with the goal to design a computer system (hardware and software) in an integrated approach, was launched at the Institut für Informatik of ETH Zürich. This system (later to be called Lilith) *was to be programmed in a single high-level language [italics mine]*, which therefore had to satisfy requirements of high-level system design as well as those of low-level programming of parts that closely interact with the given hardware.

Note that this means that all the software in the Lilith machine—operating system, windowing facilities, text editor, system utilities, and everything else—is written in Modula-2.

Other key features of Modula-2 include the concepts of the module (which separates the definition and implementation of related code and makes the language more suited to large projects that require a team of programmers) and the process (used to implement multiprogramming), an improved syntax (allowing programmers to learn the language faster and make fewer syntax errors), and the ability to use procedure and array names as subroutine arguments (both of which make programs potentially more versatile).

This issue contains a variety of Modula-related articles. There are introductory articles by Wirth and one of his colleagues, Dr. Jürg Gutknecht, a description of the Lilith machine by one of its designers, an introduction to Modula-2 for Pascal programmers, and a comparison of Modula-2 with Pascal and Ada.

Even before we announced this issue, we found a lot of people already excited about the language. Several implementations of Modula-2 are already available, and a lower-cost version of the Lilith machine may be available within a year. We hope that this issue will contribute to the ground swell of interest in Modula-2.

—Gregg Williams, Senior Technical Editor

Your IBM PC Or XT Graphics Are Only As Good As What's Under The Hood.



Get Smooth Clean Performance With Graphix Plus II™. Single Board Support Of Both Color And Monochrome Display.

When it comes to color/graphics adapter boards, your IBM Personal Computer—and you—deserve only the best. That's why Graphix Plus II gives you outstanding graphics...and a whole lot more. With Graphix Plus II, you'll get 50% faster, flicker-free scrolling over IBM's color/graphics board. And, the Graphix Plus II is the *only* product on the market which provides *dual monitor support* for both RGB color and monochrome graphics on a single board. It gives you *full screen* (640 × 352) monochrome graphics and *high resolution* color graphics with the appropriate software. When two monitors are used, Graphix Plus II *automatically* shifts to the appropriate screen.

Luxury Items Are Standard Equipment

With the Graphix Plus II, you'll be glad to know extra conveniences come standard. For example, you get a parallel printer port which allows you to hook up any IBM compatible printer or SASI compatible hard disk controller. Our 'PC Accelerator'™ software is included which gives you

the use of *two* RAM disks and a print buffer. Plus, you can access the screen RAM with absolutely no "snow" or flashing. Graphix Plus II also provides true gray scale display on composite video monitors, a light pen interface, 32K display RAM (text and graphics modes), compatibility with Lotus 1-2-3™ and other popular software packages. And much more. A battery operated clock/calendar is available as an option.

Puts You In The Driver's Seat

Graphix Plus II fits easily in any expansion slot inside your PC. And when you power up, you'll *see* the same high-powered quality you've come to expect from your machine. Incredibly smooth, versatile performance. From start to finish.

Graphix Plus II. So good, so reasonably priced, you might say...we've *outclassed* the competition. See your local dealer for all the details. Or call or write STB Systems, Inc., 601 North Glenville, Richardson, Texas 75081 (214) 234-8750.

Expansion Products
for Personal Computing



STB™
STB Systems, Inc.

Circle 288 on inquiry card.

IBM PC, XT are registered trademarks of International Business Machines Corporation.
Lotus 1-2-3 is a registered trademark of Lotus Development Corporation.

Expanding Microcomputing

PC Accelerator is a registered trademark of ResiCorp.

www.americanradiohistory.com

Modula-2 grew out of Pascal and incorporates a few major and some minor improvements.

compatible with their past; they were less likely to adhere to the widespread misconception that their software libraries were so valuable, merely because their development had cost so much.

The success of Pascal implementations for microcomputers, however, has not eliminated the value of good compilers. To the contrary, it has increased the motivation to produce high-quality implementations.

THE PROJECT LILITH

An implementation does not consist of the compiler alone but includes the interpreting computer. Our efforts in constructing a good Pascal implementation were bounded by the suitability of the target computer. In fact, we spent a large amount of energy to conceal and make up for the inadequacy of the underlying computer. We had learned a lot about compiler design, but I also recognized that a truly satisfactory design would have to encompass programming language, compiler, and computer, all properly matched.

My visit to the Xerox Palo Alto Research Center (PARC) in 1976/1977, and my confrontation with its powerful personal workstation, the Alto, provided the incentive to undertake a new research project encompassing all these aspects. I was intrigued by the Alto's singularly simple design concept and the resulting flexibility for the programmer. Thus, I embarked on learning about hardware design and, upon returning to Switzerland, started the project that resulted in the computer Lilith, a personal workstation based on a powerful processor (Am 2901), a bit-mapped display, a mouse as input device, and an architecture tailored to the needs of a compiler. With a staff of six part-time assistants this seemed to be an overly ambitious goal, a project almost certainly doomed to failure. Nevertheless, after two years, two prototypes of Lilith were operational,

together with a compiler, an operating system, an advanced full-screen mouse-driven text editor, an interactive line-drawing editor, and elementary utility programs.

Apart from the motivation and competence of the team members, the feasibility of the ambitious task rested on three fixed constraints that I had postulated at the start: (1) we would implement a *single language*, and all software would be written in that language, without exception whatsoever; (2) the operating system would be designed for a *single user*, thus avoiding difficult problems of scheduling, protection, resource management, and accounting; (3) the computer would have a *single processor*, powerful enough to execute programs and to perform the raster operations on the displayed bit map.

Indeed, considering that Lilith was to be a personal workstation, there were no advantages to be gained by deviating from these constraints, in spite of widespread popular trends to develop multiprocessor, multilanguage, multi-user systems.

The first constraint required a language equally suitable for expressing algorithms on a high level of abstraction and for expressing operations directly accessing machine facilities, equally suitable for formulating a database system as for programming a disk driver. Evidently, Pascal was not capable enough, and I did not favor the common escape of embellishing it with a few "desirable extensions": Modula, a small language that I had designed in the preceding years to experiment with the concepts of multiprogramming, clearly did not suffice either. But it featured a facility to partition programs into modules with explicitly specified interfaces. This was precisely the facility needed to allow the introduction of so-called low-level facilities in the high-level language, because it allowed you to encapsulate them and to constrain their dangerousness to clearly delineated parts of a program. Hence, the choice for the new language was Pascal augmented by the module and a few other facilities, and regularized by a more systematic syntax. Thus was born Modula-2.

MODULA-2

The language was defined in 1978 (10 years after Pascal) and implemented by

L. Geissmann, S.E. Knudsen, and C. Jacobi on the PDP-11. Its small store of available memory (28,000 16-bit words or 56K bytes) caused many obstacles and was the reason for the first compiler's five-pass structure. In the summer of 1979, the compiler was completed, and at the same time, the first Lilith prototype became operational. The operating system Medos-2 had been constructed by S.E. Knudsen concurrently, and together with the compiler it was transported from the PDP-11 to Lilith within three weeks. This was in itself an encouraging feat in software engineering and proof of Modula-2's usefulness as a system-implementation language. After a year's in-house use, I published the report on Modula-2 and we released the Modula-2 compiler to interested parties (March 1980). The defining report is included in the tutorial book *Programming in Modula-2* (N. Wirth, New York: Springer-Verlag, 1982) which I prepared up to the camera-ready stage with the aid of Lilith and a document-formatting system that I programmed, of course, in Modula-2.

As mentioned already, Modula-2 grew out of Pascal and incorporates a few major and a fair number of minor improvements. The single most outstanding added facility is the module structure. Basically, this facility allows you to partition programs into units with relatively well-defined interfaces. More specifically, it allows you to control the visibility of declared objects and to hide them from places where they better remain unknown. Since it plays such an important role, we shall now look briefly into the history of Modula-2's development.

Although the principle of information hiding was much discussed in the early 1970s, it is perhaps Modula's merit to place it consistently into the framework of a clearly defined language. To the best of my knowledge, it was David Parnas who first coined the expression *information hiding*. Both Tony Hoare and Per Brinch Hansen gave it form by connecting it to the class facility of the programming language Simula. This is essentially, in terms of Pascal, a record type: the set of instantiations of this type forms what Simula terminology calls a *class*. In contrast to Pascal records, the Simula class allows you to associate

(continued)

Blazing BASIC.

Who said BASIC had to be slow?

Microsoft® BASIC Compiler lets you create MS™-DOS programs that are so fast users will never know they were written in BASIC.

The compiler produces fast, efficient native code. The result? Three to ten times faster operation than the same interpreted program. Even faster for programs that make maximum use of integers.

But it's not only fast in execution, it's fast for development. It's **MICROSOFT** the one BASIC compiler designed to work best with our BASIC interpreter — the de facto industry standard. Together, they let you develop and debug your programs interactively using the interpreter, then compile for speed.

And like all Microsoft languages, the standard linking

interface makes it easy to combine assembly language subroutines.

Microsoft BASIC Compiler is just one reason Microsoft is your best source for high performance languages for 8088/86 based micros.

Call 800-426-9400 to order
the blazing BASIC compiler.
\$395*

In Washington State, call 206-828-8088. Ask for operator A6, who will rush you your order, send you more information, or give you the name of your nearest dealer to see Microsoft BASIC in action.



*Price exclusive of handling and Washington State sales tax.
Microsoft is a registered trademark and MS is a trademark of Microsoft Corporation.

procedures with the data represented by the field identifiers. Hoare and Brinch Hansen then postulated that while the names of the procedures would normally be visible, those of the data would remain hidden except within the associated procedures. This feature was implemented in Brinch Hansen's Concurrent Pascal and embodied the principle of information hiding, which in the meantime (1975) had been promoted to that of *data abstraction*. The example in listing 1 serves to exemplify the issue: we use a liberal Pascal notation ("N" is a constant):

In a program using this class (type), one might declare variables

```
q0,q1: queue
```

and thereafter access them by statements like

```
q0.put(13.7)    q1.get(v)
```

but statements like "q0.n := 237" or "q1.in := q0.out" which evidently interfere with the presented implementation of the abstraction of a queue, would be disallowed. More importantly, they would not be prevented by the compiler, which does not "see" the field identifiers "n," "in," and "out" that are hidden inside the class (record) declaration.

Unfortunately, these proposals intertwined several independent concepts like visibility, instantiation, indirection of access, concurrency, and mutual exclusion. Both authors had actually postulated these kinds of classes to embody areas of mutual exclusion in multiprocessing systems, and the facility became more widely known as a *monitor* (in which the HALT statements are re-

placed by synchronization operations).

In the development of the experimental multiprogramming language Modula-1, I strived for clarity of concept and was convinced that a substantial disentangling of the various intertwined concepts was mandatory. Together with H. Sandmayr we found a possible solution in the structure then called module that would concern the aspect of visibility only. This, I believe, was the major breakthrough, because in all other languages the visibility issue had always remained intimately connected with that of existence. In particular, it was now possible to declare sets of static, global objects that were visible from selected parts of the program only. This is typically desirable to encapsulate certain permanent parts of a system (like device drivers, storage allocators, window handlers, etc.). I enhanced this module facility with so-called *import* and *export* lists that allow the explicit control of visibility across the "module wall" of each individual object. Furthermore, true to Algol and Pascal tradition, modules can be nested. An export now signifies the extension of visibility to the outside, and import signifies its extension to the inside (see figure 1).

SEPARATION OF SPECIFICATION AND IMPLEMENTATION

During my aforementioned stay at PARC in 1976, I became acquainted with the language Mesa, a Pascal offspring specifically designed to meet the needs of large system development. Mesa also incorporated an information-hiding feature. It also allowed you to encapsulate program parts into modules but lacked

the ability to control the visibility of individual objects, and it entangled the facility once again with another feature, namely that of *separate compilation*, a facility of implementation. Its noteworthy contribution was the separation of the declarations of the exported objects from that of the ones to remain hidden. The former is called the *definition part*, the latter is the *implementation part*, which contains all those details that are relevant to the realization of the exported mechanisms, but not to their functional definition.

The combination of Mesa's module facility with split definition and implementation parts, and the (nestable) Modula-1 modules with controllable import and export resulted in Modula-2.

The facility of separate compilation posed some nontrivial problems. The key idea is that the compilation of a definition part results in a (compiled) symbol table (represented as a file). The file contains all information relevant to importers (clients) of that module. If, at a later time, another module imports objects from, say, modules M1 and M2, then the compiler accesses the previously generated symbol files of M1 and M2. Thus, the rules of type consistency are observed across module boundaries as well. This makes separate compilation genuinely helpful and safe, in contrast to *independent compilation* as known from assemblers and FORTRAN compilers, which is a misleading pitfall when used with high-level, data-typed languages.

It is noteworthy that Ada incorporates this form of module in almost identical form, although under the name *package*. We can attest that this is one of the more essential features of any system language because we have made extensive use of it for the last five years. Regrettably, Ada designers have failed to restrict separate compilability to global modules.

USING MODULES EFFECTIVELY

During the last five years, we have seen that postulating and providing a new facility is one thing, and learning to make good use of it is another. The more intricate and sophisticated a facility is, the smaller is the chance that it will be used wisely. In fact, finding the appropriate structure for the data and

(continued)

Listing 1: Sample queue routine in Pascal.

```

TYPE queue =
RECORD n, in, out: INTEGER;
      !'n = no. of filled slots; initially 0'
      buffer: ARRAY 10..N-11 OF REAL;
PROCEDURE Put(x:REAL);
BEGIN IF n = N THEN HALT ('full');
      buffer[in] := x; in := in + 1; MOD N; n := n + 1;
END;
PROCEDURE get(x:REAL);
BEGIN IF n = 0 THEN HALT ('empty');
      x := buffer[out]; out := out + 1; MOD N; n := n - 1;
END;
END

```


Ferocious FORTRAN.

Microsoft® FORTRAN crunches numbers with a vengeance!

It combines fast and efficient native code compilation with built-in 8087 coprocessor support. The result? Mini and mainframe performance from your MS™ DOS micro.

Based on the '77 standard, Microsoft FORTRAN supports extensive statements and data types—including complex numbers and IEEE single and double-precision floating point accuracy.

Support for large arrays (greater than 64K bytes), separate module compilation, and overlays, allow you to create very large programs—up to one megabyte, with access to more than 65 thousand records in a file as large as four gigabytes.

How do programmers feel about Microsoft FORTRAN?

“The first FORTRAN compiler

that takes advantage of the full addressing capability of the 8088 and the power of the 8087.”

—Jack Wilschke, *Softalk*

“We decided to use the Microsoft FORTRAN Compiler for its INTEGER 4 capability and the flexibility of its 8087 implementation.”

—Charlie Huizena & Chip Barnaky, *PC World*

Call 800-426-9400 to order the ferocious FORTRAN.
\$350*

In Washington State, call 206-828-8088. Ask for operator A4, who will rush you your order, send you more information, or give you the name of your nearest dealer to see Microsoft FORTRAN in action.



*Price exclusive of handling and Washington State sales tax.
Microsoft is a registered trademark and MS is a trademark of Microsoft Corporation.

program is the key to successful programming. With the module we have added another level of granularity in program structuring. The difficulties of finding a good partitioning—I carefully avoid the word “optimal”—are cumulated at this level, because often the modules are the units that are constructed by different programmers. Their contracts, in fact, are the definition parts of their modules. The definition parts establish the interfaces, which constitute the first task in a system’s design process. Lucky are those who hit a good solution at the outset, for any change affects all participants. If a definition module A has been changed in any way, then all modules that import A must be adapted (and at least be recompiled). This is not the case, however, if only the implementation part of A had been modified. Hence, a fair degree of decoupling is established. Extreme examples are the primary utility modules of an operating system, because they are used by virtually every program. The system may well be modified without hampering the users. However, the

slightest change in a definition module will require the recompilation of all clients.

The first rule to be observed when you deal with modules is that the interfaces must be considered before implementations are attempted. The terser they are, the smaller the chance for mistakes and the need for changes. Interfaces should, by their very definition, be “thin.”

A second observation is that a module usually hides a set of data and provides a set of operators to manipulate this data. By forcing the client to access this data via the offered procedures, the module’s designer may guarantee that certain consistency conditions are always observed, i.e., always remain invariant. In the queue model shown in listing 1, it is guaranteed that the counter *n* truly reflects the number of elements contained in the buffer and that their order of coming out of the queue is the same as that of going in.

As a consequence, a module is typically chosen as the collection of routines that operate on a set of data,

which can be seen by the client as an abstraction defined by the accessible set of procedures.

Often, a module is also chosen as the collection of procedures that constitute a level of abstraction of data that is residing elsewhere. For example, a module containing a set of input and output routines such as

ReadInteger(f,x) and WriteReal(f,x)

will allow you to think in terms of the abstract concept of a sequence of integers and real numbers, and to ignore the details of its implementation in terms of bits, bytes, buffers, files, disk sectors, etc.

Consequently, such a module is chosen in order to establish a new level of abstraction. The success of such an abstraction crucially depends on its rigorous definition and your willingness to genuinely ignore its implementation. Please don’t misunderstand! I do not say to remain ignorant of its implementations, but rather only use an implementation’s properties that are defined in terms of the abstraction. To cite a well-known example: if you think in terms of integers, it does not make sense to ask for the value of an integer’s last bit, even if you know that it is represented as a sequence of bits. Instead you should ask whether the integer is odd.

COMPUTERS, LANGUAGES, AND COMMERCIALISM

It is precisely the ability to think in terms of proper abstractions that is the hallmark of a competent programmer. Even more, he or she is expected to be able to jump from one level to another without mixing them up. A structured language is enormously helpful in this endeavor, but it does not do it for you. It is like with a horse: you may guide it to the water, but it has to do the drinking itself. I am afraid that this simple truth is in stark contrast to the numerous lulling advertisements being published in such abundance. They cleverly reinforce themselves with slogans like *Switching to Pascal solves all your (programming) problems* and *Our Computer speaks Pascal*, and, in fact, represent nothing more than an extremely aggressive sales campaign.

Sooner or later, people will, through
(continued)

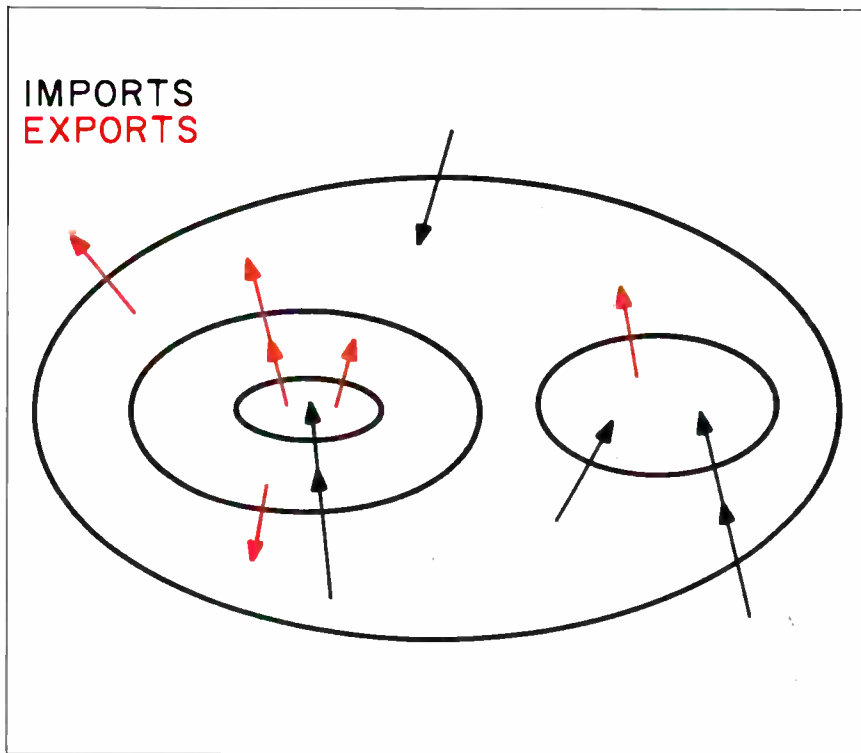


Figure 1: Crucial to the structure of Modula-2 is the concept of the module, which may be nested inside other modules. Within each module, the visibility of objects to other modules may be controlled via the IMPORT and EXPORT functions.

Potent Pascal.

Microsoft® Pascal may be the most powerful software development environment available for the MS™ DOS system. It combines the programming advantages of a structured high-level language with the fast execution speed of native code compilation.

And it exceeds the proposed ISO and ANSI standards with logical extensions that make the language more powerful and versatile. For example, programming capabilities even allow you to manipulate data at the system and machine level.

It gives you single and double precision IEEE floating point arithmetic. Numeric operations take advantage of the 8087. Or automatic software emulation is

provided if the coprocessor is not installed.

Support for long heap allocation and separate module compilation gives you the flexibility to create large programs up to one megabyte.

And the standard linking interface makes it easy to combine Microsoft FORTRAN or assembly language subroutines.

Call 800-426-9400 to order the potent Pascal. \$300*

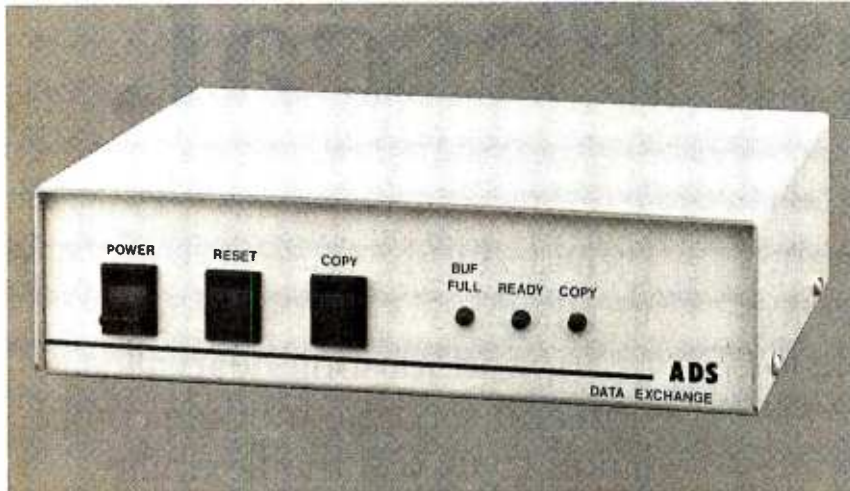
In Washington State, call 206-828-8088. Ask for operator A5, who will rush you your order, send you more information, or give you the name of your nearest dealer to see Microsoft Pascal in action.



*Price exclusive of handling and Washington State sales tax.
Microsoft is a registered trademark and MS is a trademark of Microsoft Corporation.

DATA EXCHANGE/64K SPOOLER

HISTORY AND GOALS



The ADS-8212 DATA EXCHANGE/64K is a computer independent interface converter and print spooler. It can be installed between virtually any computer and any peripheral.

Data can be input in either serial or parallel, stored in its 64K bytes of RAM, and output serial or parallel. Serial ports support baud rates from 50 to 19 200 and both hardware and software handshaking. The input and output ports are completely independent; input data with one protocol and baud rate and output it with a different protocol and baud rate. Selections are dip switch selectable.

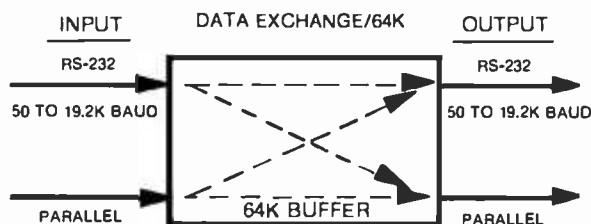
A unique feature is its ability to make unlimited numbers of copies. Hitting the copy button will send another copy to the printer. When done making copies, hit the reset button to clear the memory.

Included with the DATA EXCHANGE/64K are two 4 foot output cables, one parallel cable with standard Centronics type connector and one serial cable with standard DB 25 connector. Standard plugs are supplied for input ports.

RS-232 HANDSHAKING:
RDY/BSY (DTR)
Xon/Xoff
ETX/ACK

Suggested list price: \$339.00

Dealer inquiries welcome.



Available at your local dealer or contact:

ADS ANTEX DATA SYSTEMS
A Division of International Antex Inc.
2630 California Street
Mountain View, California 94040 ■ Phone: (415) 941-7914
Telex: 704 969 INTERAX UD

harsh experiences, realize that they have become victims of slogans and fads, and that owning the best of tools is worthless unless that tool is thoroughly understood. I am afraid that the modern trend of overselling can become counterproductive. I have seen progressive teachers proudly offering their students the chance to learn structured Pascal, and I quickly realized that the students had no inkling of what structure meant. And I have seen professional programmers proudly present Pascal programs abounding with neatly indented structures, comments (for documentation, of course), and lots of procedures and sophisticated data types. Upon closer inspection, however, the baroque nomenclatures and structures revealed themselves as dead-weight. Sometimes, redesigning these programs led to drastic, even tenfold, reduction in their size and complexity. I sadly realized that a high-level programming language could not only be used to design beautiful programs with much less effort, but also to hide incompetence underneath an impressive coating of glamour and frills. The analogy to literature became all too evident. We must do our best to avoid the misuse of modern programming languages for the selling of lousy contents through enticing packaging. Style may be essential to achieve a good design, but ultimately it is the design, and not the style, that counts.

Let me emphasize the point: neither owning a computer nor programming in a modern language will itself solve any problems, not even yours. But it may be instrumental. Predominantly, I have noticed, more effort is spent on obtaining those instrumental tools than on mastering them. And this is a grave mistake. Perhaps the most effective precaution against it is this rule: Know what the tool is to achieve and what you are going to use it for before you acquire it. This holds for language as well as computers—the more sophisticated it is, the more effort you will need for its mastery, the bigger will be the chance for its misuse, but, presumably, the higher the ultimate reward. I hope that this reward is not only measured in terms of problems solved and dollars earned, but also in the learners' satisfaction of having gained understanding, ability, and genuine insight. ■

A few smart reasons to buy our smart modem:

Features

1200 and 300 baud, auto-dial, auto-answer
 Compatible with "AT" command set
 Can be used with CROSSTALK-XVI or Smartcom II software
 Regulated DC power pack for cool, reliable operation
 Eight indicator lights to display modem status
 Speaker to monitor call progress
 Attractive, compact aluminum case
 Two built-in phone connectors
 Compatible with The Source and Dow Jones News Retrieval
 Unattended remote test capability
 Phone cable included
 Availability

Ven-Tel 1200 PLUS

Hayes

Yes	Yes
Yes	Yes
Yes	Yes
Yes	No
Yes	Yes
Yes	Yes
Yes	Yes
Yes	No
Yes	Yes
Yes	No
Yes	Yes
Now	

Price

\$499

\$699

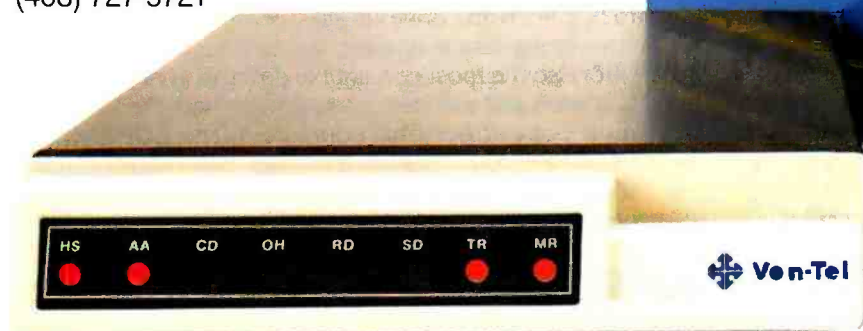
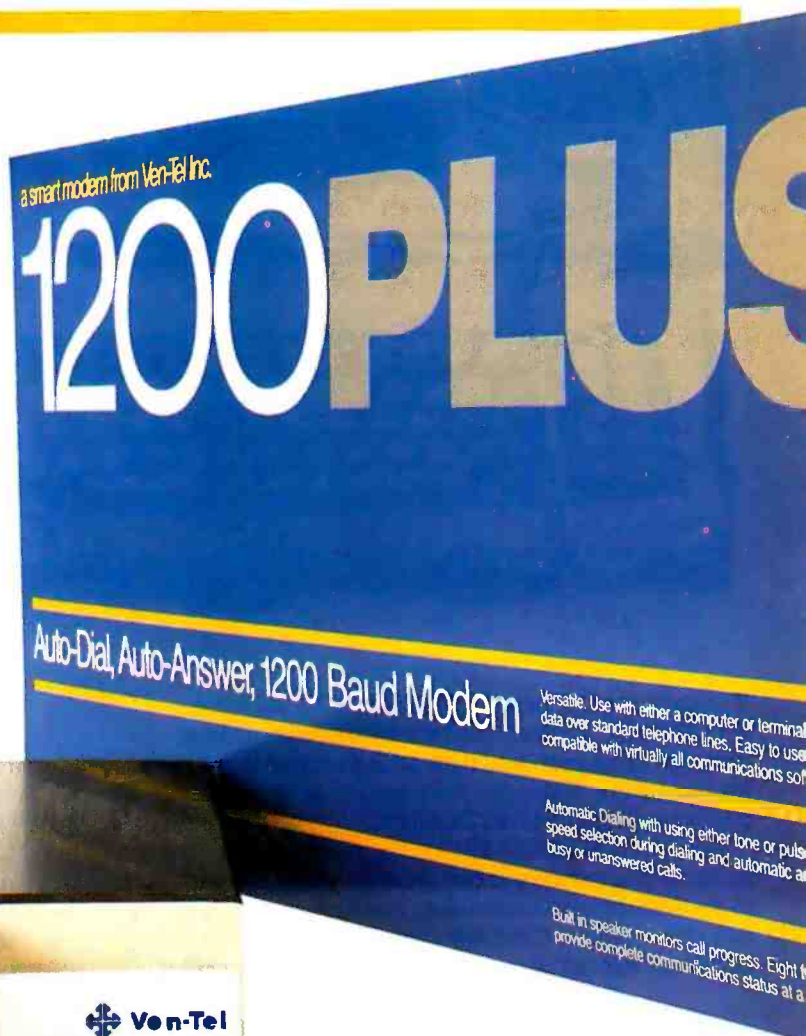
The Ven-Tel 1200 PLUS offers high speed, reliable telecommunications for your personal computer or terminal. Whether you use information services or transfer data from computer to computer, the Ven-Tel 1200 PLUS is the best product around. Available at leading computer dealers and distributors nationwide.

Also from Ven-Tel: internal modems for the IBM and HP-150 Personal Computers with all of the features of the 1200 PLUS.

You choose. The Ven-Tel 1200 PLUS—the smartest choice in modems.

Ven-Tel Inc.

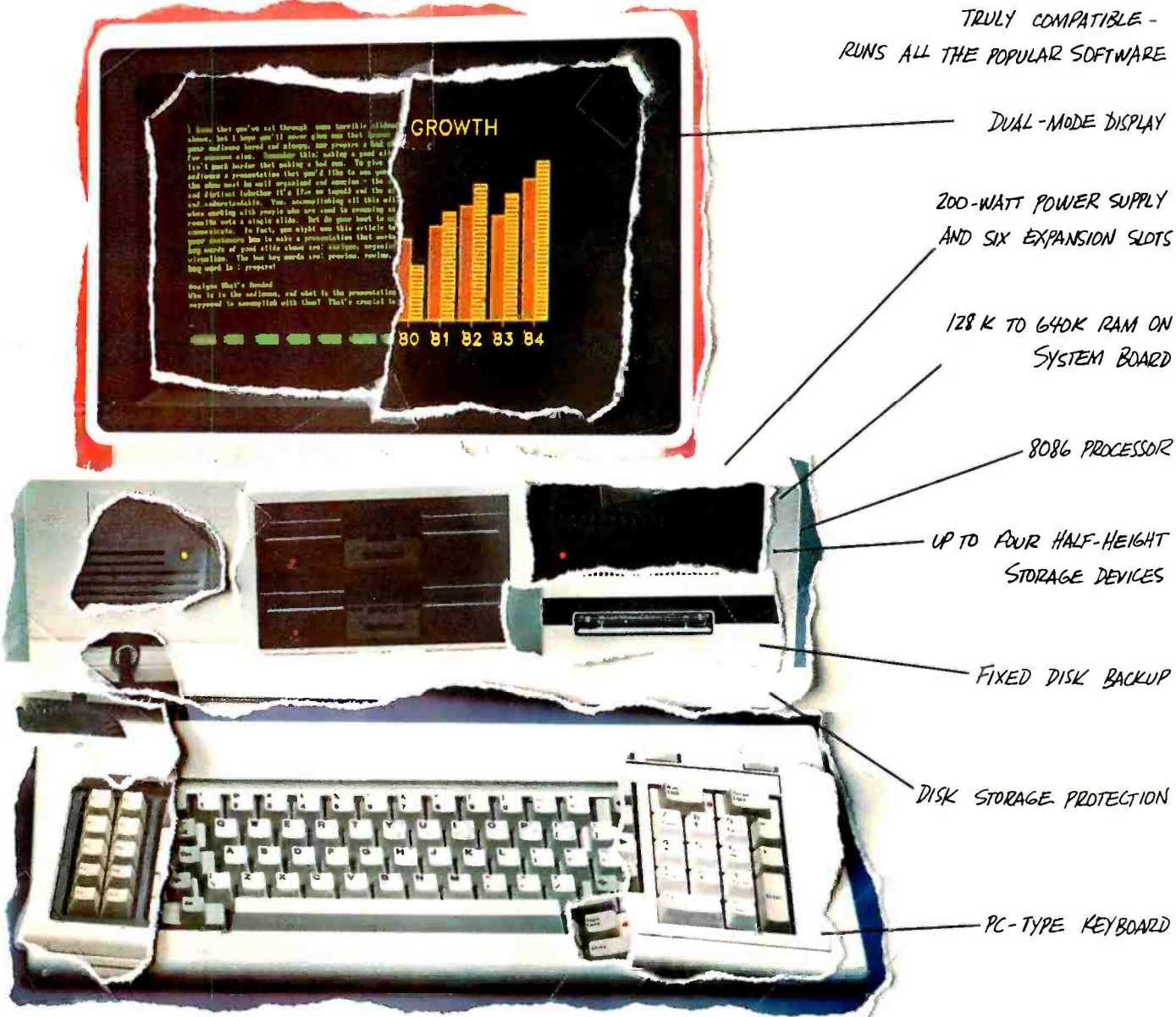
2342 Walsh Avenue
 Santa Clara, CA 95051
 (408) 727-5721



Crosstalk is a trademark of Microslut; Hayes and Smartcom II are trademarks of Hayes Microcomputer Products.

Circle 316 on inquiry card.

Computer dreams.



TRULY COMPATIBLE -
RUNS ALL THE POPULAR SOFTWARE

DUAL-MODE DISPLAY

200-WATT POWER SUPPLY
AND SIX EXPANSION SLOTS

128 K TO 640K RAM ON
SYSTEM BOARD

8086 PROCESSOR

UP TO FOUR HALF-HEIGHT
STORAGE DEVICES

FIXED DISK BACKUP

DISK STORAGE PROTECTION

PC-TYPE KEYBOARD

Introducing the new COMPAQ DESKPRO.[™] COMPAQ combined the best features of the best desktop computers. And then added exclusives you won't find on others. Today they're together in *one* personal computer. The COMPAQ DESKPRO.

The COMPAQ DESKPRO is the most expandable desktop you can buy. It can grow as you grow, with up to six available expansion slots and four storage devices, including a unique fixed disk drive backup—all *inside the computer instead of out*, saving your desk from clutter.

It's the most rugged desktop, too, because it's the only desktop with a shock-mounted mass storage compartment to help keep disk drives in alignment and help protect you from losing data, downtime, and dollars.

It's also the most compatible desktop, giving you true hardware and software compatibility with the industry's most popular personal computers. The COMPAQ DESKPRO runs thousands of programs written for the IBM[®] PC and XT right off the shelf. Which brings us to the next point.

*1984. COMPAQ[®] is a Registered Trademark and COMPAQ DESKPRO[™] is a Trademark of COMPAQ Computer Corporation. IBM[®] is a Registered Trademark of International Business Machines Corporation.

Dream computer.

The industry leader in compatibility.

Text and graphics on one screen, not two.

Power and space for almost unlimited expansion.

Add up to 640K of memory on system board and save expansion slots.

Runs software 2X to 3X faster.

*10MB fixed disk drive
10MB fixed disk backup
Two diskette drives*

Exclusive tape backup helps protect data.

Unique shock mounting helps protect your data and hardware investment.

Familiar layout enhanced with LED's on caps and num-lock keys.



The COMPAQ DESKPRO is the fastest truly compatible desktop you can buy. It's two to three times faster than the industry standard. That saves time now. And in the future, as software becomes more sophisticated and integrated, it will save you even more time as well as protect your personal computer investment.

But there's more. We gave the COMPAQ DESKPRO one other feature not found on any other machine. You can choose between an amber or green dual-mode monitor that displays high-resolution text *and* graphics with equal

brilliance, saving you the cost and clutter of a second monitor. See the Dream Computer. Then pinch yourself. It's for real.

For the location of the nearest Authorized COMPAQ Computer Dealer, or for a free brochure, call 1-800-231-0900, Operator 5 or Telex #795437 COMPAQCOMP HOU.

The New

COMPAQ

DESKPRO™

It simply works better.

AUGUST 1984 • BYTE 155

**NEW INSIDER
SUB SYSTEMS**



#IS18 SHOWN

\$895.00

**NOW WITH
HARD DISC CACHE
FOR INCREASED
SPEED PERFORMANCE**

- IS00** • 10 Mega-Byte Winchester
- Hard Disk Controller

UPGRADES FOR YOUR IBM PC /PC COMPATIBLES

- IS01** • 10 Mega-byte Winchester
• Modular hard disk controller **\$1095.00**
- IS02** • 10 Mega-byte Winchester
• Floppy/Hard disk controller **\$1295.00**
- IS16** • Half-high tape drive
• XT-Power Supply **\$ 995.00**
- IS17** • Half-high tape drive
• Half-high floppy drive
• XT-Power Supply **\$1265.00**
- IS18** • Half-high tape drive
• Half-high 10 Mega-byte Winchester
• Hard disk controller
• XT-Power Supply **\$2095.00**
- IS20** • 20 Mega-byte Winchester
• Hard disk controller **\$1595.00**
- IS21** • Half-high tape drive
• Half-high 20 Mega-byte Winchester
• Hard disk controller
• XT-Power Supply **\$2495.00**
- IS40** • 40 Mega-byte Winchester
• Hard disk controller
• XT-Power supply **\$2895.00**

- IS41** • Half-high tape drive
• Half-high floppy drive
• 40 Mega-byte Winchester
• Hard disk controller
• XT-Power Supply **\$3795.00**
- ISPS** • XT-Power Supply **\$ 290.00**

TAPE FOR YOUR IBM XT

- XT01** • Half-high tape drive
• Half-high floppy drive **\$ 995.00**

Micro Design International Inc. has been serving the computer industry for over 7 1/2 years, call us today for our complete catalog or to place your order.

**TO ORDER CALL COLLECT
(305) 677-8333**
Master Card/Visa/Check/or Money Order

**MICRO DESIGN
INTERNATIONAL INC.**
"Your internal solution"
6586 University Blvd. Suite 7
Winter Park, Florida 32792

Circle 202 on inquiry card.
* IBM is a registered trademark of International Business Machines Corporation

TUTORIAL ON MODULA-2

BY JURG GUTKNECHT

*A structured programming language
based upon the concept of autonomous modules*

MODULA-2 INTRODUCES the module into the world of systems engineering. It is a basic constituent of Modula-2 programs, appears in a variety of formats, and is comparable to that of procedures brought in by ALGOL and Pascal for structuring programs.

One module may combine a set of logically connected procedures: a second module may hide a complex data structure and provide operations to influence this structure; a third module may define the fundamental data types in a large program. Modules are either autonomous or embedded, as sub-modules, into larger modules. The autonomous are said to be embedded into the universe.

The module is essentially a separate program part, with an infrastructure that is similar to the infrastructure of a Pascal program. Types, constants, variables, and procedures declared within the module are generally not visible outside the module, and objects defined outside the module are not accessible from within.

The module technique has turned out to be surprisingly difficult to master. We have been involved with Modula-2 at the Institut für Informatik and our experience shows that it is easier to misuse the module than to use it profitably. Nevertheless, we find it to be indispensable. This tutorial may help you

in developing a good eye for appropriate program modularization.

Let us define some integral concepts. The nature of permanency is common to all types of modules. The lifetime of the module and its objects equals that of the whole program. This is in contrast to the temporary character of procedures. In fact, the notion of a module is more closely related to the notion of record than to that of procedure.

We define a module as active at a given moment if statements of the module are executed. The first time a module becomes active is when it has been loaded. The module body (also called initialization part) is then executed as a subroutine of the program loader. The last module loaded is the main module and its initialization part is the main program. A module is reactivated whenever one of its exported procedures has been called.

AN EXAMPLE

To get firm ground under our feet, we will develop a Modula-2 sample program—a text formatter. For this example, assume that the text must be printed on sheets of paper in adjusted
.....
Dr. Jürg Gutknecht (Institut für Informatik,
ETH—Zentrum (Clausiusstrasse), CH-8092,
Zürich, Switzerland) is actively involved in the
use of Modula-2.

and multicolumn form. Assume further that this text is available in an ordinary text file that consists of lines of text (see figure 1a). Let us define a paragraph as a sequence of lines that is terminated by an empty line. Thus, from our text formatter's point of view, line terminators (hereafter referred to as EOL characters) are equivalent to space characters, except when they terminate an empty line, which concludes a non-empty sequence of lines.

The crucial thing for our formatter to do is to convert the text from "straight text" representation into "columnar text" representation. We shall organize our program so that it creates a new text file, which contains the text in its new format. A standard utility program may later produce the desired printout.

The overall dynamic structure of our program now suggests itself: read text lines from the input file in sequence, and build up the text pagewise in its new format. Completed pages should be written immediately into the output file to make way for the next page in the memory. Clearly, the events of reading lines and writing pages are asynchronous.

An appropriate program structure should certainly reflect the described situation. We could regard the input handler as the main, and therefore con-

(continued)

TUTORIAL

trolling, part of the program. Alternately, we might structure the output formatter as the translation controller that periodically demands a new text portion from the input routine. From our experience, the former point of view is superior to the latter, particularly if the

input stream includes control information.

Further, we propose to encapsulate the formatter into a submodule. Let us now develop the interface to this submodule that we shall call *Layout*. Essentially, communications will consist of a

single operation: formatting an appropriate piece of text. We shall therefore call this procedure *Format*. *Format* accepts and formats a paragraph. The paragraph is handed over in the form of a pointer *lim* (end of text) into a

(continued)

1a

Lara is a document processing program consisting of an interactive editor (lara) and a printer companion (laraprint) producing hardcopies of Lara documents on the laser printer.

Lara introduces several new concepts.

We shall roughly outline the most important of them in this memo.

The memo also includes basic rules and guidelines for working with Lara.

We shall expect the reader to be familiar with the program editor and the text editor Andra.

Concepts of Lara:

Self-Consistency:

Each Lara document completely describes itself, i.e. it does not refer to any other information such as styles and user profiles.

Thus, the values of all formatting attributes occurring within the document are included in the (header of the) document file.

Hierarchical document structure:

A Lara document is structured as a sequence of so called chapters.

Each chapter starts on a new page and is made up of a sequence of paragraphs.

Each paragraph starts on a new line and consists of a sequence of characters. A chapter, resp. paragraph, is created by typing a form-feed (CTRL L), resp. line-feed (CTRL J).

In the case of adjusted paragraphs, RETURN is equivalent to line-feed.

Document, Chapter, Paragraph, Character

are the structural units of which a Lara document consists.

Each structural unit is connected with a set of formatting attributes (applicable to instances of that structure, see table below).

A structural unit of higher level is selected by a multiple click of the select button pointing at the same location.

Each clicking increases the selection menu by one.

For a selection to be successful, the beginning and end of the respective structural unit must be displayed.

An unsuccessful level may be skipped by simply clicking again.

1b

Lara is a document processing program consisting of an interactive editor (lara) and a printer companion (laraprint) producing hardcopies of Lara documents on the laser printer. Lara introduces several new concepts. We shall roughly outline the most important of them in this memo. The memo also includes basic rules and guidelines for working with Lara. We shall expect the reader to be familiar with the program editor and the text editor Andra.

Concepts of Lara:
Self-Consistency: Each Lara document completely describes itself, i.e. it does not refer to any other information such

as styles and user profiles. Thus, the values of all formatting attributes occurring within the document are included in the (header of the) document file.

Hierarchical document structure: A Lara document is structured as a sequence of so called chapters. Each chapter starts on a new page and is made up of a sequence of paragraphs. Each paragraph starts on a new line and consists of a sequence of characters. A chapter, resp. paragraph, is created by typing a form-feed (CTRL L), resp. line-feed (CTRL J). In the case of adjusted paragraphs, RETURN is equivalent to line-feed.

Document, Chapter, Paragraph, Character are the structural units of which a Lara document consists. Each structural unit is connected with a set of formatting attributes (applicable to instances of that structure, see table below). A structural unit of higher level is selected by a multiple click of the select button pointing at the same location. Each clicking increases the selection menu by one. For a selection to be successful, the beginning and end of the respective structural unit must be displayed. An unsuccessful level may be skipped by simply clicking again.

Figure 1: The test file (1a) prior to being converted into 3-column format (1b).

Why buy a VISUAL 102 instead of a DEC VT102?

14" non-glare screen

Tilt/swivel display

10 x 12 character matrix

Buffered printer port

Status line

16 programmable functions

Sculptured low profile keyboard

VISUAL See for yourself[®]

Thomas R. Foley
President

Andy
Let's show VISUAL 102 has the same extra features when compared to the DEC VT220!

→ *Tom*

Agreed.. plus our keyboard is far more compact with user-programmable, non-volatile function keys. And VT100 compatible.

- *Andy*

Plus...graphics now or graphics later.

The new VISUAL 102 gives full DEC VT102[®] performance and more features at a much lower price. Plus, when you need it, a Graphics Option card turns the VISUAL 102 into a 768 x 293 resolution graphics terminal emulating the Tektronix 4010/4014. Just insert the card and immediately you have high resolution graphics compatible with a variety of available software packages.

VISUAL 102. The low cost, DEC VT102 compatible terminal that lets you graph now or graph later.

The UL listed VISUAL 102 exceeds FCC Class A requirements and U.S. Government standards for X-ray emissions.

VISUAL See for yourself[®]

Visual Technology Incorporated
540 Main Street, Tewksbury, MA 01876
Telephone (617) 851-5000. Telex 951-539

Circle 323 on inquiry card

character buffer *buf* (see listing 1).

A few explanations on this program fragment are in order. Although similar to Pascal, some conspicuous differences can be detected:

Import lists: these refer to separate standard modules, namely *FileSystem* and *InOut*, members of the basic module library. We shall discuss the library concept later. The entries in the import lists designate objects declared in and exported from the library modules. Apart from *File*, which is a type, all listed objects are procedures. Note that *File* is a record type, as can be seen from the statement `WHILE NOT IN.EOF DO . . .`. Fields of imported records (such as *eof*) are implicitly imported together. In Modula-2's syntax, `WHILE` and `IF` statements are never initiated with a `BEGIN` but are always terminated by a keyword (`UNTIL` or `END`). This rule lets nested statements appear more elegant than their counterparts in Pascal. Also, the ambiguities that arise in Pascal with nested

`IF . . . THEN . . . ELSE` statements have been eliminated.

Type *Cardinal*: this is a new standard type describing natural numbers. Repetition of names: the module name has to be repeated at the end of the module. (This repetition convention also applies to procedures.) Character constants: `#C` designates the character with octal ordinal number *n*. Abbreviations: `#` is equivalent to `<>` and `G` is an abbreviation for `AND`.

In our program fragment, we could have used the standard Modula-2 procedure `INC` for incrementing *lim* (i.e., `INC(lim)` is equivalent to `lim := lim + 1`).

Let us now examine the imported procedures `ReadString` and `WriteString`. They accept as their parameter an array of characters of arbitrary length. The corresponding formal parameter is a so-called *dynamic* or *open* array:

```
PROCEDURE ReadString(VAR s:
  ARRAY OF CHAR):
```

Dynamic arrays are of major importance in Modula-2. The index type of dynamic arrays is always *CARDINAL*, and the low boundary is 0. The boundary of the actual array parameter can be obtained by `HIGH(s)` using the standard function `HIGH`. Dynamic arrays can only be used as formal parameters.

Next, let us look at strings (i.e., sequences of characters). Assume that a function procedure had to be developed that returns the actual length of a string. A string within an array of characters is terminated by `OC` or by the further array boundary, whichever comes first. Consider the procedure declaration in listing 2.

In Modula-2, functions differ from ordinary procedures solely by the supplement of a result type. The result is returned by the `RETURN` statement. We point out the amazing simplicity of this algorithm. It has its roots in the conditional evaluation of the test in the `WHILE` statement. If `i <= HIGH(s)` is false, then the second part of the expression is ignored rather than evaluated. Thus, an index out-of-range error cannot occur.

LAYING OUT LAYOUT

Let our attention now turn to the submodule *Layout*. We know that *Layout* exports the procedure `Format`, which formats a paragraph that is stored in the global buffer *buf*. Therefore, the wall around *Layout* has to be transparent for this variable: *buf* must be imported. But how should `Format` record its results? An obvious solution is to introduce the two-dimensional array *form* that represents a text page. By successively calling the formatting procedure, a map of the current text page will be built up. The variables *row* and *col* indicate the current status of the formatting process. Of course, these variables have to survive the procedure `Format`. On the other hand, the significance of the variables *form*, *row*, and *col* is strictly related to the specific implementation of `Format`. They have no meaning outside the submodule. They are, in fact, invisible outside the module as they are not exported. We shall say that these variables constitute the private data structure of the (sub)module.

We have seen that the procedure `Format` operates on the status variables *row*
(continued)

Listing 1: A program fragment written in Modula-2 designed to format text into columns.

```
MODULE Formatter;
FROM FileSystem IMPORT File, Lookup, Close, ReadChar, WriteChar;
FROM InOut IMPORT ReadString, WriteString, Write;
CONST EOL = 36C;
VAR in, out: File;
    name: ARRAY 10..31 OF CHAR;
    ch: CHAR;
    buf: ARRAY 10..1000 OF CHAR;
    lim: CARDINAL;
BEGIN
  WriteString("in > "); ReadString(name); WriteEOL;
  Lookup(in, name, FALSE);
  WriteString("out > "); ReadString(name); WriteEOL;
  Lookup(out, name, TRUE);
  lim := 0; ReadChar(in, ch);
  WHILE NOT in.eof DO
    WHILE ch # EOL DO
      lim := lim + 1; buf[lim] := ch; ReadChar(in, ch);
    END;
    lim := lim + 1; buf[lim] := ""; ReadChar(in, ch);
    IF ch = EOL THEN Format: lim := 0; ReadChar(in, ch) END
  END;
  Close(in); Close(out);
END Formatter.
```

Listing 2: A procedure used to return the length of a given string within an array of characters.

```
PROCEDURE Len(VAR s: ARRAY OF CHAR): CARDINAL;
VAR i: CARDINAL;
BEGIN i := 0;
  WHILE i <= HIGH(s) & (s[i] # OC) DO i := i + 1 END;
  RETURN i;
END Len.
```


Idris. **The micro UNIX** **running as** **an application** **under** **PC/MS-DOS.**



Price: \$695



Whitesmiths, Ltd.

97 Lowell Road, Concord, Massachusetts 01742
(617) 369-8499 TLX: 750246 SOFTWARE CNCM

Circle 329 on inquiry card.

UNIX is a trademark of Bell Laboratories; MS-DOS is a trademark of Microsoft Corp.
PC-DOS is a trademark of International Business Machines Corporation
Idris is a trademark of Whitesmiths, Ltd.

and *col*. How are these variables initialized? Remember the initialization part mentioned above. The Modula-2 linking loader guarantees that the statement sequence in the module body has

been executed whenever an exported procedure is called from the outside. So introducing the initialization statements in the module body solves our problem.

So far we have disregarded the out-

put. Clearly, a page should be written line by line into the output text file each time the page is completed. Format calls procedure *OutPage* when *row* and *col* have reached their maximum. Is this the only situation in which a page has to be written? It is likely that the last page of the text is only partially filled, so that the variables *row* and *col* won't reach their maximum values. So *OutPage* should also be called from the main program as termination procedure immediately before closing the files. We therefore generalize *OutPage* to include the handling of a partially filled *form* and include it in the export list.

Our submodule, *Layout*, appears in listing 3. Its text has to be included in the declaration part of the main module.

Notice the presence of a new repetitive LOOP statement. The loop statement is used whenever a repetition with more than one exit, or no exit at all, has to be programmed. The LOOP is left whenever an EXIT statement has been encountered within the loop brackets LOOP and END. It is noteworthy that the loop statement makes a jump statement (like GOTO) unnecessary. In our example, the loop is left when either the paragraph is terminated ("emergency exit") or when the current word has no room on the current line ("regular exit").

Constant expressions are another innovation of Modula-2 over Pascal. They are particularly useful for the specification of array bounds such as in $0 \dots \text{maxRow}-1$ and can also be used for the declaration of dependent constants (e.g., $\text{bndRow} = \text{maxRow} - 1$).

Until now, we have underexploited the possibilities of our submodule *Layout*. In fact, we have fixed the number of columns and the column widths as constants, although the module works correctly for arbitrary (appropriate) values of these quantities. Let us extend the format of input files with an optional header line that is initiated by a *CTLF(6C)*. *CTLF* has to be followed by a digit from 1 to 4 indicating the desired number of text columns.

A second modification concerns the overall program flow. It is not a good idea to terminate the program after having processed a single text file. Instead, the program should be ready to process

(continued)

Listing 3: The submodule *Layout*, the output formatter, must appear within the main module.

```

MODULE Layout;
IMPORT buf, lim, out, WriteChar, EOL;
EXPORT Format, OutPage;
CONST len = 30; wid = 33; maxRow = 70;
      maxCol = 3; len, bndCol = maxCol-len;
      FF = 14C; (-form feed.)
VAR form: ARRAY 10, maxRow-1, 0..maxCol-1 OF CHAR;
    row, col: CARDINAL; (-current coordinates-)

PROCEDURE OutPage;
VAR c, r, p: CARDINAL;
BEGIN r := 0;
  WHILE r # maxRow DO c := 0;
    WHILE c # col DO p := 0;
      WHILE p # len DO WriteChar(out, form[r, c + p]; c := p + 1 END;
      WHILE p # wid DO WriteChar(out, " "); p := p + 1 END;
      c := c + len
    END;
    IF r < row THEN p := 0;
      WHILE p # len DO WriteChar(out, form[r, c + p]; c := p + 1 END
    END;
    WriteChar(out, EOL);
    r := r + 1
  END;
  WriteChar(out, FF)
END OutPage;

PROCEDURE Format;
VAR beg, cur, end, pos, wds, spc, rem: CARDINAL;
BEGIN
  beg := 0; cur := 0;
  REPEAT cur := cur + 1 UNTIL buf[cur] = " ";
  REPEAT wds := 0; beg := beg + 1;
    LOOP
      wds := wds + 1; end := cur;
      IF end = lim THEN spc := 0; rem := 0; EXIT END;
      REPEAT cur := cur + 1 UNTIL buf[cur] = " ";
      IF cur - beg > len THEN
        IF wds > 1 THEN
          spc := (len + beg - end) DIV (wds - 1);
          rem := (len + beg - end) MOD (wds - 1)
        END;
        EXIT
      END;
    END;
  pos := 0;
  WHILE pos # len DO form[row, col + pos] := buf[beg];
    IF buf[beg] = " " THEN pos := pos + spc;
      IF rem > 0 THEN pos := pos + 1; rem := rem - 1 END
    END;
    pos := pos + 1; beg := beg + 1
  END;
  row := row + 1;
  IF row = maxRow THEN
    IF col = bndCol THEN OutPage; col := 0 ELSE col := col + len END;
    row := 0
  END;
  UNTIL end = lim
END Format;

BEGIN col := 0; row := 0
END Layout

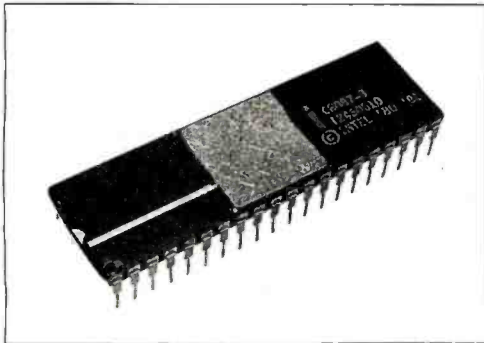
```


THE 8087 IS IN STOCK!

Micro Ware is the world's leading retailer of 8087s. We also have the most accurate statistics on chip reliability. They are: .01% infant mortality, .00% adult mortality and .02% 8088 incompatibility. As for ease of installation, we have never had a customer return a chip because of bent pins. We are so confident that you will be able to successfully install and use the chip that we offer a 180-day warranty with every chip we sell. That's 90 days more than anyone else!

To support the 8087 we stock the largest selection of 8087 software anywhere. This includes: three FORTRANs, three PASCALS, APL, Intel's ASM86, PL/M-86, several Cs, 87BASIC, 87MACRO and MATRIXPAK. For real time or multi-user applications we offer RTOS™ - our implementation of Intel's iRMX executive. Our new products include a professional debugger with 8087 support, an interface library which enables MS Fortran users to call the IBM Basic

Compiler Library, and a translator that converts object modules into readable assembly language files. If you have a question about which computer, language, compiler, operating system or application package is best suited to your problem, we can answer it. Just call:
Information and Orders—
617-746-7341
University, Corporate and Government Buyers—
617-746-7364



Micro Way™ 8087 Support

87FORTRAN/RTOS™ - our adaptation of the Intel Fortran-86 Compiler generates in line 8087 code using all 8087 data types including 80-bit reals and 64-bit integers. The compiler uses the Intel large memory model, allowing code/data structures of a full megabyte, and supports overlays. Includes RTOS and support for one year **\$1350**

87PASCAL/RTOS™ is Intel's ISO-Standard Pascal with 8087-8088 exceptions. These make it possible to use all the 8087 data types directly, while generating modules in one of the three Intel Memory Models. Includes RTOS and support for one year **\$1350**

RTOS DEVELOPMENT PACKAGE includes 87FORTRAN, 87PASCAL, PL/M-86, Utilities, TX Screen Editor and RTOS.... **\$2500**

RTOS—
**REAL TIME MULTI-TASKING/
 MULTI-USER EXECUTIVE**
 RTOS is a Micro Ware configured version of iRMX-86. Includes ASM-86, LINK-86, LOC-86, LIB-86, and the ROM Hex Loader **\$600**

MWS-286™ Configured to your specifications, our computer runs RTOS-286 or XENIX. Includes one Intel compiler, seven slot multibus chassis, hard disk, streaming tape backup and Intel Service Contract. Six to twenty times faster than your PC **CALL**

OBJ→ASM™ - a multipass object module translator and disassembler. Produces assembly language listings which include public symbols, external symbols, and labels commented with cross references. Ideal for understanding and patching object modules and libraries for which source is not available **\$200**

PC TECH JOURNAL REVIEW:
 "The Micro Ware package is preferable ... it executes the basic operations more rapidly and Micro Ware provides a free update service."

87BASIC™ includes patches to the IBM Basic Compiler and both runtime libraries for USER TRANSPARENT and COMPLETE 8087 support. Provides super fast performance for all numeric operations including trigonometrics, transcendentals, addition, subtraction, multiplication, and division..... **\$150**

87BASIC/INLINE™ generates inline 8087 code! Converts the IBM Basic Compiler output into an assembly language source listing which allows the user to make additional refinements to his program. Real expression evaluations run five times faster than in 87BASIC..... **\$200**

87MACRO™ - our complete 8087 software development package. It contains a "Pre-processor," source code for a set of 8087 macros, and an object library of numeric functions including transcendentals, trigonometrics, hyperbolics, encoding, decoding and conversions..... **\$150**

87DEBUG™ - a professional debugger with 8087 support, a sophisticated screen-oriented macro command processor, and trace features which include the ability to skip tracing through branches to calls and software and hardware interrupts. Breakpoints can be set in code or on guarded addresses in RAM **\$150**

FOR→BAS™ - a library of interface routines which allow MS Fortran programs to call the IBM Basic Compiler library and access features such as the RANDOM NUMBER GENERATOR, SOUND, PLAY, DRAW and SCREEN commands..... **\$150**

8087-3 CHIP..... \$175
 including DIAGNOSTICS and 180-day warranty
64K RAM Upgrade..... \$47.50

87/88GUIDE - an excellent tutorial on writing 8087 code and interfacing it with compilers. Full of code that runs! **\$30**

MATRIXPAK™ manages a **MEGABYTE!** Written in assembly language, our runtime package accurately manipulates large matrices at very fast speeds. Includes matrix inversion and the solution of simultaneous linear equations. Callable from MS Fortran 3.2, 87MACRO, 87BASIC, and RTOS..... each **\$150**

MICROSOFT FORTRAN 3.2... \$239
MICROSOFT PASCAL 3.2..... \$209
 These IEEE compatible compilers support double precision and the 8087

MICROSOFT C COMPILER includes Lattice C and the MS Librarian..... **\$350**

LATTICE C with 8087 support..... **\$350**
 SCO XENIX™ MICROSOFT..... **595**
 Unisource VENIX/86™ MICROSOFT..... **800**
 FLOAT87 for MS C..... **125**
 SuperSoft Fortran 66..... **299**
 Computer Innovations C86..... **345**
 STSC APL★PLUS/PC..... **500**
 TURBO PASCAL..... **45**
 TURBO PASCAL with 8087 Support..... **85**
 HALO GRAPHICS..... **CALL**
 GRAPHMATIC..... **125**
 ENERGRAPHICS..... **295**
 Professional BASIC..... **295**
 Kidger Optical Design Program..... **3000**
 COSMOS REVELATION..... **850**
 SuperCalc III with 8087 Support..... **CALL**
 MAYNARD WS1 HARD DISK..... **995**
 MAYNARD WS2 HARD DISK..... **1170**
 256K RAM CHIPS..... **CALL**
 MAYNARD ELECTRONICS Boards..... **CALL**

**NO CHARGE FOR CREDIT CARDS
 ALL ITEMS IN STOCK
 CALL FOR COMPLETE CATALOG**

IBM PC is a registered trademark of IBM Corp. 8087, iRMX-86, LINK-86, FORTRAN-86, ASM-86, LOC-86, PL/M-86 and LIB-86 are trademarks of Intel Corp. 87FORTRAN/RTOS, 87PASCAL/RTOS, 87BASIC, 87MACRO, MATRIXPAK, 87/88GUIDE, 87BASIC+ and MicroWay are trademarks of Micro Ware, Inc.

Micro Ware

P.O. Box 79
 Kingston, MA
 02364
 (617) 746-7341

**You Can
 Talk To Us!**

Structuring elements allow and invite software designers to group declarations and procedures into distinct modules.

another file. Hence, we embed our previous main program into a WHILE statement. We shall specify that entering ESC(33C) instead of a filename will bring the process to an end. Module *In-Out* exports a variable *termCH* containing the termination character of the string read by *ReadString*. Of course, this variable is exported for inspection only. See listing 4 for our extended main program.

In listing 4 we find yet another new Modula-2 statement. The IF statement from Pascal has been extended by the *ELSIF* clause. The meaning and possible application of this clause should be obvious from our example.

In contrast to our earlier solution, the submodule *Layout* may need to be initialized several times (i.e., each time new text is to be processed). The way to master this problem is to introduce

an explicit initialization procedure; in our case, this procedure is called *InitForm*, which replaces (and extends) the previous submodule body. The body of the new submodule is empty.

With that, however, the responsibility for the correct sequence of module initialization has passed over from the Modula-2 loader to the programmer.

DIVIDE AND CONQUER

Since the late 1960s serious programmers have based their software development on structured programming. This means that they have structured the dynamic flow of their programs such that a procedure call corresponds to each action in the formulation of the respective algorithm. Thereby, the question of where to program all these procedures has not been raised or answered "in the declaration section of the program." This is the point where Modula-2 intervenes. As we have already seen in the previous section, Modula-2's structuring elements allow and even invite the software designer to divide and logically group the set of declarations and procedures into distinct units called modules.

The consequences of this division reach further than expected. Separate

compilation is one new aspect. It is a small step from encapsulating a program part within a main module to completely removing this part from its environment and defining it as autonomous. In fact, the Modula-2 compiler accepts autonomous modules as compilation units and performs full compatibility checking across module boundaries.

But Modula-2 goes one step further: separate modules can be split up into a definition and an implementation part. The definition part defines the module from a functional point of view, while its implementation companion lays down the methods used to realize these functions or to represent data. The definition part can be regarded as a separately stated (and compiled), extended export list.

This concept clearly opens a new door for software engineers. They may define centrally the components of large software systems in a concise and unified way and leave the implementation to a team of programmers.

It is crucial to separate compilation that imports must always refer to definition (parts of) modules. An important consequence of this is that recompilation of an implementation (part of a) module does not influence the module's clients. However, the recompilation of a (modified) definition part can trigger a chain reaction of which the extent is determined by the number of importations in dependent definition modules. It is therefore a good idea to minimize imports in definition modules.

Let us illustrate all that by two examples: a compiler and an editor. Think of the compiler as being designed according to the method of recursive descent. The different parts in recursive-descent compilers are known to be closely interwoven. On the other hand, we have seen that modularization essentially amounts to a textual splitting of the program. Hence, modularizing a compiler has to be a difficult undertaking. Nevertheless, some functional units can be extracted: lexical analysis (scanner), syntactical analysis (parser), generating of the symbol table, and type checking and code generation. We shall assign each of these functional units to a separate module.

These modules are obviously tightly
(continued)

Listing 4: The main program that has been extended to a) use variables for the number of columns and column widths, and b) request a new text file to process after completing file output.

```
BEGIN
  WriteString("in > "); ReadString(name); Write(EOL);
  WHILE termCH # ESC DO
    Lookup(in.name, FALSE);
    WriteString("out > "); ReadString(name); Write(EOL);
    Lookup(out.name, TRUE);
    lim := 0; ReadChar(in.ch);
    IF ch = CTLF THEN ReadChar(in.ch);
      IF ch = "1" THEN InitForm(96, 96, 70, 0)
        ELSIF ch = "2" THEN InitForm(46, 49, 70, 1)
        ELSIF ch = "3" THEN InitForm(30, 33, 70, 2)
        ELSIF ch = "4" THEN InitForm(22, 24, 70, 3)
        ELSE InitForm(96, 96, 70, 0)
      END;
      REPEAT ReadChar(in.ch) UNTIL ch = EOL;
      ReadChar(in.ch)
    ELSE InitForm(96, 96, 70, 0)
    END;
  WHILE NOT in.eof DO
    WHILE ch # EOL DO lim := lim + 1; buf[lim] := ch; ReadChar(in.ch) END;
    lim := lim + 1; buf[lim] := ""; ReadChar(in.ch);
    IF ch = EOL THEN Format; lim := 0; ReadChar(in.ch) END
  END;
  OutPage;
  Close(in); Close(out);
  WriteString("in > "); ReadString(name); Write(EOL);
END
END Formatter.
```


Mylstar can cut your IBM-PC debugging time in half.



Introducing MSD! Mylstar Symbolic Debugging Program for IBM Personal Computers, PC-DOS V 1.1, 2.0 and 2.1.

MSD greatly enhances your IBMDEBUG Program. Using the same command structure as DEBUG, it lets you substitute symbol names and mathematical expressions for hex values. Batch files, on-line help, multi-command macros and other time saving entries are also included.

Symbols

Every symbol declared public in a source module becomes part of the symbol table. And new symbols can be created or old ones changed as quickly and easily as you can type them. And they can be stored for future use.

More than just a Symbolic Debugger

In addition to the examples shown below, MSD contains com-

mands for break points, repeat loops and input/output redirection. It lets you define macros which can be saved and used again. MSD also offers a Command to trace around calls, DOS interrupt calls, and repeat string instructions. And, because MSD supports the full set of DOS function calls you can debug more programs than with any other currently available debuggers.

MSD adds on what IBM left out

Call, write or check reader circle number for additional information. You can start debugging faster for only \$125. Phone orders accepted with Mastercard or Visa numbers.



MYLSTAR ELECTRONICS INC.

165 West Lake Street
Northlake, Illinois 60164
Tel (312) 562-7400
Telex 72-8463

A Columbia Pictures Industries Company

Circle 229 on inquiry card.

Arguments like source listing

Labels inserted

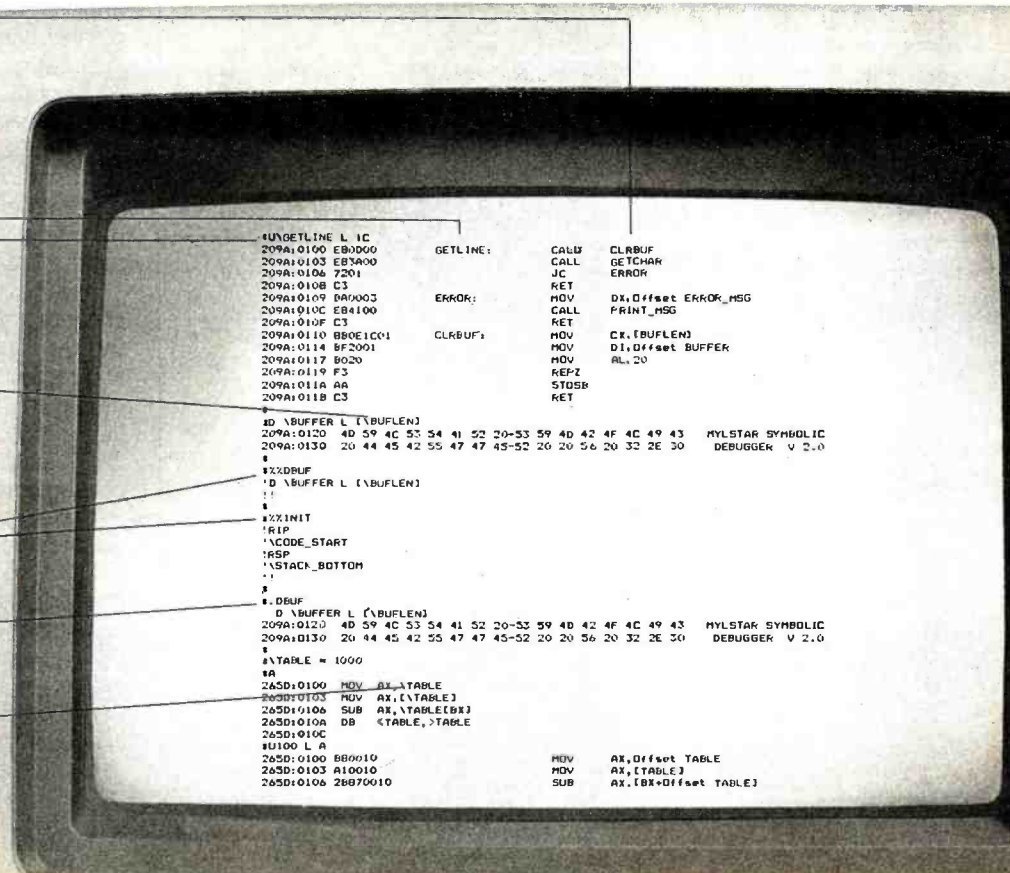
Symbolic parameter accepted

Indirection implemented (value currently stored at BUFLN used)

Create Macros

Execute Macros

Even use symbols with assemble command



```

#UNGETLINE L IC
209A:0100 EB0D00 GETLINE: CALL CLBUF
209A:0102 EB3A00 CALL GETCHAR
209A:0104 7201 IC RET ERROR
209A:0108 C3 ERROR: DX,Offset ERROR_MSG
209A:0109 DA0003 MOV PRINT_MSG
209A:010C EB4100 CALL
209A:010F C3 RET
209A:0110 B80E1C01 CLBUF: CX,(BUFLN)
209A:0114 BF2001 MOV DI,Offset BUFFER
209A:0117 B020 REPZ
209A:0119 F3 STOSB
209A:011A AA RET
209A:011B C3

#D \BUFFER L (\BUFLN)
209A:0120 4D 59 4C 53 54 41 52 20-53 59 4D 42 4F 4C 49 43 MYLSTAR SYMBOLIC
209A:0130 20 44 45 42 55 47 47 45-52 20 20 56 20 32 2E 30 DEBUGGER V 2.0
#
#%ZDRUF
#D \BUFFER L (\BUFLN)
#
#%ZINIT
#RIP
#ACODE_START
#RSP
#STACK_BOTTOM
#
#D BUF
#D \BUFFER L (\BUFLN)
209A:0125 4D 59 4C 53 54 41 52 20-53 59 4D 42 4F 4C 49 43 MYLSTAR SYMBOLIC
209A:0130 20 44 45 42 55 47 47 45-52 20 20 56 20 32 2E 30 DEBUGGER V 2.0
#
#TABLE = 1000
#A
2A5D:0100 MOV AX,TABLE
2A5D:0103 MOV AX,(TABLE)
2A5D:0106 SUB AX,(TABLE*BX)
2A5D:0109 DB <TABLE,>TABLE
2A5D:010C
#I100 L A
2A5D:0100 B80010 MOV AX,Offset TABLE
2A5D:0103 A10010 MOV AX,(TABLE)
2A5D:0106 2B070010 SUB AX,(BX+Offset TABLE)
    
```

coupled. They all rely on a central and dynamic data structure: the symbol table. How can this common data structure (i.e., the respective data types) be presented to the different modules? The solution is to place the description of the data structure itself into a module, a so-called data-type module. This data module constitutes a common base that must be imported by any module that participates in the handling of the symbol table. Notice the contrast to our first example: there, a public procedure operated on a private and hidden data structure. Here, private and public procedures operate on a common and public data structure.

What can be hidden at all in our compiler modules? Methods is the answer. Consider, for example, the symbol-table

generator. Listing 5 is an excerpt from its definition module.

ObjPtr, *ObjClass*, *StrPtr*, and *StrForm* are data types which are imported from the data module. *NewScope* and *CloseScope* open and close scopes, and *NewObj* and *NewStr* are procedures to create new entries in the symbol table. *Find* and *FindField* search for objects with a given name. *InitTableHandler* initializes explicitly the table handler, and *EndTableHandler* is the termination procedure for this module. We emphasize that no information is given about methods. It is left open, for example, which strategy is applied and whether a certain object is searched with a linear or a binary search.

Only the implementation module in listing 6 lifts the veil of secrecy.

Figure 2 shows the modular structure of our compiler in graphical representation. An arrow from module "M" to module "N" indicates that "N" imports "M" (i.e., "N" depends on the definition module of "M").

It is noteworthy that most multipass compilers show, from the point of view of time, a similar structure—first pass, lexical and syntactical analysis; second pass, table generating; third pass, type checking; and fourth pass, code generating. However, the spatial and temporal structures must not be mixed up (see figure 3).

Our second example of separate compilation is a text editor. In contrast to compilers, editors are interactive programs. Their dynamic flow is typically action oriented. Actions influence the text document's contents and, therefore, its representation on the display. This knowledge may result in the attempt of a modularization seen in figure 4.

But the display handler has to rely on the document handler. In fact, the document handler can be regarded as an abstract file system delivering a stream of characters and formatting information to the display. So we have mutual imports between the document and display handler.

Although this situation does not lead to a conflict as long as mutual import doesn't occur between definition modules, it indicates that the coupling of the two modules is too tight. A fundamental rule states that the "thinner" the interface between modules, the better the modularization.

In our example, we shall remedy the situation by eliminating the arrow from the display to the document handler and replacing it with an arrow from the display to the command interpreter (see figure 5).

This modification has some desirable consequences. First, the command interpreter can directly pass over display-oriented commands—such as scrolling the text—to the display handler without primarily involving the document handler. The second consequence is of even greater importance: the document handler is now freed from its dependence on the display. Therefore, it can also be imported by modules that process the text in a different way, say, by

(continued)

Listing 5: TableHandler. the definition module from a symbol-table generator.

```
DEFINITION MODULE TableHandler;
  FROM DataTypes IMPORT ObjPtr, ObjClass, StrPtr, StrForm;
  EXPORT QUALIFIED Scope,
    NewScope, CloseScope, NewObj, NewStr, Find, FindField,
    InitTableHandler, EndTableHandler;

  VAR Scope: ObjPtr; (*header of scope located by Find*)

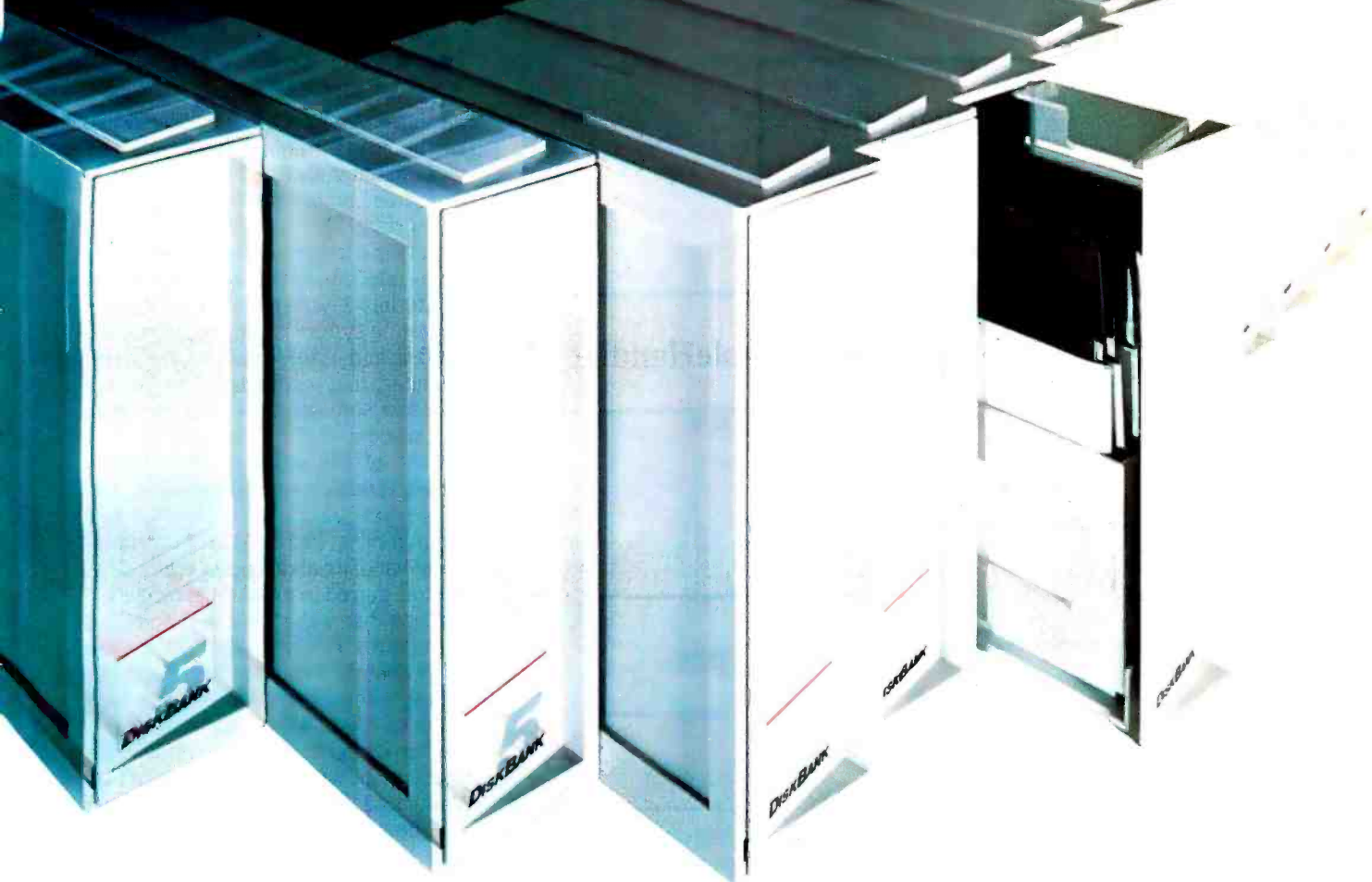
  PROCEDURE NewScope(kind: ObjClass): ObjPtr;
  PROCEDURE CloseScope;
  PROCEDURE NewObj(id: CARDINAL; class: ObjClass): ObjPtr;
  PROCEDURE NewStr(form: StrForm): StrPtr;
  PROCEDURE Find(id: CARDINAL): ObjPtr;
  PROCEDURE FindField(id: CARDINAL; rec: StrPtr): ObjPtr;
  PROCEDURE InitTableHandler;
  PROCEDURE EndTableHandler;
END TableHandler.
```

Listing 6: TableHandler. the implementation module that contains the logic (see also listing 5).

```
IMPLEMENTATION MODULE TableHandler;
  FROM Data IMPORT ObjPtr, Object, ObjClass, StrPtr, Structure, StrForm;
  ...

  PROCEDURE Find(id: CARDINAL): ObjPtr;
    VAR objx: ObjPtr;
    BEGIN Scope := topScope;
      LOOP objx := FindInScope(id, Scope);
        IF objx # NIL THEN EXIT
        ELSIF Scope?.kind = Module THEN
          objx := FindImport(id, Scope);
          IF objx = NIL THEN objx := FindInScope(id, universe) END ;
          EXIT
        ELSE Scope := Scope?.base
        END
      END;
    RETURN objx;
  END Find;
  ...
END TableHandler.
```


ADD-INFINITUM



Add Diskette Storage When You Need It With The DiskBank® System.



No matter how large or small your diskette filing and storage requirements may be, the DiskBank System by Amaray is the most revolutionary, versatile and cost-effective approach available today.

Its unique modular interlocking design allows you to add new modules as your storage needs expand. Each impact-resistant module conveniently

Circle 18 on inquiry card.

organizes up to 10 diskettes in a safe, dust-free environment. When you need a diskette, simply open the DiskBank drawer and slide it out. Diskettes automatically come forward allowing you to select the one you need.

In addition, the System is portable. DiskBank modules are designed to go with you anywhere. Simply slide out the modules you need, put them in your briefcase, and go.

Available in three media format sizes, System 3 for 3¼"-3½" diskettes, System 5 for 5¼" diskettes, and System 8 for 8" diskettes, DiskBank System may be purchased individually or in money-saving volume packs.

Why settle for less? Give your valuable diskettes the protection they deserve. Buy a Bank. Buy a DiskBank. The DiskBank System

DISKBANK®
AMARAY

AMARAY CORPORATION
2251 Grant Road, Los Altos, CA 94022
(415) 968-2840 Telex 171627 Amaray-Ltos



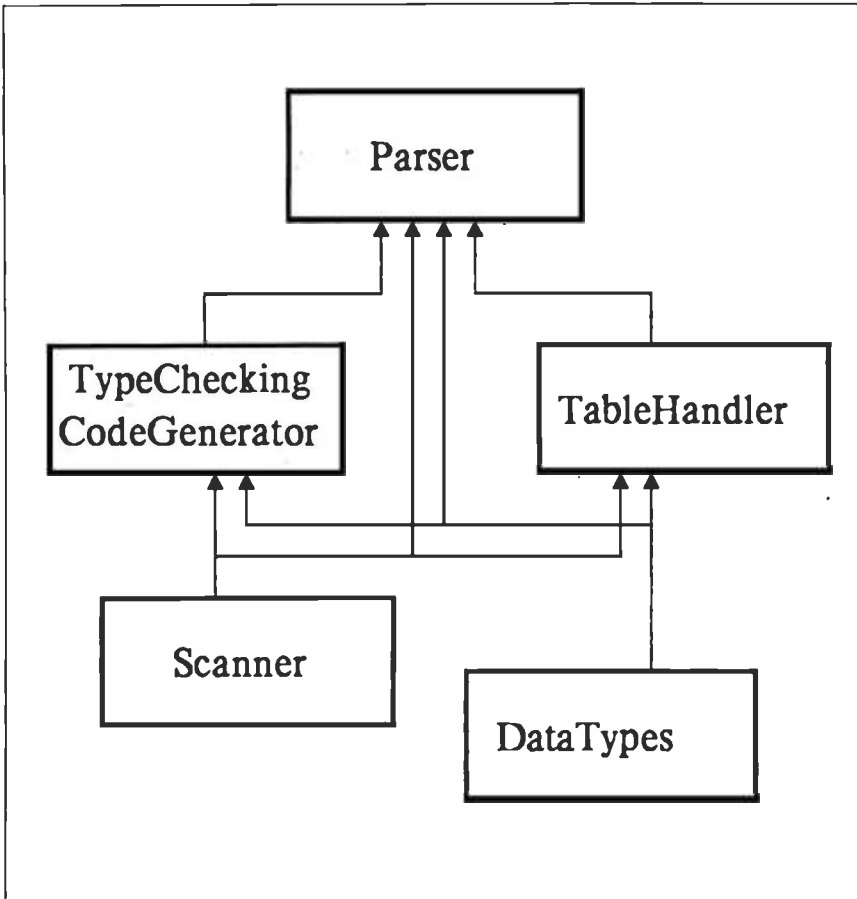


Figure 2: A representation of the modular structure of the compiler example. The arrows from one module to another indicate that the latter imports the former.

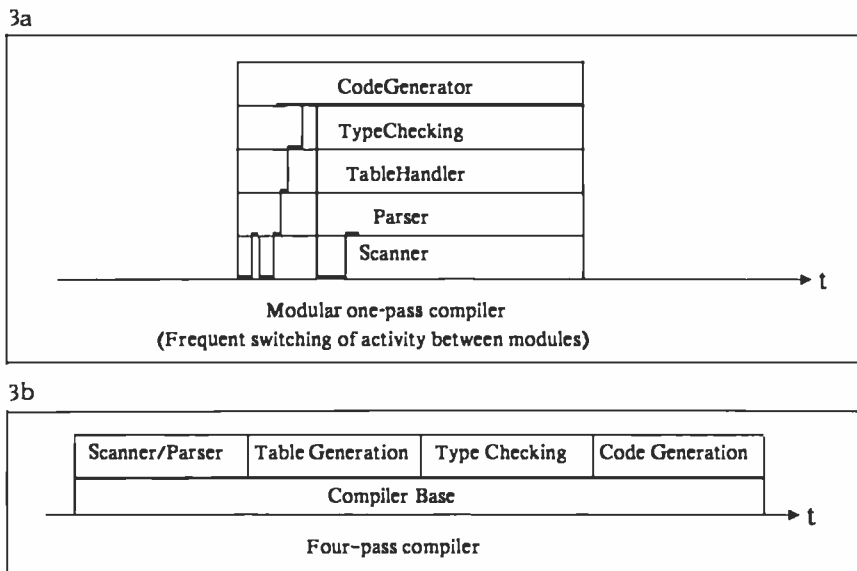


Figure 3: A one-pass compiler (3a) as contrasted to a four-pass compiler (3b) over t time.

a printing program or by an off-line statistics program.

FROM PROGRAM COMPONENTS TO LIBRARY MODULES

We have seen that a specific module can be used by different programs. This thought naturally leads to the notion of a module library. The fact that the word *library* stands for a collection of books tempts me to create the word *modularity* for a collection of modules. Actually, in a Modula-2 environment even the operating system is simply a collection of basic and usable modules. The sharp boundary that separates system and application software thus becomes even less distinct.

Most of the features that do not belong directly to the programming language but are indispensable for real programming, such as I/O (input/output) string handling and process scheduling, are transferred to modules in Modula-2. On one hand this relieves, and also generalizes, the language and, on the other hand, increases its flexibility. Figure 6 shows an example of a hierarchy of Modula-2 library modules.

When designing a library module, the question of which facilities should be made available is paramount. If the set of offered procedures is too complicated, then most users will create their own modules; if the procedures are too simplistic, they are again dissatisfied. Our goal is to find the "golden mean."

We can summarize our experience relating to this quest in the following guidelines. We recommend that the library-module designer obey these rules.

GUIDELINE 1

Do not export complex procedures from your library module (i.e., procedures with a large number of explicit or—even worse—implicit parameters and assumptions). Instead, export the atoms of complex operations as individuals. This gives the user of your module the chance to "tailor" the operation as a whole to his requests.

For example, assume that a mouse-handling module offers a procedure TrackMouse to track the mouse until a mouse button has been pressed or a character typed. This procedure would

(continued)

Now! Tek quality and expert advice are just a free phone call away!

100 MHz dual time base scope. Easy-to-read CRT; bright, full-sized 8x10 cm; 14 kv accelerating potential complete with BEAM FIND, separate A/B dual intensity controls, FOCUS and TRACE ROTATION

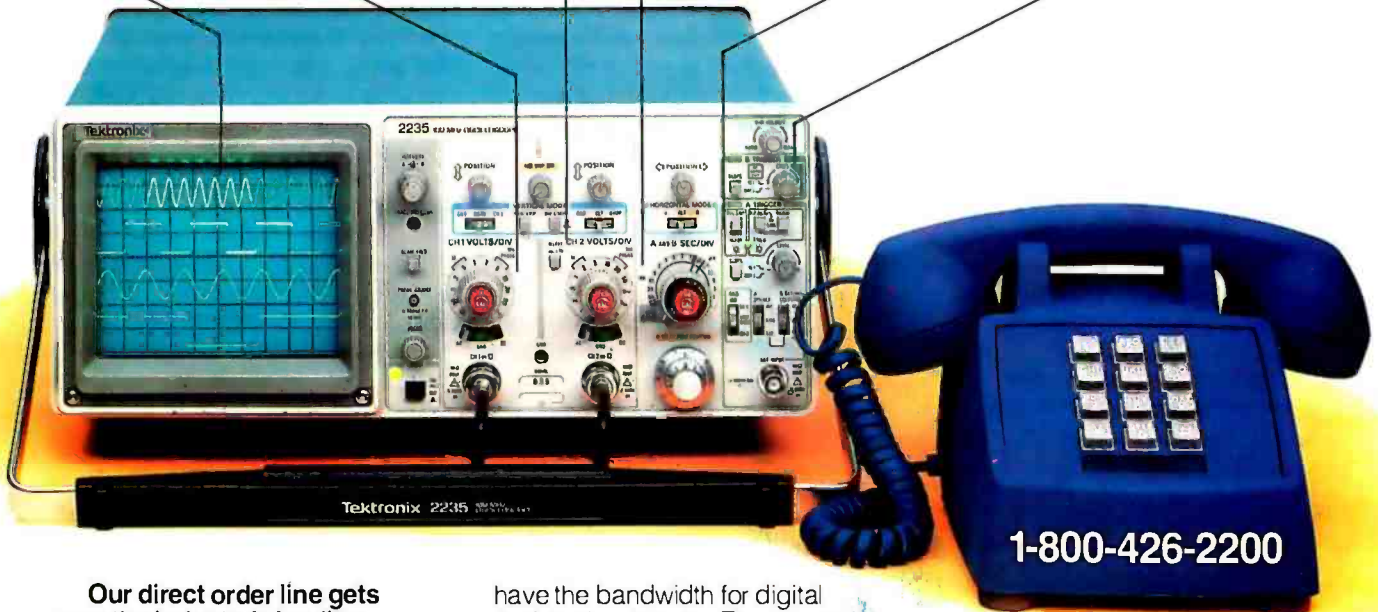
Wide range vertical sensitivity. Choose from 2 mV/div (1x probe) to 50 V/div (10x probe); color-keyed for 1x and 10x probes; variable control increases scale factor by 2.5 to 1.

Two 100 MHz, high sensitivity channels. 3.5 ns risetime; dc to ≥ 100 MHz bandwidth from 5 V/div to 5 mV/div; extended sensitivity of 2 mV/div at ≥ 90 MHz.

A/B sweep selection. Calibrated A sweeps from 50 ns/div to 0.5 s/div; B sweeps from 50 ns/div to 50 ms/div; variable control for up to 2.5 to 1 reduction and 10x magnification for sweeps to 5 ns/div.

Dual time base measurements. Select either A or B sweeps, or both alternately with A intensified by B.

B trigger slope and level. Use B trigger level to select B-triggered or run-after-delay modes; use B TRIGGER SLOPE to select transitions.



1-800-426-2200

Our direct order line gets you the industry's leading price/performance portables... and fast answers from experts! The 60 MHz single time base delay 2213A, the 60 MHz dual time base 2215A and the 100 MHz dual time base 2235 offer unprecedented reliability and affordability, plus the industry's first 3-year warranty* on labor and parts, CRT included.

The cost: just \$1200 for the 2213A, \$1450 for the 2215A, \$1650 for the 2235.† Even at these low prices, there's no scrimping on performance. You

have the bandwidth for digital and analog circuits. The sensitivity for low signal measurements. The sweep speeds for fast logic families. And delayed sweep for fast, accurate timing measurements. All scopes are UL Listed and CSA approved.

You can order, or obtain literature, through the Tek National Marketing Center. Technical personnel, expert in scope applications, will answer your questions and expedite delivery. Direct orders include comprehensive 3-year warranty*, operator's

manual, two 10X probes, 15-day return policy and worldwide service backup.

Order toll free: 1-800-426-2200, Ask for Rick.

In Oregon, call collect: (503) 627-9000. Or write Tektronix, Inc. P.O. Box 1700 Beaverton, OR 97075

Tektronix®
COMMITTED TO EXCELLENCE

satisfy all users *N* who agree to use this termination condition and to give away program control during the tracking loop.

But what about user *A* who wants the loop to stop when the left mouse button has been pressed, or user *B* who wishes to keep the cursor on a grid, or user *C* who wants to make the shape of the cursor depend on its location on the display? (See listing 7 for the general and specific cases of "mouse tracking.")

They would prefer two exported procedures, `GetMouse` and `DrawCursor`.

GUIDELINE 2

If complex objects are to be handled by your module, divide it up into several physical modules or groups of modules, each of them operating on the objects at a different level of abstraction ("distributed processing"). This enables your module's client not only to import a suitably restricted set of operations, but also to select the entry level to the module set, i.e., the level of abstraction on which he wants to have the objects handled.

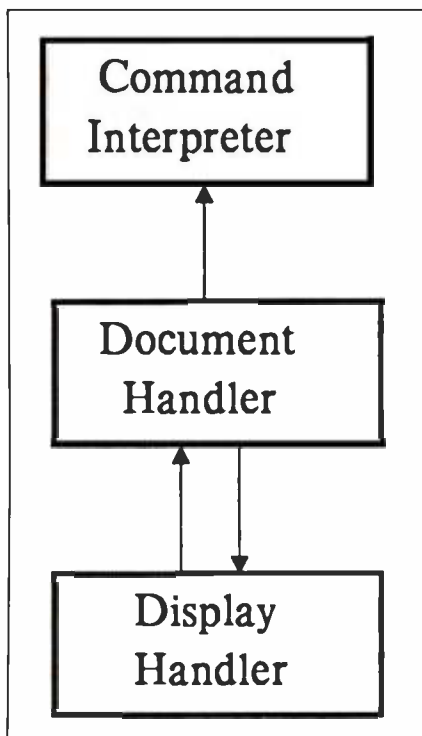


Figure 4: Our first effort to modularize the text editor leads to mutual imports between the document and display handler modules.

Moreover, later modifications in the definition can be restricted to individual modules in the set, thus reducing the number of user modules that have to be recompiled.

For example, the window handler base `Windows` (see figure 6) handles windows as a whole. It merely operates on the graph of their global overlapping hierarchy and completely disregards contents. By contrast, module `TextWindows` exports procedures to write text into the windows.

GUIDELINE 3

Assume again that your library module handles complex objects. If the maximum number of objects to be simultaneously handled is sufficiently small, identify each object by a number; for instance, define a subrange as object type. Thus, each user may store that information about the objects that is relevant for his sphere of activity in a private table that is indexed by the data type (distributed data).

Alternatively, a pointer type could have been chosen as object type. In such a case, each object points to its descriptor record. As the object descriptors are public, they cannot be effectively protected. This somehow contradicts the module concept. In fact, Modula-2 offers the possibility of hiding a type. A hidden (or abstract) type is defined in the definition module without structure indication and declared in the corresponding implementation module

(normally as a pointer). But hidden object types restrict the handling of the objects strictly to the module.

In the case under discussion, the subrange is preferable to a pointer type (be it hidden or not) as the latter demands fixing the descriptor record once and for all (see listing 8).

GUIDELINE 4

If you design a library module that handles objects of a certain category, you may decide to include a merely restricted set of (universal) operations. If so, make use of the Modula-2 procedure-type parameter mechanism to enable the user to install his own procedures. Thereby, the range of potential users of your module can radically be enlarged without its size and complexity being increased. Procedure-type parameters make it possible to keep away details from a module. Keeping away details is somehow dual to hiding details in the module.

If a default procedure is provided for a certain operation, this procedure should be exported to enable the user to reassign the default whenever required. For example, the procedure `OpenWindow` in module `Windows` expects as parameter a procedure which, upon calling, restores the contents of the window. The window handler calls this procedure whenever restoration of this window becomes necessary (see listing 9).

(continued)

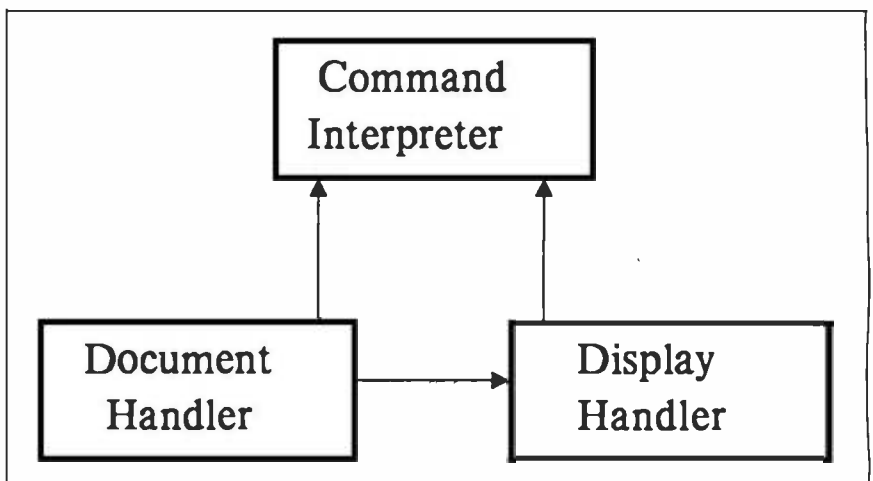
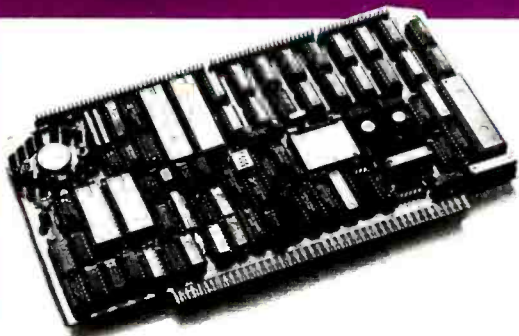


Figure 5: Our second effort to modularize the text editor frees the document handler from dependence on the display handler.

LOMAS DATA PRODUCTS PRESENTS:

THUNDER 186



THUNDER 186 offers the following standard features:

- 8 Mhz 80186 processor
- Floppy disk controller (controls both 5 1/4" and 8" drives simultaneously)
- Two RS232 ports with hand shaking
- Centronics compatible parallel port
- 256K bytes of RAM
- Full IEEE-696 COMPLIANCE
- One year warranty

THUNDER 186 provides the earth shanking performance you have come to expect from LOMAS DATA PRODUCTS. THUNDER 186 is a complete SIXTEEN BIT SINGLE BOARD COMPUTER on a standard size S100 bus board. THUNDER's low price includes Concurrent CP/M-86* version 3.1. This allows the user to run PC-DOS*** programs, as well as, CP/M-86* programs on the same system. And, for those users that prefer, MS-DOS*** is also available.

TEST: THUNDER 186 BENCHMARK.

In our April '84 advertisement, we compared the benchmarks of our other advanced CPU products, against the COMPUPRO CPU86/87 10 Mhz. The test consisted of assembling the example BIOS (BIOS. A86) distributed with standard CP/M-86. The operating system used was CP/M-86. Now, we put THUNDER 186 to the same test . . .

	LIGHTNING ONE* 10 MHZ	COMPUPRO CPU86/87 10 MHZ	LIGHTNING 286* 6 MHZ	THUNDER 186 8 MHZ
ASSEMBLY-TIME (SEC.)	47	55	41	48
RATIO TO 10 MHZ LIGHTNING ONE	1.00	1.17	.88	1.02
BOARD SET COST LIST PRICE AS TESTED	\$2545.00	\$3040.00	\$3290.00	\$1595.00
COST PERFORMANCE	\$2545.00	\$3556.80	\$2895.20	\$1629.00
RATIO	1.00	1.40	1.14	.64

RESULT: THUNDER 186 THE LEADER.

The benchmark comparisons clearly make THUNDER 186 the leader in the 16 bit price/performance race. Other THUNDER 186 advantages are too numerous to mention here. CALL US, and we'll be glad to discuss the other advantages with you.

S100 bus board products & support for the system integrator ...

- **LIGHTNING ONE *** 8086/8088 CPU**
8086 or 8088, with 8087 and 8089 coprocessors. Up to 10 MHZ operation **PRICES start at \$425.00**
- **HAZITALL SYSTEM SUPPORT BOARD**
2 serial, 2 parallel ports, battery protected clock calendar, Hard disk controller host interface **PRICE \$325.00**
- **LDP 128/256K DYNAMIC RAM**
Advanced dynamic RAM with LSI controller for failsafe operation, parity **PRICE 128K—\$495.00, 256K—\$795.00**
- **RAM67 HIGH PERFORMANCE STATIC RAM**
High speed (100ns) low power CMOS static RAM. 128K bytes, extended addressing **PRICE \$995.00**
- **LDP72 FLOPPY DISK CONTROLLER**
Single/double density, single/double sided disks, both 8" and 5 1/4" inch drives simultaneously **PRICE \$275.00**

- **LIGHTNING 286—80286 CPU BOARD**
Offers 4 times the performance of a 5MHZ 8086 CPU while maintaining software compatibility. **PRICE \$1395.00**
- **OCTAPORT 8 PORT SERIAL BOARD**
8 serial ports 0 to 19200 baud operation real time clock interrupt. Ideal for multi-user systems such as MP/M-86.* **PRICE \$395.00**

All of LDP boards are fully tested to exacting standards and carry a one year warranty. We specialize in 16-bit products & support the four major operating systems for 16-bit processors: CP/M-86*, MP/M-86, CONCURRENT CP/M-86*, and MS-DOS (PC-DOS).



Dealer inquiries invited.

LOMAS DATA PRODUCTS, INC. □ 66 Hopkinton Road, Westboro, MA 01581 □ (617) 366-6434 □ Telex: 4996272

*CP/M-86, MP/M-86 and CONCURRENT CP/M-86 are trademarks of Digital Research.
**MS-DOS is a trademark of Microsoft
***Lightning One is a trademark of Lomas Data Products, Inc.
****PC-DOS is a trademark of IBM

CONCURRENCY

Concurrent processes have a particular attraction for software engineers. The aspect of *parallelism* opens up the purely sequential world of ordinary programming. We shall distinguish between *genuine* and *logical* concurrency. "Genuine concurrency" implies that several *processors* are available to execute a program; this is not usually the case these days. "Logical concurrency" is of much greater importance. In Modula-2, an autonomously running process is called a *coroutine*.

You can create coroutines in your Modula-2 program using the standard procedure *NewProcess*. Each coroutine is controlled by a procedure. In a way, a coroutine is an "instantiation" of its
(continued)

Listing 7: Four types of users and their respective use of the procedures *GetMouse* and *DrawCursor*.

```
User N: REPEAT GetMouse(buttons, x, y);
        DrawCursor(x, y); BusyRead(ch)
        UNTIL (buttons # {}) OR (ch # 0C);

User A: REPEAT GetMouse(buttons, x, y);
        DrawCursor(x, y); BusyRead(ch)
        UNTIL (left IN buttons) OR (ch # 0C);

User B: REPEAT GetMouse(buttons, x, y);
        DrawCursor(x DIV unit+unit, y DIV unit+unit); BusyRead(ch)
        UNTIL (buttons # {}) OR (ch # 0C);

User C: REPEAT GetMouse(buttons, x, y);
        IF x < wid THEN SetPattern(private) ELSE ResetPattern END;
        DrawCursor(x, y); BusyRead(ch)
        UNTIL (buttons # {}) OR (ch # 0C);
```

Listing 8: An example of a hidden (or abstract) type.

```
TYPE Window = |0..7|; (*subrange type*)
TYPE Window; (*hidden type*)
```

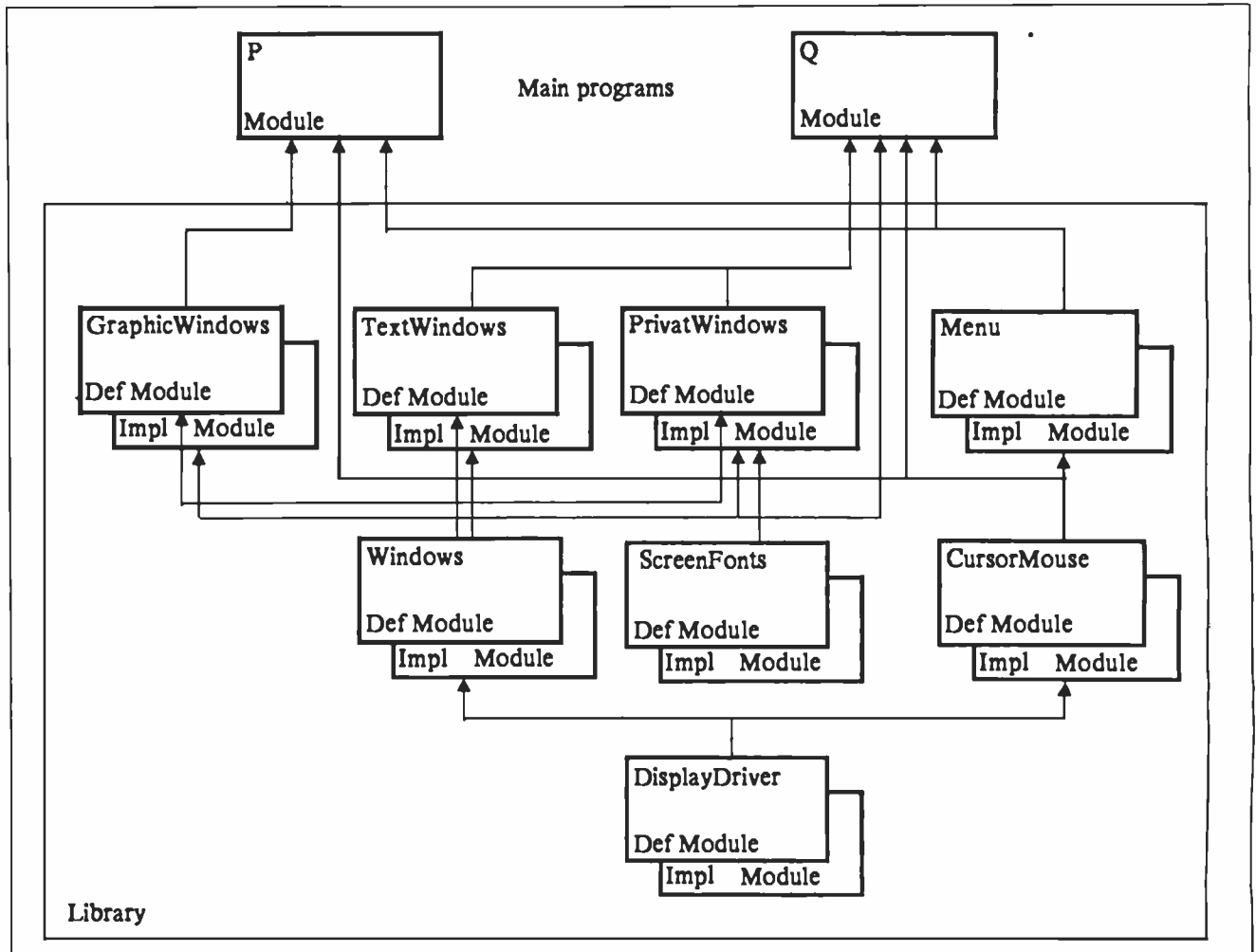


Figure 6: The structure of Modula-2 programs that use the display software library modules.

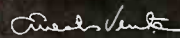
MicroAge®

**"THEY PROVIDED THE LINK BETWEEN US
AND MILWAUKEE'S MAJOR CORPORATIONS."**

"Both of us had experience in the corporate world and we wanted to open a business reflecting that orientation. We chose MicroAge because they shared our business philosophy."

"Back in 1981, some of the major vendors still hadn't entered the microcomputer market. We anticipated that when they did, they would channel their products through a national organization. With MicroAge behind us, we're able to offer Milwaukee businesspeople and professionals such respected products as IBM, Compaq, Hewlett-Packard and most recently AT&T. And we have the technical expertise to provide service after the sale."

"MicroAge has supported us from day one. Without this help, we wouldn't be opening our second store!"



Ernie Venta
Franchise Owner

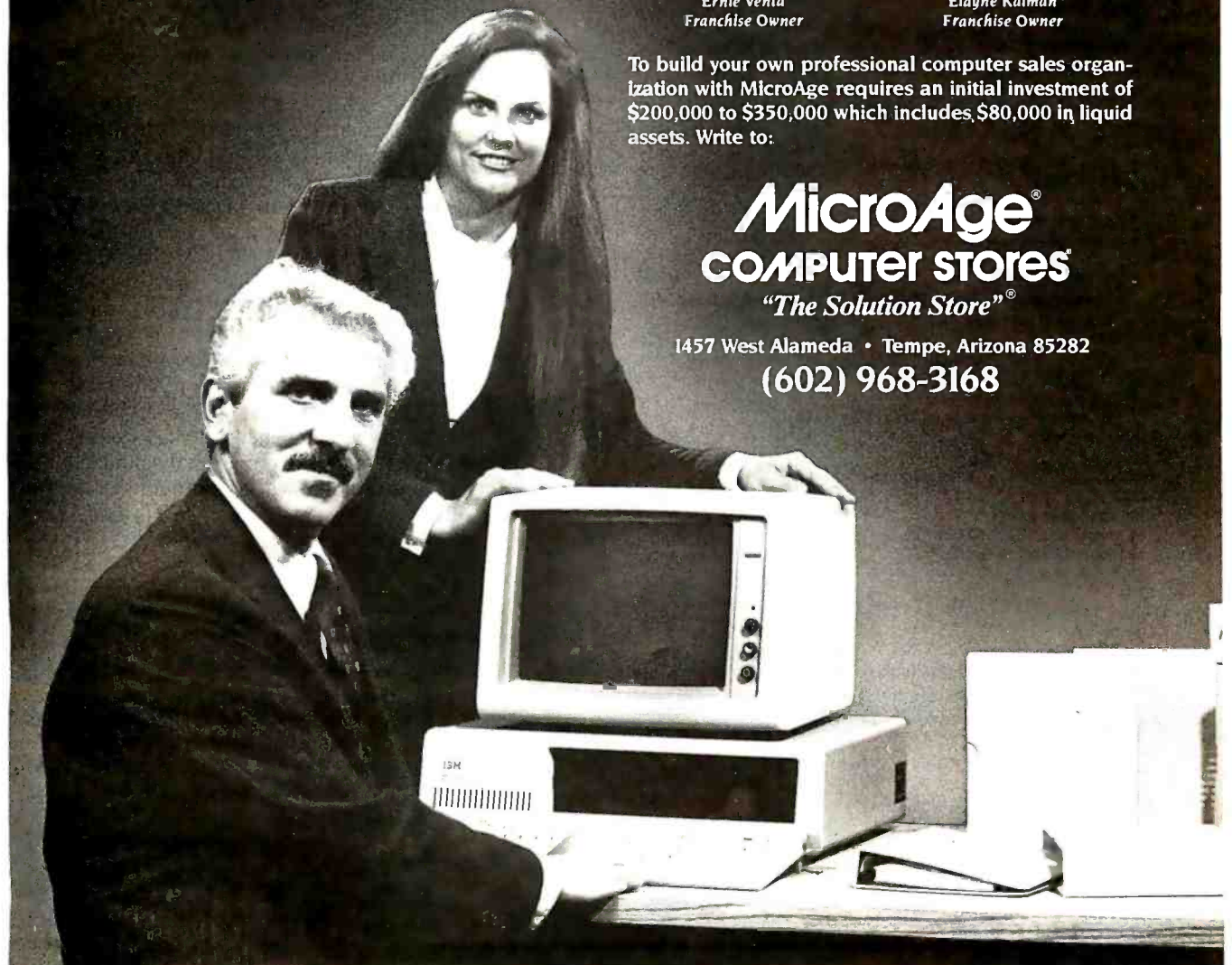


Elayne Kalman
Franchise Owner

To build your own professional computer sales organization with MicroAge requires an initial investment of \$200,000 to \$350,000 which includes \$80,000 in liquid assets. Write to:

MicroAge®
COMPUTER STORES®
"The Solution Store"®

1457 West Alameda • Tempe, Arizona 85282
(602) 968-3168



MicroAge franchisees Ernie Venta and Elayne Kalman shown with an IBM Personal Computer.

Circle 200 on Inquiry card.

procedure. The essence of the co-routine concept is that control can be transferred between the different co-routines. When your program calls the standard procedure TRANSFER with parameters *y* and *q* (both of type PROCEDURE), control is passed from *y* to *q*. Thereby, the current state of the co-routine *y* is saved and co-routine *q* is reactivated in the state of its previous interruption.

Whenever a co-routine of a program terminates, i.e., its procedure terminates, then the program itself terminates. Therefore, procedures of auxiliary co-routines are typically embedded into an infinite LOOP...END loop, such that program termination is controlled by the main process, i.e., the co-routine created by the program loader.

Let us illustrate the co-routine with a program that creates reservation lists.

Listing 9: The digital procedure OpenResList will create the content of the input file when needed.

```
TYPE ResList = PROCEDURE (input:
PROCEDURE OpenResList (A: integer; B: integer; C: integer; Request: ResList);
```

Listing 10: Procedure GetList, which creates reservation lists, demonstrates the use of co-routines in Module 3.

```
PROCEDURE GetList:
CONSTANT N = 20;
VAR I, J, K, temp: CARDINAL;
    All: ARRAY [0..N] OF RECORD name: string;
        CHRS:
        ListCount = 0; ListList = 0; ListItems = 0;
        ResListCount = 0; ResListItems = 0;
        temp := 0; (count: ARRAY [0..N] OF);
    LOOP
        IF temp = 0 THEN EXIT END;
    > CoRoutines:
        IF count = 0 THEN EXIT END;
        GetResListCount := count;
        K := 0; (count: ResList);
    LOOP
        I := GetResListCount; J := count;
        WHILE count = 0 AND J < (count: ResList) + 10 DO
            I := I + 1; J := J + 1;
        END;
        IF I > (count: ResList) THEN EXIT END;
        K := GetResList;
    END;
        GetResListCount := GetResListCount; ListCount := temp;
        temp := temp + 1;
    END;
    IF temp = 0 THEN (count: chronological list);
    LOOP
    > CoRoutines:
        IF count = 0 THEN EXIT END;
        GetResListCount := count;
        temp := temp + 1;
    END;
    END;
    (count: ResList);
    I := GetResList;
    WHILE count > 0 DO I := GetResList;
        WHILE count > 0 DO (count: ResList); I := I + 1; END;
        K := GetResList;
    END;
    (count: ResList);
    I := I + 1;
    WHILE I < (count: ResList) DO I := GetResList;
        WHILE count > 0 DO (count: ResList); I := I + 1; END;
        (count: ResList);
        I := I + 1;
    END;
    (count: ResList);
END GetList;
```

Assume that different courses in institutions, with restricted attendance were announced. Students are accepted according to the sequence of their registration.

We shall design the program so that it accepts chronologically ordered reservations stored on a text file. A reservation is a pair of the desired course ID-# and the student's name. As long as the number of applicants for a course has not yet reached the limit, the name of each new student is alphabetically inserted into the main list of that course. Additionally, our program maintains a standby list for each course containing the names of surplus applicants. Obviously, the standby lists have to be chronologically ordered.

Of course, the process of generating (and printing) the two lists is exactly the same for each course. We shall formulate it as a procedure GetList, notice that *name* is in fact an index into a name buffer *Res* and that *temp* = 0 signals termination. See listing 10.

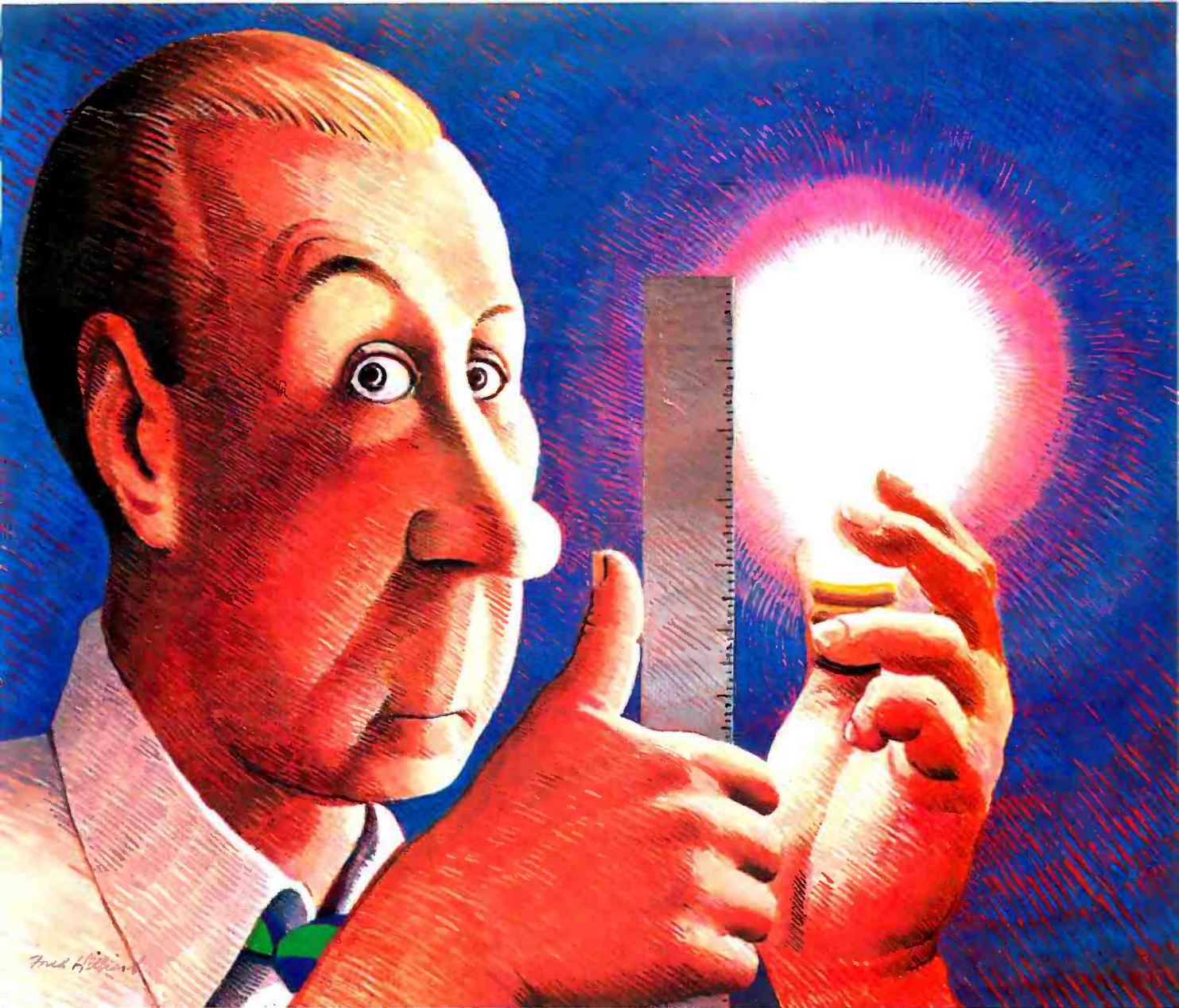
Let us emphasize again that this procedure describes the whole process of generating and printing the two lists of an individual course in a very coherent way. Hence, we should try to find a formulation that does not force us to split up the procedure—for technical reasons—into smaller portions.

In fact, assigning a co-routine to each course—with GetList as controlling procedure—is an elegant way of formulating our program. The main process shall activate the respective co-routine whenever it has read a new reservation item from the input file. The co-routine will transfer control back to the main process when it is ready to accept a new registration.

You can obtain the final form of GetList by simply embedding the procedure body into a LOOP...END loop and replacing CoRoutines (marked with a >) by TRANSFER (see listing 11), *name*.

The crucial thing for the main process to do is reading reservations from the input file, one after the other, and passing control to the appropriate course handler (see listing 11).

Note that all process-oriented types and procedures stem from a standard module SPEDes. This module can be regarded as the interface between (private)



©1984 Cosmos Inc.

How long is an idea?

With Revelation® by Cosmos, it won't matter. Our variable length structure lets you think long or short without worrying about needing disk space you don't have, or squandering space you can't afford. Think of it. Relational Data Base Management Software that saves up to 40% of your PC's disk space.

As a powerful, enhanced version of the PICK™ Operating System, Revelation uses plain English to create files, menus, entry screens, process information and generate reports. Plus, you can build,

customize and update your data base application without being an experienced programmer.

When you introduce your IBM® PC or compatible to Revelation, you'll see it change into a friendly brute that can communicate with other computers. Also featured is a hybrid full-structured programming language with an interactive debugging tool for serious development work.

Besides bringing the power, speed and flexibility of a minicomputer to your PC, Revelation works with

MS/DOS™ so you can use all the popular microcomputer software packages with the applications you develop.

Indeed, Revelation is easy to get along with. A veritable gentle giant. But, you need to know more before you decide to buy what may become your most valuable business tool. So call us at (206) 824-9942 and let us arrange for you to see what we've got here.

MS/DOS™ of Microsoft Corp. IBM PC Registered TM of International Business Machines Corp. PICK Operating System™ of PICK SYSTEMS.

Cosmos Inc. 19530 Pacific Highway S.

COSMOS™

Circle 85 on inquiry card.

Seattle, WA 98188, (206) 824-9942

www.americanradiohistory.com

Modula-2 and the system. *SYSTEM* also exports a type *ADDRESS*. An object of type *ADDRESS* is a pointer to a memory-word. (The type *WORD* is also

exported from *SYSTEM*.)

Each coroutine is connected with a memory section where its variables are allocated. Beginning and size of this sec-

tion have to be specified as parameters of *NEWPROCESS* at the time of creating the coroutine. In our example, we have called procedure *AllocateHeap* of another low-level module *Program* to reserve the desired amount of storage (400 bytes).

Notice finally that the standard function *CAP* returns the uppercase variant of its character argument.

SUMMARY

Modula-2 is a modern programming language invented for the development of large software systems. The module is a new structuring tool, comparable in its relevance with the procedure and locality introduced by ALGOL and Pascal. Although conceptually simple, the module has proven to be surprisingly difficult to master. On the other hand, the modular way of thinking has far-reaching and unexpected consequences, even for the design of operating systems and for computer architecture.

The coroutine concept of Modula-2 allows processes to be coherently formulated as procedures. Coroutines are a kind of dynamic counterpart to modules. In contrast to modules, procedures can be instantiated. Thus, thanks to a mechanism to transfer control between coroutines, different instances of the same procedure may simultaneously be alive. ■

Listing 11: Module *Lists* reads a reservation item from the input file and then invokes the respective coroutine handler.

```
MODULE Lists;
FROM SYSTEM IMPORT ADDRESS, PROCESS, NEWPROCESS, TRANSFER;
FROM Program IMPORT AllocateHeap;
FROM FileSystem IMPORT File, Lookup, Close, ReadChar, WriteChar;
FROM InOut IMPORT ReadString, Write, WriteString;

CONST EOL = 36C; FF = 14C; (*form-feed*)
VAR buf: ARRAY [0..10000] OF CHAR;
    name: I, cur: CARDINAL; ch: CHAR; A: ADDRESS;
    main: PROCESS; handler: ARRAY [0..9] OF PROCESS;
    in, out: File; fname: ARRAY [0..31] OF CHAR;
BEGIN
  buf[0] := 0C; buf[1] := 255C; buf[2] := 0C; i := 3;
  FOR cur := 0 TO 9 DO
    A := AllocateHeap(400); NEWPROCESS(GenList, A, 400, handler[cur])
  END;
  WriteString("in > "); ReadString(fname); Write(EOL);
  Lookup(in, fname, FALSE);
  WriteString("out > "); ReadString(fname); Write(EOL);
  Lookup(out, fname, TRUE);
  ReadChar(in, ch);
  WHILE (ch >= "0") & (ch <= "9") DO
    cur := ORD(ch) - ORD("0"); name := i;
    ReadChar(in, ch); ReadChar(in, ch);
    WHILE (CAP(ch) >= "A") & (CAP(ch) <= "Z") DO
      buf[i] := ch; i := i + 1; ReadChar(in, ch)
    END;
    buf[i] := 0C; i := i + 1;
    TRANSFER(main, handler[cur]);
    ReadChar(in, ch)
  END;
  name := 0;
  FOR cur := 0 TO 9 DO TRANSFER(main, handler[cur]) END;
  Close(in); Close(out)
END Lists;
```

Triple Your Programming Speed!



GUARANTEED!

APB-102
\$189⁰⁰

Adds mainframe editing power to your Apple's language! Uses **NO** program memory space. Works with **ANY** size program! Hundreds of programming features never before combined in one package! **ALWAYS AVAILABLE** and **NEVER IN THE WAY!** The features of this system are far too extensive to describe here, so call or write for more information, and get a **FREE** quick reference card. **OEM'S PLEASE NOTE:** Now you can market your turnkey systems in ROM! Eliminate worries about copy protection. Your program auto-boots from ROM which can even eliminate the need for a disk drive. **Call or write for details.**

Optional Additions Include:

NEW!! APU-2: superNUMBER, multiHIDE, multiMERGE, VARIABLE CROSS REFERENCE, AUTONUMBER, NEW programs by Paul Johnson. Far more powerful and mistake proof than other versions...and always at hand. **\$35⁰⁰**

NEW!! COPY ZAP by Glen Bredon, author of **BIG MAC, SMART DISK COPIER**, and ZAP utilities written for our system. Also copies 40 track disks! **\$39⁹⁵**

NEW!! ROM DEVELOPMENT SYSTEM: Program your own firmware! Includes software, documentation and emulation RAM. **\$99⁰⁰**

12 Bit 16 Channel A/D Convertor



AD16B
\$299⁹⁵ ★VERY HIGH SPEED
★7 VOLTAGE RANGES
★COMPLETE SOFTWARE

SIGNAL CONDITIONING & DIFFERENTIAL INPUTS AVAILABLE

Professional Prototyping Board

THE BIGGEST—THE BEST ★IDEAL LAYOUT FOR WIRE WRAPPING



PRO-1
\$29⁹⁵ ★GOLD PLATED EDGE CONNECTOR
★VERY LARGE—UP TO 52 (16 PIN) SOCKETS

48 Line Parallel I/O



PD48
\$249⁹⁵ ★48 LINES IN/OUT (SOFTWARE SELECTABLE)
★6 TIMERS PLUS INTERRUPT
★FULL DOCUMENTATION

APPLE IS A REGISTERED TRADEMARK OF APPLE COMPUTERS INC.



Hollywood Hardware 6842 VALJEAN AVENUE, VAN NUYS, CA 91406 (818) 989-1204

A faulty disk drive can scuttle a lot of software.

And just as crucial, it can wash out data interchange between compatible drives so they can't talk to one another. These potential problems can be easily and quickly detected with Dymek's R.I.D.™ (Recording Interchange Diagnostic).



The seven most important test parameters in less than a minute.

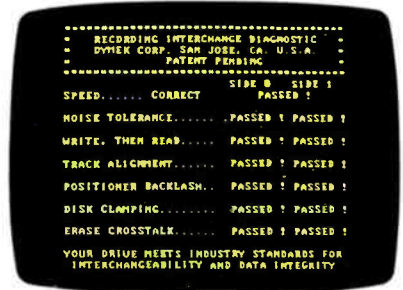
Simply insert the R.I.D. diskette in your drive and receive the "pass/fail" results on your screen for drive speed, noise tolerance, write/read, alignment, backlash/hysteresis, clamping, and erase crosstalk. No disassembly or special test equipment needed. If there's an error you can immediately pinpoint where maintenance is required.

You protect your software library investment for only \$34.95.

With daily use of the R.I.D. diskette, you're ready to read and write with complete confidence in your system. Confidence backed by Dymek,™ the leading supplier of alignment diskettes to head, drive, and system manufacturers worldwide.

Available now for IBM PC and XT, Apple and Radio Shack systems.

All it takes is a toll free call to MEDIA PRODUCTS for more information or to place an order. (800) 858-7700 outside California or (800) 345-4700 inside California. Do it today so you'll have a safe drive tomorrow.



1851 Zanker Road, San Jose, CA 95112
 DEALER INQUIRIES INVITED
 Circle 114 on Inquiry card.

This drive diagnostic

can save you from data disaster



YOU O TO IN PIC

To help you communicate more clearly. To make tough subjects easy. To make work go faster. To visualize, really visualize what you have in mind.

Pictures of your ideas. Produced by Mindset.[™] A new breed of hardware that gives you the next generation of mouse-driven graphic

Intel's true 16-bit 80186 microprocessor. Two custom VLSI processors for high speed, high resolution bit-mapped graphics from 320 x 200 pixels in 16 colors. Runs Lumena[™] and other professional graphic design programs, IBM PC software, and the next generation of icon-based, mouse-driven, windowed software.

IBM is a registered trademark of International Business Machines Corporation. Lumena is a trademark of Time Arts.



UGHT BE TURES.

power today. More impressive graphics than any we could show you on this page.

You can draw ideas. You can plot and rotate dimensional designs. Even change their perspective.

You can create charts, diagrams and layouts with brilliant clarity from Mindset's palette of 512 colors.

Mindset works, thinks and plays as fast as your mind. It runs IBM® PC software at blazing speed. Never puts your mind on hold.

Always goes with the idea flow.

Mindset's price? About one-third less than an IBM PC.

Bring us the programs you're using today. Try them on Mindset. Watch your ideas pop on the screen the way they come to your mind. Quickly. Completely. Your ideas never looked so good. So fast.

Call 1-800-447-4700 for your nearest Mindset dealer.

Mindset: The possibilities are endless.

INTRODUCING MINDSET

Mindset Corporation, 617 North Mary, Sunnyvale, California 94086

COHERENT™ IS SUPERIOR TO UNIX® AND IT'S AVAILABLE TODAY ON THE IBM PC.

Mark Williams Company hasn't just taken a mini-computer operating system, like UNIX, and ported it to the PC. We wrote COHERENT ourselves. We were able to bring UNIX capability to the PC with the PC in mind, making it the most efficient personal computer work station available at an unbelievable price.

For the first time you get a multi-user, multitasking operating system on your IBM PC. Because COHERENT is UNIX-compatible, UNIX software will run on the PC under COHERENT.

The software system includes a C-compiler and over 100 utilities, all for \$500. Similar environments cost thousands more.

COHERENT on the IBM PC requires a hard disk and 256K memory. It's available on the IBM XT, and Tecmat, Devong and Corvus hard disks.

Available now. For additional information, call or write,

Mark Williams Company
1430 West Wrightwood, Chicago, Illinois 60604
312/472-6639



LILITH AND MODULA-2

BY RICHARD OHRAN

A case study of high-level-language processor design

THE LILITH IS a specialized computer (called an engine) designed specifically to execute Modula-2 programs. Its specialization makes it fast and efficient with Modula-2. It would not be particularly effective as an engine for programming in other high-level languages, such as FORTRAN or BASIC.

The Lilith achieves its exceptional performance through a combination of an efficient architecture specifically tailored to Modula-2 and a hardware implementation of that architecture that further enhances performance of the system.

THE HISTORY OF THE LILITH COMPUTER

The driving force behind Modula-2 and the Lilith computer was Niklaus Wirth, the designer of Pascal. Wirth's own account of the development of Modula-2 and the Lilith appears in this issue (see "History and Goals of Modula-2," page 145).

After the Modula-2 language had been defined, the team's hardware engineers began work on the computing engine that was to support Modula-2: the Lilith computer. Two overriding goals shaped the design of the Lilith:

- to provide efficient support for the programming language Modula-2
- to provide a flexible and advanced user interface so that the computer

would be an effective single-user workstation

As it turned out, these two goals were compatible.

The efforts to design a machine that was particularly suited for Modula-2 were based upon earlier, similar projects. Early in Pascal's history, efforts at the ETH (the Swiss Federal Institute of Technology) in Zürich to transport Pascal from Control Data systems to other computers led to the development of the P-machine architecture. (Ken Bowles, then at the University of California at San Diego, took a version of the P-machine compiler and added an operating system to it to make the UCSD p-System.)

The P-machine was a specialized architecture particularly well suited for Pascal. This architecture has been widely used as a mechanism for producing portable code, which is then interpreted by the host processor. The P-machine perhaps should have been given a more glamorous name: as it stood, it was never widely accepted as the elegant

Richard Ohran (950 North University Ave., Provo, UT 84604) is director of the Modula Research Institute and assistant professor of computer science at Brigham Young University. In addition to Lilith, he devotes his spare time to table tennis, motorcycles, and amateur radio.

machine architecture that it was.

The architecture designed for Modula-2 (called the M-machine) is similar to this idealized Pascal architecture, except that the M-machine is specifically designed for high-performance execution of Modula-2 programs. Only those instructions that would be useful to the Modula-2 compiler have been included in its instruction set. Instructions that would benefit only the assembly-language programmer have been left out—no excess baggage.

Another important part of the Lilith's performance is its user interface, on which the greatest influence was Wirth's experience with the Xerox Alto during a sabbatical spent at Xerox's Palo Alto Research Center. The Alto computer had a bit-mapped display and used a mouse for rapid cursor positioning. These strong features of the Alto, with some improvements that support the display without sacrificing performance, help make the Lilith an effective and flexible workstation.

M-CODE: LILITH'S INSTRUCTION SET

One of the advantages the Lilith has over other computer systems that support Modula-2 is the carefully designed instruction set of the M-machine. The effectiveness of any computer processor

(continued)

depends in large measure upon its instruction set. If the instructions are inadequate for the job, performance is poor. Conversely, if there are many instructions that are not used by the compiler, performance is likely to be poor because extra instructions mean extra bits, which must be moved and tested. The Lilith engine has only 256 carefully chosen instructions: the language constructs of Modula-2 map neatly to the Lilith's instruction set, without extra instructions to add fat to the processor.

The size of an object-code program is a good measure of its execution speed. (For this reason, whenever a benchmark test is done, the size of the program object code is usually listed along with the execution times.) Note that the size of the code is a relative measure of the number of instructions required to execute a certain program.

M-code, the Lilith's instruction set, is dense: few instructions are required for each Modula-2 language statement. PDP-11 code for a Modula-2 program is typically three times the size of M-code for the same Modula-2 program. With other aspects equal (i.e., clock speed, memory cycle), Lilith would be faster than the PDP-11 because fewer instruction executions would be required to accomplish the same task. The Lilith's high

code density is achieved through use of an expression evaluation stack, several addressing schemes, and short instructions for performing sophisticated high-level operations.

STACK ARCHITECTURE

One reason for the Lilith's high code density is that the M-machine is a stack machine. The elegance and simplicity of stack architectures for higher-level-language programs is well known (see reference 1). Effectively implemented stack machines are faster than register-based machines because stack machines need fewer instructions.

The Lilith engine has an expression stack used for calculations and also organizes its main memory as a stack. Using an expression stack eliminates the need for user-accessible registers because stack operations simply pop operands off the stack and push the result back on the stack. Of course, no address is associated with the expression-stack operations for the same reason. This means that operations on the expression stack use only single-byte instructions and are, therefore, fast. The stack organization of main memory efficiently supports procedures and block structure. The result of the Lilith engine's stack organization is a reduction in the

number of instructions needed to support the constructs of the Modula-2 language.

M-MACHINE ADDRESSING SCHEMES

To keep data addresses as short as possible, the M-machine uses several addressing modes, depending upon the type of data being referenced. In general, data is referenced by very short addresses (4 or 8 bits). The arithmetic and logical instructions require no address because they reference the expression evaluation stack. Only in the case of indirect reference and external data (from another module) does the M-machine use a 16-bit address. The result of using several addressing modes depending upon the needs of the instruction is that the most commonly used instructions are the shortest and the less commonly used instructions are longer.

Because of the frequent use of short addresses (see the text box, "The 4-bit Constant"), the average length of the M-instructions in a typical program, including op code and data address, is only 10 bits. The overwhelming majority of M-codes in a typical program are only 1 byte long. It takes only a small number of bits to instruct the Lilith

(continued)

The 4-bit Constant

One of the unique features of the Lilith's instruction set is its use of 4-bit constants embedded in a byte along with a 4-bit op code. It may seem that a constant of only 4 bits is so small that it would be useless. In fact, because a single byte with an embedded 4-bit constant can often be made to serve instead of a 2-byte instruction, the use of 4-bit constants reduces code size. The ability of the Lilith engine to effectively use 4-bit constants is partly responsible for the Lilith engine's compact code.

Four-bit embedded constants are used in at least four ways: 1) for loading a constant value onto the stack; 2) for loading and storing a procedure's local variables; 3) for calling procedures within a given module; and 4) for referencing fields within a record. In each case, using a 4-bit constant embedded in the same byte with the instruction allows something that

would normally require at least 2 instruction bytes to be accomplished with only 1 instruction byte.

Of course, 4-bit constants are limited to values within the range 0 to 15. However, consider how useful it is to be able to load a small value onto the stack with a single-byte instruction. Such small constant values are often used for incrementing and comparisons.

When employed as the address of a local variable, a 4-bit value can be used to access the first 12 local variables in a procedure (the number is 12 rather than 16 because the four-word procedure activation record described in the text occupies words 0 to 3). Procedures often have 12 or fewer items of local data. For such procedures, the Lilith engine can load and store all local data within that procedure with single-byte instructions!

In a similar way, a 4-bit value can be

used to select one of the first 16 procedures in a module. Often, modules have fewer than 16 procedures. As with manipulating local data, embedded 4-bit constants make most procedure calls on the Lilith unusually concise.

When a structured variable is used in Modula-2, it is frequently referenced through the use of a pointer address loaded onto the expression evaluation stack. For subfields of a record so addressed, Lilith offers a selection of short instructions with embedded 4-bit offsets to provide quick and efficient access. Many other situations in Modula-2 programming also use this technique.

The Lilith's use of the 4-bit constant is partly responsible for the fact that over 70 percent of the instructions in a typical Lilith program are only 1 byte long. This means that the code for a Modula-2 program on the Lilith is short and also fast.

\$675 GETS YOU THE WORKS.



For about half the price of anything like it, now there's a complete plotting system with all you need for creative and professional graphics.

Everything's included: The Pixy microplotter, its dedicated Pixygraph software, paper, mylar film for overheads, two 8-color pen sets and a concise, easy-to-follow manual.

Even if you've never used a plotter before, it's never been easier to turn numerical data into pie charts, bar comparisons and area graphs. Or use your imagination to create unique designs.

Just connect Pixy to your IBM®-PC, Apple® or IBM compatible computer and you'll be turning out colorful graphics in no time.

Everything shown is specially offered at the one low suggested retail price for a limited time only. So if you've ever wanted to make your point with graphics, the right time is right now.

See your Mannesmann Tally dealer today or call toll-free for more information: 800-447-4700.

**MANNESMANN
TALLY**

In Illinois, 800-322-4400

Apple is a registered trademark of Apple Computer, Inc. IBM is a registered trademark of International Business Machines, Inc.

engine (see reference 3).

One of the ways the Lilith engine achieves such short addresses is that the M-machine does not use absolute addressing (see table 1). Both local and global data are addressed by offsets to base registers. Indirect addressing is done by adding an offset to the top of stack, and external addressing (for data in other modules) is done by adding an offset to a pointer to the appropriate module's data space. Using offsets instead of absolute addresses means that instructions usually need only 8 address bits (rather than 16). While many computers make use of base registers and offsets to calculate actual addresses, the Lilith engine automatically updates the base registers whenever the context is changed. This means that the addressing schemes are both short and efficient.

SHORT ADDRESSES SPEED PROCESSING

The advantage of the Lilith engine's multiple addressing modes is that there is no need to supply insignificant address bits as part of an instruction as would be the case if there were only one long address used at all times. Because the most common instructions use either no address (because they address the stack) or only a 4-bit address, M-code is unusually concise. This means that the processor spends more time doing useful work because it does not have to fetch as many bits for its instructions as most computing engines.

HIGH-LEVEL INSTRUCTIONS

The Lilith engine provides a number of sophisticated, high-level instructions, which speed the execution of some of the syntactic constructs of Modula-2. These instructions include context

switching (transferring to a coprocess), FOR and CASE statements, and procedure calls.

As an example, let's consider the procedure call. Procedure calls in Modula-2 are more complicated than procedure calls in FORTRAN, for instance. Rather than simply saving the address to return to when the procedure terminates, Modula-2 requires the creation of an activation record whenever a procedure is called. This record includes not only the return address, but also information about where the procedure call came from, a link to global data accessible from inside the called procedure (this is determined by Modula-2's scope rules), and the priority of the module containing the procedure (this is important when handling interrupts).

In order to effectively support Modula-2, any processing engine must provide this relatively complex activation record for each procedure call. If the M-machine needed many instructions to perform all the operations associated with building a procedure activation record, procedure calls would be slow. However, the Lilith engine builds the activation record with a single 1-byte instruction. The processor takes care of all the associated memory references and data manipulations without the need for detailed instructions. By comparison, the 8088 processor used in the IBM PC would require perhaps a dozen bytes of instructions to perform the same task.

Perhaps the crowning example in the Lilith of a concise instruction for performing a sophisticated task is the coroutine transfer. Coroutine transfers are the basis for multiprogramming. In a coroutine transfer, one process (program) is suspended at some point and another process is started. Such a trans-

fer involves a complete change of context. The Lilith engine accomplishes a coroutine transfer with a 2-byte instruction.

HARDWARE PERFORMANCE ENHANCEMENT

The Lilith computer is more than an implementation of a well-conceived architecture. It is effective hardware that makes the most of its architecture. I present here five crucial elements of the Lilith implementation of the M-machine, which improve the overall performance of the system significantly: the implementation of the expression stack, masking the data portion from a 1-byte immediate-type instruction, an unusual memory configuration, a special instruction fetch unit, and a special barrel shifter.

BIPOLAR EXPRESSION STACK

In the past, stack machines often used a reserved part of main memory for evaluating expressions. This type of implementation has been considered slower than using registers (even though stack machines use fewer instructions) because it requires many references to main memory, and main memory is much slower than registers. In order to get around this speed problem, the Lilith (like the Burroughs and Hewlett-Packard stack machines) uses a small array of fast bipolar registers to implement its expression stack.

Because the Lilith implements the M-machine's expression stack with very fast registers that are connected to the 2901 bit-slice processors so that the top two operands on the stack are always accessible, all basic stack operations are performed in a single microcycle (150 nanoseconds). Basic stack operations include PUSH, POP, AND, OR, addition, and subtraction. The M-machine uses an expression stack to reduce the number of instructions needed to support the Modula-2 language; the hardware implementation of the M-machine stack makes the most of the architecture by making stack operations very fast indeed.

While the Lilith is much like the Burroughs and Hewlett-Packard stack machines, the Lilith has an additional advantage. The Burroughs and HP stack machines constantly test to ensure that

(continued)

Table 1: M-machine instruction formats. The Lilith takes advantage of proven principles of stack architecture and addressing from base registers. The Lilith engine uses six different instruction formats to ensure that instructions are never longer than necessary (see reference 4).

Class	Size	Format	Location of Data
Implicit	1 byte	op	Expression Stack
Immediate	1 byte	op : n	n is data or offset to data
Local	2 bytes	op | n	Data at L-register + n
Global	2 bytes	op | n	Data at G-register + n
Indirect	3 bytes	op | n	Data at Top Of Stack + n
External	3 bytes	op | m | n	At Frame table m offset n

Announcing the Only 97 Function Key Detached Keyboard for Your Apple II/Apple II Plus



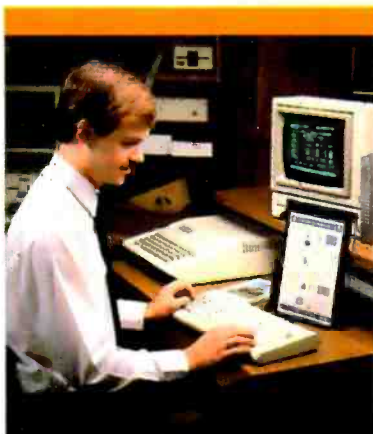
Enhance and Upgrade Your Apple II/Apple II Plus

The new detached keyboard from DATA SPEC™ offers you a convenient, cost-effective upgrade for your Apple II/Apple II Plus. Experience more versatility than ever before with 97 effortless pre-programmed functions. Functions include basic keywords, operating system commands, CP/M commands and much more. ① 20 of the most used functions are conveniently located on a separate keypad for handy access. And all four mathematical functions ② sit next to a 10-key numeric pad ③ for added ease-of-use. Eliminate the need to enter commands manually. Find your programming time cut by 50% or more.

State-of-the-Art Design Keeps You in the Forefront

The new, sleek low-profile design on the DATA SPEC detached keyboard includes a convenient 3-position tilt adjustment ④ to correspond to your ergonomic needs. Familiar "posi-touch", quality typewriter style keys give you "room to

work". Separate LED power-on ⑤ and "cap" lock ⑥ indicators add to your visual comfort. In addition, a handy 10 foot coiled cable ⑦ lets you move your keyboard without the burden



of relocating your computer. And, durability is never compromised in this scientifically formatted design.

You Can Depend On DATA SPEC

The APL-KB-825 detached extension keyboard is brought to you by DATA SPEC, from Alliance Research Corporation where quality, service and reliability have been our primary concerns. See the 97 Function Keyboard at a DATA SPEC dealer in your area, or contact us today for a retailer near you.

- Suggested List Price: \$299.95
- Warranty-One Year, Parts/Labor
- Watch for our Apple IIe and IBM PC Detached Keyboards Available Soon.
- Dealer and Distributor Inquiries Welcome.

Apple is a trademark of Apple Computer, Inc.
CP/M is a trademark of Digital Research
IBM is a trademark of
International Business Machines Corporation

DATA SPEC™

The Family of High Integrity Computer Support Products
18215 Parthenia Street • Northridge, CA 91325
(818) 993-1202

Why Stack Architecture?

The Lilith engine is a stack machine because stack structures effectively support high-level, block-structured programs. The important fact about a stack is that it is inherently dynamic. As operations that place new operands on the stack occur, the stack grows accordingly; as operands are removed from the stack, the stack shrinks accordingly. Moreover, stack operations use no address: operations always address the top of the stack. This means that stack operations are both elegant and efficient.

Consider the following Modula-2 expression:

$((4 + 3) * 5) \text{ DIV } 16$

The evaluation of this expression on a stack proceeds as follows:

PUSH 4	<table border="1"><tr><td>4</td></tr></table>	4	
4			
PUSH 3	<table border="1"><tr><td>3</td></tr><tr><td>4</td></tr></table>	3	4
3			
4			
ADD	<table border="1"><tr><td>7</td></tr></table>	7	
7			

(removes top two operands, adds them, and places the result on the stack).

PUSH 5	<table border="1"><tr><td>5</td></tr><tr><td>7</td></tr></table>	5	7
5			
7			
MULT	<table border="1"><tr><td>35</td></tr></table>	35	
35			
PUSH 16	<table border="1"><tr><td>16</td></tr><tr><td>35</td></tr></table>	16	35
16			
35			
DIV	<table border="1"><tr><td>2</td></tr></table>	2	
2			

Notice that at the end of the sequence, the final value is all that remains on the stack. In addition, notice how the stack grows and shrinks as needed. If the same expression were calculated using registers, more bits of instructions would almost certainly be needed (Lilith requires only 8 bytes for each of the above operations). Typically, a register machine would leave at least one useless intermediate result in one register and the value of the expression in another. When the expression is calculated on a stack, there is no possibility of ambiguity (now which register holds the right value?). You are left with only the result—the intermediate values are gone. (An important benefit of this is that there is no need

to have separate load and store instructions for each register. Code for stack operations is concise.)

The same technique works effectively on a larger scale. Whenever a procedure is called, space must be allocated for its local data. Because local data is defined only within a procedure, once the procedure terminates, the space allocated to the local data should be recovered. Using a stack to organize procedure calls and their local data performs the necessary allocation and deallocation without extra bother (i.e., with fewer instructions and with greater speed).

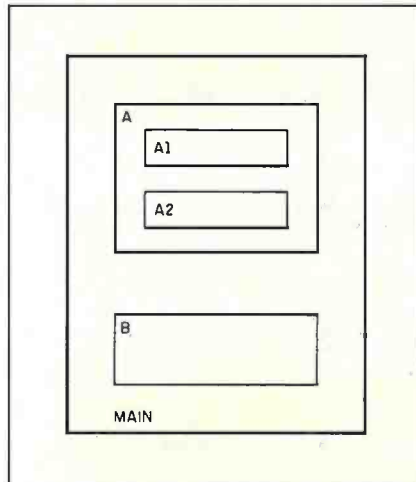


Figure 1: The schematic representation of a simple program.

Consider the schematic representation of a simple program in figure 1. The program consists of the main routine, which calls two procedures A and B. A has two local procedures A1 and A2. A2 is a recursive procedure. A typical execution of this program might proceed as shown in table 2.

At each call, the local data of the called procedure is pushed onto the stack. In the return operation, the terminating procedure's local data is popped off the stack. In particular, notice how elegantly recursion occurs. At each invocation of the recursive procedure, another instance of its local data is pushed onto the stack. As the program "backs out" of the recursive calls, the data from each instance of the procedure is removed from the stack.

Of course, a register-based machine architecture could allocate storage to procedures and recover that storage upon termination of the procedure. The key point is that a stack-based machine naturally communicates via the stack. Parameters and local values are pushed onto the stack and popped off when the procedure terminates.

Because this necessary allocation and deallocation occurs as a natural consequence of stack architecture, stack machines are efficient. While any high-level-language processor has to perform the same kinds of tasks, a stack machine can perform them with fewer instructions because the stack structure is inherently dynamic and requires only short addresses.

Table 2: A typical execution of the program from figure 2.

Program Calls	Stack Activity
Main called by host system	Push A's data onto stack
Main calls A	Push A1's data onto stack
A calls A1	Push A2's data onto stack
A1 calls A2	Push A2's data onto stack
A2 calls A2	Push A2's data onto stack
A2 calls A2	Pop A2's data off stack
A2 returns	Pop A2's data off stack
A2 returns	Pop A2's data off stack
A1 returns	Pop A's data off stack
A returns	
Main calls B	Push B's data onto stack
B returns	Pop B's data off stack
Main terminates	

the stack does not overflow or underflow. In these two machines, when an operation causes an overflow/underflow, part of the stack is automatically writ-

ten into main memory. In the Lilith engine, use of the expression stack is limited by the compiler to operations in which the compiler can control the

number of levels of the stack employed. Operations like function calls are not allowed to use the expression stack

(continued)

Get XT performance at a Jr. price.

\$2995.

plus tax



Now you can get the instantaneous response, massive storage, and easy operation of a hard disk in a truly affordable desktop computer system—the Morrow MD-11! At \$2995, it's less than many floppy disk computers!

The Morrow MD-11 comes complete with monitor, keyboard, and computer with 11-megabyte hard disk and 384k backup floppy disk drive. Plus, the MD-11 price includes over \$1200 worth of name-brand software: super fast CP/M[®] 3.0 operating system, NewWord[™] word processor, Correct-It[™] spelling checker, SuperCalc[™] spreadsheet, Personal PEARL[™] data base manager, Quest[®] business bookkeeping system, and 2 programming languages.

And now, affordable 16-megabyte (\$3495) and 34-megabyte (\$4995) Morrow systems are also available!

You've never been able to buy this eXTra measure of performance at such a JR. price. Come try the MD-11 for yourself at your nearest Morrow dealer.

**Call us today for the name of a dealer near you.
(800) 521-3493, or (415) 430-1970 in California.**

MORROW

600 McCormick Street
San Leandro, California 94577

CP/M is a registered trademark of Digital Research Inc. NewWord is a trademark of New Star. Correct-It is a trademark of Morrow Designs, Inc. SuperCalc is a trademark of Sorcim Corporation. Personal PEARL is a trademark of Relational Systems, Inc. *\$37.50 licensing fee required.

directly because there is no way to know at the time of the call whether a function (particularly a recursive one) will cause a stack error.

What this means is that the Lilith engine's stack cannot overflow or underflow. The hardware does not even support testing for overflow and underflow in the usual way. (The Lilith engine tests the stack only to see if it is empty when unloading the values on the expression stack into main memory—as might happen in a coroutine transfer.) In effect, the Lilith tests for over/underflow when a program is being compiled rather than when it is running.

If assembly-level programming were to be done on the Lilith, the protection of run-time testing would have to be built into all stack operations. But because expression stack use is controlled by the compiler, errors that could arise in assembly-language programming cannot occur. For example, it is not possible for a program to attempt to pop an operand off the stack when there is nothing in the stack (causing an underflow). Because the Lilith is specialized as a Modula-2 engine, control of expression stack size can be conve-

niently entrusted to the compiler. This makes the stack operations run faster than they would otherwise, because it eliminates the overhead of run-time testing.

MASKING CONSTANTS FROM OP CODES

It was mentioned above that the Lilith engine saves on instruction size by embedding 4-bit constants in the same byte with a 4-bit op code. While this means that the Lilith does not have to move 2 bytes when I will do (see the text box if you haven't already), it also means that the same byte contains both the op code and an operand. Separating the byte into two parts and sending the parts to the appropriate places poses a problem. An innovative solution actually makes these instructions even more efficient.

The instruction fetch unit (the portion of the Lilith engine responsible for supplying the processor with instructions) sends instructions that have embedded operands to two parts of the processor at the same time. Both the microcontrol unit (MCU) and the arithmetic-logic unit (ALU) receive the single byte that con-

tains both the op code and the operand. While the microcontrol unit decodes the machine instruction, the ALU masks the op code out of the byte and prepares the operand for the coming operation.

The use of the dual path for instructions with embedded operands is partly responsible for the fact that more than 60 percent of the instructions in a typical program are executed in three microcycles or less (450 nanoseconds or less). (See figure 2.) Common instructions execute at an average rate of 1.2 million instructions per second, including memory wait time.

UNUSUAL MEMORY CONFIGURATION

As mentioned earlier, the Lilith's large high-resolution bit-mapped display is handled by its main processor with little loss of performance. In contrast, the Xerox Alto (which heavily influenced the Lilith's design) was unable to control the screen without sacrificing overall performance. The Alto used about 50 percent of its power just to drive its screen (see reference 2).

The key factor in the loss of computing power experienced by the Alto was the excessive number of memory cycles required to service the display. To reduce this loss, I chose to expand the memory width and make memory accessible to the main processor via a 64-bit bus. This means that screen refresh requires approximately one memory reference per five microseconds. Only 11 percent of the Lilith's memory time is used to refresh the display, and the memory itself is idle 60 percent of actual operating time. I verified these figures with a measured benchmark: using the Lilith's main processor to control the display causes less than 3 percent overall system degradation. The Lilith engine controls its high-resolution raster display without significantly reducing the general effectiveness of the main processor.

For 16-bit memory read operations, special logic selects the group of 16 bits needed from the full 64-bit memory word. However, it is not practical to write to memory in 64-bit chunks. This would make writing a 16-bit value cumbersome and slow. Therefore, Lilith writes its memory in single word units.

(continued)

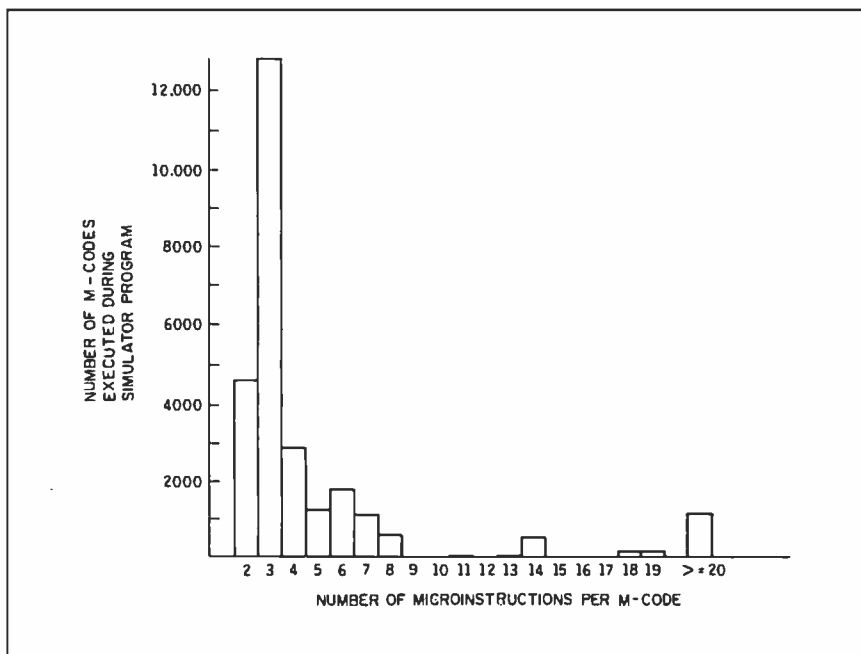


Figure 2: This microinstruction profile of M-codes shows that the overwhelming majority of op codes in the test program (which attempted to accurately reflect the Lilith's basic performance) require three microcycles or less (450 nanoseconds or less). The conspicuous peak at ≥ 20 microinstructions is mainly due to the fact that floating-point operations require many microinstructions.

THE SHARP PC-5000

COMPUTERS TO GO

Finally, Sharp's PC-5000 puts desktop computing where it's never been before. In the field. Now you can do word processing on the train, information management on site and spread sheet analysis in your hotel room. You can now communicate with mainframes and databases. Plus, it's designed so it can easily be integrated into your systems.

Specifications:

- Weighs under 10 lbs*/3½"H x 12"D x 13"W
- 16-bit, 8088 CPU/128K expandable to 256K RAM
- Two 5¼ floppy drives/320K each**
- Integrated 37 CPS whisper-quiet correspondence-quality printer**
- MS-DOS® operating system/IBM® compatibility*
- Fold-down display for briefcase transporting/ 8 lines x 80 columns
- 6-hour rechargeable battery
- Software offering—number processing, word processing, communications and information management
- Direct connect modem**
- Nationwide service program
- Immediately available

So before you decide to buy a computer that's not going anywhere, look into Sharp's PC-5000. It goes everywhere!

For more information just call toll-free 1-800-BE SHARP or send in the coupon.

**Options.

*Without optional printer and modem.
MS-DOS® is a registered trademark of Microsoft Corporation.
IBM® is a registered trademark of International Business Machines Corporation.
Sharp Electronics Corp., Paramus, NJ 07652
Circle 278 on inquiry card.

Sharp Electronics Corp., 1909 E. Cornell, Peoria, IL 61614

Please send me more information about Sharp's PC-5000.

Please set up a demonstration.

Name _____ Title _____

Company _____

Street _____

City _____ State _____ Zip _____

Phone (____) _____

SHARP

**FROM SHARP MINDS
COME SHARP PRODUCTS**

Lilith spends much more time executing instructions than it does getting them.

16 bits at a time. The rather unusual combination of a memory that has a broad read bandwidth and a more typical write bandwidth allows the Lilith to operate its screen effectively without making memory write operations slow.

GETTING INSTRUCTIONS FASTER

Because the Lilith engine can read four words of instructions at a time, but most often may need only a single instruction byte at the time, an extra device, the instruction fetch unit (IFU), is included in

the Lilith engine to support the processor. The IFU performs a prefetch of 64 bits of instructions and presents bytes of instructions to the processor as needed. As soon as the IFU sends the last byte of instruction to the processor, the IFU prefetches the next 64 instruction bits. Usually, the IFU is ready with an instruction whenever the processor is ready to accept one. But even at worst, the processor waits only one memory cycle for the IFU to read another 64 bits and deliver the next instruction byte. The IFU then has 7 more bytes waiting to be delivered to the processor without any delay.

What this means for performance is that the Lilith processor spends much more time executing instructions than it does getting them. Most processors have to wait one memory cycle for each instruction. They actually spend more time fetching instructions than they do manipulating data. In contrast, the Lilith can prefetch as many as eight instruc-

tions in one memory cycle. One instruction goes directly to the processor, and during the next seven memory cycles, the processor does only useful work. If the IFU were considered a cache memory device, it would have the respectable hit ratio of 84 percent (instructions waiting to be executed versus needing to get an instruction before proceeding). The IFU makes the main processor wait while it gets the next batch of instructions during only 16 percent of the processor's cycles.

In practice, executing typical Modula-2 programs, the Lilith processor spends only 22 percent of its operating time fetching instructions and the remaining 78 percent doing useful work. (Other processors typically use at least 50 percent of their operating time fetching instructions.) This impressive performance is partly due to the ability of the Lilith engine to read its main memory in 64-bit chunks. It is also partly due to the

(continued)

SOFTWARE AND MORE THE EASY WAY: BUYMAIL

BUYMAIL offers the best in software and computer peripherals at the lowest prices available.

Call **1-800-821-7757**

to place your order for:

	SUGGESTED RETAIL	BUYMAIL		SUGGESTED RETAIL	BUYMAIL
Wordstar	495.00	217.95	Riteman 80 Column Printer (MX-80 compatible)	399.00	297.00
Lotus 1-2-3	495.00	307.95	Silver Reed 400 (letter quality printer)	399.00	297.00
Wordstar Professional (Wordstar, Correctstar, Starburst, Mailmerge)	695.00	357.95	Taxan Amber Monitor	189.95	87.00
Professional Options Pack (Correctstar, Starburst, Mailmerge)	395.00	197.95	Novation Access 123 w/Crosstalk (IBM Internal 1200 baud)	595.00	367.00
Multimate	495.00	297.00	Hayes 1200	699.00	479.00
Supercalc 3	395.00	217.00	Maxell Disks SSDD	49.95	17.70
Multiplan	195.00	117.00	DSD	64.95	29.90
			Flip 'N File	29.95	14.95

Don't forget to ask about other BUYMAIL products and our free catalog. We ship your order within one working day or we pay the shipping charges.

BUYMAIL thanks you in advance for your order. Prices and availability subject to change without notice!

Payment: MasterCard, VISA, check (please allow 10 days to clear). COD orders gladly accepted, you may pay by cash or Cashier's check

when your order arrives. D&B listed businesses may pay by company check, just give us your Duns number when you call. Payment by wire transfer is easily done, just call us for our bank information. Qualified firms may receive open terms.

Shipping Charges: UPS ground, 3% of your order, subject to a minimum of \$4.00 UPS 2nd day air 6% of order, minimum \$8.00. Prepaid orders with Cashier's check get free shipping!

ad#: 201



FUJITSU PRINTERS

*You can't buy
more Performance
for the Price.*

Finally, there is a full line of quality printers available to meet a variety of needs. And all from a single manufacturer...

FUJITSU. From dependable dot matrix printing to advanced thermal printing, you can't buy more performance for the price.

Quality That's Built In: Fujitsu quality is built into every printer manufactured. That quality translates into high reliability (MTBF), versatile print capability, low maintenance, low noise,

and high speeds. And Fujitsu printers are serviced by TRW, a nationwide service organization.

A Complete Printer Line: Fujitsu's dot matrix printer, with its 24 wire head, offers letter quality printing at 80 CPS. With its ability to also produce draft quality, correspondence quality and high resolution graphics, the Fujitsu DPL24 leads dot matrix technology.

In daisy technology, Fujitsu's SP830 is the fastest letter quality printer in the industry at 80 CPS. Fujitsu's SP320 daisy-wheel printer also provides cost effective letter quality printing at medium speeds.

Fujitsu offers thermal printing with its TTP16 printer. The low-cost printer accepts a wide variety of papers and operates quietly at less than 50 dBA.

Call Us Today: Contact Fujitsu America, Inc., at 408-946-8777 for the printer distributor nearest you.

DISTRIBUTORS: Algoram Computer Products (415) 969-4533, (714) 535-3630, (206) 453-1136, (916) 481-3466; Allen Edwards Associates, Inc. (213) 328-9770, (714) 552-7850, (619) 273-4771, (805) 498-5413; Four Corners Technology (602) 998-4440, (505) 821-5185; Gentry Associates, Inc. (305) 859-7450, (305) 791-8405, (813) 886-0720, (404) 998-2828, (504) 367-3975, (205) 534-9771, (919) 227-3636, (803) 772-6786, (901) 683-8072, (615) 584-0281; Hopkins Associates, Inc. (215) 828-7191, (201) 273-2774; Inland Associates, Inc. (913) 764-7977, (612) 343-3123, (314) 391-6911; Logon, Inc. (201) 646-9222; Lotory Computer Products, Inc. (313) 229-7200, (216) 398-9200, (614) 451-7494, (513) 435-7684, (616) 363-9839, (412) 922-5110, (502) 561-5629; MESA Technology Corp. (301) 948-4350; NACO Electronics Corp. (315) 699-2651, (518) 899-6246, (716) 233-4490; Peak Distributors, Inc., (An affiliate of DytectCentral) (312) 394-3380, (414) 784-9686, (317) 247-1316, (319) 363-9377; R² Distributing, Inc. (801) 298-2631, (303) 455-5360; S&S Electronics, (617) 458-4100, (802) 658-0000, (203) 878-6800, (800) 243-2776; USDATA (214) 680-9700, (512) 454-3579, (713) 681-0200, (918) 622-8740.



PERIPHERAL PRODUCTS DIVISION

Quality Lives



Circle 132 on inquiry card.

The high performance of Lilith and the flexibility of its user interface combine to make it an effective workstation.

fact that the average Lilith instruction is only 10 bits long—that means that the IFU fetches an average of 6.4 instructions each time it is activated.

THE BARREL SHIFTER

Although the full power of the Lilith's processor is available for screen manipulation, moving a portion of the screen image is particularly difficult. Imagine the image of a tiny plane "flying" across the screen. Internally, the movement of the plane's image is actually accomplished by moving the bits that represent the plane. Obviously, these bits must be moved as a unit one bit at a time if the plane's movement is to be smooth (that is, it should appear to move one pixel with each refresh of the screen).

Moving an irregularly organized group of bits (that is, not full words or even bytes) by irregular units (bits rather than words or bytes) is not straightforward. Assume that our plane's image is 32 bits long and it starts out fitting nice-

ly into a column of words. The first move puts 1 bit into the next word and shifts the original two words over by 1 bit and leaves 1 bit of the first word empty. Anyone who has attempted to program animation in assembly language knows how much shifting and masking this involves.

The Lilith employs a special shifting device called a barrel shifter to accomplish the shifting and masking needed for image movement on the screen. A barrel shifter rotates the bits in a given word by one to 15 positions in a single cycle. This allows very fast shifting and masking and, consequently, movement of graphic data in memory. The Lilith can easily move large portions of its screen in real time—ignoring byte and word boundaries.

The use of the barrel shifter allows the Lilith's processor to accomplish complex shifting and masking in a single cycle. This permits the impressive graphic performance the Lilith is noted for and, incidentally, makes operations on Modula-2's type BITSET very fast. The use of the barrel shifter is another example of the hardware implementation of the Lilith engine enhancing the performance of the M-machine architecture.

LILITH AS A WORKSTATION

The high performance of the Lilith computer and the flexibility of its user interface make it an effective workstation. When developing programs on the Lilith, the user may take advantage of program-development and diagnostic programs that are specifically designed to make the most of the Lilith's process-

ing power and user interface. The Lilith environment also includes software tools that may be incorporated into user programs (such as multifont character displays; bit-map operations; and window, mouse, and cursor manipulation).

The Lilith processor is also microprogrammable, meaning that special instructions can be added to the instruction set of Lilith to speed up sophisticated tasks. Lilith has been successfully microprogrammed to draw vectors on the display, increase the precision of floating-point operations, and control a laser printer. Such micro-level flexibility in a processing engine can be invaluable.

CONCLUSION

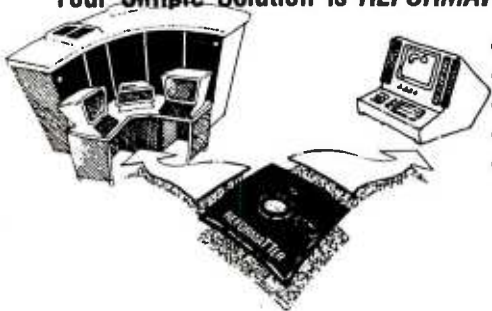
The Lilith is a specialized engine designed specifically to execute Modula-2 programs. It achieves exceptional performance through a combination of efficient architecture tailored to Modula-2 and an efficient hardware implementation. Although Lilith is a specialized processing engine, compared to other machines in its price class, it is a highly flexible engine for Modula-2 programming. ■

REFERENCES

1. Bulman, D. M. "Stack Computers: An Introduction." *Computer*. IEEE Computer Society, May 1977, page 18.
2. Thacker, C. P. et al. *Alto: A Personal Computer*. Palo Alto, CA: Xerox Corporation, 1979, page 14.
3. Jacobi, Christian. *Code Generation and the Lilith Architecture*. Diss ETH No. 7195, Zurich: Swiss Federal Institute of Technology, 1982.
4. Wirth, Niklaus. *The Personal Computer Lilith*. Report 40, Zurich: Swiss Federal Institute of Technology, 1981.

DATA TRANSFER PROBLEMS?

Your Simple Solution is **REFORMATTER®** Diskette Conversion Software



- Avoids serial communication protocols.
- Needs only one system to transfer data.
- Converts source code and data files.
- Allows 2-way transfer.
- Quick, reliable, and inexpensive.



VERSIONS	
Runs On	Reads/Writes
CP/M	↔ IBM 3740
CP/M	↔ DEC RT-11
CP/M-86	↔ IBM 3740
CROMIX	↔ DEC RT-11
DEC RT-11	↔ CP/M
MS-DOS	↔ IBM 3740
TRSDOS II*	↔ CP/M
TRSDOS II	↔ DEC RT-11
PRICE:	\$350 *\$249

Requires 8" floppy drive.

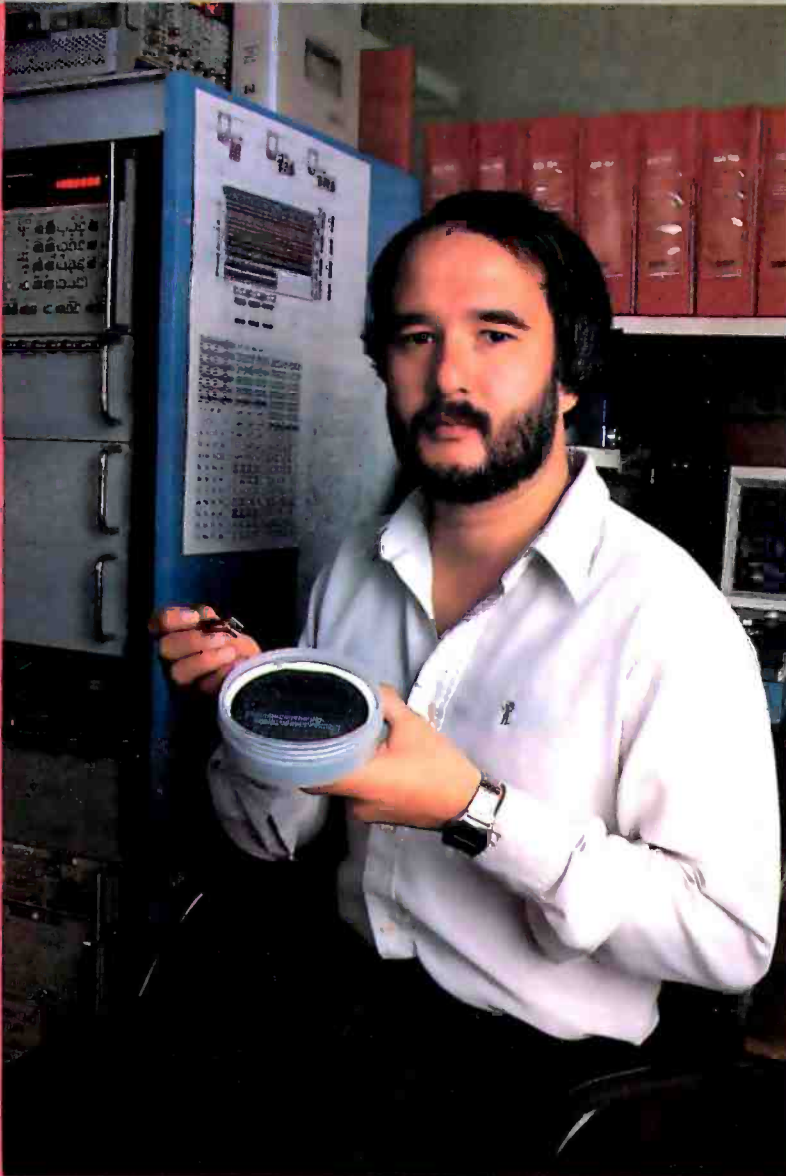
(415) 324-9114 TWX: 910-370-7457

467 Hamilton Avenue, Suite 2, Palo Alto, Calif. 94301

Pascal-2™

PROVING GROUNDS

Pascal-2 Performs in Parametric Testing for VLSI Technology Group at Jet Propulsion Laboratory.



“The nature of the instrumentation we use and the speed at which we need to acquire data created the need for a compiler that would let us push our PDP-11 to the limit.”

Glenn Jennings
Senior Engineer, Programming
Jet Propulsion Laboratory
Pasadena, California

Glenn Jennings' parametric testing software is used in a quality assurance program for the VLSI circuits in deep space exploration spacecraft. Pascal-2 permits ease and speed of programming in acquiring data from the tested VLSI circuits.

Why is Pascal-2 the group's choice in software? "This highly optimizing compiler produces code which is very efficient, using our RSX operating system to the maximum. Pascal-2 allows us to easily use memory overlays for writing our very large programs. It has a very clean interface to assembly level language modules."

To see how Pascal-2 meets your application needs, call

1-800-874-8501.

Oregon Software

2340 S.W. Canyon Road
Portland, Oregon 97201
(503) 226-7760

The Pascal-2 system is available on Digital's PDP, VAX and Professional Computer systems running on the RSTS, RT-11, RSX and Unix Operating Systems.

Digital, PDP, VAX, RSTS, RT-11 and RSX are trademarks of Digital Equipment Corporation. Unix is a trademark of Bell Laboratories. Pascal-2 is a trademark of Oregon Software.



StorageMasterTM Media is Here!

Now you can buy flexible disks with a five year warranty from Control Data.

A lot of companies make diskettes. But Control Data also makes disk drives. In fact, we're the leading independent supplier of disk drives to computer manufacturers.

Now we've put our expertise into a truly superior line: StorageMaster diskettes from Control Data.

You can choose from a com-

plete line of premium 8" and 5.25" diskettes in single or double densities, single or double-sided. And each diskette is 100% certified and backed by a 5 year warranty. So you can depend on them to perform for years to come.

Look for StorageMaster diskettes at your local computer store or ask for them from your computer supplies distributor.

Or give us a call toll-free at 1-800/328-6207 (in Minnesota call 612/853-8065) and we'll tell you where to find StorageMaster diskettes.

**CONTROL
DATA**

AN INTRODUCTION TO MODULA-2

BY ROBERT J. PAUL

*This new language is
a superset of Pascal*

IN THIS ARTICLE we'll take a look at the differences in control structure, expressions, and general syntax between Pascal and Modula-2. First, however, I should mention three fundamental philosophical differences between the two languages.

First, the introduction of the module concept in Modula-2 extends the "separate compilation" features that various Pascal implementations have often added. You can build a library of modules that provide standard routines to perform common operations. You can also use the modules to create hidden data structures and to isolate a program from the specific data structures used.

Second, Modula-2 replaces the Pascal I/O (input/output) routines read and write with the standard module TTIO, a logical change considering the module concept. This module provides the primitive routines Read and Write, which function one character at a time. Another module, InOut, provides more sophisticated routines, including ReadInt, to read an integer in character form; WriteInt and WriteCard, to write integers and cardinals (unsigned integers) in decimal notation; WriteOct and

WriteHex, to write integers or cardinals in octal and hexadecimal notation, respectively; and WriteString, to write character strings.

The third major change from Pascal is the addition of concurrency primitives to Modula-2, which lets you write concurrent (multitasking) programs in a standard and portable way. Concurrency can make certain programming tasks easier, and some applications require it. Concurrent variations of many languages (including Pascal) have been developed, but Modula-2 is a standard language in which to write concurrent programs.

COMPARISON TO PASCAL

You can use several criteria to distinguish one programming language from another: program structure, control structure, expressions, and data typing facilities. One language is clearly superior to another. For example, if it ranks higher in all four areas: mixed results, on the other hand, highlight the

Robert J. Paul is a senior software engineer with Turning Point Software (11A Main St., Watertown, MA 02172). He has a B.S. in computer science from Rensselaer Polytechnic Institute.

relative strengths and weaknesses of each one.

Of course, these criteria refer to the language definition alone. Its implementation on a specific machine determines the time required to compile and execute a program. In general, competent implementations of either Pascal or Modula-2 should result in almost identical compile and run times.

PROGRAM STRUCTURE AND PROCEDURES

The main routine in a Modula-2 program is called the "main module." It contains all the sections of a Pascal program as well as features that provide for external subroutines (in other modules). Listing 1 shows a schematic of the main module.

The bulk of any Pascal or Modula-2 program is a collection of procedures or subprograms that perform specific functions. Pascal distinguishes between a function, which returns a value, and a procedure, which does not. Modula-2 offers the same facilities, although the distinction between procedures and functions blurs because the keyword PROCEDURE introduces both of them.

(continued)

Listing 1: A schematic representation of the main module. The programmer provides the names in lowercase; the words in uppercase are Modula-2 keywords.

```

MODULE modulename:
FROM librarymodule IMPORT libraryroutine1, libraryroutine2;
FROM librarymodule2 IMPORT libraryroutine3;
CONST                                (* constant declarations go here *)
  charcount = 80 * 24;                (* sample constant *)
TYPE                                  (* type declarations go here *)
  type1 = {apple, pear, orange};      (* enumeration type *)
  type2 = { 1960 .. 1990 };           (* subrange type *)
  returntype = CARDINAL;              (* unsigned integer *)
VAR                                   (* variable declarations go here *)
  foo: returntype;                    (* declare 1 variable *)

PROCEDURE procedure1(parmi, parm2: type1; VAR parm3: type2);
VAR                                  (* local variables declared here *)
BEGIN                                (* body of procedure goes here *)
  END procedure1;

PROCEDURE function1(parmi: type1) : returntype;
VAR                                  (* local variables declared here *)
BEGIN                                (* body of function goes here *)
  RETURN integerexpression;          (* to exit with value use the return statement... *)
END function1;
BEGIN                                (* beginning of main procedure *)
  (* body of main program goes here *)

  procedure1(apple,orange,1967);
  foo := function1(pear);
END modulename.

```

Listing 2: Variable-size array as a procedure parameter of the function CountThem. This example also illustrates the output routines required to write text strings and cardinals and to terminate an output line.

```

MODULE sample1;
FROM WriteStrings IMPORT WriteString, WriteLn;
FROM TTIO IMPORT WriteCardinal;
CONST
  smallsize = 20;                      (* small sized array *)
  largesize = 35;                      (* large sized array *)
VAR
  t: CARDINAL;
  smallarray: ARRAY 10 .. smallsize OF CARDINAL;
  largearray: ARRAY 10 .. largesize OF CARDINAL;
(*
  Procedure: CountThem
  Parameters: one variable size array of CARDINALs (unsigned integers)
  Returns: CARDINAL, sum of the elements in the array
*)
PROCEDURE CountThem1(vector: ARRAY OF CARDINAL): CARDINAL;
VAR
  l sum: CARDINAL;
BEGIN
  sum := 0;                             (* initialize sum *)
  FOR i := 0 TO HIGH(vector) DO         (* for all elements *)
    sum := sum + vector[i];            (* add to sum *)
  END;                                   (* end of FOR *)
  RETURN sum;                           (* and return value *)
END CountThem;
(*
  Main Program starts here
  Initialize two arrays and call the function CountThem
  once with each of the two arrays.
*)
BEGIN (* main program *)
  FOR i := 0 TO smallsize DO           (* initialize small array *)
    smallarray[i] := i;

```

(continued)

The syntax of a procedure definition is

```

PROCEDURE
  name (<fp>|:<fp>|)
  |: return-type:
[CONST (* optional constant
  declarations *)]
[TYPE (* optional type
  declarations *)]
[VAR (* optional variable
  declarations *)]
BEGIN
  statement-sequence
END name;

```

Above, <fp> is shorthand notation for a formal parameter section (an identifier list followed by a colon and a type name).

The two methods of passing parameters in Pascal are the same in Modula-2. "Call by value" means that a copy of the parameter value is sent to the subprogram. This makes it impossible for the subprogram to modify the calling program's copy of the parameter. In the alternative method, "call by reference," the subprogram receives the parameter's address, meaning that changes made to its value by the subprogram also affect its value in the calling program. You can request "call by reference" in Modula-2 by placing the keyword VAR (the same as in Pascal) before the formal parameter section. The default is "call by value."

Modula-2 can also pass variable-size arrays to procedures; Pascal cannot. If you substitute ARRAY OF typename for the type name in the formal parameter section, you can pass an array of the specified type to the procedure. The special function HIGH(arrayname) returns the upper bound of the array passed (see listing 2).

STATEMENTS AND CONTROL STRUCTURES

The heart of any language is how you control the program-execution flow. Modula-2 provides all the familiar Pascal control structures and a few more to make special programming circumstances easier to handle.

One important change from Pascal is that every control structure in Modula-2 has an explicit termination, usually an END statement. This prevents the ambiguity possible in the following Pascal program sequence:

(continued)

ORDER DESK ONLY
(800) 292-3360
 TOLL FREE IN CALIFORNIA

"WHY PAY MORE"
COMPARE THESE PRICES

MC-P APPLICATIONS
Brings Software & Hardware
At Unbeatable Prices

ORDER DESK ONLY
(800) 292-3360
 TOLL FREE OUTSIDE CALIF.

SOFTWARE

	LIST	OUR
APPLIED SOFTWARE TECHNOLOGY		
VersaForm	\$389	\$269
ASHTON TATE		
dBASE II	700	295
Friday	295	175
BPI ACCOUNTING SYSTEMS		
GL/AP/AR (Each)	395	285
CONTINENTAL		
Property Management	495	327
FOX & GELLER		
Quick Code	295	165
Quick Code DutilPack	—	185
FUNK SOFTWARE Sideways		
	60	45
HOWARD SOFT		
Real Estate Analyzer II Apple	199	135
HUMAN SOFT DB Plus		
		89
LATTICE C Compiler		
	500	325
LIFETREE Volkswriter Deluxe		
		175
LIVING VIDEOTEXT		
Think Tank	195	125
METASOFT Benchmark		
	499	295
MICROSTUFF Crosstalk		
	195	129
MICROPRO Spell Star		
Word Star w/Applicard	250	105
Mail Merge	495	349
Super Sort	250	155
Calc Star	250	135
Info Star	145	86
Word Star Pro	495	320
	695	369
MICRORIM		
R Base 4000	495	325
MICROSOFT		
Flight Simulator (IBM)	50	35
Flight Simulator (Apple) Sublogic		29
Multi Plan	250	129
Multitool Word W/Mouse	475	325
Pascal Compiler	350	245
C Compiler	500	345
PBL CORPORATION		
Personal Investor	145	98
PETER NORTON		
Peter Norton Utility	80	55
PEACHTREE		
Peach Pack (AR, AP, GL)	595	249
ROSESOFT Prokey		
		95
SOFTWARE DIMENSIONS		
Accounting Plus		
GL, AR, AP, PR, INV - Each	495	295
SOFTWARE PRODUCTS INTERNATIONAL		
Open Access	575	369
SATELLITE SOFTWARE		
Word Perfect	495	285
SOFTWARE PUBLISHING		
Pfs: File		
Apple	125	79
IBM	140	79
Pfs: Report	125	79
SOFTWORD SYSTEM		
Multimate	495	275
SORCIM SuperCalc II		
	295	185
SuperCalc III	395	275
STATE OF THE ART (FM Series)		
GL/AP/AR/INV/PR-Each	595	375
SYNPSE File Manager		
	150	97
WOLF Move-It		
	199	125
VISICORP		
Visicalc IV	250	175
Visifile (Apple)	250	187
Visifile (IBM)	300	195
VisiSchedule	300	1 95
VisiWord w/free VisiSpell	375	285
Visitrend/Plot	300	195

Monthly Specials

- Tandon TM 100-2
\$205⁰⁰
- AST SIX PAK (64K)
\$265⁰⁰
- AMDEK 310A
\$169⁰⁰
- MULTIMATE
\$275⁰⁰
- IRMA 3270
\$1045⁰⁰
- OPEN ACCESS
\$369⁰⁰
- LOTUS 1-2-3
\$299⁰⁰

Value Paks

- PLANTRONIC +
PRINCETON GRAPHIC
\$869⁰⁰
- R:BASE 4000 +
MULTITOOL WORD
W/MOUSE
\$585⁰⁰
- LOTUS 1-2-3 +
HERCULES CARD
\$669⁰⁰

**ORDER STATUS &
 TECHNICAL
 SUPPORT — CALL
 (408) 293-3360**

**Call for Hardware &
 Software Prices Not
 Listed This Ad**

**Used PC's & Apples
 Bought & Sold**

HARDWARE

	LIST	OUR
HAYES MICROCOMPUTER PRODUCTS		
Hayes 300 Baud	\$289	\$209
Smart Modem 1200B	599	445
Smart Modem 1200	699	495
ADVANCED LOGIC SYSTEM (Apple II)		
Z-Card	169	115
Printer Mate (Parallel)	99	55
CP/M Card (W/ CP/M 3.0)	399	315
MPC PERIPHERALS (Apple)		
Parallel Interface Card (w/Cable)	90	68
MOUSE SYSTEMS		
PC Mouse w/Software	295	219
NOVATION		
Apple - Cat II	389	275
12 Auto Cat	695	595
Smart-Cat 103/121	595	445
Smart-Cat 103	249	187
PEGASUS		
Hard Disk 10 mgb (internal)		1195
PERSONAL COMPUTER PRODUCTS		
Applicard 6 Mhz	375	280
KRAFT & TG Joystick		
IBM	70	35
Apple	65	35
STB Color Graphix Card		
		375
TALL GRASS Hard Disk 10 mgb		
	3495	2995
TEAC Half Height		
		175
VERBATIM DISC		
S/S D/D 10 Pk.	49	24
D/S D/D 10 Pk.	71	34
AMDEK MAI BOARD		
	599	435
ELECTRONICS PROTECTION DEVICES		
Orange	140	94
Peach	98	64
QUADRAM		
Quadboard II 64K	395	285
Quadcolor I	295	219
Quadlink	660	525
MEMORY CHIP SET (64K/9 chips)		
	95	45
PRINTERS		
NEC 3550	2299	1799
Qume 1140 Plus	1685	1349
MONITORS		
Amdek 12" 310A	230	169
Princeton RGB Hi Res	795	485
ORCHID TECHNOLOGY		
Blossom 64K	395	265

**International
 Dealer Inquiries
 Welcomed**

Circle 194 on inquiry card.

MC-P APPLICATIONS, Inc.
 1630 Oakland Road, Suite A114
 San Jose, CA 95131, USA Phone (408) 293-3360
 Telex: 821396 MCPA UD
 HOURS: 8:30 a.m. to 5:30 p.m. — Mon. - Sat.
 Call for Prices in Australia at 02-929-8468

TERMS: All prices subject to change. Cashier's check/MO/
 Bank Transfer. Allow time for company or personal checks to
 clear. Prices reflect cash prepaid discount. VISA/MASTER
 CARD/COD/PO's =3%. California residents add sales tax.
SHIPPING: \$4 per item for UPS surface (\$8 for Blue Label);
 Monitors \$20, Printers \$25, within continental USA.

```

END:
FOR i := 0 TO largesize DO
  largearray[i] := i
END:
WriteString('The sum of the numbers 0 to ' +
WriteCardinal smallsize, 5 i:
WriteString(' is '):
WriteCardinal Count.Themsmallarray, 5 i:
WriteLn
WriteString('The sum of the numbers 0 to ' +
WriteCardinal largesize, 5 i:
WriteString(' is '):
WriteCardinal Count.Themlargearray, 5 i:
WriteLn
END sample1.

```

```

| 'A'..'Z'
  : WriteString('Uppercase
letter')
| '+', '-', '*', '/'
  : WriteString('Operator')
ELSE WriteString('Other
punctuation or symbols')
END

```

```

IF (oregano IN recipe[])
THEN
  IF (thyme IN recipe[])
  THEN writeln('Use oregano
and thyme')
ELSE
  writeln('No oregano');

```

```

IF (thyme IN recipe[])
THEN
  WriteString('Use oregano
and thyme')
ELSE
  WriteString('No oregano');
END

```

Although the indentation implies that the first message should print if the recipe specifies both oregano and thyme and the second message if it does not specify oregano, this is not how the program executes. In fact, the program matches the ELSE clause with the most recent IF statement, so the second message prints if the recipe does have oregano but does not have thyme.

Modula-2 smooths out this Pascal problem and a few other rough edges. The basic control structure needed to provide conditional execution, the IF-THEN-ELSE statement, is the best example of this improvement.

```

IF expression
THEN statement sequence
| ELSIF expression
  THEN statement sequence|
| ELSE statement sequence|
END

```

You can repeat the ELSIF clause as many times as you wish, providing for a number of mutually exclusive cases. When the program encounters the expression, it can execute only one of the statement sequences: if none of the expressions is true, then the program executes the ELSE clause. You can write the Pascal oregano example in Modula-2 as

```

IF (oregano IN recipe[])
THEN

```

The placement of the END statements tells the compiler which IF statement goes with the ELSE clause.

The CASE statement provides a way to select between mutually exclusive conditions.

```

CASE expression OF
label1 [,label2,...]
  : statement sequence
| label3 [,label4,...]
  : statement sequence
| [ELSE statement sequence]
END

```

The expression is evaluated and compared to the labels: if the program finds a match, it executes the corresponding statement sequence. If it does not find a match, the program executes the ELSE clause. You can place as many labels as you wish before each statement sequence, and you can specify as many statement sequences as you need. The type of the case expression must be INTEGER, CARDINAL, CHAR, BOOLEAN, or an enumeration or subrange type, and you cannot repeat labels. For example, the following program fragment determines what type of character the variable *ch* contains.

```

CASE ch OF
'0'..'9'
  : WriteString('Digit')
| 'a'..'z'
  : WriteString('Lowercase
letter')

```

The next basic type of control flow is the loop. Modula-2 provides three loop-control statements like Pascal's and one new statement that provides a more general form of loop control.

The FOR statement sets a control variable to some initial value and then executes a statement sequence, varying the control variable through the progression of values specified in the FOR statement.

```

FOR var := expr1 TO expr2
| BY expr3 |
DO statement sequence
END

```

This initializes the simple variable *var* to the value of the expression *expr1*. If the variable is not greater than the second expression, *expr2*, the program executes the statement sequence and increments the variable by the value of the third expression, *expr3*. This process repeats itself until *var* exceeds the limit in *expr2*. If you omit *expr3*, the default increment is one. If the increment is negative, the repetition continues until *var* is less than *expr2*. Thus, Modula-2 offers greater flexibility through the use of *expr3* while Pascal requires the increment to be either 1 or -1.

In Modula-2 as in Pascal, the WHILE and REPEAT statements provide indefinite looping. These statements have the following forms:

```

WHILE expression
DO statement sequence
END
and
REPEAT
statement sequence
UNTIL expression

```

The WHILE statement evaluates expression, and, if it is logically true, executes the statement sequence. The program repeats this process until expression is logically false. The REPEAT

(continued)

Only from Topaz...

Powermaker[®] Micro UPS

Uninterruptible, computer-grade power
—at half the cost



It's in a class by itself.

For about half the cost of other Uninterruptible Power Systems, you can now get the same degree of protection with our Powermaker Micro UPS. This remarkable new system eliminates computer problems caused by blackouts, brownouts, voltage sags and power-line noise.

Providing up to 75 minutes of continuous computer-grade power, our Powermaker Micro UPS is compatible with microcomputers and PC's. It's fully automatic, maintenance-free, portable and compact. It fits neatly alongside or under your desk or workstation. And because you can't always tell when you've lost primary power, our little UPS even features an audible line-loss alarm.

But best of all is the price. The Powermaker Micro UPS is priced right and is ready for immediate shipment. Find out more about our Powermaker Micro UPS. Call us at (619) 279-0831, or contact your local Square D distributor.

TOPAZ[®]
Excellence in Computer Power

SQUARE D COMPANY

Listing 3: Examples of the LOOP construct. The first example shows proper use of the LOOP statement; the second, poor use; and the third, the appropriate corrections to the second.

(*
The following procedure processes keystrokes until it reads the character 'X'. If it reads the éomahd 'A', 'B', or 'C', the procedure calls the function *function1*, *function2*, or *function3*, respectively. These functions return a positive integer return code. This routine also demonstrates the proper use of the LOOP and CASE constructs. Note that this logic is virtually impossible to duplicate in Pascal without the use of a GOTO statement.
*)

```
PROCEDURE ProcessCommand( VAR cmd: CHAR ) : CARDINAL;
VAR
  rc: CARDINAL;
BEGIN
  LOOP
    Read(cmd);                                (* read one character *)
    CASE cmd OF
      'X' : EXIT;                              (* get out of LOOP stmt *)
      'A' : rc := function1();
      'B' : rc := function2();
      'C' : rc := function3();
    ELSE rc := 0;
    END;                                       (* end of CASE *)
    IF (rc # 0) THEN RETURN rc;
    END;                                       (* end of IF *)
  END;                                       (* end of LOOP *)
```

(*
If you are here, you must have executed the EXIT statement above
*)

```
  WriteString('Normal termination');
  RETURN 0;
END ProcessCommand;
```

(*
The following procedure illustrates a questionable use of the LOOP construct. It is improper because the WHILE statement is a more informative way of expressing the logic. This procedure reads an input file and looks for a match with an already initialized global array, *MasterArray*. The search continues until either a match or an end-of-data character, '@', is found. If it finds a match, the procedure returns the position in the array. If no match is found, it returns a zero.
*)

```
PROCEDURE SearchList ( VAR token: CHAR ) : CARDINAL;
VAR
  index: CARDINAL;
BEGIN
  LOOP
    Read(token);
    index := 1;
    IF (token = MasterArray[ index ])
      THEN RETURN index;
    END;                                       (* end of IF *)
    index := index + 1;
    IF (index > MaxIndex)
      THEN
        Read(token);
        index := 1;
        IF (token = '@')
          THEN RETURN 0;
        END;                                   (* end of nested IF *)
      END;                                       (* end of outer IF *)
    END;                                       (* end of LOOP *)
  END SearchList;
```

(*
The better procedure to handle this is . . .
*)

```
PROCEDURE SearchList( VAR token: CHAR ) : CARDINAL;
VAR
  index: CARDINAL;
BEGIN
  index := 1;
  Read(token);
  WHILE (token # '@') DO
```

(continued)

A new looping statement, appropriately called LOOP, provides an infinite iteration.

statement, on the other hand, executes the statement sequence first and then evaluates expression. If expression is logically false, the process repeats until it is true. The major difference between the two loops is that a WHILE statement executes its statement sequence *zero* or more times, while the REPEAT statement executes its statement sequence at least *once*. Note that the REPEAT statement does not end with the END clause but rather with the UNTIL clause.

The new looping statement is called, strangely enough, LOOP. The syntax is simply

LOOP statement sequence END

and provides for an infinite loop. There are two statements that can terminate this endless loop, EXIT and RETURN. The EXIT statement can appear only within the statement sequence of a LOOP statement; program execution continues at the first statement after the LOOP statement. The RETURN statement, on the other hand, terminates the current procedure and returns control to the calling procedure. If you use this statement in a function, an expression follows the RETURN statement, indicating the value to return. If RETURN appears in a main procedure, it terminates the program. For both good and bad examples of the LOOP statement, see listing 3.

DATA TYPES

The data types available in Modula-2 are almost identical to those of Pascal. The basic data types BOOLEAN, INTEGER, REAL, and CHAR from Pascal are all available, along with the data type CARDINAL, which represents an unsigned (positive) integer. Enumeration types, which permit the programmer to name the acceptable values for the type, and subrange types are also available. Array types, which create a collection of identical data items, and record types, which create a collection

(continued)

HERE TODAY HERE TOMORROW

When buying a computer, you can't limit yourself to just satisfying today's needs. **The best value in a system comes from its productivity . . . both for today and tomorrow.** CompuPro's System 816™ computer has that value. With all the power and capacity to handle your needs now and down the road.

System 816's longevity stems from top quality components . . . high storage capacity . . . the flexibility to handle a large variety of applications . . . and the speed to get the job done fast. Upgrading is easy, and when it's time to expand from single to multi-user operation, it's as simple as plugging in boards and adding terminals. Your system grows as you grow.

CompuPro also provides a library of the most popular software programs with your system and because it's CP/M® based, you have more than 3,000 other programs to choose from.

Even our warranty is for today and tomorrow. It spans 365 days — and includes the additional security of Xerox Americare™ on-site service nationwide for designated systems.*

What's more, CompuPro is one company you can count on to be around tomorrow. For more than ten years we've been setting industry standards, increasing productivity and solving problems.

For a free copy of our business computer buyer's primer, and the location of the Full Service CompuPro System Center nearest you, call (415) 786-0909 ext. 206.

CompuPro's System 816. The computer that's just as essential tomorrow as it is today.

CompuPro®

A GODBOUT COMPANY

3506 Breakwater Court, Hayward, CA 94545

*Available from Full Service CompuPro System Centers and participating retailers only.

System 816 and The Essential Computer are trademarks of CompuPro. CP/M is a registered trademark of Digital Research Inc. Americare is a trademark of Xerox Corporation.

System 816 front panel design shown is available from Full Service CompuPro System Centers only. ©1984 CompuPro

The Essential Computer™



WHAT TO WEAR WHILE BALANCING THE BOOKS.

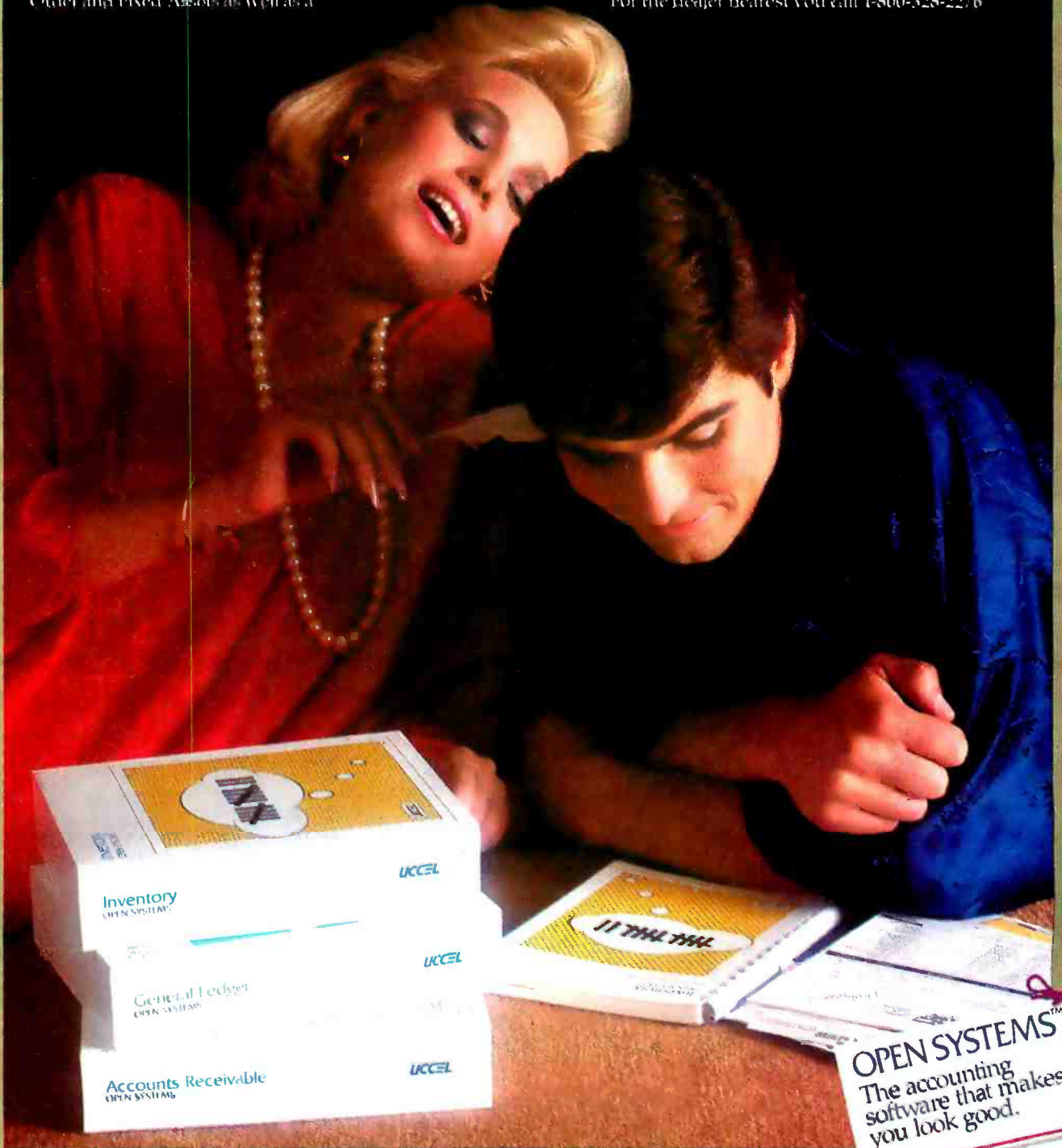
Go ahead. Slip into something comfortable. Wear the most comfortable, most sophisticated microcomputer accounting software in the world. Open Systems. Accounting software so rich in features, it can handle the complex problems of today's small business with unprecedented ease. Software so flexible, it runs on all popular microcomputers. And can grow right along with your business needs.

No other accounting software line is so complete. With a choice of General Ledger, Accounts Receivable, Accounts Payable, Inventory, Payroll, Job Cost, Sales Order, Purchase Order and Fixed Assets as well as a

Report Writer that links your accounting data to popular spreadsheets, word processors and graphics software. Assuring you the luxury of a perfect software fit.

The fact is, Open Systems meets the needs of today's small business so completely, it's become one of the best selling lines of accounting software on the market. More than 300,000 accounting products are providing comprehensive accounting solutions for businesses throughout the world. Now that's comforting. Call Open Systems right now. And get your mind off the books.

For the dealer nearest you call 1-800-328-2276



OPEN SYSTEMS™
The accounting software that makes you look good.

INTRODUCTION

```

IF (token = MasterArray| index })
  THEN RETURN index;
END;                                     (* end of IF *)
index := index + 1;
IF (index > MaxIndex)
  THEN
    Read(token);
    index := 1;
  END;
END;                                     (* end of IF *)
END;                                     (* end of WHILE *)
RETURN 0;
END SearchList;

```

Listing 4: Examples of type and variable declarations and their uses. The three sections give several type definitions, variable declarations using the type definitions, and some program fragments that manipulate the variables.

```

MODULE sample2;                             (* sample module header *)
TYPE
(*
Declare an enumeration type Color with 5 possible values.
*)
Color = (yellow, red, green, blue, purple);
(*
Declare a subrange type Index that can take on values between 1 and 80, inclusively.
*)
Index = 1 | .. 80 |;
(*
Declare an array type CardImage to be an array of 80 characters, identified by indexes of 1 to 80.
*)
CardImage = ARRAY Index OF CHAR;
(*
Declare a record type Name to be a last name, a first name, and a middle initial.
*)
NameType = RECORD
  last: ARRAY [1 .. 20] OF CHAR;
  first: ARRAY [1 .. 10] OF CHAR;
  middle: CHAR;
END;
(*
Declare a record type Person to be a collection of a name, city, state, zipcode, and age. Note that
you must store the zip code as characters, not as integers or cardinals, because a 16-bit computer
only allows integers up to 32767 and cardinals to 65535.
*)
Person = RECORD
  name: NameType;
  city: ARRAY [1 .. 30] OF CHAR;
  state: ARRAY [1 .. 2] OF CHAR;
  zipcode: ARRAY [1 .. 5] OF CHAR;
  age: CARDINAL;
END;
(*
Now, declare some variables using the above types
*)
VAR
  yes, no: BOOLEAN;                          (* logical true/false *)
  foo, bar: INTEGER;                          (* signed integers *)
  temperature, height: REAL;                  (* floating-point numbers *)
  ch, nextchar: CHAR;                          (* single characters *)
  distance, age: CARDINAL;                     (* unsigned integers *)
  myrose, herdaisy: Color;                    (* can be any of 5 colors *)
  i, j, k: Index;                              (* indexes into a CardImage *)
  card1, card2: CardImage;                     (* arrays of 1 .. 80 chars *)
  me, you: NameType;                           (* records for names *)
  somebodyelse: Person;                       (* record for name and addr *)
(*
This declaration creates an array with room for 50 people
*)

```

(continued)

BIG NAME, NO NAME DISKETTES: THE BEST BUY YOU CAN FIND!

LIFETIME WARRANTY!

\$119^{ea.} 5 1/4" SS-DD Qty. 50 **\$159**^{ea.} 5 1/4" DS-DD Qty. 50
\$189^{ea.} 5 1/4" SS-DD-96TPI Qty. 50 **\$214**^{ea.} 5 1/4" DS-DD-96TPI Qty. 50

(These are bulk packed diskettes with reinforced hubs and separate white Tyvec sleeves.)

(Add \$3.00 shipping per 100 diskettes. For C.O.D. orders, add another \$3.00 handling charge.)

SPECIAL!



Act now and you can get a special bonus: an Amaray Media-Mate 50 disk storage unit. Extremely well designed with grooves for stacking. Normally \$14.95. When ordered with 50 BIG NAME, NO NAME diskettes, you can get one for \$9.99 (Shipping Included).

WELL, OUR SEARCH OF MORE THAN A YEAR HAS PAID OFF.

We found a diskette that you've used a hundred times...but have never heard of. It's the one used by a lot of major software houses for their copy-protected originals...the kind of diskettes that receive a lot of heavy use.

These BIG NAME, NO NAME diskettes exceed all ANSI and IBM standards. They are individually tested track by track, sector by sector and certified 100% error-free.

Moreover, the company that makes them has their own proprietary coating formulation which results in a super-smooth, anti-static surface.

In short, these are good diskettes.

If they weren't, we wouldn't be selling them.

LIFETIME WARRANTY!

As with every diskette we sell, BIG NAME, NO NAME diskettes are covered by a LIFETIME WARRANTY by us and the manufacturer.

If you have any problems with them at any time because of materials or workmanship, just call us to arrange a return.

DON'T SAY NO!

Sure, you've never heard of BIG NAME, NO NAME diskettes.

But a lot of software manufacturers who use hundreds of thousands of diskettes for their copy-protected originals have...and a lot of them use BIG NAME, NO NAME diskettes.

DISKETTE HEAVEN GUARANTEED!

Order your supply of BIG NAME, NO NAME diskettes today.

If you're not totally happy with them at the end of 30 days, we'll give you a refund, credit or exchange.

That's confidence. That's DISK WORLD!...the nice people who sell almost a million good diskettes a month.

TO ORDER:

Call DISK WORLD between 9AM-5PM, Central Time, Monday through Friday at:

1-800-621-6827

or in Illinois, at:

1-312-944-2788

Or write us:

DISK WORLD!, Inc.

Suite 4806 • 30 East Huron Street • Chicago, Illinois 60611

DISK WORLD!

Home of
BIG NAME,
NO NAME
DISKETTES

magnum p.c.

800-544-4354



GA Residents
(404) 441-3112



4056 WETHERBURN WAY, SUITE 205, ATLANTA, GA 30092

PRINTERS

RITEMAN 3" TALL - LIKE EPSON BUT FASTER BEST PRICE
C. ITDH LETTER QUALITY.....CALL
OKIDATA ALL MODELS.....CALL
NEC SPINWRITERS, P2 & P3.....CALL
EPSON MX, FX, RX.....CALL
TI 855.....NOW IN STOCK
TOSHIBA P1351 & P1340.....CALL
SILVER-REED.....SAVE

DISK DRIVES

TANDON TM100-2.....CALL
10 MEG HARD.....1395
QUADDISK 6 MEG REMOVABLE.....CALL
TECMAR 5 MEG REMOVABLE.....CALL
IDEA 5 MEG REMOVABLE.....CALL
MICRO SCI (FOR APPLE).....CALL
QUENTIN (FOR APPLE & IBM)...SAVE
TALLGRASS HARD DISK WITH BACKUP.....CALL
IOMEGA BERNOULLI BOX (20 MEG).....CALL
SHUGART HARD DISKS & CONTROLLERS...SAVE

COMPUTERS

EAGLE PC'S.....SAVE
IBM PC YOU CONFIGURE.....CALL
SANYO MBC.....NEW LOW PRICES
TAVA PC.....MORE PC FOR LESS

BOARDS

QUADRAM ALL PRODUCTS.....CALL
AST SIX PAC PLUS.....275
IRMA 3278 EMULATOR.....BEST PRICE
HERCULES GRAPHICS CARD.....CALL
TECMAR ALL PRODUCTS.....CALL
IDEASSOCIATES ALL PRODUCTS.....CALL
MA SYSTEMS PC PEACOCK.....CALL
PERSYST.....CALL

MONITORS

TAXAN 105 AMBER / 100 GREEN.....109/104
420 IBM RGB LOOK ALIKE.....CALL
RGB-III SUPER HI RES.....CALL
AMDEK 310 DIRECT IBM PLUG IN - A OR G.....CALL
300 AMBER / GREEN.....154/144
QUADRAM QUADCHROME.....CALL

MODEMS

NOVATION - ACCESS 1-2-3 W/CROSSTALK XVI.....CALL
SMART CAT 300/1200.....CALL
J-CAT 300.....117
APPLE-CAT 300/1200.....CALL
HAYES SMART MODEM 300/1200.....212/499
1200B.....CALL
ANCHOR SIGNALMAN MARK VII/XII.....CALL

SOFTWARE

D-BASE.....355 SUPERCALC 3....249
WORDSTAR.....CALL EASYWRITER...CALL
FRIDAY.....194 MULTIPLAN.....CALL
LOTUS 1-2-3.....SAVE MULTIMATE....CALL
KNOWLEDGEMAN...CALL 10 BASE.....CALL

ACCESSORIES

STANDBY POWER SYSTEMS.....BEST PRICE
SWITCH BOXES PARALLEL & SERIAL.....SAVE
CHIPS 64K.....55
MICROFAZER PRINT SPOOLER.....FROM 127
COMPUSERVE STARTER KIT.....32

DISKETTES

	CASE 100	BOX 10
VERBATIM SS/DD	180	24
DS/DD	300	36
MAXELL SS/DD	220	27
DS/DD	330	39

AVAILABILITY AND PRICES SUBJECT TO CHANGE

APPROVED CORPORATE ACCOUNTS WELCOMED

INTRODUCTION

```

friends: ARRAY [0..49] OF Person;
BEGIN
  yes := TRUE;
  no := (NOT yes);
  foo := -32768;
  bar := 32767;
  temperature := 96.8;
  height := 6.125;
  Read(ch);
  IF (ch = 'Y')
    THEN nextchar := 'N';
    ELSE nextchar := 'Y';
  END;
  distance := 65535;
  age := 0;
  myrose := red;
  herdaisy := purple;
  IF (myrose = herdaisy)
    THEN WriteString('We Match!');
  END;
  FOR i := 1 TO 80 DO
    j := 81 - i;
    card1[i] := card2[j];
  END;
  me.last := 'Paul';
  me.first := 'Robert';
  me.middle := 'J';
  somebodyelse.name := me;
  somebodyelse.city := 'Watertown';
  somebodyelse.state := 'MA';
  somebodyelse.zipcode := '02172';
  somebodyelse.age := 23;
  (*
  Because Modula-2 allows record assignments, you can copy the entire structure above into another
  structure using one statement. In this case, it would appear that I am my own best friend.
  *)
  friends[0] := somebodyelse;
END sample2.
  
```

(* begin main program of module sample2 *)
 (* set yes to logical TRUE *)
 (* set no to the opposite of yes *)
 (* signed integers have range -32768 *)
 (* to 32767 on a 16-bit machine *)
 (* floating point numbers have *)
 (* several decimal places of precision *)
 (* read a single character *)
 (* do a comparison *)
 (* and some assignments *)
 (* unsigned integers have range 0 *)
 (* to 65535 on a 16-bit machine *)
 (* the color names are constants *)
 (* can't exceed this range *)
 (* note that string assignments *)
 (* pad with nulls if necessary *)
 (* record assignments allowable *)
 (* don't forget to end the module definition *)

of nonidentical data items, also follow the Pascal precedent (see listing 4).

Modula-2 inherits another data type, sets, from Pascal in a restricted form. The set type reflects the mathematical concept of a set: a collection of items that is not ordered—either an element is a set member or it's not. Pascal permits sets with many elements (the exact number depends on the implementation); Modula-2 restricts the set size to the number of bits in a word, the basic unit of storage. On most microcomputers and minicomputers, the word size is 16 bits, so sets can have only 16 elements on these systems. Listing 5 shows the declaration and use of a set type.

Modula-2 pointers provide a means of dynamically allocating storage. They are identical to the pointers available in Pascal. The compiler translates the standard Modula-2 procedures NEW and DISPOSE into calls to routines called ALLOCATE and DEALLOCATE—an interesting feature. You must either import

these procedures from the standard library module Storage providing the standard functionality, or provide your own version. Thus, you can tailor storage allocation and deallocation routines to your particular application, if that is appropriate. Listing 6 illustrates the declaration and use of pointers in Modula-2.

One new data type added to Modula-2, the procedure type, is used to declare a formal parameter as a procedure. This allows you to pass the name of a function or procedure as a parameter to another procedure. (Note that you cannot declare the passed procedure local to any other procedures and that it cannot be a standard procedure.) Listing 7 illustrates the declaration and use of this facility.

EXPRESSIONS

Expressions in Modula-2 are virtually identical to those in Pascal. Operands, the items you manipulate, can be sim-

(continued)



Advancing the technology of data security

Introducing Data Sentry.™ Computer security so advanced, even Mata Hari couldn't hack it.

Your most confidential files may be easy prey for the advances of an artful hacker.

That's why Lockheed used its years of experience with high-technology systems to create Data Sentry.

Protection for sensitive data

Its own internal computer gives you the telecommunications features of an intelligent modem. But unlike other modems, Data Sentry is smart enough to keep your secrets from the most persistent computer intruders.

Data Sentry puts an electronic wall around both large and small computers. And because its protection is external to your CPU, it can eliminate the expense of internal security software. It blocks the inquiries of would-be Mata Haris with a sophisticated security sequence.

Security for every situation

First, Data Sentry requests the phone number of a caller desiring access to your computer. Then it hangs up the phone and searches its list of authorized phone numbers. If the caller's number is authorized, Data Sentry dials the caller back and requests entry of a password. If the correct password isn't supplied within three tries, Data

Sentry disconnects and will not return further calls from that phone number.

Data Sentry also lets users select other lower levels of security if desired, including callback to any number with entry of password. And an option, Remote-ON®, lets you turn your computer's power on and off from a remote terminal after security has been cleared.

Versatile and confidential

Data Sentry logs all attempted contacts for audit trails and analysis of users. Its security set-up is locally controlled by a master password that is accessible only to authorized personnel. And its design includes high-reliability components, the latest LSI circuitry, plus Autodial 300/1200 baud full-duplex communications, with auto ranging for incoming data.

Data Sentry will deal with your toughest security problems.

And it'll never fall for just a pretty face.

For a list of your nearest Data Sentry distributors, call toll-free 1-800-443-0100, Ext. 471. Or write: Lockheed GETEX, Suite 945, 1100 Circle 75 Parkway, Atlanta, Georgia 30339.



 **Lockheed-GETEX**
Leadership in Technology

Circle 177 on inquiry card.

Your Key To Microcomputer Software!

WESTICO

Personal Computer
Business,
Engineering and
Professional
Programs

More software for more computers ... and more.

Whatever your software needs, all you need to know is Westico. We have hundreds of business and professional software programs in formats to fit more than 120 microcomputers, including IBM PC, MS DOS and CP/M-compatible systems. Our large inventory means you get the software you want, when you want it. Plus, our after sales service is designed to keep you smiling. Westico helps you get the most from your microcomputer.

Find out more with our new directory. Detailed descriptions of all our programs help you select the correct software to fit your needs. Start getting more with Westico.

— Order Your Copy Today —

Rush me the brand new Westico software directory.

Name _____

Firm _____

Address _____

City _____ State _____ Zip _____

Mail to:

WESTICO

The Software Express Service™

25 Van Zant Street • Norwalk, CT 06855
(203) 853-6880 • Telex 64-3788

© Copyright 1984 Westico, Inc. WES-37.

206 BYTE • AUGUST 1984

INTRODUCTION

Listing 5: This example of set type and variable declarations uses sets to represent a collection of spices in recipes. It's a reasonable use of sets, because you don't care about the order of the spices, and you wouldn't list the same spice twice for one recipe.

```

MODULE sample3;
TYPE
(*
Declare an enumeration type that represents the spices that can go into a recipe
*)
Spices = (basil, ginger, oregano, paprika, parsley, thyme);
(*
Declare a data type to indicate that none, some, or all of the individual spices have been selected
*)
SetOfSpices = SET OF Spices;
VAR
recipes: ARRAY [1..20] OF SetOfSpices; (* Declare an array of recipes *)
BEGIN (* main program *)
(*
Mark the first recipe as using oregano and thyme, but no other spices
*)
    recipes[1] := { oregano, thyme };
(*
Mark the second recipe as using no spices; the third recipe as using ginger, parsley, and thyme;
and the fourth recipe as using those spices used in recipes 1, 2, and 3 (that is, ginger, oregano,
parsley, and thyme). Note that you can't list thyme twice, as the set merely records whether the
item appears in the list or not.
*)
    recipes[2] := {};
    recipes[3] := { ginger, parsley, thyme };
    recipes[4] := recipes[1] + recipes[2] + recipes[3];
END sample3.

```

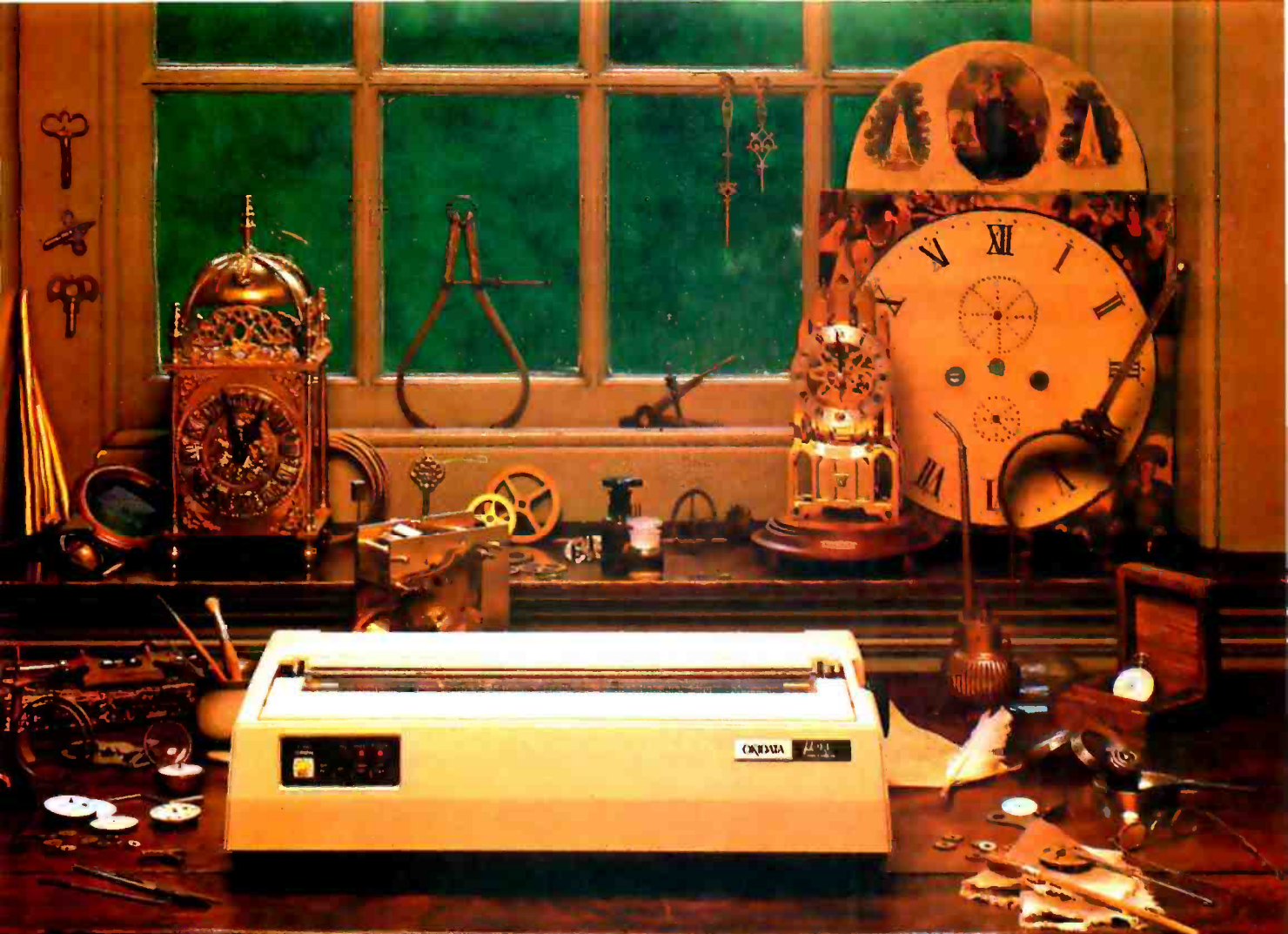
Listing 6: An example of pointer types and usage. Pointers are one of the most difficult features of Modula-2 (and Pascal, for that matter) to use properly. This example reads characters from the input file until a control character (value less than ASCII space) is found. If a space is read, the list assembled so far is printed; otherwise, the character is added to the list. The list is singly linked, with each entry pointing to the next one using the "next" field of the record. The list is stored in ascending alphabetical order, so you must search the list to look for an appropriate place to insert.

```

MODULE sample4;
(*
Note: the usage of the standard procedures NEW and DISPOSE requires, in turn, the definition
of procedures ALLOCATE and DEALLOCATE. Usually, these are the standard routines.
*)
FROM Storage IMPORT ALLOCATE, DEALLOCATE;
FROM TIO IMPORT Read, Write, WriteLn;
TYPE
link = POINTER TO element; (* declaration of pointer type *)
element = RECORD (* type that we're pointing to *)
    symbol: CHAR; (* data in element *)
    next: link; (* pointer to next element *)
END;
VAR
list: link; (* the list is merely a pointer *)
(*
Procedure: Insert
Parameters: sym, CHAR, element to insert
Purpose: inserts the element sym into the linked list
Local variables:
p = pointer to new element created for sym
ptr = pointer into list, points to element just AFTER the element to be inserted
last = pointer into list, points to element just BEFORE the element to be inserted
*)

```

(continued)



WHAT A CLOCKMAKER IN 18TH CENTURY ENGLAND TAUGHT US ABOUT MAKING QUALITY PERSONAL PRINTERS.

Each gear finely honed. Each pendulum carefully balanced. Each timepiece a combination of precision and function. He was a craftsman, building a quality product to stand the test of time.

Today, Okidata makes the most technologically advanced dot matrix printers the same way. With quality, performance, and a healthy respect for value.

Function with affordability. All printers print, but an Okidata does it with more performance and versatility than any other. There are seven models to choose from, priced at \$349 to \$2,595.

Affordability with flexibility. Okidata offers three print modes, too. The data processing mode lets you print up to 350 characters per second. That's five pages a minute. Another mode lets you print emphasized or enhanced text for more effective presentations, while the correspondence mode prints letter

quality at up to 85 characters per second, with clarity that rivals daisywheel. And an Okidata can print graphics and charts, which a daisywheel can't. This allows you to fully use the latest integrated software packages like Lotus 1-2-3™ and Symphony™.

Flexibility with compatibility. Each Okidata printer is fully compatible with all popular software packages and personal computers. Special interfaces are available for IBM and Apple, including the Apple Macintosh.

Compatibility with reliability. Here's where Okidata quality really shows. With a warranty claim rate of less than 1/2 of 1%. With printheads that last well beyond 200,000,000 characters and come with a full year guarantee. With service available nationwide through Xerox Service Centers.

Precision and performance. Quality

and value. That old English clockmaker would have been very proud of us.

Call 1-800-OKIDATA (609-235-2600 in New Jersey) for the name of the Authorized Okidata Dealer nearest you.



OKIDATA
an OKI AMERICA company
Technological Craftsmanship.

Lotus 1-2-3 and Symphony are trademarks of Lotus Development Corp.

FREE SHIPPING

WEST OF MISSISSIPPI
EAST - 1/2 UPS CHARGES

CALL FREE
1-800-841-2748

COMPUTERS

ALTOS 580-20	\$3625
ALTOS 586-20	\$5545
ALTOS 986-40	\$CALL
APPLE LOOK-A-LIKE	\$CALL
SANYO 550-555	\$CALL

TELEVIDEO

803	\$1769	1603	\$2019
PORTABLE			\$CALL

NORTHSTAR

ADV	\$2135	15MEG	\$3799
-------------	--------	---------------	--------

PRINTERS

ABATI	\$389
BROTHER HR15P	\$479
DAISYWRITER 48K	\$975
DATASOUTH DS220	\$1575
GEMINI 10X	\$260
JUKI 6100	\$439
OKIDATA (LOW PRICES)	\$CALL
QUME 1140+	\$1275
QUME 1155+	\$1475

CITOH

8510	\$339	1550	\$539
F10-40C PS	\$970	F1055	\$1299

DIABLO

620	\$799	630	\$1669
-----	-------	-----	--------

NEC

3550	\$1535	3510	\$1235
7710	\$1655	2030	\$659

TERMINALS - MONITORS

ALTOS II	\$875
QUME 102G	\$529
WYSE 50	\$485
TELEVIDEO 924	\$689
TELEVIDEO 950	\$905
TELEVIDEO 970	\$965

AMDEK 300G	\$129
AMDEK 300A	\$145
AMDEK COLOR I+	\$275
AMDEK COLOR II+	\$429
TAXAN COLOR	\$299
B.M.C. COLOR	\$235
PRINSTON HX12	\$489

DISK DRIVES - MODEMS

INDUS APPLE	\$259
MICRO SCI A2	\$199
ATARI 1050	\$365
INDUS ATARI	\$345
RANA 1000	\$299

PROMODEM	\$359
HAYS SMART MODEM	\$199
SMARTMODEM 1200	\$475
SMARTMODEM 1200B	\$415
MICROMODEM II E	\$235
RIXON 212A	\$449
U.S. ROBOTICS PASSWORD	\$325

1st PLACE

COMPUTER SYSTEMS
13422 N. CAVECREEK RD.
PHOENIX, AZ. 85022

OTHER INFORMATION: 602-867-9897



Free shipping is on UPS ground only.

Send cashier's check or money order all other checks will delay shipping two weeks.

Prices & availability subject to change without notice.



INTRODUCTION

```

PROCEDURE InsertSym: CHAR);
VAR
    p, ptr, last: link;                                (* local pointers *)
BEGIN
    NEW(p);                                           (* create a new element *)
    p^.symbol := sym;                                (* and initialize it *)
    ptr := list;                                     (* make copy of pointer to list *)
    last := NIL;                                    (* pointer to element pointing to ptr *)
    WHILE (ptr # NIL) AND (ptr^.symbol < sym) DO
        last := ptr;                                (* track parent of ptr *)
        ptr := ptr^.next;                            (* and get next element *)
    END;                                             (* end of WHILE *)
    IF (last = NIL)
    THEN                                             (* insert at top of list *)
        p^.next := ptr;                              (* point to rest of list *)
        list := p;                                   (* make new first element *)
    ELSE                                             (* insert in middle of list *)
        last^.next := p;                             (* point to p instead of ptr *)
        p^.next := ptr;                              (* new element points to rest *)
    END;                                             (* end of IF *)
END Insert;
(*
Procedure: PrintList
Parameters: t, link, list to print
Purpose: write the characters in the list to the terminal
*)
PROCEDURE PrintList(t: link);
BEGIN
    WHILE (t # NIL) DO                                (* for entire list *)
        Write(t^.sym);                                (* print characters *)
        t := t^.next;                                (* go to next entry *)
    END;                                             (* end of WHILE *)
    WriteLn;                                          (* go to next line *)
END PrintList;
BEGIN
    list := NIL;                                     (* main program *)
    list := NIL;                                     (* initialize to empty list *)
    LOOP
        Read(ch);                                    (* get character command *)
        IF (ch > ' ')
        THEN Insert(ch);                              (* insert the character *)
        ELSIF (ch = ' ')
        THEN PrintList(list);                          (* print the list *)
        ELSE
            EXIT;                                    (* exit the program *)
        END;
    END;                                             (* end of IF *)
END;                                             (* end of LOOP *)
END sample4.

```

Listing 7: Example of the PROCEDURE data type. This facility lets you construct general-purpose routines that require an (otherwise unspecified) auxiliary function to perform some calculation. For example, many FORTRAN libraries provide plotting, graphing, or statistical functions that require a user-specified function to work.

```

MODULE sample5;
(*
This module sets up a statistical function, Average, which computes the average value of a function fx.
*)
TYPE
    fcn = PROCEDURE ( REAL ) : REAL;
VAR
    avg1, avg2: REAL;
PROCEDURE Average(fx: fcn; low, high, step: REAL) : REAL;
VAR
    sum: REAL;
BEGIN
    sum := 0;

```

(continued)

Announcing
the sudden obsolescence
of the floppy disk.

NEW

HELIX PC BUBBLE DISK™

HALF-MEGABYTE MEMORY BOARD

The first bubble memory board for
IBM PC/XT and compatible computers.

- **NON-VOLATILE:** You don't lose data when there is no power.
 - Eight times faster than a floppy disk.
 - For fixed or portable use without need for back-up storage.
 - Impervious to dust, dirt, humidity, cold— as reliable in the North Sea, the Sahara, a Space Station, as in your office.
 - Mean time between failure (MTBF) more than 20 years.
 - Rugged enough to withstand vibration and shock up to 200Gs.
- For complete details contact:



Helix Laboratories, Inc., 8123 Remmet Ave.,
Canoga Park, CA 91304
(818) 710-0300—outside California, 800-468-0004
Dealer Inquiries Welcome

INTRODUCTION

```

WHILE ( low < high ) DO                                (* until entire range done *)
  sum := sum + fx(low);                                (* find value and sum *)
  low := low + step;                                  (* bump index *)
END;
RETURN (sum / (high-low));                             (* return average value *)
END Average;

(*          Sample function : f(x) = x                *)
PROCEDURE Linear(x: REAL) : REAL;
BEGIN
  RETURN x;
END Linear;

(*          Sample function : f(x) = x * x           *)
PROCEDURE Quadratic(x: REAL) : REAL;
BEGIN
  RETURN x * x;
END Quadratic;

(*          Begin main procedure                    *)
BEGIN
  avg1 := Average(Linear, -1.0, 1.0, 0.01);
  avg2 := Average(Quadratic, -1.0, 1.0, 0.01);
END sample5.

```

greater than ($>$), and greater than or equal to (\geq). You can use the relational operators set membership (IN) and improper set inclusion (\leq and \geq) to operate on sets. However, you can compare only pointer variables with the equality and inequality operators.

CONCLUSION

Modula-2 clearly surpasses Pascal in terms of its program-structuring facilities. It contains all the procedures and functions of Pascal and adds a standard way to separately compile portions of a program.

The control structures of the two languages are very close. Modula-2 has the edge over Pascal with the new LOOP statement and the consistent use of the END clause to terminate control statements.

Data typing in the two languages is also very close, but this time Pascal has a slight edge—Modula-2's restriction of sets to 16 elements (on a 16-bit computer) is unnecessary and too often inconvenient.

Both Modula-2 and Pascal provide powerful and flexible expressions, and neither language has an advantage over the other in this respect.

In many ways, Modula-2 is really a superset of Pascal. It takes the good points of the language and strengthens them with some logical and important extensions. When high-quality compilers become available on many machines, Modula-2 may replace Pascal as a language of choice. You can use Modula-2 everywhere you can use Pascal, and in many places where you can't. ■

ple variables (foo, count), array references (recipe[4] refers to the fourth element of array recipe; priceindex [April, 1967] refers to the 1967th element of the Aprilth array of priceindex), record field references (bob.name.middle refers to the middle field of record name, in the name field of record bob), and pointer dereferences (ptr[~] refers to the item referenced by pointer ptr).

The standard operators from Pascal are also available in Modula-2. Arithmetic operators that work on both signed integers (INTEGER) and unsigned integers (CARDINAL) are addition (+), subtraction (-), multiplication (*), integer division (DIV), and modulus (MOD). Integer division ($x \text{ DIV } y$) produces the integer part of the result of real division (x / y); the modulus function produces the remainder after an in-

teger division. Real arithmetic includes addition (+), subtraction (-), multiplication (*), and real division (/).

Set operators include set union (+), yielding all elements that appear in either set; set difference (-), yielding all elements in the first set and not in the second set; set intersection (*), yielding those elements appearing in both sets; and symmetric set difference (/), yielding all elements in one set and not in the other (that is, a/b is equivalent to $(a-b) + (b-a)$ if a and b are sets).

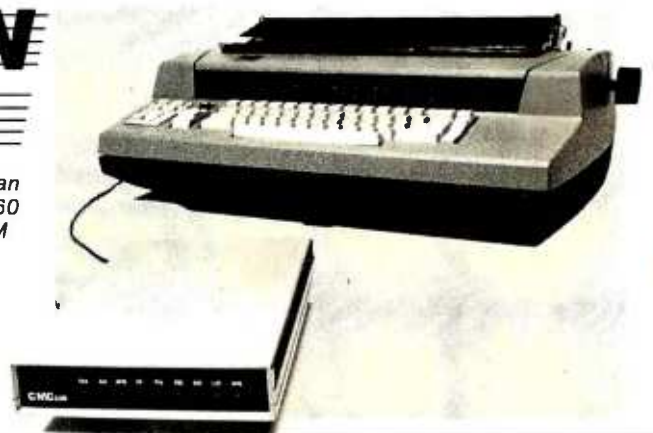
Relational operators produce Boolean (TRUE or FALSE) results, and you can use them to compare the basic types—INTEGER, CARDINAL, REAL, and CHAR—as well as enumeration and subrange types. These operators include equal to (=), not equal to (#), less than (<), less than or equal to (\leq),

IN LESS THAN 3 MINUTES

Your IBM Model 50, 60, 65, 75, 85 or 95 Electronic Typewriter can be an RS232 PRINTER or TERMINAL using our Model 5060 Interface. Our Model 300 Interface can even connect your IBM Electronic typewriter directly into a phone connector to send or receive ELECTRONIC MAIL.

Both Versions can be easily installed and require NO modifications to the typewriter.

CMC CALIFORNIA MICRO COMPUTER
9323 Warbler Ave., Fountain Valley, CA 92708 (714) 848-3947



OLYMPIA

Before you pick a printer, make sure it's fully compatible with your computer. Make sure it's right for your software programs. Make sure it's flexible enough for the functions it must perform. And if the return on investment that you expect is durable construction, trouble-free performance and letter-quality printing, make sure it's Olympia.

Consider the Olympia printer portfolio: *Electronic Compact RO*. If you need an entry level printer, this is the one to consider. Compatible with every personal computer and low in price, it provides all the features needed for efficient day-to-day performance. *Electronic Compact 2*.

Combines excellent print quality with the versatility of a built-in typewriter keyboard. Perfect for business and personal use. *ESW102*. Excellent value in a medium-speed office printer, with broad flexibility for forms and letter formats. *ESW3000*. Your best investment in a fully featured, high-speed printer for a demanding work load. *Electronic Compact NP*. Our dot-matrix printer offers speeds of up to 165 CPS, as well as a correspondence mode, for a surprisingly low investment.

With Olympia, you can invest in the printer that's exactly right for you.



Before you invest in printers, make sure you consider Olympia.



Send for our booklet: "Olympia takes the mystery out of selecting a printer." Also request product information on any or all of these excellent printers.

- Electronic Compact RO
- Electronic Compact 2
- ESW102
- ESW3000
- Electronic Compact NP

Name _____
Title _____
Company _____
Address _____
City _____ State _____ Zip _____

Olympia USA Inc., Dept. 1-Y, Box 22,
Somerville, New Jersey 08876



Setting the standard for 80 years.

© 1984 Olympia USA Inc.

Circle 236 on inquiry card.

Super assemblers plus the world's largest selection of cross assemblers!

Z-80 Macroassembler \$49.50

Power for larger programs! This 2500AD macroassembler includes:

- Zilog Z-80 Macroassembler (with the same powerful features as all our assemblers)
- powerful linker that will link up to 128 files. Com files may start at any address
- Intel 8080 to Zilog Z-80 Source Code Converter (to convert all your Intel source to Zilog Syntax in one simple step)
- COM to Hex Converter (to convert your object files to Hex for PROM creation, etc.)
- 52 page User Manual

8086/88 Assembler with Translator \$99.50

Available for MSDOS, PCDOS, or CPM/86! This fully relocatable macro-assembler will assemble and link code for MSDOS (PCDOS) AND CPM/86 on either a CPM/86 or MSDOS machine. This package also includes:

- An 8080 to 8086 source code translator (no limit on program size to translate)
- A Z-80 to 8086 translator
- 64 page user manual
- 4 linkers included:
 - MSDOS produces .EXE file
 - CPM/86 produces .CMD file
 - Pure object code generation
 - Object code and address information only

Linker features:

- Links up to 128 files
- Submit mode invocation
- Code, Data Stack and extra segments
- Handles complex overlays
- Written in assembly language for fast assemblies.
- MICROSOFT .REL format option

Z-8000 Cross Development Package \$199.50

Instant Z-8000 Software! This package allows development and conversion of software for the Z8001, 8002, 8003 and 8004 based machines on a Z-80, Z-8000 or 8086 machine. This powerful package includes:

- a Z-80/8080 to Z-8000 Assembly Language Source Code Translator
- Z-8000 Macro Cross Assembler and Linker

The Translators provide Z-8000 source code from Intel 8080 or Zilog Z-80 source code. The Z-8000 source code used by these packages are the unique 2500AD syntax using Zilog mnemonics, designed to make the transition from Z-80 code writing to Z-8000 easy.

All 2500 AD Assemblers and Cross Assemblers support the following features:

Relocatable Code — the packages include a versatile Linker that will link up to 128 files together, or just be used for external reference resolution. Supports separate Code and Data space. The Linker allows Submit Mode or Command Invocation.

Large File Handling Capacity — the Assembler will process files as large as the disk storage device. All buffers including the symbol table buffer overflow to disk.

Powerful Macro Section — handles string comparisons during parameter substitutions. Recursion and nesting limited only by the amount of disk storage available.

Conditional Assembly — allows up to 248 levels of nesting.

Assembly Time Calculator — will perform calculations with up to 16 pending operands, using 16 or 32 Bit arithmetic (32 Bit only for 16 Bit products). The algebraic hierarchy may be changed through the use of parentheses.

Include files supported— Listing Control — allows listing of sections on the program with convenient assembly error detection overrides, along with assembly run time commands that may be used to dynamically change the listing mode during assembly.

Hex File Converter, included — for those who have special requirements, and need to generate object code in this format.

Cross reference table generated— Plain English Error Messages —

System requirements for all programs: Z-80 CP/M 2.2 System with 54k TPA and at least a 96 column printer is recommended. Or 8086/88 256k CP/M-86 or MSDOS (PCDOS).

Cross Assembler Special Features

Z-8 — User defined registers names, standard Zilog and Z-80 style support. Tec Hex output option.

8748 — standard Intel and Z-80 style syntax supported.

8051 — 512 User defined register or addressable bit names.

6800 Family — absolute or relocatable modes, all addressing modes supported. Motorola syntax compatible. Intel Hex or S-Record format output.

6502 — Standard syntax or Z-80 type syntax supported, all addressing modes supported.

8086 and Z-8000 XASM includes Source Code Translators

	Z-80 CP/M®	ZILOG SYSTEM 8000 UNIX	IBM P.C. 8086/88 MSDOS	IBM P.C. 8086/88 CP/M 86	OLIVETTI M-20 PCOS
8086/88 ASM			\$ 99.50	\$ 99.50	
8086/88 XASM	\$199.50	\$750.00			\$199.50
80186 XASM <i>new</i>	199.50	750.00	199.50	199.50	199.50
16000(all) XASM <i>new</i>	199.50	750.00	199.50	199.50	199.50
68000 XASM <i>new</i>	199.50	750.00	199.50	199.50	199.50
Z80000 XASM <i>coming soon</i>	199.50	750.00	199.50	199.50	199.50
Z-8000™ ASM		750.00			299.50
Z-8000 XASM	199.50		199.50	199.50	
Z-800 XASM <i>coming soon</i>	199.50	750.00	199.50	199.50	199.50
Z-80 ASM	49.50				
Z-80 XASM		500.00	99.50	99.50	99.50
Z-8 XASM	99.50	500.00	99.50	99.50	99.50
6301(CMOS) <i>new</i>	99.50	500.00	99.50	99.50	99.50
6500/11 XASM <i>new</i>	99.50	500.00	99.50	99.50	99.50
6502 XASM	99.50	500.00	99.50	99.50	99.50
65C02(CMOS)XASM <i>new</i>	99.50	500.00	99.50	99.50	99.50
6800,2,8 XASM	99.50	500.00	99.50	99.50	99.50
6801,03 XASM	99.50	500.00	99.50	99.50	99.50
6804 XASM <i>new</i>	99.50	500.00	99.50	99.50	99.50
6805 XASM	99.50	500.00	99.50	99.50	99.50
6809 XASM	99.50	500.00	99.50	99.50	99.50
8748 XASM	99.50	500.00	99.50	99.50	99.50
8051 XASM	99.50	500.00	99.50	99.50	99.50
8080 XASM	99.50	500.00	99.50	99.50	99.50
8085 XASM	99.50	500.00	99.50	99.50	99.50
8096 XASM <i>new</i>	99.50	500.00	99.50	99.50	99.50
1802 XASM	99.50	500.00	99.50	99.50	99.50
F8/3870 XASM	99.50	500.00	99.50	99.50	99.50
COPS400 XASM	99.50	500.00	99.50	99.50	99.50
NEC7500 XASM	99.50	500.00	99.50	99.50	99.50
NSC800	99.50	500.00	99.50	99.50	99.50

Subtotal \$ _____ \$ _____ \$ _____ \$ _____ \$ _____

Name _____
 Company _____
 Address _____
 City _____ State _____ Zip _____
 Phone _____ Ext. _____
 Make and model of computer system _____
 C.O.D. (2500AD pays C.O.D. charges)
 VISA or MasterCard #, Exp. Date (mo./yr.) _____
 Signature _____

TO ORDER. Simply circle the product or products you want in the price columns above, enter the subtotal at the bottom of that column and add up your total order. Don't forget shipping/handling.

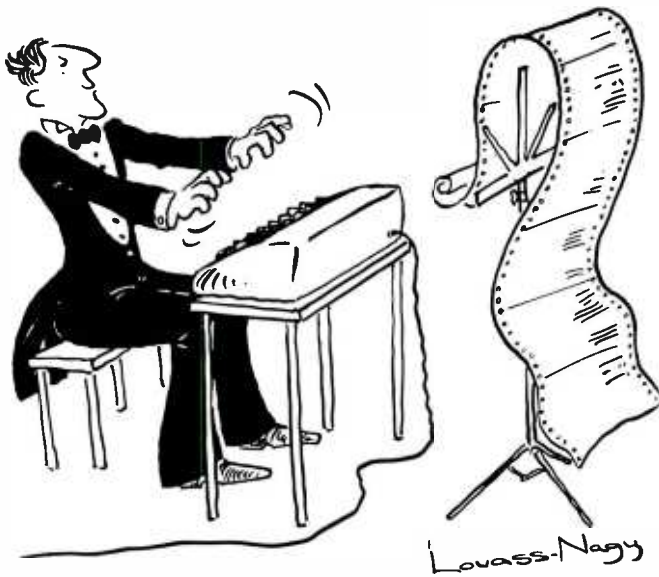
Check one:
 8" Single Density
 5 1/4" Osborne
 IBM P.C.
 Cartridge Tape
 Apple (Softcard)
 Kaypro DSDD
 other formats available, please call!

shipping/handling (\$6.50 per unit, \$20.00 per unit for Int'l. airmail) \$ _____
Total Order \$ _____
CP M is a registered trademark of Digital Research, Inc.

#211

2500AD SOFTWARE INC.

17200 E. Ohio Drive, Aurora, CO 80017, 303-752-4382 TELEX 752659/AD



Before Johann Sebastian Bach developed a new method of tuning, you had to change instruments practically every time you wanted to change keys. Very difficult.

Before Avocet introduced its family of cross-assemblers, developing micro-processor software was much the same. You needed a separate development system for practically every type of processor. Very difficult and very expensive.

But with Avocet's cross-assemblers, a single computer can develop software for virtually any microprocessor! Does that put us in a league with Bach? You decide.

The Well-Tempered Cross-Assembler

Development Tools That Work

Avocet cross-assemblers are fast, reliable and user-proven in over 3 years of actual use. Ask NASA, IBM, XEROX or the hundreds of other organizations that use them. Every time you see a new microprocessor-based product, there's a good chance it was developed with Avocet cross-assemblers.

Avocet cross-assemblers are easy to use. They run on any computer with CP/M* and process assembly language for the most popular microprocessor families.

5¼" disk formats available at no extra cost include Osborne, Xerox, H-P, IBM PC, Kaypro, North Star, Zenith, Televideo, Otrona, DEC.

Turn Your Computer Into A Complete Development System

Of course, there's more. Avocet has the tools you need from start to finish to enter, assemble and test your software and finally cast it in EPROM:

Text Editor VEDIT -- full-screen text editor by CompuView. Makes source code entry a snap. Full-screen text editing, plus TECO-like macro facility for repetitive tasks. Pre-configured for over 40 terminals and personal computers as well as in user-configurable form.

CP/M-80 version \$150
 CP/M-86 or MDOS version \$195
 (when ordered with any Avocet product)

EPROM Programmer -- Model 7128 EPROM Programmer by GTek programs most EPROMS without the need for personality modules. Self-contained power supply ... accepts ASCII commands and data from any computer through RS 232 serial interface. Cross-assembler hex object files can be down-loaded directly. Commands include verify and read, as well as partial programming.

PROM types supported: 2508, 2758, 2516, 2716, 2532, 2732, 2732A, 27C32, MCM8766, 2564, 2764, 27C64, 27128, 8748, 8741, 8749, 8742, 8751, 8755, plus Seeq and Xicor EEPROMS.

Avocet Cross-assembler	Target Microprocessor	CP/M-80 Version	CP/M-86 IBM PC, MSDOS** Versions
XASMZ80	Z-80	\$200.00 each	\$250.00 each
XASM85	8085		
XASM05	6805		
XASM09	6809		
XASM18	1802		
XASM48	8048/8041		
XASM51	8051		
XASM65	6502		
XASM68	6800/01		
XASMZ8	Z8		
XASMF8	F8/3870		\$300.00 each
XASM400	COP400		
XASM75	NEC 7500	\$500.00	
NEW! XMAC68K	68000		\$595.00

(Upgrade kits will be available for new PROM types as they are introduced.)

Programmer \$429
 Options include:
 Software Driver Package -- enhanced features, no installation required.
 CP/M-80 Version \$ 75
 IBM PC Version \$ 95
 RS 232 Cable \$ 30
 8748 family socket adaptor ... \$ 98
 8751 family socket adaptor ... \$174
 8755 family socket adaptor ... \$135

G7228 Programmer by GTek -- baud to 2400 ... superfast, adaptive programming algorithms ... programs 2764 in one minute.

Programmer \$549
 Ask us about Gangand PAL programmers.

HEXTRAN Universal HEX File Converter -- Converts to and from Intel, Motorola, MOS Technology, Mostek, RCA, Fairchild, Tektronix, Texas Instruments and Binary formats.

Converter, each version \$250

Call Us

If you're thinking about development systems, call us for some straight talk. If we don't have what you need, we'll help you find out who does. If you like, we'll even talk about Bach.

CALL TOLL FREE 1-800-448-8500
 (In the U.S. except Alaska and Hawaii)

ISA and Mastercard accepted. All popular disc formats now available -- please specify. Prices do not include shipping and handling -- call for exact quotes. OEM INQUIRIES INVITED.

*Trademark of Digital Research **Trademark of Microsoft



AVOCET SYSTEMS INC.
 DEPT. 884-B
 804 SOUTH STATE STREET
 DOVER, DELAWARE 19901
 302-734-0151 TELEX 467210

PASCAL, ADA, AND MODULA-2

BY DAVID COAR

A system programmer's comparison

WHEN FACED WITH a reasonably large software project, many factors can influence the choice of an implementation language. Some are technical and some are not. In comparing Pascal, Ada, and Modula-2, I will deal with the major technical factors by using basic properties that these languages possess as measuring tools. In each case, I will describe the relevant programming issues briefly and then discuss the three languages within that context, pointing out differences, commenting on the relative merits of certain features, and offering opinions concerning possible improvements. Since I'm focusing on the capabilities provided by the language features rather than the specific syntax used to invoke them, this article complements detailed descriptions published elsewhere (see references).

Why did I choose these particular languages? Over the years, Pascal has achieved popularity as an implementation language. Nevertheless, its creator, Niklaus Wirth, apparently never thought of Pascal as a true systems-implementation language. Modula-2, on the other hand, represents a conscious effort on his part to define such a language. Modula-2 has facilities for hardware interfacing and allows many programmers to work together on the same project. Of course, these are the same goals that were established by the Department of

Defense for the new programming language, Ada. Thus, Pascal and Modula-2 are different attempts by the same person to design a programming language, while Ada and Modula-2 have different origins but the same stated goals.

STRONG TYPING

In most modern programming languages you must declare each data element and routine before using it. First, you choose an alphanumeric identifier to serve as its name. Then, specify its type. You know certain primitive types, such as integer, real, Boolean, and character in advance (see table 1). You must declare the others explicitly before using them. You may create new types either by making certain minor modifications to previous types or by combining one or more previous types into composite structures such as arrays and records. In any case, the type of an element completely determines its storage requirements and the uses to which it may be put. This is what is meant by strong typing. Typing plays a major role in all three languages by restricting the

.....
David Coar (POB 23489, Portland, OR 97223) is a member of the technical product staff of Floating Point Systems Inc. He received his bachelor's and master's degrees in mathematics from the University of California at Berkeley. His hobbies include skiing and classical guitar.

way you can allocate and use data elements.

STORAGE ALLOCATION

In order to generate code for your program, the compiler must know the size and location of each data element you declare. The data element's type completely determines its size. Its location normally is offset from the beginning of a multiple-element memory area. The compiler assigns an offset of zero to the first element in the area, the second gets offset more than the first, and so on. The details of this algorithm completely determine the resulting memory area's size. Each memory area location and the way it gets allocated depend on the kind of memory area it is. There are three possibilities: *stack*, *heap*, and *main*.

Stack areas are contained within a large memory area called an execution stack. A special *top-of-stack* pointer keeps track of the execution stack's current end. When you call a function or procedure, you change the *top-of-stack* pointer and the program uses the area between the old and new *top-of-stack* for your newly called routine's data elements. When the call completes, the program restores the *top-of-stack* pointer to its previous value and returns control to the calling procedure or function.

(continued)

Heap-memory areas contain a single data element, usually an array or a record. To use this data element, you must have a pointer to the heap-memory area containing it. A pointer is a special kind of data element that always contains the address of a data element in the heap. Your program must explicitly allocate each heap area that it needs, using special syntax provided for this purpose. The address of each new area is stored in a pointer. Pascal and Modula-2 also have syntax for explicit release of heap areas, but not Ada.

Main memory is allocated once when you load your program. A Pascal program has only one main-memory area, which contains all the data elements declared in the main part of your program and all the executable code. In Modula-2, each *library module* your program uses has a separate main-memory area that contains its data elements and the executable code for all its procedures and functions. Similarly, each *library unit* of an Ada program has its own main-memory area for data elements and executable code.

Ada is the only one of these three languages that gives you explicit control over the size and relative location of data elements. In Pascal and Modula-2, an element's size, as well as location within each enclosing memory area, is controlled completely by the compiler. For most applications this is not a prob-

lem. However, if you must generate or use data that has a predefined, external format, then you must have control over a data element's size and relative location within a record.

Both Ada and Modula-2 let you specify an absolute address for a data element or routine. This facility, which does not exist in Pascal, is essential for implementing interrupt handlers and memory-mapped I/O (input/output). It would be nice if there were a related facility in any of the three languages that would allow you to specify a data element or routine's symbolic address for linking it with an external system.

It's a little surprising that Modula-2 has no mechanism for creating variable-length arrays. Instead, when you declare an array you must specify its type fully, including the range of acceptable index values. Because the upper and lower bounds for such a range must be constant, the number of elements in the array will also be constant. Modula-2 inherited this unfortunate feature from Pascal with only one minor improvement. When you specify the type of an array parameter to a procedure or function in Modula-2, you need not include its size. This allows you to use a parameter to pass different size arrays to a procedure or function. However, Modula-2 doesn't let you create an array whose size is determined at run time, which makes the language unnec-

essarily restrictive. It should at least give you pointers to such arrays.

TYPE CONFLICTS

Each expression in your program belongs to two potentially different data types. One type comes from the way it's used, because that tells you the type of data value it must produce. The second comes from the expression's structure. Given inputs of a specific type, each operator in the expression produces outputs of a specific type. So the expression's data elements and the operators that are used to combine them tell you what type of data value it will produce.

If these two types are different, the compiler must decide how to resolve the conflict. In a strongly typed language, conflicts are generally treated as programming errors. This has one unfortunate consequence: an element's data type is not determined by its intrinsic properties but by your need to combine it with other data elements. In Modula-2, for instance, I learned to avoid cardinal (unsigned integer) data elements quickly because they could not be mixed with integers in expressions.

Pascal provides almost no relief from the regimen of strict typing. There are few implicit type conversions, and functions for explicit type conversion are limited to ORD, CHR, TRUNC, and ROUND. With the function ORD you can convert an enumerated value into an unsigned integer. With the function CHR you can convert an unsigned integer into a character. The functions TRUNC and ROUND convert values of type real into values of type integer. The program has to handle other type conversions by using case statements, explicitly initialized arrays, or untagged variant records. In particular, there is no safe and easy way to recover an enumerated value from an unsigned integer. All too often conversions that are perfectly natural from a conceptual standpoint, and which should be programmatically simple, lead to the use of untagged variant records—probably the least safe construct in the language.

Modula-2 provides a little more relief from strict typing. In certain situations, it provides implicit type conversion when a value is assigned to a different-

(continued)

Table 1: The data types available in each of the three languages are shown in the table. Enumerated types, records, and arrays are not primitive types; the others are. Strictly speaking, characters are a special enumerated type and strings are a particular class of character arrays.

Language	Integer Types	Real Types	Structured Types	Special Types
Pascal	enumerated character integer	real	record array string	pointer Boolean set (bit mask)
Modula-2	enumerated character integer	real	record array	word address Boolean set (bit mask) procedure
Ada	enumerated character integer short long integer	real short real long real	record array string	pointer Boolean exception task

MEMORIES · SHOULD · ALL · —BE · MADE · LIKE · THIS— ·

All memories are good memories when they come from Cumana. Available for the Apple, Dragon, British Broadcasting Corporation and IBM personal computers, Cumana slimline disk drives are designed and manufactured to the highest standards to give outstanding performance and quiet operation.

Supplied with an extended 12 months warranty and fully assembled and tested before packaging, Cumana slimline drives are available in single and dual versions. All power and interface cables are supplied with the drives to enable you to plug in, switch on and go!



IBM PC



The best name in memory

Cumana, Inc., Orangewood Business Center,
1701 East Edinger, Suite E12, Santa Ana,
CA 92705. Call: (714) 953-7622.

Cumana Ltd., Pines Trading Estate,
Broad Street, Guildford, Surrey, England.
Tel: (0483) 503121. Telex: 859380.

Apple is a registered trademark of Apple Computer, Inc.
The British Broadcasting Corporation Microcomputer is
manufactured under licence by Acorn Computers Limited.
Acorn is a registered trademark of Acorn Computers
International PLC.

Dragon is a registered trademark of Dragon Data Ltd.
IBM is a registered trademark of International Business
Machines Corporation.

Listing 1: This listing shows how subtypes and derived types are declared in Ada. In Ada, everything between the "—" symbol and the end of line is ignored by the compiler. Text included in this manner may be used to explain the details of a program.

Subtypes and Derived Types in Ada

```

TYPE day IS (mon, tue, wed, thu, fri, sat, sun); — an enumerated type.
SUBTYPE weekday IS day RANGE mon..fri; — a subtype of the type day.
— Values of type day may be stored into data elements of type weekday
— and conversely.
TYPE midweek IS NEW day RANGE tue..thu; — a new type derived from the
— type day. Values of type midweek may not be stored into data elements
— of type day or weekday. Similarly, values of type day and weekday may
— not be stored into data elements of type midweek.
SUBTYPE nibble IS integer RANGE 0..255; — a subtype of the type integer.
— Values of type nibble may be stored into data elements of type integer
— and conversely.
TYPE byte IS NEW nibble; — a new type derived from the type nibble.
— Values of type byte may not be stored into data elements of type
— nibble or integer. Similarly, values of type nibble and integer may
— not be stored into data elements of type byte.
    
```

ly typed data element. For example, you may store a cardinal value in an integer data element and a positive integer in a cardinal element. However, neither an integer nor a cardinal may be stored in a real element. There is a slightly richer set of functions for making explicit type conversions. In particular, the function VAL allows you to recover enumerated values from unsigned integers. Additionally, certain types have a built-in function that shares the type name and converts input values of that type. The drawback of this feature is that it appears to be system dependent because no computation can be performed in making the conversion. Consequently, use it with care if you intend to move your software from one system to another.

Ada is similar to Modula-2 in its enforcement of strict typing. For certain well-defined types, there is a built-in function that shares the type name and converts input values into the particular values of that type. This means that many type conversions are reasonably easy. Moreover, the collection of type names that can be used for sharing and converting is well defined, and the results are independent of any implementation. All of this is a definite improvement over Modula-2.

Ada's implicit type conversion is based on the notion of a *subtype*. When a type is created by placing restrictions on another one, it is called a subtype (see listing 1). Its values may be mixed with expressions of the original type, and values of either type may be stored

in data elements on the other, as long as the constraints of the subtype are not violated. While subtypes (called sub-ranges) exist in both Pascal and Modula-2, Ada tries to make their meaning more precise.

DERIVED TYPES AND OVERLOADING

Ada further refines strong typing by introducing the notion of a *derived type*: an exact copy of another logically distinct type (see listing 1). Derived types allow you to have look-alike data types whose corresponding data elements cannot be confused with one another. In order to make the derived type an exact copy of the original, Ada gives it logically distinct copies of each original operation. While this feature seems reasonable at first, it has some undesirable side effects. To understand them, however, we must first discuss another distinctive Ada feature, overloading.

Two elements of your program are *overloaded* if both are visible and have the same name. In a strongly typed language, overloaded elements normally cannot be confused with one another as long as they have different types. In spite of this, both Pascal and Modula-2 prohibit overloading. Ada allows it, but only for procedures and functions. An Ada procedure or function call may refer to any one of several routines with the same name. The compiler then chooses the correct one according to the number of its parameters, the type of each parameter, and the type, if any, of its return value.

Overloading is closely associated with another distinctive Ada feature, the ability to redefine basic operators such as addition, subtraction, and multiplication. To do this, you simply declare a function that has the right number of parameters and use the appropriate symbol for its name. If you have defined a collection of operators, you can use them in an expression with values of the correct type exactly as you would use any ordinary operator. One desirable consequence of all this is that it lets you create versions of the basic operators that mix types in a more or less arbitrary way.

Another less desirable consequence of overloading comes from the rules governing types in general and derived types in particular. There is a set of operations for each type in your Ada program. Each set of operations is a procedure or function with at least one type-oriented parameter or return value. The operations belong to the type either because they were inherited by the type or because both the type and the operations set were declared in the visible part of the same package.

Now consider the following situation. Types x_1 and x_2 are declared in package x along with a procedure q whose parameters are of type x_1 and x_2 . In package y , type y_1 is derived from x_1 , and type y_2 is derived from x_2 . As mentioned earlier, a derived type inherits a copy of each operation belonging to the original type. Inside y there are now two procedures named q : one with parameters of type y_1 and x_2 belonging to y_1 , and one with parameters of type x_1 and y_2 belonging to y_2 (see figure 1). Of course, you probably wanted a procedure with parameters of type y_1 and y_2 , but to get it you'd have to explicitly declare it. And that would not be the end of your problems. The literal values for types x_1 and y_1 are indistinguishable, as are those for x_2 and y_2 . So a call on q that substitutes a literal value for one of its parameters will be ambiguous inside y , unless the literal value is appropriately qualified. What makes this ambiguity especially frustrating is that there is really only one procedure q . The copies are merely pseudonyms. Ambiguity regarding a literal value's type is probably unavoidable. Nevertheless, the automatic proliferation of overloaded procedures and functions that

occurs in the Ada language seems unreasonable.

INITIALIZATION

The problem of initialization is related to strong typing and storage allocation. When you declare a data element, you often might want to give it an initial value. Occasionally, you might even want to specify an initial value for all data elements of a given type. This would let you document important properties of such data elements. For stack and heap elements, convenience, documentation, and control centralization are the major advantages provided by initial values. For main-memory data elements, however, the initial value's primary virtue is efficiency, since the loader generates them from a map at run time. If you don't generate them at that time, you wind up with two copies of each initial value in main memory. The list of hardware instructions that must be executed to initialize the data element will contain one copy, while the data element itself will hold the other once the hardware instructions are executed. In addition, there will be hardware instructions to write the value into the correct memory location. For a large table of error messages, this could lead to a significant increase in memory requirements.

Beyond some reasonably simple syntax extensions for declarations, a strongly typed language must have facilities for creating structured constants if you want to implement initial values. Otherwise you can't describe the initial values for compound data structures such as records and arrays. Ada is the only one of the three languages that supports either declarations or structured constants. The decision not to include these features in Pascal and Modula-2 presumably was motivated by a desire to keep the language as simple as possible. Most Pascal implementations have extensions in this area, but they differ substantially and will cause problems if you want software that is easy to move from one system to another.

STRUCTURED CONTROL

The data elements in your program control its behavior. Depending on their contents, you may decide to examine an input value, compute a new value for

one of them, or produce an output value. Statement lists in the body of the program specify these actions in detail. Program execution is basically sequential in nature. At any given instant, only one statement controls your program. Certain kinds of statements let you transfer control to either a different statement list or to another statement within the same list. In the absence of such explicit transfers, however, the program executes the statement list in order, starting with the first one. All three languages provide essentially the same facilities for dealing with this type of deliberate, sequential control. Ada provides two additional control mechanisms, the rendezvous and the exception, but both have serious flaws, and the rendezvous is not an appropriate construct for a low-level systems implementation language.

SEQUENTIAL CONTROL

All languages let you explicitly transfer control from one part of your program to another. The GOTO statement is the most primitive example of such a feature. It lets you jump to a more or less

arbitrary location within the same list of statements. Often, a particular relationship between two or more data elements, such as $x + y = z$, is consciously preserved for a number of consecutive statements. Because you run the risk of destroying such relations whenever you jump into the middle of a list of statements, you should use GOTO statements sparingly. Good programming languages discourage explicit transfers by providing more structured methods for altering the flow of control, e.g., procedures, functions, conditional statements, and looping constructs. Ada and Modula-2 transfer control similarly and both are a substantial improvement over Pascal.

In both Ada and Modula-2, a procedure's or function's return statement lets you cut off its execution and transfer control to the place where it was called. However, when you invoke the return statement to get you out of a function, you must always supply an appropriate return value. Unlike Pascal, neither Ada nor Modula-2 have a special data element that contains the

(continued)

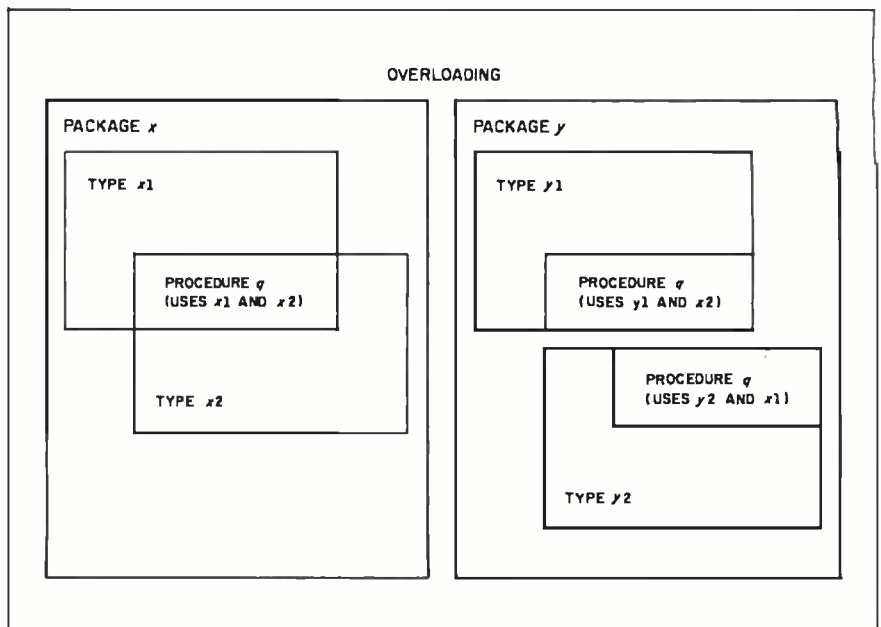


Figure 1: Procedure q in package x has parameters of type x1 and x2. Type y1 in package y is derived from type x1. Type y2 is derived from type x2. As a result, package y contains two procedures named q. One has parameters of type y1 and x2. The other has parameters of type y2 and x1. If you want a procedure that does the same thing for y1 and y2 that the original q does for x1 and x2, you will have to declare it yourself. If you call it q, it will be overloaded with these two other procedures named q that you got for free.

MICROPROCESSOR COMPONENTS

Table with columns: Part No., Pins, Price. Lists various microprocessors like SN7400N, SN7401N, etc.

Table with columns: Part No., Pins, Price. Lists various microprocessors like SN7472N, SN7473N, etc.

Table with columns: Part No., Pins, Price. Lists various microprocessors like SN74155N, SN74156N, etc.

Table with columns: Part No., Pins, Price. Lists various microprocessors like 80C80, 80C85, 80C88, etc.

Table with columns: Part No., Pins, Price. Lists various microprocessors like Z80, Z80A, Z80B, Z8000 SERIES.

Table with columns: Part No., Pins, Price. Lists various microprocessors like 74LS00, 74LS01, 74LS02, etc.

Table with columns: Part No., Pins, Price. Lists various microprocessors like 74LS50, 74LS51, 74LS52, etc.

Table with columns: Part No., Pins, Price. Lists various microprocessors like 74LS123, 74LS124, 74LS125, etc.

Table with columns: Part No., Pins, Price. Lists various microprocessors like 6800, 6801, 6802, etc.

Table with columns: Part No., Pins, Price. Lists various microprocessors like 6800, 6801, 6802, etc.

Table with columns: Part No., Pins, Price. Lists various microprocessors like 74S00, 74S01, 74S02, etc.

Table with columns: Part No., Pins, Price. Lists various microprocessors like 74S10, 74S11, 74S12, etc.

Table with columns: Part No., Pins, Price. Lists various microprocessors like 74S15, 74S16, 74S17, etc.

Table with columns: Part No., Pins, Price. Lists various microprocessors like 74S20, 74S21, 74S22, etc.

Table with columns: Part No., Pins, Price. Lists various microprocessors like 74S20, 74S21, 74S22, etc.

Table with columns: Part No., Pins, Price. Lists various microprocessors like CA-Linear, CA301, CA302, etc.

Table with columns: Part No., Pins, Price. Lists various microprocessors like CD-CMOS, CD4001, CD4002, etc.

Table with columns: Part No., Pins, Price. Lists various microprocessors like CA-Linear, CA301, CA302, etc.

Table with columns: Part No., Pins, Price. Lists various microprocessors like CA-Linear, CA301, CA302, etc.

Table with columns: Part No., Pins, Price. Lists various microprocessors like CA-Linear, CA301, CA302, etc.

DT1050 Applications: Teaching aids, appliances, clocks, automotive, telecommunications, language translations, etc.

DT1057 - Expands the DT1050 vocabulary from 137 to over 260 words. Includes 2 ROMs and specs. \$24.95 ea.

DT1050 Digitalker™ Processor Chip \$14.95 ea. DT1057 Processor Chip \$24.95 ea.

30009 1983 INTERSIL Data Book (136pp) \$9.95

Table with columns: Part No., Pins, Price. Lists various microprocessors like 74HC00, 74HC01, 74HC02, etc.

74C-G/MOS

Table with columns: Part No., Pins, Price. Lists various microprocessors like 74C00, 74C01, 74C02, etc.

LINEAR

Table with columns: Part No., Pins, Price. Lists various microprocessors like LM741, LM742, LM743, etc.

WIRE WRAP SOCKETS (GOLD) LEVEL #3

Table with columns: Part No., Pins, Price. Lists various microprocessors like LP, SG, ST, WW.

SOLDIERT STANDARD (TIN)

Table with columns: Part No., Pins, Price. Lists various microprocessors like LP, SG, ST, WW.

MasterCard amecore VISA ELECTRONICS 1355 SHOREWAY ROAD, BELMONT, CA 94002

Commodore

RS232 ADAPTER FOR VIC-20 AND COMMODORE 64

New!



New!

The JE232CM allows connection of standard serial RS232 printers, modems, etc. to your VIC-20 and C-64. A 4-pin switch allows the inversion of the 4 control lines. Complete installation and operation instructions included.

• Plugs into User Port • Provides Standard RS232 signal levels • Uses 6 signals (Transmit, Receive, Clear to Send, Request to Send, Data Terminal Ready, Data Set Ready).
JE232CM \$39.95

VOICE SYNTHESIZER FOR APPLE AND COMMODORE

Great Educating Tool!



JE520AP

• Over 250 word vocabulary-affixes allow the formation of more than 500 words • Built-in amplifier, speaker, volume control, and audio jack • Recreates a clear, natural male voice • Plug-in user ready with documentation and sample software • Case size: 7 1/4" L x 3 1/2" W x 1-3/8" H

APPLICATIONS: • Security Warning • Telecommunication
 • Teaching • Handicap Aid
 • Instrumentation • Games

The JE520 VOICE SYNTHESIZER will plug right into your computer and allow you to enhance almost any application. Utilizing National Semiconductor's DIGITALKER™ Speech Processor IC (with four custom memory chips), the JE520 compresses natural speech into digital memory, including the original inflections and emphases. The result is an extremely clear, natural vocalization.

Part No. Description Price
JE520CM For Commodore 64 & VIC-20 \$114.95
JE520AP For Apple II, II+, and IIe \$149.95



New! Software & Documentation for CP/M Computers

JE664 EPROM PROGRAMMER 8K to 64K EPROMS — 24 & 28 Pin Packages

Completely Self-Contained — Requires No Additional Systems for Operation
 • Programs and validates EPROMs • Checks for properly erased EPROMs • Emulates PROMs or EPROMs • RS232C Computer Interface for loading and program loading • Loads data into RAM by keyboard • Changes data in RAM by keyboard • Loads data from an EPROM • Compares EPROMs for content differences • Copies EPROMs • Power Input: 1.5V AC, 60Hz, less than 10W power consumption • Enclosure: Color-coordinated, light tan panels with matted end pieces in mocha brown • Size: 15 1/2" L x 8 1/4" D x 3 1/2" H • Weight: 5 1/2 lbs.

The JE664 EPROM Programmer emulates and programs various 8-Bit Word EPROMs from 8K to 64K. Memory capacity data can be entered into the JE664's address 0K & B-PROM in three ways: (1) from an EPROM; (2) through a terminal computer to the optional JE664RS232C BUS; (3) on a keyboard. The JE664's RAMs may be organized by emulating the purpose from the panel's test socket to an external microprocessor. In programming and emulation, the JE664 allows for examination, change and validation of program content. The JE664's RAMs can be programmed (or may be "I/O" for any value, allow unused addresses in the EPROM to be programmed later without necessity of "I/O" writing). The JE664 displays DATA and ADDRESS in convenient hexadecimal (alphanumeric) format. A "DISPLAY EPROM DATA" button changes the DATA readout from RAM word to EPROM word and is displayed in both hexadecimal and binary code. The front panel features a convenient operating guide. The JE664 Programmer includes one JUMPER/JUMPER MODULE as listed below.

JE664-A EPROM Programmer \$995.00
 Assembled & Tested (includes JUM16A Module)

JE665 — RS232C INTERFACE OPTION — The RS232C Interface Option allows computer access to the JE664's RAM. This allows the computer to manufacture, store and transfer EPROM data from the JE664. A sample program is included to support the JE664 for CP/M computers. Documentation is provided to adapt the software to other computers with RS232 ports, 500 baud, 8-bit word, odd parity and 2 stop bits.

FOR A LIMITED TIME A SAMPLE OF SOFTWARE WRITTEN IN BASIC FOR THE TRS-80™ MODEL I LEVEL II COMPUTER WILL ALSO BE PROVIDED

JE664-ARS EPROM Prog w/JE665 Option \$1195.00
 Assembled & Tested (includes JUM16A Module)

EPROM JUMPER MODULES — The JE664's JUMPER MODULE (personally Model) is a plug-in Module that pre-sets the JE664 for the proper programming pulses to the EPROM and configures the EPROM socket connectors for that particular EPROM.

JE664 JUMPER	EPROM	Programming Voltage	EPROM MANUFACTURER	PRICE
JUM1A	2708	25V	AMD, Motorola, Int. Intel, TI	\$15.95
JUM1B	2716, 2732, 2764	25V	Intel, Motorola, Int. NEC, TI, AMD, Hitachi, Mitsu.	\$15.95
JUM1C	2721, 2722, 2723, 2724	25V	Hitachi, NEC, National, Mitsu.	\$14.95
JUM1D	2732	25V	AMD, Int. NEC, National, Mitsu.	\$14.95
JUM1E	2732	25V	Hitachi, Int.	\$14.95
JUM1F	2732	25V	Hitachi	\$14.95
JUM1G	2764	25V	Int. Fairchild, Int.	\$14.95
JUM1H	2764	25V	Int.	\$14.95

ProModem 1200

PROMETHEUS



Intelligent 300/1200 Baud Telephone Modem with Real Time Clock/Calendar

The ProModem™ is a Bell 212A (300/1200 baud) intelligent stand-alone modem. Full featured expandable modem • Standard features include Auto Answer and Auto Dial, Help Commands, Programmable Intelligent Dialing, Touch Tone™ and Pulse Dialing & More • Hayes command set compatible plus an additional extended command set • Additional options & models available

PM1200 \$375.00

KEYBOARDS



13 1/2" L x 4 1/2" W x 3/4" H

Mitsumi 54-Key Unencoded Matrix All-Purpose Keyboard

• SPST keyswitches • 20 pin ribbon cable connection • Low profile keys • Features: cursor controls, control, caps lock, function, enter and shift keys • Color (keycaps): grey • Wt.: 1 lb. • Pinout included
KB54 \$14.95

New!



16-9/16" L x 6 1/2" W x 1 1/2" H

76-Key Serial ASCII Keyboard

• Simple serial interface • SPST mechanical switching • Operates in upper and lower case • Five user function keys: F1-F5 • Six finger edge card connection • Color (keys): tan • Weight: 2 lbs. • Data incl.
KB76 \$29.95

Nationally Known Manufacturer!

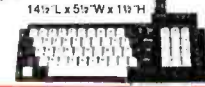


21 1/2" L x 9 8/16" W x 3 1/2" H

106-KEY 8-BIT SERIAL ASCII KEYBOARD

• The terminals were designed to be daisy chained around a central host computer and used as individual work stations • Half elect switching • numeric and cursor keypad • 10 user definable keys • 50' interface cable with 9-pin sub-miniature connector • 7 LED function displays • Security lock • N-key rollover • Automatic key repeat function • Color (case): white w/black panel—(key caps): grey and blue • Weight: 6 1/2 lbs. • Data included.
KB139 \$59.95

New!



14 1/2" L x 5 1/2" W x 1 1/2" H

68-Key Keyboard with Numeric Keypads for Apple II and II+

• Plugs directly into Apple II or II+ motherboard with 16-pin ribbon cable connector • 26 special functions • Color (keys): white/grey • Weight: 2 lbs.
KB-A68 \$99.95

POWER SUPPLIES



TRANSACTION TECHNOLOGY, INC. 5VDC @ 1 AMP Regulated Power Supply

• Output: +5VDC @ 1.0 amp (also +3.0VDC regulated) • Input: 115VAC, 60 Hz • Two-tone (black/beige) self-enclosed case • 6-foot, 3-conductor black power cord • Size: 8 1/2" L x 7 1/2" W x 2 1/2" H • Weight: 3 lbs.
PS51194 \$14.95



Power/Mate Corp. REGULATED POWER SUPPLY

• Input: 105-125/210-250 VAC @ 47-63 Hz • Line regulation: 0.05% • Three mounting surfaces • Overvoltage protection • UL recognized • CSA certified
 Part No. Output Size Weight Price
EMA5/6B 5V@3A/6V@2.5A 4 1/2" L x 4 1/2" W x 2 1/2" H 2 lbs. \$29.95
EMA5/6C 5V@6A/6V@5A 5 1/2" L x 4 1/2" W x 2 1/2" H 4 lbs. \$39.95



POWER SUPPLY +5VDC @ 7.6 AMP/12VDC @ 1.5 AMP SWITCHING

• Input: 115VAC, 50-60Hz @ 3 amp/230VAC, 50Hz @ 1.5 amp • Fan w/low power, supply select switches 115/230VAC • Output: 5VDC @ 7.6 amp, 12VDC @ 1.5 amp • 8-foot black power cord • Size: 11 1/2" L x 13 1/2" W x 3 1/2" H • Weight: 6 lbs.
PS94VOS \$39.95



KEPCO/TDK 4-OUTPUT SWITCHING POWER SUPPLY

• Ideal for disk drive needs of CRT terminals, microcomputers and video games • Input: 115/230VAC, 50/60Hz • Output: +5V @ 5 Amp, +12V @ 1.0 Amp, +12V @ 2 Amp, -12V @ 0.5 Amp • UL recognized • CSA certified • Size: 7 1/2" L x 6 3/16" W x 1 1/2" H • Weight: 2 lbs.
MRM 174FK \$59.95



POWER PAC INC. REGULATED POWER SUPPLY

• Perfect for computer systems • Output: +5VDC @ 1 Amps, -5VDC @ 1 Amp, +12VDC @ 2 Amps, -12VDC @ 0.5 Amp and +24VDC @ 3 Amps • Overvoltage protection • Size: 12 1/2" L x 6 1/2" W x 4 1/2" H • Weight: 17 lbs. • Spec incl.
PS2922 \$69.95



4-CHANNEL SWITCHING POWER SUPPLY

• Microprocessor, mini-computer, terminal, medical equipment and process control applications • Input: 90-130VAC, 47-60Hz • Output: +5VDC @ 5A, -5VDC @ 1A, +12VDC @ 1A, -12VDC @ 1A • Line regulation: ±0.2% • Ripple: 30mV p-p • Load regulation: ±1% • Overcurrent protection • Add: 5V main output • 100% • Size: 6 1/2" L x 1 1/2" W x 4 1/2" H • Weight: 1 1/2 lbs.
FCS-604A \$69.95 each

Switching Power Supply for APPLE II, II+ & IIe™

• Can drive four floppy disk drives and up to eight expansion cards • Short circuit and overload protection • Fits inside Apple computer • Fully regulated +5V @ 5A, +12V @ 1.5A, -5V @ 5A, -12V @ 5A • Direct plug-in power cord included • Size: 9 1/2" L x 3 1/2" W x 2 1/4" H • Weight: 2 lbs.
KHP4007 \$79.95



\$10.00 Minimum Order — U.S. Funds Only
 California Residents Add 6 1/2% Sales Tax
 Shipping — Add 5% plus \$1.50 Insurance
 Send S.A.S.E. for Monthly Sales Flyers!
 Spec Sheets — 30c each
 Send \$1.00 Postage for your
 FREE 1984 JAMECO CATALOG
 Prices Subject to Change



1355 SHOREWAY ROAD, BELMONT, CA 94002
 8/84 PHONE ORDERS WELCOME — (415) 592-8097 Telex: 176043

Fiberoptics

NEW! The EDU-LINK Learning Kit



The EDU-LINK fiber optic system is a low-cost, TTL compatible data transmission system designed specifically as an educational tool for students and engineers working in many different industries. Includes: transmitter PCB, a receiver PCB, one meter of plastic optical fiber, and all the necessary electrical hardware • Complete step-by-step instructions, theory of operation, and tutorial information are included.

ELK-1 ONLY \$19.95

APPLE ACCESSORIES

5 1/4" APPLE™ Direct Plug-In Compatible Disk Drive and Controller Card



The ADD-514 Disk Drive uses Shugart SA390 mechanicals—143K formatted storage • 35 tracks • Compatible with Apple Controller & ACC-1 Controller. The drive comes complete with connector and cable — just plug into your disk controller card • Size: 6 1/2" L x 3 1/2" W x 8-9/16" D • Weight: 4 1/2 lbs.

ADD-514 (Disk Drive) \$195.95
ACC-1 (Controller Card) \$ 69.95

Also Available...
JE864 (80 Col. + 64K RAM for IIe) \$124.95
JE614 (Numeric/Aux. Keypad for IIe) \$89.95

INDUSTRIES Protect Yourself... DATASHIELD® Surge Protector

• Eliminates voltage spikes and EMI-RFI noise before it can damage your equipment or cause data loss • 6 month warranty • Power dissipation: 1100 mW (max. dissipation); 1000,000 watts • 8 sockets • 6 foot IPOWER cord • Normal line voltage indicator light • Brown out/black out reset switch • Weight: 2 lbs.
Model 100 \$69.95

Protect Yourself... DATASHIELD® Back-Up Power Source

Provides up to 30 minutes of continuous 120 VAC 60Hz power to your computer system (load dependent) when you have a black out or voltage sag • Output rating: 200 watts • Six month warranty • Weight: 24 lbs.
Model 200 (PC200) \$349.95

For more demanding systems (e.g. with hard disks)
 • Output rating: 300 watts
XT300 \$489.95

IBM MEMORY EXPANSION KIT COMPAQ COMPATIBILITY

SAVE HUNDREDS OF \$\$\$ BY UPGRADING MEMORY BOARDS YOURSELF!

Most of the popular memory boards allow you to add an additional 64K, 128K, 192K, or 256K. The IBM64K Kit will populate these boards in 64K byte increments. The kit is simple to install — just insert the nine 64K RAM chips in the provided sockets and set the two groups of switches. Directions are included.

IBM64K (Nine 200ns 64K RAMs) \$49.95

TRS-80 MEMORY EXPANSION KIT

TRS-80 to 16K, 32K, or 48K
****Model 1 = From 4K to 16K Requires (1) One Kit**
Model 3 = From 4K to 48K Requires (3) Three Kits
 Color = From 4K to 16K Requires (1) One Kit
 *Model 1 equipped with Expansion Board up to 48K Two Kits Required — One Kit Required for each 16K of Expansion
TRS-16K3 *200ns for Color & Model III \$12.95
TRS-16K4 *250ns for Model I \$10.95

TRS-80 Color 32K or 64K Conversion Kit

Easy to install kits complete with 8 ea. 4164-2 (200ns) 64K dynamic RAMs and conversion documentation. Converts TRS-80 color computers with D, E, F, G and NC circuit boards to 32K. Also converts TRS-80 color computer II to 64K. Flex D05 or OS-9 required to utilize full 64K RAM on all computers.
TRS-64K2 \$44.95

UV-EPROM Eraser

8 Chips — 51 Minutes
 1 Chip — 37 Minutes

Erases 2708, 2716, 2732, 2764, 2516, 2532, 2564. Erases up to 8 chips within 51 minutes (1 chip in 37 minutes). Maintains constant exposure distance of one inch. Special conductive foam liner eliminates static build-up. Built-in safety lock to prevent UV exposure. Compact — only 9.00" x 3.70" x 2.60". Complete with holding tray for 8 chips.

DE-4 UV-EPROM Eraser . . . \$79.95
UVS-11EL Replacement Bulb . . \$16.95

Why are over

58%

of our customers
since 1978 repeaters?
It's very simple...
they call and
save money!

1-800-841-0860

For example:

SANYO MBC SERIES
We have the **LOWEST** prices.
Call us before you buy.

**STAR MICRONICS
GEMINI 10X**
\$245

COMPUTERS

PRINTERS

EQUIPMENT

 **SANYO**

EPSON

OKIDATA

 **Hayes**

Radio Shack
The biggest name in electronics.

 **STAR MICRONICS**

C. Itoh

 **Novation**

 **COLUMBIA**
DATA PRODUCTS, INC.

 **daisywriter**

 **JUKI**

 **AMDEK**

 **Franklin**
Computer

**MANNESMANN
TALLY**

Diablo

 **TAXAN**

Transtar

TOSHIBA
TOSHIBA AMERICA, INC.

 **PGS**
PER CARD
COLOR SYSTEMS

VISA and MasterCard accepted; also Wire Transfer of funds
directly from your bank to ours.

micro management systems, inc.

Name
brands at
wholesale
prices

2803 Thomasville Road East
Cairo, Georgia 31728
For info, call 912-377-7120

Ask for
a free copy
of our
latest catalog

THREE LANGUAGES

result of the function. Consequently, the function cannot return an uninitialized data value. If you reach the end of a function before executing a return statement, the program generates a run-time error. This makes it much easier to guarantee that the generated value is appropriate.

In both Ada and Modula-2, an exit statement within a program loop allows you to cut off its execution and transfer control to the next statement beyond it. In Ada you can label a loop, and you can exit from any one of several nested loops by supplying the correct label. In Modula-2, however, you cannot label loops, and there is no easy way to curtail an outer loop. The exit statement always terminates the innermost loop, as it does in Ada when the program doesn't supply a label.

Of the three languages, only Modula-2 has no GOTO statement. The availability of exit and return statements makes them unnecessary. However, Ada has retained them. The Modula-2 exit statement, on the other hand, is too restrictive, and the Ada construct seems more appropriate. In fact, it might be better if an exit statement always required a label. This would prevent problems from arising when one loop is inserted within another after it's written.

A final difference between the three languages has to do with the handling of statement lists. When you write a loop in Ada or Modula-2, the body of the loop is assumed to contain a list of statements. The same is true for each branch of a conditional or case statement. In Pascal, on the other hand, most of these constructs require a single statement, which can, if necessary, be a list of statements enclosed within a begin-end pair. The absence of explicit begin-end bracketing in Ada and Modula-2 creates the need for a way to terminate the corresponding statement list. Ada has introduced three new tokens, end if, end case, and end loop, while Modula-2 has simply reused the reserved word end for all three. The Ada solution is often helpful in pinpointing the cause of syntax errors.

EXCEPTION HANDLING

Exceptions are conditions you wish to exclude from normal processing considerations. They are normally the result

(continued)

MAKE THE CONNECTION...IN THE SLOT

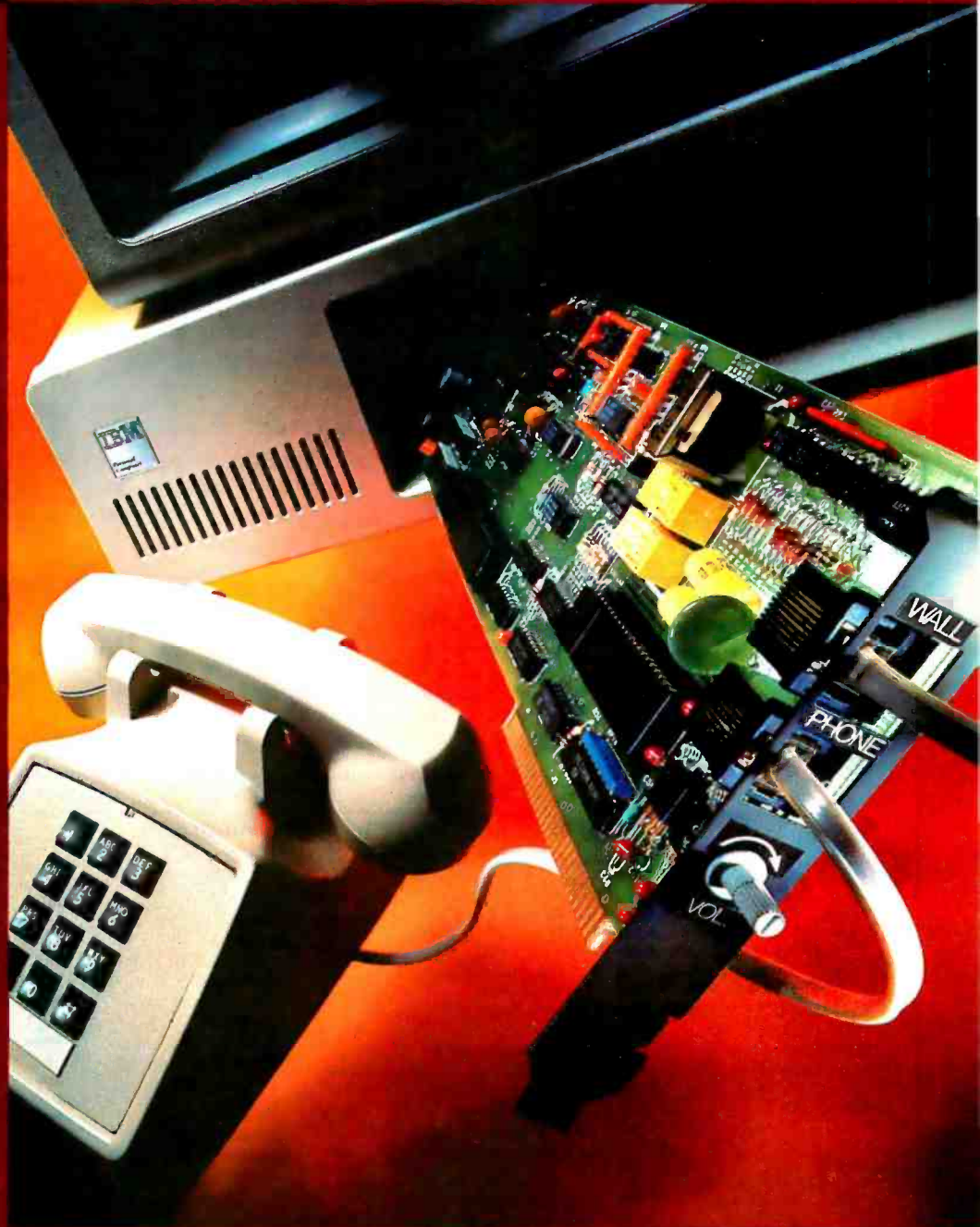
Now you can plug the ease of use and leadership features of a POPCOM™ personal communications modem directly into one of the expansion slots of your IBM® PC, XT, Portable, or IBM slot compatible computer.

With the new POPCOM modem from Prentice Corporation...

- Your personal computer becomes essentially a voice and data workstation, and the need for costly extra telephone lines is eliminated.
- Activity on the phone line is detected (most modems don't do this) and the costly extra load placed on your company's internal phone system is reduced.
- You communicate at the fast, economical 1200 bps rate as well as the standard 300 bps rate.
- Telephone numbers you have selected are automatically dialed and redialed if busy, and incoming calls are automatically answered.
- You have compatibility with the popular communications software packages of today, and advanced features that will let you take advantage of the next generation of communications software as well.
- Only one slot in your PC, XT, or Portable is required.

With a suggested retail price of \$445, the C100 means real price/performance. All of these leadership performance features are also available in the external POPCOM X100 modem so now you have a choice...inside or outside.

See your local dealer for more information, or contact
PRENTICE Corporation
266 Caspian Drive
P.O. Box 3544
Sunnyvale, CA 94088-3544
(408) 734-9855



PRENTICE
Corporation

POPCOM™
C100
MODEMS

POPCOM™ is a trademark of PRENTICE Corporation
IBM is a registered trademark of International Business Machines Corporation
© 1984 Prentice Corporation

of an unlikely set of circumstances that may or may not represent an error. Many times a particular exception can arise at almost any point during the execution of your program, and you would like to be able to deal with it without continually testing for it. A hardware interrupt, especially one caused by an arithmetic error such as dividing by zero, is a perfect example of this type of exception. Since the hardware must check for it, additional software tests may be wasteful. A mechanism for handling exceptions should probably be rated by its ability to deal with this kind of hardware interrupt.

Of the three languages, only Ada has attempted to solve the problem of exception handling. At the end of each function or procedure, and at certain other points in your program, you can define an exception handler. It is essentially a case statement containing one branch for each exception you are willing to handle. Exceptions must be

declared and you may activate one at any point in your program by executing a raise statement that references it. When an exception is raised during the execution of a procedure or function, by the routine itself, by another routine that it called, or by the hardware, the appropriate branch of its exception handler is invoked.

Once a routine has dealt with an exception, it must return control to the list of statements that called it. You can prevent the exception from propagating, but you can't fix things up and return to the place where the exception occurred. For this reason, Ada exceptions have only marginal value. They will be adequate for many situations, but they aren't useful enough to justify an expensive implementation.

TASK MANAGEMENT

As mentioned earlier, most program execution is sequential. If you wish to simultaneously execute more than one

statement sequence you need to create a separate task or process. You also need to control it once you create it. At any given moment, there is a potentially different statement in control of each task in your program. If your program contains more than one active task, a collection of statements (rather than just one) determine its behavior. A task may or may not be active, and an active task may or may not be executing on a processor. Active tasks must share the available processors. If there are several processors, then several tasks may be executing at once. Otherwise there will be only one.

Pascal has no task-management facilities. Modula-2 allows you to create them by calling the procedure NEW-PROCESS and to control them by calling the procedure TRANSFER, which suspends the execution of one task and resumes the execution of another at the point where you last left it. Both of

(continued)

FREE SHIPPING
Order line: 800-354-7330

SYSTEM #1		SANYO SUPER SYSTEMS		SYSTEM #2	
SANYO MBC-550-2		\$1399		SANYO MBC-555-2	
• SANYO GREEN MONITOR				• SANYO GREEN MONITOR	
• GEMINI 10X • SOFTWARE				• GEMINI 10X • SOFTWARE	
Sanyo MBC-550-2 Single 360K Drive Computer, Sanyo Cr1-36 Monitor, Star Gemini 10X, Cabling, Wardstar, Colstar, MS-DOS, Sanyo Basic.					
Sanyo MBC-550 System w/160K Drives		\$1199		Sanyo MBC-555 System w/160K Drives	
				\$1799	
Sanyo MBC-555-2 Dual 360K Drive Computer, Sanyo Cr1-36 Monitor, Star Gemini 10X, Cabling, Wardstar, Colstar, Infostar, Spellstar, Mailmerge, MS-DOS, Sanyo Basic.					

PRINTERS		TERMINALS		DISKETTES	
C-ITOH	NEC	ADDS		MAXELL	
A10-20 \$465	2010, 2015, 2030	A-2 \$480		MD-1 \$180	
B510 SP \$445	2050 \$795	A-3 \$480		MD-2 \$280	
B510 SCP \$515	3510, 3515, 3530 \$1225	Viewpoint 60 \$495		SCOTCH	
B510 BPI \$395	3550 \$1539	Viewpoint 90 \$865		5 1/4 55/DD (Qty 100) \$205	
B510 Prowriter \$325	7710, 7715, 7730 \$1649	ALTOS		5 1/4 DS/DD (Qty 100) \$250	
F-10 Parallel or Serial \$920		Smart II \$855		ELEPHANT	
55CPS Parallel or Serial \$1205	OKIDATA			5 1/4 55/SD (Qty 100) \$160	
COMPUTER INTERNATIONAL	All Printer Models Save	HAZELTINE		5 1/4 DS/DD (Qty 100) \$220	
Daisywriter 2000 \$990	PANASONIC	All Terminal Models Save		COMPUTERS	
COMREX	All Printer Models Save	QUME		ALTOS All Computer Models Save	
CR-II Parallel or Serial \$445	SILVER REED	QVT102, 103, 108 Save		EAGLE	
CR-II Keyboard \$155	All Printer Models Save	TELEVIDEO		All Computer Models Save	
DATASOUTH	STAR MICRONICS	All Terminal Models Save		NEC	
DS-180 \$1165	All Printer Models Save	WYSE		8201 Computer Save	
DS-220 \$1475	TALLY	All Terminal Models Save		SANYO	
DIABLO	M.T. 160L w/Tractors Save	MONITORS		See Special Above Save	
620 \$745	M.T. 180L w/Tractors Save	AMDEK		ZENITH	
630 API \$1709	Spirit 80 Save	300 Green \$150		All Model Z-150 & Z-160 Save	
630 ECS Save	TOSHIBA	300 Amber \$275		Prices reflect 3% to 5% cash discount.	
630 ECS/IBM \$1995	P1340 Parallel or Serial \$730	Color 1+ Save		Product shipped in factory cartons with manufacturer's warranty.	
Series 36 Save	P1351 Parallel or Serial \$1265	ZENITH		Free shipping is on UPS ground only. Prices & availability subject to change without notice. Send cashier's check or money order...all other checks will delay shipping two weeks.	
EPSON	TRANSTAR	All Monitor Models Save			
All Printer Models Save	120 Parallel or Serial \$400	MODEMS			
INFORUNNER	130 Parallel or Serial \$555	HAYES			
Rilemon \$255	T315 \$395	Smartmodem 300 Baud \$205			
IDS	DISK DRIVES	Smartmodem 1200 Baud \$490			
Prism 132 Color \$1500	RANA	Smartmodem 1200B \$435			
JUKI	Elite I \$220	US ROBOTICS			
6100 \$435	Elite II \$350	Password 1200 Baud \$315			
	Elite III \$415	212A Autodial \$430			

SILICON SPECIALTIES
2034 WEST SOUTHERN
MESA, ARIZONA 85202
602-969-0909

Two more great reasons to buy the Canon[®] AS-100 Microcomputer.

1. Incredibly low price.
2. Free software.



Now there's even more incentive to buy Canon's AS-100 Microcomputer.

Because not only will you get one of the most advanced, small business microcomputers you can buy, but with a price that's now dramatically reduced, you'll also get value that's just as far ahead of its time. Plus free business management programs.

That's an unprecedented saving on this elegantly compact, yet powerful microcomputer.

It has a high-speed, 16-bit microprocessor with standard 128K-bytes RAM expandable to 512K bytes.

A high-resolution, color display system for easy-to-read figures, charts and graphs (monochrome green display if you prefer).

The convenience and versatility of a lightweight keyboard that's adjustable for maximum comfort. Plus external storage capacity that includes 5¼-inch mini or 8-inch floppy disks, with hard disk drive

also available.

And if all this isn't reason enough, the AS-100 now comes fully equipped with a choice of popular business software packages. Software such as WordStar* for word processing, CalcStar* and SuperCalc 2*** for spreadsheet analysis and dBase II**, InfoStar* and Friday!** for data base management. There's also a choice of Canon's exclusive software—Canowriter† and Canobrain II†.

Terrific savings and a choice of software packages.

Two more great reasons to buy the only microcomputer that comes with the assurance, reliability and technological quality of Canon.

The Canon AS-100.

For more information:
Call 1-800-323-1717, Ext. 302.
(In Illinois call 1-800-942-8881, Ext. 302.)
Or Write Canon U.S.A., Inc.,
Systems Division, P.O. Box CN 11250
Trenton, N.J. 08638.

*InfoStar, CalcStar and WordStar are trademarks of MicroPro. **Friday! is a trademark and dBase II is a registered trademark of Ashton-Tate. ***SuperCalc 2 is a trademark of Sorcim. †Canowriter and Canobrain II are trademarks of Canon, Inc.

Available through Canon authorized dealers.
Offer good through October 31, 1984.

© 1984 Canon U.S.A., Inc.

Canon Systems Division

these routines, as well as the type PROCESS, are contained in the special module called SYSTEM, and little is said about their implementation. Ada, on the other hand, has defined an elaborate set of tasking facilities.

An Ada task is activated along with the part of your program that contains its declaration, and it must be terminated before that part of your program can be deactivated. If it's declared within a procedure or function, a copy of the task will be activated each time the routine is called, and this copy must terminate before the call can complete. If you don't want the task to run to completion, you can terminate it explicitly with an ABORT statement.

To communicate with an Ada task you must declare one or more entries for it. When you declare an entry you specify only its name and parameter structure. An accept statement within the body of your task associates a list of statements with the entry and thus defines its

meaning. If there is an outstanding call on the entry, it will be executed and the caller will be activated. Otherwise the task suspends execution until the entry is called. If an entry is called before the accept statement is executed, the call is queued along with any others that are pending for that entry and the caller is suspended. The pairing of a call and an accept statement is called a rendezvous. Special syntax allows you to accept one of several possible entries and to make conditional calls on an entry.

The Ada tasking model is complex and cumbersome. It has lots of features and not much flexibility. As a result, it will be costly to implement and not very useful. And to top it off, the problems associated with updating shared data elements are dealt with only as an afterthought. The moral of this story is that elaborate tasking models have no place in a systems-implementation language. A few simple mechanisms are needed, not a complicated structure.

MODULARITY

You can partition almost any large software system into reasonably small, self-contained units, or modules—each with a number of related data elements and the procedures and functions needed to manipulate them. If you have carefully defined and suitably restricted the module interfaces, you will be able to code and debug them independently. As a general rule, focusing on individual modules reduces the number of variables you have to contend with at any given moment and makes the system as a whole easier to design, debug, and maintain. Moreover, to the extent that you can overlap work on several parts of the system, less time will be required to implement it.

Pascal discourages modular design by preventing you from breaking up your implementation. In the first place, you must group your declarations as follows: label declarations, followed by type

(continued)

The Library of Computer Supplies and Accessories




Organize while you computerize. It's easy with our 1984 MISCO catalog. We've packed it with over 1000 brand name products, from flexible disks to media storage, to cables. Use our easy, direct-dial, TOLL-FREE ordering system to guarantee fast delivery of quality supplies and accessories at great prices!

FREE CATALOG
1-800-631-2227 ext. 541

Name _____
Company _____
Address _____
City _____ State _____ Zip _____
P.O. Box 399 B20
Holmdel, N.J. 07733
201-946-3500



Call toll-free or mail in the convenient coupon to order your FREE MISCO catalog.



Verbatim®

we're making
them your
best buy.

Verbatim Datalife® Minidisks are super quality, super durable. You get better data transfer, longer data life, less head wear.

Now from ABComputers get our best price ever on factory-fresh, 100% error-free certified Verbatim Minis.

	PRICE PER 5 1/4" MINIDISK*		
	(Sold in Boxes of 10)		
	QTY. 10	QTY. 50	QTY. 100
SS/DD	\$1.95	\$1.90	\$1.85
DS/DD	\$2.60	\$2.55	\$2.50

*Larger quantity prices available. Add \$1.50 per order for continental U.S. UPS surface shipping.

Don't miss out. Mail or phone your order today!

215-822-7727
ABComputers
THE VALUE LEADER SINCE 1976

252 BETHLEHEM PIKE, COLMAR, PA 18915

Now you don't have to sacrifice print quality for speed.

The Canon® Impact Matrix Series Printers.



High speed and high quality in one functional, compact unit. That's what Canon's Impact Matrix Printers offer you.

They print hard copy at a rapid 160 characters per second. While in the double pass mode you get an impressive, high-density 23 X18 dot matrix that gives near letter quality printing suitable for word processing.

Canon's unique technology has also dramatically reduced bothersome clatter down to a muted noise level of less than 60dB.

Even at high speed.

And that, unlike many other impact matrix printers, makes them a pleasure to work with.

Plus there's limitless flexibility with the optional down-loading function that lets you print

whatever character fonts your host computer can create. As well as a choice of four different character styles (all printable on the same line) that you can enlarge or condense.

The Impact Matrix Series Printers give you a convenient choice of special paper widths—the PW-1080A for 80-character column printout and the PW-1156A for 156-character column.

Exceptional quality and high speed.

The Canon® Impact Matrix Series Printers give you the best of both worlds.

For more information:
Call 1-800-323-1717, Ext. 300.
(In Illinois call 1-800-942-8881, Ext. 300.)
Or Write Canon U.S.A., Inc.,
Printer Division, P.O. Box CN 11250,
Trenton, N.J. 08638.

© 1984 Canon U.S.A., Inc.

Canon Printer Division

Circle 48 on inquiry card.

www.americanradiohistory.com

DeSmet C The fastest 8088 C Compiler available

FULL DEVELOPMENT PACKAGE

- C Compiler
- Assembler
- Linker and Librarian
- Full-Screen Editor
- Newsletter for bugs/updates

SYMBOLIC DEBUGGER

- Monitor and change variables by name using C expressions
- Multi-Screen support for debugging PC graphics and interactive systems
- Optionally display C source during execution
- Breakpoint by Function and Line #

COMPLETE IMPLEMENTATION

- Both 1.0 and 2.0 DOS support
- Everything in K&R (incl. STDIO)
- Intel assembler mnemonics
- Both 8087 and Software Floating Point

OUTSTANDING PERFORMANCE

Sieve Benchmark	
COMPILE	4 Sec. RAM — 22 Sec. FDISK
LINK	6 Sec. RAM — 34 Sec. FDISK
RUN	12 Sec.
SIZE	8192 bytes

**DeSmet C
Development Package \$159**

To Order Specify:

Machine _____

OS MS-DOS CP/M-86
Disk 8" 5 1/4 SS 5 1/4 DS

CWARE
CORPORATION

P.O. BOX 710097
San Jose, CA 95171-0097
(408) 736-6905

California residents add sales tax. Shipping: U.S. no charge. Canada add \$5, elsewhere add \$15. Checks must be on a US Bank and in US Dollars

THREE LANGUAGES

declarations, then variable declarations, and finally, procedure and function declarations. This makes it virtually impossible to group functionally related elements. In the second place, there are no mechanisms for splitting your program into smaller pieces for separate encoding. Everything you do is part of a single program, and data files are the only mechanism for communicating between separate programs.

As its name implies, modularity is a strong point of Modula-2. A Modula-2 module contains data elements, procedures, and functions, all of which are declared within its scope. You must explicitly export any elements you need somewhere else, and you must explicitly import any external elements you need inside. A module that is not contained within another is called a library

module. You may declare a library module all at once, in which case it is called a program module. Alternatively, you may declare it in two stages. The first stage is called a definition module. In it you declare only those portions of the module that are visible from the outside. Procedures and functions may be introduced but not fully declared. The second stage is called an implementation module. You use it to complete your declaration of the elements you introduced in the corresponding definition module. Additionally, you declare any other elements that may be required. A definition module and its implementation module need not import the same external elements (see listing 2). This lets library modules serve each other without creating circular de-

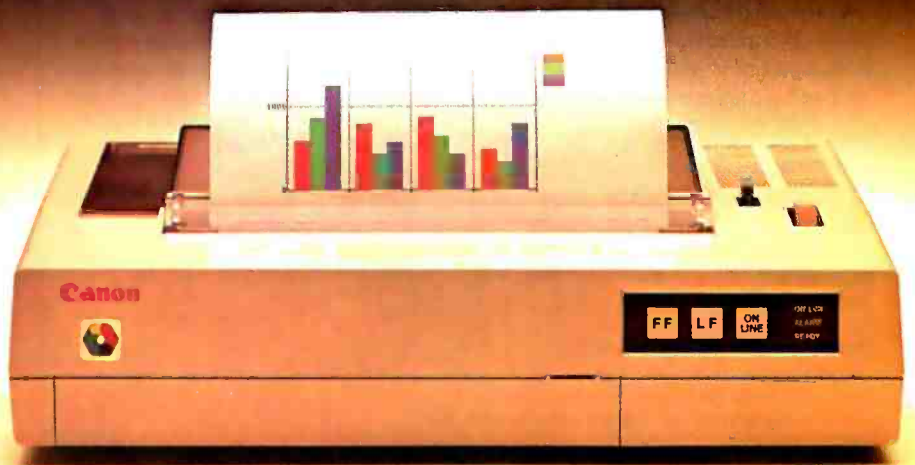
(continued)

Listing 2: This listing shows a pair of library modules that depend on each other. The implementation of module a makes use of procedure q in module b, while the implementation of module b makes use of procedure p in module a. In Pascal and Modula-2 everything between the symbols ``(*' and '*)' is ignored by the compiler.

```
DEFINITION MODULE a;
  EXPORT QUALIFIED p;
  PROCEDURE p(x: INTEGER);
END a.
DEFINITION MODULE b;
  EXPORT QUALIFIED q;
  PROCEDURE q(x,y: INTEGER);
END b.
IMPLEMENTATION MODULE a;
  FROM b IMPORT q;
  PROCEDURE p(x: INTEGER);
  BEGIN
    (* statements defining the behavior of p *)
  END p;
  PROCEDURE r(x: INTEGER);
  BEGIN
    (* statements defining the behavior of r *)
    q(x,4); (* a call on the procedure q from module b *)
    (* more statements defining the rest of r *)
  END r;
BEGIN
  (* statements for initializing a *)
END a.
IMPLEMENTATION MODULE b;
  FROM a IMPORT p;
  PROCEDURE q(x,y: INTEGER);
  BEGIN
    (* statements defining the behavior of p *)
  END q;
  PROCEDURE r(x: INTEGER);
  BEGIN
    (* statements defining the behavior of r *)
    p(2); (* a call on the procedure p from module a *)
    (* more statements defining the rest of r *)
  END r;
BEGIN
  (* statements for initializing a *)
END b.
```


What's more incredible about Canon's color ink-jet printer?

The quality... or the price?



Take a look at the beautiful clarity of the Canon®PJ-1080A's color ink-jet printing. Then discover that Canon's color printer actually costs well under a thousand dollars. You'll be hard-pressed to decide which is more amazing.

What makes the quality so incredible? Features like:

- The advanced drop-on-demand printing system. Canon's patented ink-jet technology gives a sharp 640 dot-per-line scan mode, for dazzling high-resolution color and exceptionally clean, crisp printouts.
- Whisper-quiet operation of less than 50dB and an impressive speed of 37 c.p.s.
- A choice of seven bold colors for bright, imaginative graphics.
- A special dual-ink cartridge system that gives cleaner

resolution on blacks and saves you money, because when black is used up only the black cartridge need be replaced.

- The ability to print high-fidelity characters and images on transparencies for overhead projection.
 - Compatibility with most computers you can buy.
- And how much does all this cost? Far less than a thousand dollars. So what's more incredible about the PJ-1080A color ink-jet printer? There's only one way you'll really be able to find out.

And that's to buy one and decide for yourself.

For more information:
Call 1-800-323-1717, Ext. 300.
(In Illinois call 1-800-942-8881, Ext. 300.)
Or Write Canon U.S.A., Inc.,
Printer Division, P.O. Box CN 11250,
Trenton, N.J. 08638.

Canon Printer Division

© 1984 Canon U.S.A., Inc.

Circle 49 on Inquiry card.

dependencies in their definition modules.

All of the Modula-2 compilers I know implement the following mechanism to allow one library module to use the exported element of another. When a definition module is compiled, a file is created that contains a summary of its declarations and a timestamp that was generated by the compiler. This summary file is used to establish correct typing information for any elements that are imported by other library modules

(see listing 3). It is also used when the implementation module is compiled. In both cases, the timestamp contained in it is copied to the resulting code file, and run-time checks guarantee that all code referring to the definition module was compiled using the same summary file. Since the functionality provided by this mechanism is a requirement of the language, Modula-2 is excellent for modular decomposition of large systems.

An Ada package equates to a Modula-2

module, except for the way you make elements visible externally. All elements declared in a package specification (the Ada equivalent of a definition module) are assumed to be visible outside the package unless they are declared in its private part. In Ada you must explicitly hide an element, while in Modula-2 you must explicitly make it public.

In Modula-2 a compilation unit must be a library module. In Ada it may be a procedure, a function, or a package, and it may or may not be declared within another compilation unit. Ada's generality adds little to the overall capabilities of the language but does increase the compiler's cost by making it more difficult to implement. The facilities provided by Modula-2 seem adequate for most applications, and anything less would certainly be unacceptable.

One final point on modularity. In Ada you may demand in-line expansion for selected procedures and functions. You can thus implement new arithmetic operators and have the compiler generate the code for them in line, exactly as it would for normal arithmetic operators. Since this code can make use of any resource within the package that declared the operator, it can create external dependencies on routines and data elements of the package that are supposed to be hidden. If you change the implementation of such a package in any way, you must recompile every compilation unit that uses one of its in-line routines. It would be better if Ada required you to supply a complete definition for any such routine in the public part of its package. However, this is not only not required, it's not allowed.

ABSTRACT TYPING

When combined with modules or packages, strong typing provides a fine tool for creating data structures that have specific, well-defined properties. However, strong typing is representation-oriented by its very nature. It is inevitably tied to the production of types and data structures rather than to their consumption. Another form of typing, which I shall call abstract typing, has to do with consumption rather than production. It comes into play when you wish to write a program dealing with data structures having certain properties but whose exact representation is

(continued)

Listing 3: When a definition module is compiled, a summary file is produced that contains a timestamp. When a module imports anything from another module, the compiler uses information from the appropriate summary file to insure correct usage. When an implementation module is compiled, the timestamp from its definition module is included in the resulting code file, along with timestamps for any imported modules. At load time, all copies of the timestamp for a particular module must agree.

```
DEFINITION MODULE a;
  EXPORT QUALIFIED p;
  PROCEDURE p(x,y: INTEGER);
END a.
```

The summary file resulting from this definition module contains a timestamp whose value, for instance, is vt.

```
MODULE b;
  FROM a IMPORT p;
  (* declarations for b *)
BEGIN
  (* statements initializing b *)
  p(32,1); (* calls the procedure p from module a *)
  (* other statements defining the behavior of b *)
END b.
```

The code file for module b contains a copy of the timestamp value vt. The compiler obtained this value from the summary file for module a because of the import statement at the beginning of b.

```
IMPLEMENTATION MODULE a;
  PROCEDURE p(x,y: INTEGER);
  BEGIN
    (* statements defining the behavior of p *)
  END p;
BEGIN
  (* statements initializing the module a *)
END a.
```

The code file for this implementation module contains the timestamp value vt. The compiler obtained this value from the summary file for module a. The implementation module may be changed and recompiled. As long as it agrees with the description contained in the summary file, there will be no need to recompile module b.

```
DEFINITION MODULE a;
  EXPORT QUALIFIED p;
  PROCEDURE p(x: INTEGER);
END a.
```

The summary file resulting from this definition module contains a timestamp whose value v2 is not equal to vt.

```
IMPLEMENTATION MODULE a;
  PROCEDURE p(x: INTEGER);
  BEGIN
    (* statements defining the behavior of p *)
  END p;
BEGIN
  (* statements initializing the module a *)
END a.
```

The code file for this implementation module contains the timestamp value v2. The compiler obtained this value from the summary file for the second definition module. The module b must now be changed and recompiled before it can be used with this new version of module a.



If you could get your investment information where Wall Street gets its investment information, you'd get it from us.

Now CompuServe's Executive Information Service puts the most accurate, comprehensive investment information available at your fingertips.

For the first time ever, individual investors can join the ranks of the most prestigious Wall Street firms who depend on CompuServe to provide them with a broad spectrum of comprehensive financial information for research, portfolio management and merger/acquisition strategies. *Instant retrieval* of continuously updated quotes on over 9,000 issues and 10 years of daily historical pricing on over 50,000 securities... *Standard and Poor's* descriptive information on more than 3,000 companies... *Value Line Data Base-II* extensive fundamental data to analyze the performance of more than 1,700 major corporations...

Circle 337 on Inquiry card.

Disclosure II descriptive and financial information derived from SEC filings for over 8,500 companies...

Institutional Brokers' Estimate System (IBES) earnings projections on over 2,800 widely followed companies...

Evans Economics daily updated economic forecasts, historical statistics and analysis of more than 20 major economic indicators plus continuous public opinion polls on economic and financial issues...

Reports on technical market trends, personal portfolio evaluation and the most comprehensive analysis capabilities currently available.

You get all this plus demographic information on every zip code in the U.S., access to consultants through the Geneva Series, state of the art electronic communications, the full scope of the prestigious AP Wire Services, travel information and reservations and more of the high quality financial information that has made CompuServe

the premier supplier of investment information to the greatest names on Wall Street.

For a free illustrated guide to CompuServe's Executive Information Service, write or call:

Name

Address

City

State Zip

CompuServe

Executive Information Service
P.O. Box 20212
5000 Arlington Centre Blvd.
Columbus, Ohio 43220

800-848-8199

In Ohio, call 614-457-0802

815

An H&R Block Company

unimportant to the algorithm.

The traditional way of doing this is to require that each external data structure be represented internally by a tag or address, and that all necessary operations on them be passed as explicit parameters to the algorithm. You can do this in Pascal and Modula-2 but not in Ada. The first two languages allow you to pass procedures and functions as parameters, while the latter does not. In Pascal, you would probably use integers for the data structure tags. In Modula-2, you could use pointers passed in as parameters of type "word." Of course, this solution forces you to bypass all type checking by the compiler. It would be nice if you could declare a routine with some parameters that are pointers to a data structure of type *x* and others that are routines to manipulate such pointers where *x* is left unspecified. Then the compiler could verify that all appropriate types matched.

At first glance, this is what an Ada

generic declaration appears to do. You specify a collection of parameters, some of which may be types, and then you declare a routine or package using these parameters wherever necessary. However, what you get is not a simple routine or package. Instead, you get a routine or package that will generate a second one when supplied with the correct parameters. You may use it to declare any number of nongeneric instances, and each time you execute a part of your program that contains such a nongeneric routine, a new version of the underlying routine or package will be generated. By using generics you end up with more routines and packages, not fewer. While the algorithm is shared, the code and data are not, and each copy of the generic routine or package will require its own memory. However, since Ada doesn't allow you to pass procedures and functions as parameters, generics are all you've got.

With procedure types, Modula-2 has

provided a consistent way of dealing with functions and procedures as data values in an arbitrary data structure, and not just as parameters to a routine. With this feature, which has no counterpart in either Pascal or Ada, you can declare a type that defines the parameter structure for a procedure or function. A data element of that type behaves like a procedure or function, but it may be located anywhere in memory, including the heap (see listing 4). Any routine that belongs to a library module and has the right parameter structure may be assigned to it. Procedure types may be used in high-level structures, such as files, that include both data and control, and in low-level structures such as interrupt handlers. They allow you to simplify the structure of your application without obscuring its intent.

CONCLUSIONS

As a systems-implementation language, Modula-2 is a major improvement over Pascal. In fact, it is substantially better than most currently available languages. From what I have said so far, you might be tempted to call it the "poor man's Ada," but this is certainly wrong. While there are many extra features in Ada, most of them are marginal improvements. The only one that seems really necessary is the feature that allows you to control the size and relative location of data elements within a data structure.

With all its shortcomings, Modula-2 is a good implementation language and a technical success. It has no surprises and no overlapping functionality. Ada, on the other hand, is a questionable experiment at best. It contains several costly features that are of little value, and the implications of certain other features, such as derived types, seem to lack forethought. Of course it's easier to criticize than to create, but it seems that without the support of the Department of Defense the many "gotchas" and funny features of Ada would have caused its demise. ■

REFERENCES

- The Ada Programming Language*. ANSI/MIL-STD-1815A: American National Standards Institute, 1983.
- Jensen, K., and N. Wirth. *Pascal User Manual and Report*. New York, Heidelberg, Berlin: Springer-Verlag, 1975.
- Wirth, N. *Programming in Modula-2*. New York, Heidelberg, Berlin: Springer-Verlag, 1982.

Listing 4: *Modula-2 procedure variables can be used to provide handlers for a data structure within the data structure itself.*

```

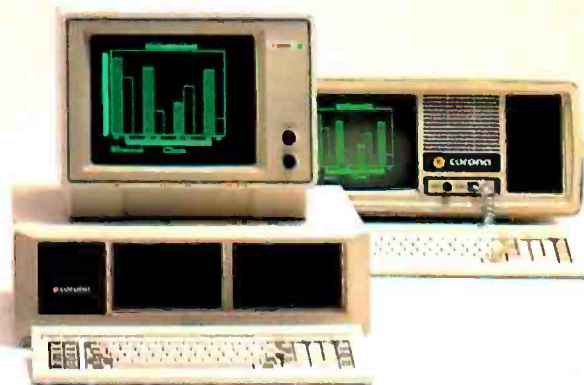
DEFINITION MODULE structure;
  EXPORT QUALIFIED reference, node, handler, create;
  TYPE reference = POINTER TO node;
  TYPE handler = PROCEDURE(REAL,INTEGER,reference);
  TYPE node =
    RECORD
      link: reference;
      x,y: INTEGER;
      h: handler;
    END;
  PROCEDURE create(h: handler); reference;
END structure.

IMPLEMENTATION MODULE structure:
  FROM Storage IMPORT ALLOCATE;
  PROCEDURE create(h: handler); reference;
    VAR r: reference;
  BEGIN
    NEW(r); (* calls ALLOCATE *)
    r.f.h := h;
    RETURN(r);
  END create;
BEGIN
  (* statements initializing the module structure *)
END structure.

MODULE manager;
  FROM structure IMPORT reference, node, handler, create;
  PROCEDURE transition(x: REAL; y: INTEGER; r: reference);
  BEGIN
    (* statements defining the behavior of transition *)
  END transition;
  VAR ref: reference;
  BEGIN
    ref := create(transition);
  END manager.

```


YOU DON'T HAVE TO REMODEL TO ADD ON.



With some computers, the more you do, the more you have to add on.

A little memory expansion here. A graphics adapter there. Next thing you know, you need an expansion chassis. And a loan from the bank.

Corona builds memory expansion (up to 512K) and high-resolution graphics right into the main board. That saves you money. And expansion slots. Plus, our 128K standard memory and IBM® compatibility let you run thousands of software packages right out of the box. The net result is a PC that grows on you. Painlessly.

The Corona PCs.

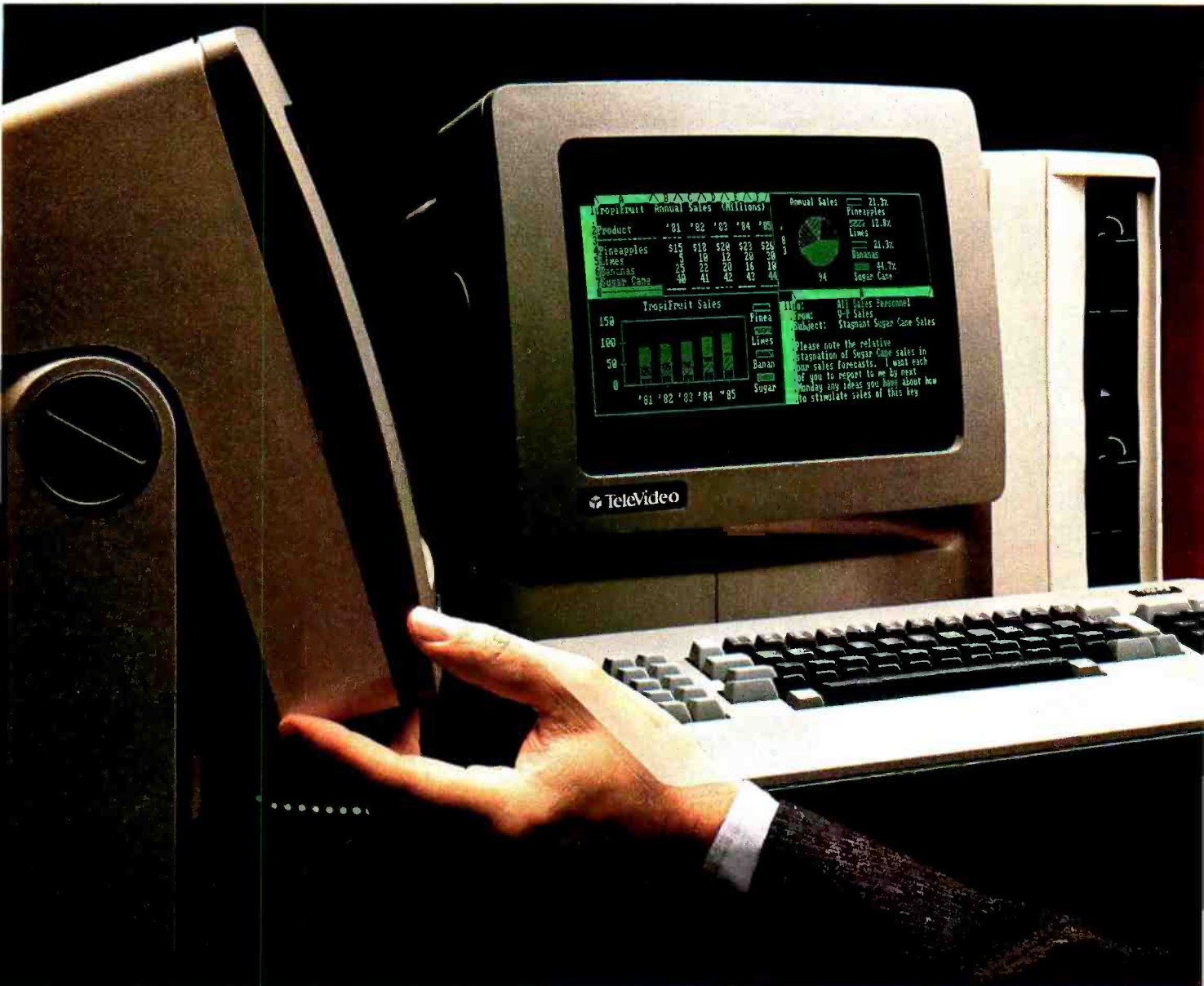
It's a matter of simple addition.

In North America, call 1-800-621-6746 for the Authorized Corona Dealer near you. In Holland, call 020-03240-18111. There are over 1,600 dealers worldwide. And their job is to help. Service by Xerox.



THE CORONA PC

The TeleVideo The best hardware



TeleVideo versus IBM. Make a few simple comparisons and you'll find there is no comparison.

RUNS IBM SOFTWARE.

With the TeleVideo® IBM Compatible line—PC,XT and portable computers—you'll get the most out of all the most popular software written for the IBM® PC—more than 3,000 programs.

Because every TeleVideo Personal Computer offers the highest level of IBM compatibility on the market and

THE BEST HARDWARE FOR THE BEST PRICE.

Features	Tele-PC	IBM PC	Tele-XT	IBM XT
Monitor	YES	OPTIONAL	YES	OPTIONAL
Screen Size	14"	12"	14"	12"
Tilt Screen	YES	NO	YES	NO
Quiet Operation	YES (NO FAN)	NO	YES	NO
Memory	128K	128K OPTION	256K	256K OPTION
Graphics Display (640 x 200 resolution)	YES	OPTIONAL	YES	OPTIONAL
Printer Port	YES	OPTIONAL	YES	OPTIONAL
Communications Port	YES	OPTIONAL	YES	YES
MS™-DOS/BASIC®	YES	OPTIONAL	YES	OPTIONAL
System Expansion Slot	YES	YES	YES	YES
RGB and Video Port	YES	OPTIONAL	YES	OPTIONAL

PC compatibles. for the best software.

has the standard—not optional—features you need to take full advantage of every job your software can do.

Study the chart below. It proves that TeleVideo—not IBM—offers the best hardware for the best price.

Note that TeleVideo's ergonomic superiority over IBM extends from fully sculpted keys and a comfortable palm rest to a 14-inch, no glare screen that tilts at a touch.

THE BEST MICROCHIPS.

What is perhaps most impressive about the TeleVideo IBM PC Compatible can be found deep within its circuitry. We use the same 8088 central processing unit that runs an IBM PC. But we also employ new VLSI (Very Large Scale Integration) microchips that are designed and built exclusively for TeleVideo. These interface more efficiently with the powerful 8088 and yield numerous benefits.



For example, our tiny custom chips do the work of many of the larger, more expensive circuit boards in an IBM PC. So we can offer a computer system that comes in one attractive, integrated case, is ready to run and occupies less desk space. A computer that edges out IBM's added-cost component system for reliability, ease of service and purchase simplicity.

Fewer circuit boards to cool also allowed us to eliminate the noisy, irritating fan IBM and most other PCs force you to put up with. And TeleVideo compatibles accept



THE BEST PORTABLE FOR THE BEST PRICE.

Features	TPC II-S	IBM PC
High Capacity Storage	YES	YES
Quiet Operation	YES (NO FAN)	NO
Display	YELLOW	AMBER
Memory	256K	256K
Graphics	YES	YES
Communications Port	YES	OPTIONAL
Printer Port	YES	OPTIONAL
MS™ DOS 2.11	YES	OPTIONAL

any IBM hardware options without modification.

THE BEST LINE.

But the Tele-PC is only one element of the TeleVideo IBM PC Compatible line.

The TeleVideo XT is the best hardware for users of popular IBM XT software who would appreciate an extra 10 megabytes of storage capacity along with the advantages listed on the chart at the left.

As the chart above demonstrates, our portable IBM compatible computer, the TPC II, is far and away better hardware than IBM. Better hardware—standard—at a better price.

THE BEST MANUFACTURER.

The TeleVideo IBM PC Compatible line is made by the world leader in multi-user computer systems and the number one independent manufacturer of terminals.

Call 800-538-8725 for the dealer nearest you. In California, call 800-345-8008.

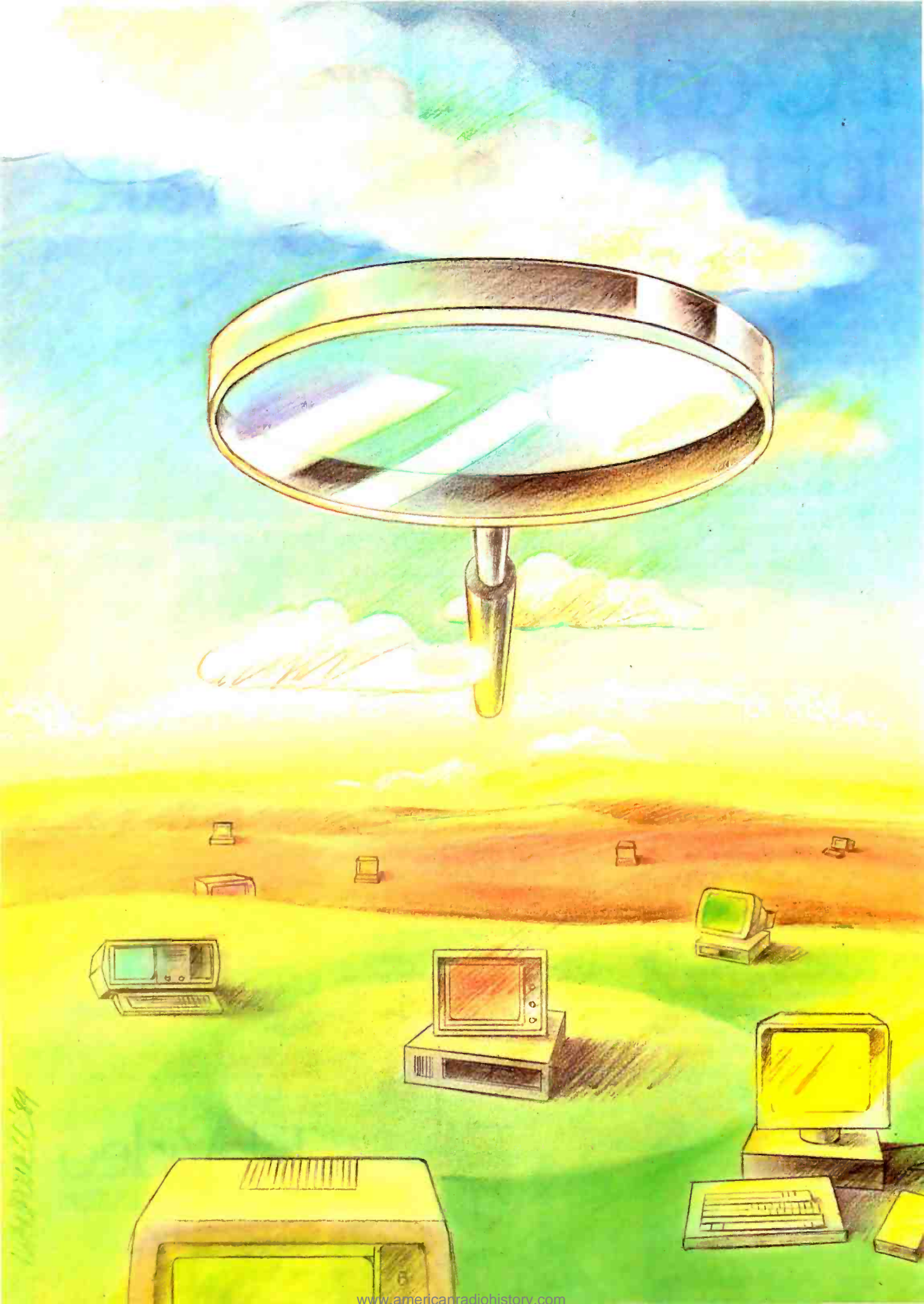
Before you invest, make a few simple comparisons. You'll find that TeleVideo—not IBM—has the best hardware for the best software. At the best price.

IBM is a registered trademark of International Business Machines. MS is a trademark of MicroSoft Corporation. CW Basic is a registered trademark of MicroSoft Corporation.



TeleVideo®
Personal Computers
• TeleVideo Systems, Inc.

Circle 303 on inquiry card.



Reviews

THE MACINTOSH <i>by Bruce F. Webster</i>	238
THE IBM PCjr <i>by Rowland Archer Jr.</i>	254
THE SANYO MBC-550 <i>by Bill Sudbrink</i>	270
FOUR LOGOS FOR THE IBM PC <i>by Mark Bridger</i>	287
THE JUKI 6100 PRINTER <i>by G. Michael Vose</i>	305
REVIEW FEEDBACK	308

REVIEWER'S NOTEBOOK

WordStar—the old, reliable word-processing program from MicroPro—is being besieged on all sides. First there were the competing word processors. Then came NewWord, a low-cost WordStar work-alike program written by some of the same people who wrote the original. And now there's a WordStar work-alike written in BASIC.

At the BYTE/*Popular Computing* show in Chicago, Bruce Tonkin approached me, claiming that he had a compiled-BASIC program called My Word!. He said that it runs faster than WordStar, that it runs on everything except Apple computers, and that it costs only \$25.

Fortunately, he had a version for the IBM Personal Computer (PC) with him and there was a new Zenith Z-150 just across from the BYTE booth. (I'll talk more about the Zenith later.) Anyway, this \$25 program actually worked. Of course, it doesn't do everything that WordStar does (such as on-screen justification), but it does almost everything. And it does some things that WordStar can't do. For example, you can set up a long table and then sort the table according to information in any of its columns.

Bruce Tonkin's company is called TNT Software (34069 Hainesville Rd., Round Lake, IL 60073).

About six months ago we did a review of the Zenith Z-100, the Heath company's first MS-DOS machine. The Z-100 has the best version of MS-DOS I've seen on any machine. The only problem with the Z-100 is that it cannot take advantage of the large variety of IBM PC software that is available.

Now we're trying to get the Z-150, Heath's true IBM PC-compatible machine. If they applied the same care and intelligence that they did on the Z-100, then the new Z-150 must be some machine. I must admit, however, that the portable version—the Z-160—looks a bit strange.

A few months ago, I mentioned the Leading Edge Word Processor, a slick package with unique, rather unwieldy file-handling procedures. Now, because of competition from IBM's own word-processing programs called DisplayWrite, the basic price of the LEWP has been reduced to about \$200. Also, the Leading Edge PC has finally arrived here. The Leading Edge PC is one of the newest IBM PC clones. An identical twin of the Sperry PC, it is produced by Mitsubishi in Japan, and its most distinguishing characteristic is its dual-speed processor.

The 8088 microprocessor in the LEPC can run at either 4.77 MHz (just like the IBM PC) or 7.6 MHz (a significant improvement). Running your favorite programs at this higher clock speed is a bit of a thrill.

The Leading Edge PC—like every PC clone I've seen—is not 100 percent compatible. In fact, I give it a "98." All of the major non-graphics programs run on it (we haven't received the graphics board yet).

Heading our reviews this month is a look at the Macintosh, the machine that has probably received more attention than any other. Contributing Editor Bruce F. Webster examines whether the "Mac" can do serious work.

Next, our veteran analyst Rowland Archer Jr. examines the IBM PCjr, another machine that has been in the news a lot. Rowland carefully examines what this machine can and cannot do.

Then we shift to a popular MS-DOS-based system—the Sanyo MBC-550. Bill Sudbrink determines whether this low-cost machine—which looks like part of your stereo system—is a real alternative to the high-priced office systems.

For programmers, we have a review of four Logos for the IBM PC that offer turtle graphics of varying quality.

And finally, we have a review of a new low-cost daisy-wheel printer—the Juki 6100—written by our features editor, Mike Vose.

—Rich Malloy, Product-Review Editor



The Macintosh

The many
facets of a
slightly
flawed gem

BY BRUCE F. WEBSTER

Few computers—indeed, few consumer items of any kind—have generated such a wide range of opinions as the Macintosh. Criticized as an expensive gimmick and hailed as the liberator of the masses, the Mac is a potentially great system. Whether it lives up to that potential remains to be seen.

Personally, I think the Macintosh is a wonderful machine. I use one daily at work, and then at night I play with the one I have at home. Or, at least, I try to play with it. You see, my wife—who for years resisted all my attempts to introduce her to computers—has fallen in love with the Mac (her words, not mine). She uses it to type up medical reports, notes on her clients, and personal letters. In fact, she's suggested that we get a second Macintosh so that we won't have to fight over the one we have.

The Macintosh is not without its problems. Resources are tight—it needs more memory and disk space—and software has been slow in coming to market. Many have criticized its price (\$2495). In fact, there are indications that Apple considered a lower price (\$1995) and then rejected it. It doesn't seem to have hurt the Mac's market—people are still buying them faster than Apple can make them—but there's the potential for backlash if the machine doesn't deliver on all its promises.

Whatever its problems and limitations, the Mac represents a breakthrough in adapting computers to work with people instead of vice versa. Time and again, I've seen individuals with little or no computer experience sit down in front of a Mac and accomplish useful tasks with it in a matter of minutes. Invariably, they use the same words to describe it: "amazing" and "fun." The question is whether "powerful" can be added to that list.

In an industry rapidly filling up with IBM PC clones, the Macintosh represents a radical departure from the norm. It is a small, lightweight computer with a high-resolution screen, a detached keyboard, and a mouse (see photo 1). It comes with 128K bytes of RAM (random-access read/write memory), 64K bytes of ROM (read-only memory), and a 400K-byte 3½-inch disk drive. If you throw in an Imagewriter printer (see photo 2 and

figure 1) the system costs \$2990. The processor is a Motorola 68000, running a nameless operating system (see the text box, "A Second Opinion" on page 248 for a full description). It has absolutely no IBM PC/MS-DOS compatibility, and it would appear Apple plans none.

THE DISPLAY

The display is small (9-inch diagonal), but it has very high resolution (512 by 342 pixels). Every pixel is crisp. Several things make the display unusual. First, the Macintosh has no "text mode." Instead, the display is always bit-mapped graphics. Second, the display is black-on-white rather than amber-, green-, or color-on-black, giving it an ink-on-paper effect. Third, the pixels are equally dense both horizontally and vertically, eliminating the "aspect-ratio" problem that plagues other graphics systems. (In other words, a box 20 pixels wide and 20 pixels high will be a square.)

The effect is excellent. The display is clear, crisp, easy to read, and easy on the eyes. Because all text is graphically generated, true "what you see is what you get" word processing is available (with multiple fonts, sizes, and styles). Embedded drawings and proportional spacing are also possible. Some criticism has been made about the lack of a color-graphics capability. Frankly, I am unconvinced of its necessity. Most applications I have seen use color graphics as a substitute for detail, and the Mac can give you lots of detail. (An interesting footnote: the QuickDraw graphics routines in the Mac's ROM *do* provide for color, although Apple has not announced any intentions for supporting such.)

The Mac's display does create a problem. Computer graphics are memory-intensive: once you start drawing pictures, you start using up lots of memory. The video display itself consumes about 22K bytes (or about one-sixth) of the total RAM. Any off-screen manipulation (windows) or information (text fonts) chews up additional memory quickly.

THE KEYBOARD

Like the rest of the machine, the keyboard is significantly different from those found on

other systems (see photo 3). It's smaller than most and has only 58 keys. It is detached but the 3-foot coiled cord has lots of give to it so you don't have to wrestle the computer for the keyboard. The full printable ASCII (American National Standard Code for Information Interchange) set is available, and the layout of alphanumeric and punctuation keys is pretty standard. There are no function keys, no cursor keys, and no control key. Instead, you will find two Option keys and a Command key. The Option keys, located directly under either Shift key, are used to generate special text characters (Greek letters, math symbols, and the like). The Command key, whose symbol looks like a freeway cloverleaf, is an alternative to the mouse. For example, if I'm typing along and wish to underline some text, I can type Command-U instead of stopping and using the mouse to select Underline in the Style pull-down menu.

All in all, I like the keyboard. I'm a fast touch-typist and occasionally I overrun the two-key "rollover" (the number of keys you can press down simultaneously), but I never lose characters because of buffer overflow. The keyboard's layout is compact, so I can easily reach any key—well, almost any key. The Command key, located between the left Option key and the space bar, is in an awkward position. I often hit the Shift key or Option key instead.

I don't like function or cursor keys and the mouse renders them fairly useless, so their absence doesn't bother me at all. A separate numeric keypad is available for \$99 (it plugs in between the keyboard and the Mac). This keypad has cursor keys on it, but I wonder how many applications will recognize them.

THE MOUSE

The Macintosh has a standard, one-button, mechanical-tracking, optical-shaft-encoding

.....
Bruce F. Webster (7909 Ostrow St., Suite F, San Diego, CA 92111) is vice-president of FTL Games and Oasis Systems. He received his B.S. in computer science from Brigham Young University and did graduate work at the University of Houston. His hobbies include reading and war-gaming, especially science-fiction and fantasy war games.

mouse (again a departure from industry norms). The mouse has a 3½-foot cord, its own port in the back, and full support from the ROM routines and the operating system. In other words, almost every application on the Macintosh will use the mouse. (I say "almost" because someone is bound to come out with a program that ignores it altogether.)

Before buying my Macintosh, I used a mouse on an IBM PC and was not impressed. The Macintosh mouse impresses me. In some applications, such as MacPaint, I seldom touch the keyboard, except to hold the Shift, Option,

(continued)



Photo 1: The Apple Macintosh computer.



Photo 2: The Macintosh dot-matrix printer.

This is 9-point text, Geneva.
 This is 12-point text.
 This is 14-point text.
 This is 18-point text.
This is 9-point text, Geneva, bold.
This is 12-point text, bold.
This is 14-point text, bold.
This is 18-point text, bold.
This is 9-point text, New York, and this is bold.
This is 12-point text, New York, bold.
This is 14-point text, New York, bold.
This is 18-point text, bold.

Figure 1: A sample printout from the Macintosh using its printer and the MacWrite word-processing program. The printout was obtained using MacWrite's high-quality output mode, as opposed to the draft and ordinary quality modes. The output here is shown at 100 percent of actual size.

or Command key down with my left hand while moving the mouse with my right. I find using the mouse faster, easier, and less disruptive than using function and cursor keys. Function and cursor keys do not fall within the standard touch-typing layout because they vary in size, number, position, and function. To use them, I have to stop and think about what key I need, look down at the keyboard, find it, hit it, and look

up again. Often this process has to be repeated several times. With the mouse, I never take my eyes off the screen. I just reach to my right, grab the mouse, and do what I need to do.

Of course, the mouse isn't always a perfect solution. Some commands can be tedious to perform via the mouse and pull-down menu. For example, deleting text to the right of the cursor in MacWrite can only be done with the

mouse. This is a nuisance if you have only one or two characters to delete. I'd also like the mouse's cord to be a little longer and sometimes I have trouble finding enough surface area to work the mouse, but these are minor complaints. The mouse is an excellent feature of the Macintosh.

USER INTERFACE

Macintosh's user interface is far different from those of other personal computers. Strictly speaking, it is not all that new. The original concepts were pioneered at Xerox's Palo Alto Research Center (PARC) several years ago. Apple used them heavily in the original Lisa machine, released a year before the Mac. However, that Lisa sold for \$10,000, and the Xerox machines for much more. The people who most needed the interface were those who could least afford it: small businesspeople, students, etc. The Macintosh is still a bit expensive, but it's within the reach of far more people than any of its predecessors.

In creating the Macintosh's unique user interface, Apple has attempted to make the abstract seem concrete. Few things are as abstract as the data and programs stored and used on a computer. The Mac takes that abstraction and presents it as something familiar: a desktop cluttered with pencils, papers, manila folders, and even a wastebasket. Do you want to put a document in a folder? Pick it up with the mouse and put it in the folder. Do you want to throw something away? Pick it up and put it in the wastebasket. Abstractions take on real forms that we can understand and use without obscure commands or bizarre syntax.

Another important aspect of this user interface is the way in which the Macintosh makes commands available to the user. As I write this review with MacWrite, the top of my screen has an Apple symbol and six words (File, Edit, Search, Format, Font, and Style) written across the top. If I point at any of the items with the mouse and press the button, a menu of options appears on the screen. When I release the button, the menu disappears. All available commands appear in the menus. I haven't had to memorize or learn much; in fact, I opened my MacWrite manual only

(continued)

AT A GLANCE

Name

Macintosh

Manufacturer

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

Components

Size: 13.5 by 9.7 by 10.9 inches (main unit)
2.6 by 13.2 by 5.8 inches (keyboard)
Weight: 19.5 pounds
Processor: Motorola 68000 (7.8336 MHz)
Memory: 128K bytes of RAM; 64K bytes of ROM
Display: 9-inch built-in monitor; high-resolution bit-mapped display (512 by 342 pixels); adjustable
Keyboard: 58 keys, detached, standard layout, no function keys, software-mapped
Mouse: single button, mechanical tracking, optical shaft encoding
Mass storage: built-in single-sided 3½-inch Sony drive (400K bytes)
Sound generator: four-voice sound
Interfaces: two RS-422A serial ports (230.4K bps transfer rate); external-disk interface for second (optional) disk drive; mouse interface; synchronous serial keyboard bus

Operating System

Proprietary unnamed

Optional Hardware

Imagewriter dot-matrix printer: \$595
Numeric keypad: \$99
Carrying case: \$99
Modem (300 bps): \$225
(300/1200 bps): \$495
Security Accessory Kit: \$49
Second floppy-disk drive: \$495

Optional Software

See text box

Documentation

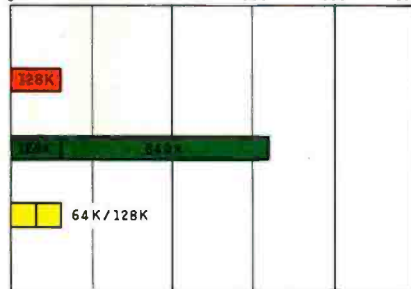
160-page user's manual

Price

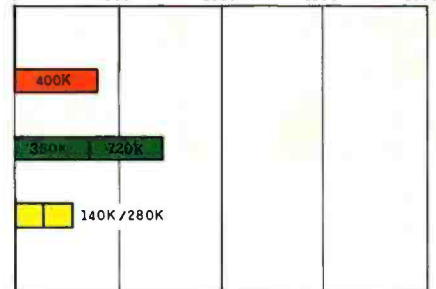
\$2495 (\$2990 with Imagewriter)



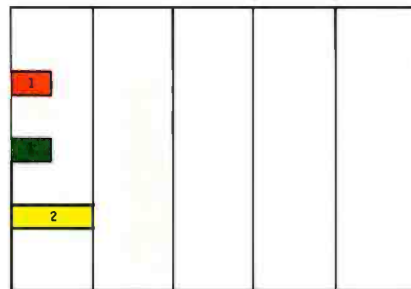
MEMORY SIZE
0 200 400 600 800 1000K



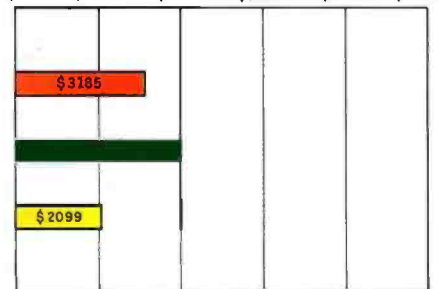
DISK STORAGE
0 500 1000 1500 2000K



BUNDLED SOFTWARE
0 2 4 6 8 10



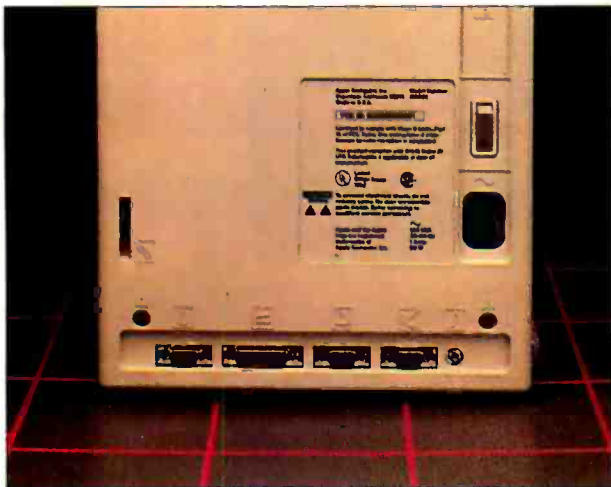
PRICE
\$0 \$2000 \$4000 \$6000 \$8000 \$10,000



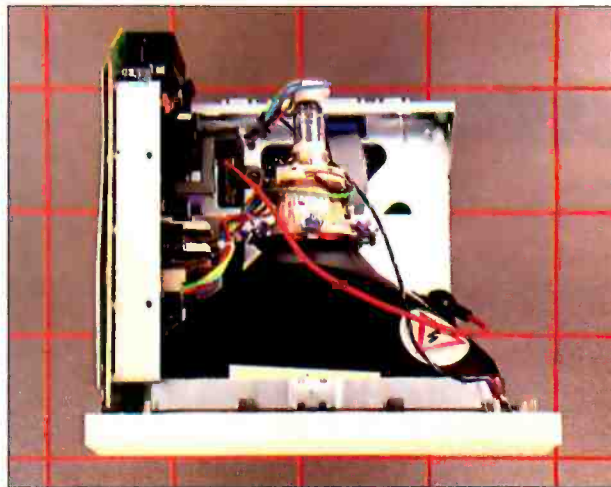
MAC IBM PC APPLE IIe

The Memory Size graph shows the standard and optional memory available for the computers under comparison. The Disk Storage graph shows the highest capacity of a single floppy-disk drive for each system. The Bundled Software graph shows the number of software packages included with each system. The Price graph shows the list price

of a system with two high-capacity floppy-disk drives, a monochrome monitor, graphics and color-display capability, a printer port and a serial port, 256K bytes of memory (64K bytes for 8-bit systems), the standard operating system for each system, and the standard BASIC interpreter for each system. The Mac's price includes 128K bytes of memory only.

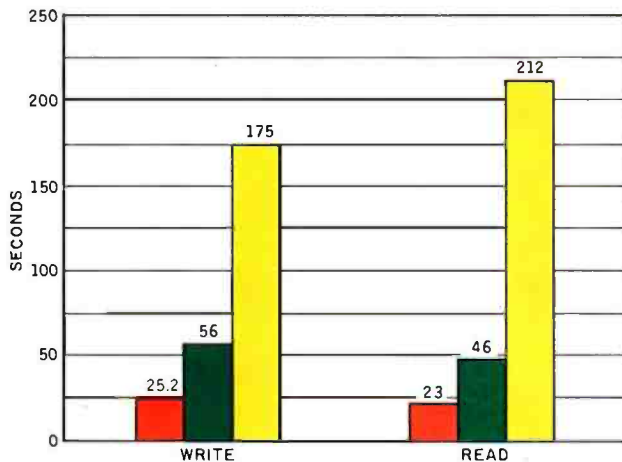


The rear of the Mac. Note the icon labels. The bottom row of connectors is for (from left) the mouse, second floppy disk, printer, modem, and speaker.

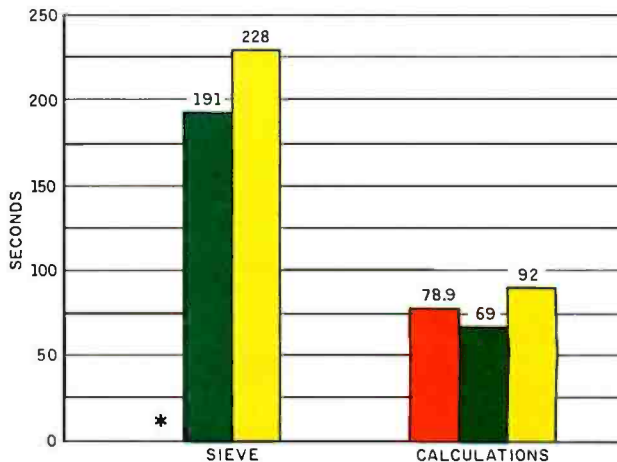


The top of the Mac with the cover removed. The disk drive and digital circuitry are below the cathode-ray tube; the analog circuitry is to its left.

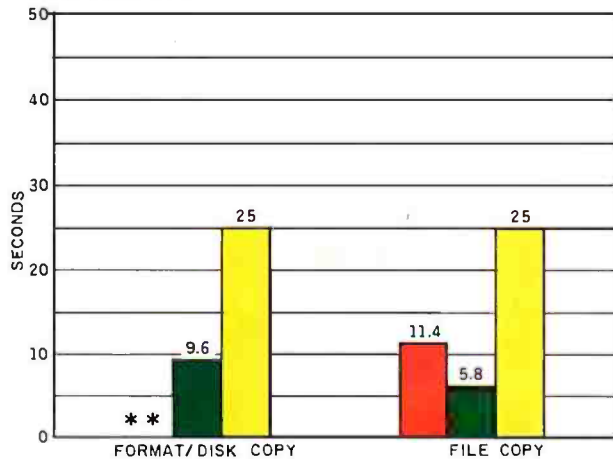
DISK ACCESS IN BASIC



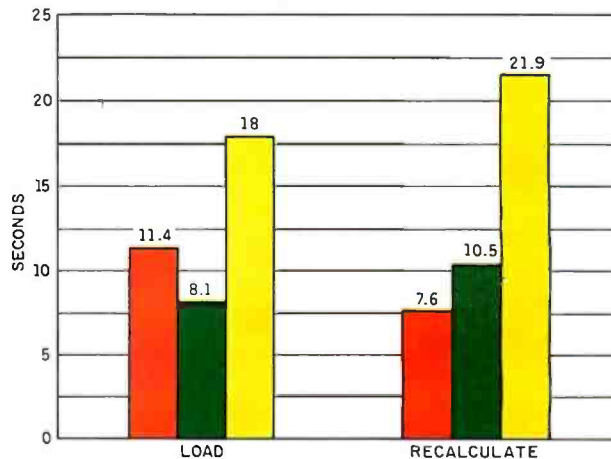
BASIC PERFORMANCE



SYSTEM UTILITIES



SPREADSHEET (MULTIPLAN)



MACINTOSH IBM PC APPLE IIe

The graph for Disk Access in BASIC shows how long it takes to write a 64K-byte sequential text file to a blank floppy disk and how long it takes to read this file. (For the program listings, see "The Chameleon Plus," by Rich Krajewski, June 1984, page 327.) The BASIC Performance graph shows how long it takes to run one iteration of the Sieve of Eratosthenes prime-number benchmark. In the same graph, the Calculations results show how long it takes to do 10,000 multiplication and division operations using single-precision numbers. The System Utilities graph shows how long it takes to transfer a 40K-byte

file using the system utilities. The Spreadsheet graph shows how long the computers take to load and recalculate a 25- by 25-cell spreadsheet where each cell equals 1,001 times the cell to its left. The spreadsheet program used was Microsoft Multiplan. The time for the format/disk copy test on the Macintosh reflects using the disk-copy utility on a single-drive system. Four disk-swaps are required for the complete disk copy, the time for which is included in the benchmark. *The Sieve benchmark couldn't be run on the Mac (see text for details). **The new Disk Copy program was not available at press time.

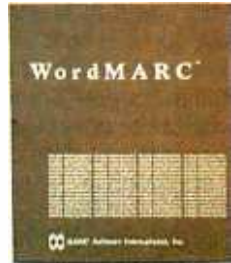
Minis and mainframes have used WordMARC for four years. Now there's WordMARC word processing for your micro.

Originally created for minis and mainframes, WordMARC is now available for use on your micro*. And quite simply, it's the best office-quality word processing software package a micro user could buy. After all, it was the best word processor mainframe and mini users like universities, national laboratories, and Fortune 500 companies could find over the last four years. But, if you need more proof, read on.

□ *No Problems, No Nonsense, No Competition.* For starters, everything you see on your screen appears exactly as it will be printed on paper. Scientific notation. Foreign language characters. Underlining. Subscripts. Everything. □ *A Partial List of Features. That's Right, Partial.* Menu driven w/function keys. Easy self-paced tutorials. Spelling checker. Mail merge. Scientific notation. Foreign language characters. Automatic reformatting. Automatic pagination. Document recovery system. Document encryption. ASCII file handling. And so on. □ *If Word Processing's Your Call, Call 800-831-2400.*

Granted, just because the call is free is no reason for picking up the phone. You should stop and consider our track record with minis and mainframes. You should stop and think what that can mean for your micro. And you should stop thinking about any other word processing software. OK. Now that you've done that, it's time to pick up the phone.

*WordMARC is compatible with the IBM PC or XT, as well as the Eagle, Compaq, Corona, Columbia, NCR PC, DEC Rainbow, and TI Professional computers. All versions of WordMARC on micro, mini and mainframe computers are compatible.



MARC Software International, Inc.
260 Sheridan Avenue, Suite 200
Palo Alto, California 94306
800-831-2400 □ In Calif., 800-437-9900

*WordMARC is a trademark of MARC Software International, Inc. © 1984 MSI, Inc. IBM PC and XT, Eagle, Columbia, Compaq, Corona, NCR PC, DEC Rainbow, and TI Professional computers are trademarks, respectively of International Business Machines Corporation, Eagle Computer, Inc., Columbia Data Products, Compaq Computer Corporation, Corona Data Systems, Inc., NCR Corporation, Digital Equipment Corporation, and Texas Instruments.



once or twice, briefly. The same is true at the "desktop" level. Any actions can be performed via the pull-down menus or by direct "physical" manipulation of the objects shown. The best feature of the Mac documentation is that I almost never have to refer to it.

My one complaint about the user interface is that it's slow. Sometimes running a program or opening a file seems to take longer than it should. File copying on a one-drive system is also tedious.

A special disk-copy utility is now available that lets you copy an entire disk in just four swaps—not too shabby when you realize that this utility uses nearly 80 percent of the total RAM just to hold the data. Unfortunately, this utility won't solve the problem of copying several files onto a disk that's already formatted and in use. There is a simple solution: more RAM.

MEMORY LIMITATIONS

The 68000 is a powerful microprocessor but it has a limited environment in the Macintosh. The Mac comes with 128K bytes of RAM: less than 1/100th of the 16-megabyte RAM the 68000 could use, and there's no way to expand it. True, Apple is planning to upgrade the Mac to 512K bytes sometime in the future, but that still leaves 97 percent of the

Apple is planning to upgrade the Mac to 512K bytes sometime in the future, but that still leaves 97 percent of the potential memory space unused and unusable.

potential memory space unused and unusable. The Mac has no provisions for expanding memory beyond replacing the 64K-bit chips it currently uses with 256K-bit chips as they become available. It has no expansion slots and no external bus. And remember, this is a graphics-intensive environment where memory often gets eaten up rather quickly.

So the question arises: why did the Macintosh design team so limit their machine? The most common reason I've come across is that the Macintosh team wanted to provide a standard environment for software developers and users (although the latter is less often cited). In other words, software developers know that a Mac will always have 128K bytes of RAM and users will never have to worry about software requiring more RAM than they have. The idea is sound, but it causes two problems. First, 128K bytes is *not* enough RAM for a standard, especially in the Macintosh environment, where graphics chew

away at your free space. Second, there will be no standard for software developers when the 512K-byte upgrade becomes available. Many software developers are ignoring (or unable to use) the 128K-byte machine and will release their packages for 512K-byte machines only. Unless Apple plans a free update to all Mac owners, the standard environment will no longer be standard.

Another argument I've heard to support the concept of such limited memory is that the expansion slots were dropped to avoid power and cooling problems and to keep the user out of the machine. Again, this is a good idea if you provide sufficient resources in the unexpandable model. I have no complaints with Apple's choice of two RS-422A ports, an external disk port, the mouse port, and audio output. External video would be nice, but it isn't critical. But there's just not enough memory.

Others argue that 128K bytes of RAM is enough because so much of the work is done for you in the 64K-byte ROM. The ROM toolbox (the optimized 68000 machine-language routines that handle all aspects of the user interface) is truly a marvelous thing, but it doesn't change the fact that large, complex programs need lots of memory, *especially* if the displays are all graphical. A supporting argument points to MacPaint and MacWrite, saying, "See, these work fine!" Yes, they do, but both have easily reached limits. Furthermore, these programs were developed over a long period of time, concurrently with the Macintosh. The authors of these programs knew a lot about optimizing code for the Mac. Software developers with less time and more ambitious designs will find the lack of RAM a serious roadblock.

I also have heard that the upgrade to 512K bytes will eliminate all such problems because there will be more than enough RAM for any application. Again, I disagree. You can never have enough RAM. I think it no accident that the

(continued)



Photo 3: The Macintosh keyboard. Note the absence of a control key, but the presence instead of a "cloverleaf" key just to the left of the space bar. This key performs several of the functions usually performed by a control key.

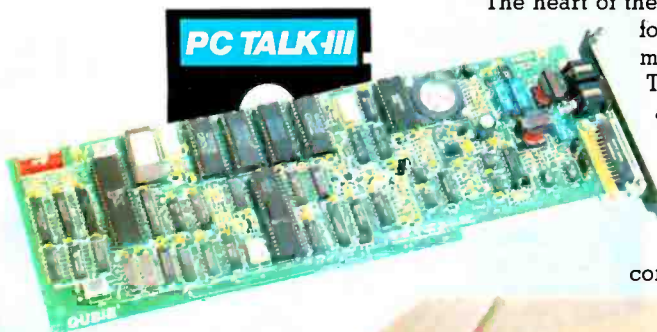
**Thinking of
buying a modem?
You owe it
to yourself to check out the Qubie' 212A modems.**

Inside Outside

Just a few years ago, computers needed big air-conditioned rooms to operate in, balefuls of money to buy, and a team of wizards to keep them running. The constant march of technological progress has given more and more powerful machines which cost less and less. Desktop computers more powerful than the early mainframe computers are the result of the evolution. The Qubie' modems represent the latest extension of this progress. Because up until now, a 212A compatible modem cost at least \$500. Through the use of four low-cost, state of the art microprocessors, we can now offer two versions of our full featured 212A modem at prices the competition sells 300 baud modems for.

In The Beginning

In September of 1983 we introduced the first 212A modem card for the IBM PC available for under \$300. The PC212A/1200 is a complete communications package including PC-TALK III software, modular phone cable, card edge guide, and instruction manual. The modem is an auto-dial, auto-answer type, which uses all the Hayes software commands so it can be used with any of the popular software packages including Crosstalk™, and Smartcom™. We picked the best software package we could find based on it's ease of use and features, PC-TALK III. Our modem includes features the old industry standard missed out on. Like being able to fit in one slot in a Portable PC or PC/XT.



PC212A/1200 Includes: Modem Card, PC-TALK III software, card edge guide, modular phone cable, quick reference card, and instruction manual. **\$299**
Optional external serial port connector **\$20**.

212E/1200 Includes: Standalone modem with cable (specify male or female), modular phone cable, and instruction manual. **\$329**.

Or an optional connector to use the modem's serial port when not using the modem. Of course the topper is the \$299 price, hundreds less than the competition.

Now Available Outside

Our standalone modem, the 212E/1200 can be used with any computer or terminal with a RS-232C serial port. You can use any Hayes compatible communications software on anything from an Apple to a Zenith. Many owners of IBM PC's are using it because they lack available expansion slots, or have more than one computer they want to use their modem with.

It's attractive gold anodized case houses seven status lights (who says low prices means a shortage of features). It fits comfortably under a standard telephone. It is also a 212A compatible auto-dial, auto-answer modem which supports all Hayes software commands. Even the switch settings are the same, so any software giving recommended switch settings for a Hayes modem can be used, without knowing what the switches do. There is a volume control knob for easy adjustment of the speaker's output. Included in the package is modular phone cable, a cable to hook it to your computer or terminal, and instruction manual. Choose the communications package right for your needs, and you're ready to go!

Four Hearts

The heart of the Qubie' modems are four digital signal microprocessors. Two handle sending, and two do the receiving. Rather than attempt to filter all but the relevant tones used for modem communications, the

microprocessors measure the tones digitally. This allows them to overcome line noise and static better than analog filter based modems

Why Buy From Qubie'

Because you will get a product as good or better than any available, pay less for it, and get factory direct help if you need it. If at any time during the one year warranty period your modem should require service, we will fix it or replace it within 48 hours. Notice also there are no hidden charges in our prices. No extra for freight, insurance, credit cards, or COD fees. In a hurry? UPS 2nd day air service is just \$5 extra. If you are like many who say, "Nah, it's too good to be true," just apply the acid test and find out. Then you will be asking yourself, "Why should I pay what these modems used to cost?"

The Acid Test

Qubie' gives you a 30 day satisfaction guarantee on your modem. If you are not completely satisfied we will refund the entire amount of your purchase including the postage to return it. If you can, get anyone selling another modem to give you the same guarantee. Buy both, and return the one you don't like. We know which one you will keep.

IBM is a trademark of International Business Machines Corporation.
Crosstalk is a registered trademark of Microsoft Inc.
PC-Talk III is a registered trademark of The Headlands Press Inc.



Order Today, Shipped Tomorrow!

All prices include UPS surface freight and insurance. Add \$5 for two day air service. For fastest delivery send certified check or credit card. Personal checks take 18 days to clear. Calif. residents add 6% sales tax. Corporations and Institutions call for purchase order details.

(800) 821-4479

Toll Free Outside California

(805) 987-9741

Inside California

QUBIE'

4809 Calle Alto
Camarillo, Ca. 93010

Tempo House, 15 Falcon Road,
London SW11 2PH, United Kingdom

© Copyright Qubie' 1984

Circle 262 on inquiry card.

Apple says the 68000 is much better than the 8086/8088 chips used in the IBM PC and its compatibles, yet they can use more RAM than the Mac.

Commodore 64, with 64K bytes, has dominated the low-end market over machines that have (or had) 8K, 16K, or 24K bytes. Apple gave the IIc, which uses an 8-bit 6502 chip, 128K bytes of RAM. Why the company limited the 68000, a 32-bit chip, to the same initial amount of memory is beyond me. Even the fourfold upgrade is too limiting. Apple delights in stating how much better the 68000 is than the 8086/8088

chips used in the IBM PC and compatibles, yet most of those systems can use more RAM than the Mac. Where's the advantage?

Obviously, I think that 128K bytes is not enough RAM to make the Macintosh a truly powerful machine. My attempt to run the Sieve of Eratosthenes benchmark on the Mac provides one indication of its RAM limitations. Once BASIC was loaded into the Mac, there was too little space left in memory for the Sieve program. To fit the program into memory, I had to declare all variables integer. This will, of course, speed the execution time considerably. Thus, the speed of the Mac Sieve is not commensurable to the other two systems. (If you are curious, the modified benchmark took 96.4 seconds on the Mac.) The upgrade to 512K bytes will help considerably, but it's still an inexcusable limit. I am convinced that this limited RAM has held up the release of Mac software. As I write this, it has been

three months since the Macintosh was released, and all the Apple dealers in town have only three software packages for the Mac besides MacPaint and MacWrite, which are still bundled. Mac should have had at least double the initial and upgrade RAM, i.e., 256K bytes and 1 megabyte, respectively. It may be that Apple will release yet another upgrade when 1-megabit chips become available in mass quantities, or they may just release a new machine.

Although the RAM is a limitation on the Macintosh, the ROM is a tremendous strength. In what is undoubtedly one of the marvels of modern programming, the Macintosh design team crammed an unbelievable amount of power into the 64K bytes of ROM in the form of tightly written, highly optimized machine code. In doing so, the team provided standard user interfaces so that most application programs on the Mac will be used in similar forms. I tried

(continued)

SUPER APPLE® COMPATIBLE

**SUPERIOR TO APPLE. COMPARE FEATURES
AMERICAN SUPER COMPUTERS Elite 4**

1. Dual CPU's 6502 & Z80, 64K RAM
2. Runs APPLE & CPM, detached keyboard
3. Numeric keypad, 90 key keyboard
4. No copyright problems, completely legal
5. SAVES YOU LOTS OF MONEY! ONLY \$499

Disk Drive \$199 - Controller \$49 - Monitor \$109

Complete System:

Computer + Controller + Drive + Monitor ONLY \$839

APPLE is T.M. of APPLE Computers, Inc.

WE HAVE ALL APPLE CARDS - CALL I SAVE!

Phone **American Super Computers (919) 883-1105**

COMPUTERS	TERMINALS	PRINTERS, LETTER QUALITY
Advanced Digital Z808 64Hz	Televideo 910	Super Quality - Super Price!
Super Siva/128 W/PS NET/I	Televideo 924	Smith-Corona TP-1
Super Siva/128	Televideo 928	FEC A10
Compuero 816C Demo (1 only)	Televideo 970	NEC2010
Morrow D120	Addi 3A*	Televideo TP-720P
HeadStart VPU-128	Visionary Color	Silver Road 500P
North Star Monitor or Advantage	Zenith Z-29	
BVI PC Copy of IBM PC	Visual 50	PRINTERS DOT MATRIX
Alpha 586 20 B User		ProPrinter
Televideo 800	MONITORS	Epson RX-80FT
Televideo 806/20	BMAC BM-12AUW	Microprint
Senro 360	SMC Amber	Oldstar 80 Per
Polo B0188	SMC Color	Oldstar 92 Per
Zenith ZF-161-21	Amdek Color-I B Demol	Tally Sprint
Eagle PC Sprint II		Anady 9500B
NEC PC 8201A		

IBM is T.M. of International Business Machines/CompuPro is a Godbout Company

**We Sell Entire Line Of Most Compaines
Call For Latest Prices, Shipping & Availability
Factory Warranties - WE BEAT PRICES!**

WHICH COMPUTER IS BEST? - FREE BROCHURE



4167 Kivett Dr., Jamestown, North Carolina 27282
Phone: (919) 883-1105 or (919) 889-4577

Prices & Specifications subject to change

**When switching or lightning cause voltage surges—
is your computer safe?**

Perma Power® Surge Suppressors provide the transient protection computers need

- Protects components; prevents data errors
- Eliminates both line-to-line and line-to-ground surges
- Automatic failure shutdown prevents unprotected operation
- Extended Life models have RF and EMI filters and a three-year warranty

UL

Now at your computer store.

**PERMA POWER®
Electronics Inc.**

5615 West Howard Avenue • Chicago, Illinois 60648 • (312)647-9414

Build The Ideal PC Network

IBM Compatible



Digital Microsystems opened up the world of shared micro computer resources with its HiNet™ Local Area Network in 1980. Now, 3000 HiNet LAN systems later, comes the DMS-816, the cost-effective solution to the need for multiple IBM-compatible PCs.

Up to 63 DMS-816 workstations can be interconnected to share common data and expensive peripherals. Cost per user can be half that of stand-alone PCs. And if you

already own IBM PCs, connect them to HiNet™ with low-cost HiNet/PC Adapter cards. Conserve your investment while expanding the utility of your system.

With the DMS-816 you take advantage of the wealth of PC-DOS™

software, as well as existing CP/M-80™ and CP/M-86™ programs. 128K to 512K RAM memory means you

can handle large, data-intensive applications immediately without the expense of purchasing added memory. Your network is controlled by an extremely fast and reliable master station. And your communication pathways are unlimited—HiNet gateways let you talk to mainframes and public data networks.

As part of an international communications company—Exel Group PLC—Digital Microsystems is the dependable

supplier for everything you need on your HiNet LAN: large hard disk servers, network software, cabling and connectors, intelligent workstations, optional local storage. This translates into easy installation, training and support.

For a view of the world you never had before, call or write today.



DD Digital Microsystems™

Circle 101 on inquiry card.

HiNet is a trademark of Digital Microsystems, Inc. IBM PC is a trademark of International Business Machines. PC-DOS is a trademark of International Business Machines. CP/M-80 and CP/M-86 are trademarks of Digital Research, Inc. Corporate Offices: U.S. 1840 Embarcadero, Oakland, CA 94606. Tel. (415) 261-1034, TWX 910-366-7310. U.K.: Tel. (0734) 793131, Telex 851849925. Hong Kong: Tel. 3-7237962, Telex 78041153. Germany: Tel. 6102340367/78. U.S. Sales Offices: California: (415) 261-1034. New York: (516) 829-4772. Texas: (214) 234-4940. Washington D.C.: (301) 576-2922.

International Distributors: Australia, Daro Systems, (02) 699-3877 • Benelux, Digital Systems, (2) 384-80-62 • Denmark, Data APS (1) 780141 • India, American Components, (91) 222999 • Ireland, Digicom, (0001) 604544 • Israel, Osnat Computers, (3) 492122 • Italy, Condor Informatics, (2) 4987549 • Norway, Nor Sales, (2) 680555 • Portugal, Monteiro, (1) 322500 • Saudi Arabia, EECC, (2) 6690221 • South Africa, Digital Computer (11) 706 7182 • Spain, MOS, (3) 239 3604 • Sweden, Macrotek, (8) 870190 • Switzerland, Compuserve (42) 366155

A Second Opinion

BY J. EDWARD CHOR

The Macintosh is advertised as a 128K-byte machine. In reality, the Finder (Macintosh's operating system) and other systems software take about 40K bytes. Subtract from this another 40K to 70K bytes for any applications programs that may be in memory and the 128K-byte Macintosh becomes an 18K- to 38K-byte machine. For example, when Mac's Microsoft BASIC package is loaded on top of the resident software, there is only 13K bytes of space for programs and data left. Similarly, MacWrite, Macintosh's word-processing program, only allows documents with a maximum size of about 24K bytes. This problem seems to be an inherent limitation in the current design of the Macintosh because there is no way to expand the memory capacity of the machine. When 256K-bit memory chips become available the Macintosh will be upgraded to a 512K-byte machine, enough space for the most ambitious application programs. However, at the time of this writing these chips are only in the development stage. This means that they will not be commercially available before 1985.

DISK SWAPPING

Closely related to the memory limitations is the problem of "disk swapping." Because the basic Macintosh system has only one disk drive, transferring data from one disk to another requires that the Macintosh read from the input disk, eject the input disk, and prompt the user to insert the output disk. After sending the data to that disk, it is ejected and the user is told to reinsert the input disk. This cycle is repeated until the data transfer is complete. Initially, this shuffling of disks seemed to be tolerable. At least I thought it was until I attempted to back up a disk with 270K bytes of data on it. It took more than 50 disk swaps and 20 minutes to perform this simple operation. This works out to an effective transfer rate of about 5K bytes per swap. The process becomes even more hectic when the Mac has to consult systems software during the transfer. The user must then swap three disks in and out of the internal

drive. Unfortunately, this is precisely the kind of design flaw that will prevent the Macintosh from gaining widespread acceptance in a business environment. Disk backups are absolutely essential to business applications. Therefore, the need for a second drive is a hidden and unadvertised cost of owning the machine.

All things considered, the Desk Accessories (accessory programs that can be run at the same time as another program) are an excellent complement to the Finder. These accessories are available to the user at all times, regardless of the application program that may be resident in memory. This means, of course, that users will be able to cut and paste between diverse application programs. Although not as sophisticated as Lisa's information-passing capability, the Macintosh currently is the only machine in its price range that provides this feature as a system-resident function. However, sometimes the Finder does its job too well. If there are two or three disk icons present on the desktop, each with a copy of the System Folder, calling up a Desk Accessory such as the Alarm Clock will cause the Finder to request that the disk under which the system was initialized be inserted. The Finder then gets the data pertaining to the Desk Accessory from that disk's System Folder instead of using the System Folder of the disk that was in the internal drive. After the Finder gets that information, the user must then reinsert the disk he or she was originally working with to display the accessory. Although not a major inconvenience, this procedure does become somewhat aggravating when one wants to do a simple thing like set the Alarm Clock.

PROGRAMMER'S PERSPECTIVE

Nothing much has been said about Macintosh from the programmer's point of view. Unfortunately, the reason for this is that there is very little to say. The Macintosh is the only machine in recent history to be offered without a programming language. However, Apple has promised assembly language, BASIC, and Pascal for the Mac. As of April 1984 none

of these packages was being marketed. The only language currently available, Microsoft BASIC, is extremely disappointing. Programs written with it will essentially look like MBASIC programs written for the IBM PC. Even when Apple's language packages for the Macintosh are released, users should not expect to be able to produce application programs that utilize Macintosh features like the menu bar, dialog boxes, and windows. Because any language that is run on a Macintosh will be treated like an application program, these routines will be inaccessible to programs created at a lower level than the application program that uses those features. The Macintosh applications that use those features are being done currently in one of two ways. They are either created on a Lisa and downloaded to the Mac, or two Macs are used in tandem (one for writing the program and the other for running it). Developing software in this fashion can be an expensive proposition.

Although Apple has indicated that programmers will be given assistance in developing application programs for Macintosh, in fact this assistance will be available only to a certain chosen few, i.e., established software houses or individuals who have a proven track record of commercial success. Of course, one can always purchase the technical manual for Macintosh, which presumably contains all of the information regarding the highly touted Macintosh toolbox, and attempt to develop Mac applications from scratch. It can be obtained from Apple for \$150. Regrettably, it is unlikely that a "cottage industry" will grow up around the Mac in the same way that one grew around the Apple II. But in spite of its shortcomings, the Macintosh is a significant advance in user-friendly computing.

.....
 J. Edward Chor (1307 West Addison St., Chicago, IL 60613) is an attorney. He received his B.A. in psychology from Eastern Illinois University and his J.D. from Southern Illinois University. His hobbies include reading, sports, and fiddling with machines.



BUILT FOR SPEED

CompuPro has now dramatically increased your micro-computing power and speed.

With our System 816/F™ super-micro with **CPU 286/287™** board. The computer that gives you results. Fast.

Built to provide sophisticated computer users with the fastest 16-bit system available, the System 816/F is a multi-user computer so powerful it virtually has no supermicro peer.

The reason for such a strong statement? We configure the system around the **80286**—among the most powerful 16-bit processors available anywhere and one that's built for speed. The 286/287 board lets you run anything from the 8086/8088 family and includes the 80287 math processor and as much as 16 Kb of EPROM on-board.

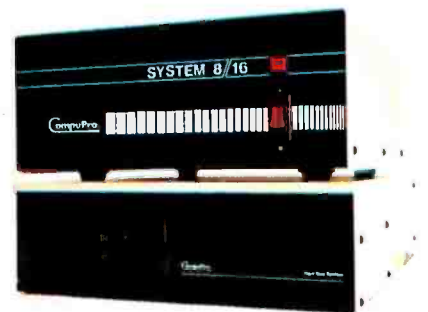
But this board is only part of the story. CompuPro has included a long list of features that enhance this exclusive system even more. Like 1.5 Mb of our

MDRIVE®/H—a solid-state disk with the capacity to dramatically increase the speed of the 286 processor even more . . . 512 Kb of 16-bit main memory expandable to 16 Mb . . . 1.2 Mb floppy disk and up to 80 Mb of hard disk storage . . . 12 serial ports . . . and much more.

And even though our System 816/F has set some industry standards, we still designed it to conform to the IEEE 696/S-100 bus standard. And virtually no one else can say that.

The time you save with CompuPro will save you money, too. Our System 816/F speeds up software development. So the quality and capacity of your programs is enhanced, and the value, maximized.

The CompuPro System 816/F. It's the essential system for OEMs and system integrators who want all the power and speed they can get. And best of all, we've shipped hundreds of them already.



The Essential Computer™

CompuPro®

A GODBOUT COMPANY

3506 Breakwater Court, Hayward, CA 94545
(415) 786-0909

MDRIVE is a registered trademark and System 816/F, CPU 286/287 and The Essential Computer are trademarks of CompuPro. Front panel shown is available from Full Service CompuPro System Centers only. ©1984 CompuPro.

Software for the Mac

When I bought my Macintosh in mid-February, three software packages were available for it: MacWrite/MacPaint, which Apple developed and gave away with the system, and Microsoft Multiplan and Microsoft BASIC (Microsoft has been working with the Mac for two years.) By the end of April, the number of available packages had climbed to four: MacFORTH, from Creative Solutions Inc. (CSI) had hit the shelves. (CSI already had a commercially available 68000-based FORTH.)

By the time you read this, the trickle of Mac software should have grown modestly. The torrent probably won't hit until early 1985 when the 512K-byte, two-disk Macintosh emerges as the new standard and software firms have a year of development under their belts. The 512K-byte Mac will increase the flow of software in another way. With the extra RAM, individuals will be able to develop Mac software without having to buy a Lisa. Programs will be able to do fancier things because graphics capability increases as memory does. And the programs themselves will not have to be as tightly coded to fit into available memory; therefore, they will be developed more quickly. I think the result will be a flood of programs, both public-domain and entrepreneurial.

MACWRITE AND MACPAINT

Both MacWrite and MacPaint are great. Get them, use them, and have fun with them.

MacWrite gives you nine different fonts, six different point sizes, five different styles (mix and match), and superscript-



An example of MacPaint on the Macintosh.

ing and subscripting. The program has three types of spacing, four types of justification, adjustable margins, and two kinds of tabs. It also has headers, footers, rulers, and page breaks. And it has a screen that shows you what you're going to get and a printer that gives you what you saw. The result: the fanciest letter and report writer you ever saw. I don't think I'd use it to write a book, though. The amount of text you can edit is too limited and some things (such as pulling in or appending files) are awkward or impossible. Still, it's great fun.

MacPaint is also destined to be a classic. Admit it: you've always wanted to draw nice pictures but you haven't had the time to learn the necessary skills. Enter MacPaint (see the photo on this page). In seconds, you can create images that would take you hours by hand (if you could do them at all). Children and adults can learn to use it in an amazingly short time (a tribute to Bill Atkinson). My boss and I laid out a 16-page manual for a new software product in two days, complete with borders, boxes for illustrations, and

varying type sizes (MacPaint will generate text). We also designed the disk labels and drew up specs for some booth props we had built. However, you can only draw in a 3- by 5-inch window, which in turn moves around on an 8- by 10-inch area. The small drawing window makes large pictures tedious, especially if you're trying to put in text that is wider than the window. But this is a minor problem. MacPaint is a perfect example of what's amazing and fun about the Macintosh.

MacWrite/MacPaint is available from Apple Computer Inc. (20525 Mariani Ave. Cupertino, CA 95014) for \$195.

MULTIPLAN

Microsoft Multiplan is a Macintosh version of a standard spreadsheet. Not so standard are the crisp display, pull-down menus, and ease of cell manipulation via the mouse. The worksheet is limited to 63 columns and 255 rows, but these figures should increase once the 512K-byte machine becomes widely available.

I found Multiplan easy to use—easier, in fact, than any other spreadsheet I've used. But I do have a few complaints. The documentation assumes a fair amount of knowledge on the part of the user, a poor assumption considering the Macintosh's market. For example, this is the documentation for conditional expressions:

IF(logical-expression,value-if-true,value-if-false)

The IF function evaluates the logical expression, then returns the value-if-true if the expression is TRUE; or it returns the value-if-false if the expression is FALSE.

There are no examples and no explanation.

some prerelease programs with no documentation and I was able to use them almost immediately. Try that under CP/M or MS-DOS. The ROM toolbox is a vital facet of the overall amazing nature of the Macintosh.

The Macintosh also lacks adequate mass storage. At first, it doesn't look bad: it consists of one single-sided 3½-inch built-in disk drive (made by Sony) holding 400K bytes. Having only one disk drive can be a nuisance, but it's acceptable if the drive holds enough

data and if you can copy it easily. However, the system files on a Macintosh disk take up over 200K bytes, or half the disk. Even with trimming, you only have about 220K bytes of usable space on a bootable disk. If any other company marketed a CP/M or MS-DOS system with a single disk drive with only 220K bytes of free space, no one would buy it. It takes a lot of time and disk swapping to copy files or to back up a disk. The Mac's only saving grace on this point is that it automatically ejects the

disk and prompts you for a new one.

The 128K-byte Macintosh with one single-sided drive is not a powerful machine. You can do useful work with it, and the user interface beats all others cold. But for the same price or less, I could go out and buy, for example, a Compaq with 256K bytes of RAM and two 360K-byte disk drives. And I could get lots of software for it—programs that can handle larger, more difficult tasks than the Mac currently can.

The upshot is this: a \$3000 Macintosh,

tion of what a "logical expression" is or how it resolves to true or false. The index refers us to the definitions of NOT or OR; the latter gives us a little more information and one complex example (demonstrating IF, OR, AND, and NOT). This will be confusing to novice users.

But consider getting Multiplan anyway. Not only does it work well, it can share its information with other Microsoft programs, such as BASIC, Word, Chart, and File. The program is available from Microsoft Corporation (10700 Northrup Way, Bellevue, WA 98004) for \$195.

MICROSOFT BASIC

Microsoft BASIC is fairly standard. It does have lots of Mac-specific graphics calls. However, most of the them are poorly documented; instead, the documentation refers you to the *QuickDraw Programmer's Guide*, which doesn't come with the system.

The BASIC itself runs in an environment with three windows: Command, Output, and List. All commands, typing, and editing take place in the Command window; program output and echoed commands show up in the Output window; and program text is seen in the List window. It all works nicely, although I find a few things annoying. The Command/Output window dichotomy can cause problems, especially when the Output window insists on writing text behind the Command window (and nowhere else). Also, the List window has a tendency to propagate itself, so that you end up with several List windows stacked behind each other.

Even with its shortcomings, Microsoft

BASIC is useful. Several public-domain programs for it have already shown up on computer bulletin boards, including a terminal-emulation program and a 68000 disassembler. The program is available for \$195 from Microsoft Corporation (10700 Northrup Way, Bellevue, WA 98004).

MACFORTH

MacFORTH (Level I) lets you do amazing things on the Macintosh. You can create windows complete with close and size boxes and "attach" programs that will execute automatically when a given window is activated. You can build your own pull-down menus with check marks, inactive items, and command-key options. In fact, you could code your own application and have it "take over" the Mac, putting up its own menu bar and controlling all the windows.

The only catch to all of this is that you have to learn FORTH, a programming language unlike any other. FORTH isn't difficult to learn, but it can be a bit confusing to use because of its stack orientation and "reverse Polish notation" syntax. CSI's Going FORTH module helps a bit. Going FORTH is a clever program that sets up two side-by-side windows. One window steps you through an introduction to FORTH. The other is an active FORTH window, where you can try out the things you're learning. Also, each chapter in the printed documentation is a tutorial on a given subject (menus, windows, etc.) with lots of examples to key in and try out.

I think CSI has developed a solid FORTH implementation. (I programmed

in FORTH professionally for a year, but I am by no means an expert.) The window, menu, and graphics functions are well done and easy to use. For example, if you create a window called Easel, and a program to run within Easel called Sketch, the FORTH command EASEL ON.ACTIVATE SKETCH links Sketch to Easel. If you select the Easel window with the mouse, the Sketch program will automatically start executing.

All in all, CSI has done an excellent job. It has made FORTH relatively easy to learn. The documentation is easy to read and use, although the glossary can be cryptic to a FORTH neophyte. Best of all, CSI has unlocked a lot of the Mac's power. FORTH produces very compact code, which means that the Mac's limited RAM isn't so limited anymore.

CSI has three levels of MacFORTH. I reviewed Level I (\$149), which is designed as an introductory package. It does all the things I mentioned, but it doesn't support real (floating-point) numbers or all of the ROM toolbox routines. Level II (\$249), aimed at in-house developers, has real numbers and advanced graphics as well as provisions for inserting 68000 assembly routines. Level III (\$2500) is for software developers interested in marketing programs developed in MacFORTH. It includes technical support, a run-time package, and licenses for 250 copies. Additional licenses cost \$5 per copy.

If you want to make your Mac do things, get a copy of MacFORTH and have fun. MacFORTH is available from Creative Solutions Inc. (4801 Randolph Road, Rockville, MD 20852).

with 128K bytes of RAM, a 400K-byte disk drive, and an Imagewriter printer, is an amazing machine but not really a powerful one. A 512K-byte Mac with two 400K-byte disk drives is both amazing and powerful, but it is also expensive (\$3500, including printer and not counting any cost for the RAM upgrade). In the two-and-a-half months that I've owned my Mac, I've often wondered if I should have bought one so quickly. However, the arrival of MacFORTH (see the text box "Software for the Mac" on

this page) has done much to quell my reservations. I can now create my own windows, graphics, and pull-down menus, and the "fun quotient" of my Mac has made a quantum leap. Besides, I suspect that by the time this sees print, prices will have dropped and the software base will have expanded considerably.

CONCLUSION

You won't find another machine that's as easy to use or as much fun as the

Macintosh. In the right configuration, it can do as much as any microcomputer on the market. However, you should go for a 512K-byte system with two disk drives and a printer. Anything less and you'll find yourself frustrated by the machine's limits.

I have no doubt that I would have bought a Macintosh sooner or later, and I have no intention of getting rid of the one I own. The Mac's a gem—rough, slightly flawed, but a gem nonetheless. ■

OUR AD #B7

THE WORLD'S LARGEST COMPUTER MAIL ORDER FIRM

CONROY

ALL MAIL: Conroy-LaPointe, Inc. 12060 SW Garden Place, Portland, OR 97223
SHOWROOMS AT: PORTLAND, OR and SEATTLE, WA — BOTH OPEN M-SAT 10-6

HARDWARE for your APPLE

APPLE IIe, STARTER SYSTEM BY APPLE CALL



APPLE MACINTOSH CALL
LIMITED WARRANTY is 100% Parts & Labor for 90 days by us

DISK DRIVES

AMDEK Amdisk I, 3" Micro Floppy, 143K \$ 299 \$ 249

* CENTRAL PT., Fier, Utility & Apple DOS \$ 20 \$ 15

μ-SCI

* A2, 143K Disk Drive \$ 345 \$ 219
A2 Controller Card \$ 100 \$ 79
* A40, 160K, Drive \$ 449 \$ 299
* A70, 286K, Drive \$ 599 \$ 299
A40/A70 Controller \$ 100 \$ 79

1/2 HIGH ALPS, A40, Belt Drive, 163K \$ 299 \$ 199
TEAC, 14Q Direct Drive, 163K \$ 349 \$ 219
TEAC, 18Q Double Sided, 326K \$ 449 \$ 329
Controller Card by ComX \$ 110 \$ 49

Rana Elite I, 163K, 40 Track \$ 379 \$ 239
Elite 2, 326K, 80 Track \$ 649 \$ 399
Elite 3, 652K, 160 Track \$ 849 \$ 499
Elite Controller \$ 145 \$ 89

RAM EXPANSION

* ComX, 80 col. + 64K RAM for IIe, 1 Yr. Wty \$ 199 \$ 99
RAM Card, 1 Yr. Wty. (II+) 16K \$ 179 \$ 39
* Microsoft, RAM Card (II+) 16K \$ 100 \$ 69
* Titan/Saturn RAM Card (II+) 32K \$ 249 \$ 159
RAM Card (II+) 64K \$ 425 \$ 249
RAM Card (II+) 128K \$ 599 \$ 359
Software



VIDEO CARDS

* ComX, 80 col. + 64K RAM (IIe) 1 Yr. wty. \$ 199 \$ 99
* Videx, VideoTerm 80 col. (+ or e) \$ 279 \$ 189
* UltraTerm (+ or e) \$ 379 \$ 279
* Soft Video Switch (II+) \$ 35 \$ 25
Enhancer II (II+) \$ 149 \$ 99
Function Strip (II+) \$ 39 \$ 29
We Have Full Videx Line. Call. Up to 35% off

MISCELLANEOUS

* ALS, The CP/M Card V3.0 (+ or e) SPECIAL \$ 399 \$ 199
Z-Card II (+ or e) CP/M 2.2 SPECIAL \$ 169 \$ 99
* ASTAR, RF Modulator, to use TV \$ 35 \$ 25
* CCS, Serial Interface 7710 (Set BAUD) \$ 150 \$ 99
Chalkboard, Power Pad \$ 100 \$ 75
Digital Res., CP/M Gold Card (W/64K) \$ 495 \$ 359
* Expand 64K Gold Cd. to 192K \$ 325 \$ 239
* Eastside, Wild Card (copier, II+ only) SPL \$ 110 \$ 59
Wild Card 2 (copier, + or e) \$ 140 \$ 99
KENSINGTON, System Saver \$ 90 \$ 65
Modem (Mac) \$ 140 \$ 109
Surge Suppressor (Mac) \$ 50 \$ 39
Starter Pak (Mac) \$ 90 \$ 64
Key Tronic, KB200keyboard (II+) \$ 298 \$ 219
Koala, Touch Tablet w/Micro Illustrator \$ 125 \$ 85
Kraft, Joystick (Ap II+/II+) \$ 65 \$ 49
Paddle (Ap II+/II+) \$ 50 \$ 39
M&R, Sup Rlan (+ or e) \$ 50 \$ 30
* Microsoft, 280 Softcard (+ or e) \$ 345 \$ 345
* 280 Softcard Plus (+ or e) \$ 465 \$ 465
* 280 Softcard Premium (II+) \$ 695 \$ 479
* 280 Softcard Premium (Ile) \$ 495 \$ 339
* Orange Micro, Grappier Plus (e or +) \$ 149 \$ 119
16K Buffer Board for Grappier Plus \$ 175 \$ 119
Buffered Grappier Plus, 16K \$ 239 \$ 179
Paymar, Lower Case Chip, Rev. 7 (II+) \$ 50 \$ 39
* PCPI, Applicard, 14 features 6Mhz \$ 375 \$ 275
RH Electronics, Super Fan II \$ 75 \$ 59
* Titan/Saturn, Accelerator II \$ 599 \$ 399
Transend/SSM, AIDII, Serial/Para I/F \$ 225 \$ 169
TG Products, Game Paddles (II+) \$ 40 \$ 29
Joystick (II+) \$ 60 \$ 45
Videx, PSIO I/F Card \$ 229 \$ 169
WICO, Mouse, Complete \$ 179 \$ 119

SOFTWARE for your APPLE

BUSINESS & TRAINING

Arktronics, Jane (Ile or Iic only) NEW \$ 179 \$ 119
Jane II (+) NEW \$ 295 \$ 195
* Applied Soft Tech., VersaForm \$ 389 \$ 299
Artaci, Magic Window I \$ 150 \$ 99
* Ashton-Tate, dBase II (Req CP/M 80) \$ 495 \$ 399
Friday (Requires CP/M 80) \$ 295 \$ 199
* Broderbund, Bank St Writer or Speller \$ 395 \$ 269
Business Solutions, Jack 2 (Ile) NEW \$ 395 \$ 265
Incredible Jack NEW \$ 129 \$ 89
* Continental, GL, AR, AP or PR, each \$ 250 \$ 165
Home Accountant \$ 75 \$ 49
Tax Advantage \$ 75 \$ 49
CDEX, on Viscalc, MultiPlan or Apple Ile, ea. \$ 60 \$ 40
Dow Jones, MarketAnalyzer \$ 350 \$ 225
Market Manager \$ 300 \$ 195
Market Microscope \$ 700 \$ 450
Fox & Keller, Quickcode or dGraph, ea. \$ 295 \$ 195
dUtility (for dBase II) \$ 99 \$ 65
Hayden, Pie Writer (Specify 80 col. bd) \$ 150 \$ 99
* Howard Soft, Tax Preparer, 1984 \$ 250 \$ 185
Knoware, Knoware NEW \$ 95 \$ 64
LJK, Letter Perfect w/Mail Merge \$ 150 \$ 99
Micro Pro, (all require 280 CP/M Card) \$ 695 \$ 295
* WordStar w/Applicard & CP/M SPECIAL \$ 695 \$ 295
* WordStar w/Applicard & CP/M SPECIAL \$ 695 \$ 295
* WordStar II+ Training Manual SPECIAL \$ 495 \$ 239
* SpellStar™ or MailMerge™, ea. SPECIAL \$ 250 \$ 129
* WordStar Professional, 4 Pak SPECIAL \$ 695 \$ 355
* Ophons Pak, SS/M/S/I, SPECIAL \$ 345 \$ 155
Microsoft, MultiPlan, Apple DOS or CP/M \$ 195 \$ 129
* Osborne/ComX, (Disk and Book) (Stat. Bus. & Math) \$ 100 \$ 49
Some Common Basic Programs (75 ea.) \$ 100 \$ 49
Practical Basic Programs (40 ea.) \$ 100 \$ 49
Peachtree, Requires CP/M & MBASIC, 64K Series 40 GL & AR & AP, all \$ 395 \$ 239
Perfect, Perfect Writer/Spell-2pak (CP/M) \$ 399 \$ 199
* Quark, Word Juggler & Louchek (Ile) \$ 189 \$ 139
Sensible, See, Speller or Bookends, ea. \$ 125 \$ 85
Sierra/On-Line, ScreenWriter Pro, 2 Pak \$ 200 \$ 135
ScreenWriter II \$ 130 \$ 89
The Dictionary, NEW! \$ 100 \$ 69
Gen. Manager II NEW! \$ 230 \$ 155
Homework \$ 50 \$ 34
* Silicon Valley, Word Handler \$ 60 \$ 39
* List Handler \$ 50 \$ 35
* Handler Pak (Word, List & Spell) \$ 130 \$ 83
Software Arts, TK Solver for (Ile or Iic) \$ 299 \$ 199
Software Publishing, PPS: File \$ 125 \$ 84
(Specify + or e) PPS: Report \$ 125 \$ 84
PPS: Graph \$ 125 \$ 84
PPS: Write (Ile) \$ 125 \$ 84
Stoneware, DB Master Version 4.0 \$ 350 \$ 229
DB Utility I or II \$ 129 \$ 87
Videx, UltraPlan \$ 189 \$ 119
ViziCorp, Viscalc 3.0 (II+) \$ 250 \$ 169

ViziCorp, Viscalc Enhanced (Ile) \$ 250 \$ 179
Visfile or Visdex, each \$ 250 \$ 179

UTILITY & SYSTEM

Beagle, GPL or Alpha Plot, each \$ 35 \$ 27
Ap. Mechanic, Disquick or Promo DOS, ea. \$ 30 \$ 19
Double Takeover Utility City, each \$ 30 \$ 19
Flex Test or Frame Up, each \$ 30 \$ 19
Typefaces, Tip Disk #1 or DOS Boss, each \$ 20 \$ 15
Central Point, Filer, DOS 3.3 & Util. \$ 20 \$ 15
* Copy II Plus (dot copier) \$ 40 \$ 30
Einstein, Compiler—Applesoft BASIC \$ 129 \$ 85
Epson, Graphics Dump \$ 15 \$ 9
Hayes, Terminal Prog. for Smartmodem \$ 100 \$ 65
* Insoft, GRAFTOR II by Paul Lutus \$ 95 \$ 65
Microsoft, A.L.T.S. \$ 125 \$ 85
Fortran 80 \$ 195 \$ 135
COMPLETE MICROSOFT LINE IN STOCK
* Omega, Locksmith (dot copier) \$ 100 \$ 75
Penguin, Complete Graphics System II \$ 80 \$ 54
Graphics Magician \$ 60 \$ 41
Phoenix, Zoom Graph \$ 40 \$ 34
Quality, Bag of Tricks \$ 40 \$ 29
Terrapin, Logo \$ 99 \$ 65
United SWI, ASCII Express-The Pro \$ 130 \$ 87
Unico, Essential Data Duplicator III \$ 80 \$ 49

HOME & EDUCATIONAL

Atari, Centipede, PacMan or Donkey K, ea. \$ 35 \$ 28
Barrows, Study Program for SAT \$ 90 \$ 60
Beagle Bros., Beagle Bag \$ 60 \$ 40
Bluechips, Millionaire \$ 60 \$ 40
Broderbund, Oxyprior or Lode Runner, ea. \$ 35 \$ 23
Arcade Machine \$ 60 \$ 40
Apple Panic \$ 30 \$ 20
CBS, C. Core Learning Bridge \$ 80 \$ 54
* Continental, Home Accountant \$ 75 \$ 49
DataSoft, Aztec or Zaxxon, each \$ 40 \$ 27
Davidson, Speed Reader II \$ 70 \$ 47
Word Attack or Math Blaster! ea. \$ 50 \$ 34
Edu-Ware, (Large Inventory) 35% off list
Harcourt, Computer Prep for SAT \$ 80 \$ 54
Hayden, Sargon III (Chess) \$ 50 \$ 34
Infocom, Zork I, II, III, or Starcross, each \$ 40 \$ 27
* Insoft, 3 Games, Zarg/Spider Rad/Grapple \$ 62 \$ 25
Knoware, Knoware NEW \$ 95 \$ 64
Koala, Full line in stock, CALL \$ 35% off list
Learning Co., (Large Inventory) \$ 25 \$ 17
Microsoft, Typing Tutor I \$ 35 \$ 27
Monogram, Dollars and Sense \$ 100 \$ 69
Origin, Ultima III \$ 60 \$ 40
Scarborough/Lighting, Mastertype \$ 40 \$ 27
Sierra/On-Line, Ultima II \$ 60 \$ 40
Sir-Tech, Wizardry \$ 50 \$ 35
Spinmaker, Full line in stock, CALL \$ 35% off list
Sub Logic, Flight Simulator I \$ 50 \$ 37
Terrapin, Logo \$ 99 \$ 65

OVERSTOCK SPECIALS

* OKIDATA MICROLINE 80

ONE TIME, QUANTITY LIMITED



80 cps, Pin/friction feed, 80 col., 132 col. compressed
96 ASCII, Graphics, Parallel \$ 299 \$ 179

MISCELLANEOUS

	LIST PRICE	OUR PRICE
Electronic Protection, Lemon	\$ 60	\$ 40
Line	\$ 90	\$ 60
Peach	\$ 98	\$ 66
Orange	\$ 140	\$ 95
Kensington, PC Saver**Line Cover w/Filter	\$ 50	\$ 39
NetworkX, Wiretree, 4 outlet, w/Filter surge	\$ 70	\$ 49

* MEANS A BEST BUY

DISKETTES

CONROY-LAPOINTE DISKETTES

3 Year Limited Warranty, Top Quality product and we guarantee with our name. Bulk packaged.
10ea. SS/SD, 35 Track (Apple, etc.) \$ 21
100ea. SS/SD, 35 Track (Apple, etc.) \$ 149
1000ea. SS/SD, 35 Track (Apple, etc.) \$ 1245
10ea. DS/DD, 40 Track (IBM, H/P) \$ 29
Smartmodem 1200 (RS-232) \$ 239
100ea. DS/DD, 40 Track (IBM, H/P) \$ 239
1000ea. DS/DD, 40 Track (IBM, H/P) \$ 1995

	LIST PRICE	OUR PRICE
AMDEK, 3" Diskettes, Pac-10	\$ 60	\$ 49
CDC, 100ea. SS/DD, 40T (Apple, IBM)	\$ 550	\$ 195
10 ea. SS/DD, 40T (Apple, IBM)	\$ 55	\$ 21
100 ea. DS/DD, 40T (IBM, H/P)	\$ 750	\$ 295
10 ea. DS/DD, 40T (IBM, H/P)	\$ 75	\$ 29
DYSAN, 10ea. SS/DD (Apple, etc.)	\$ 41	\$ 29
10ea. DS/DD 48T (IBM, H/P etc.)	\$ 69	\$ 43
MAXELL, 10 each, MD1, SS/DD	\$ 55	\$ 29
10 each, MD2, SS/DD	\$ 75	\$ 39
VERBATIM, 10 each MD25/01, SS/DD	\$ 49	\$ 25
10 each MD34, DS/DD	\$ 84	\$ 35

GENERIC**DISKETTES—ASLOWAS \$1

W/Jackets, no labels, top quality, 90 day limited warranty
100 ea. SS/SD, 35 Track (Apple, Atari) \$ 415 \$ 130
1000ea. SS/SD, 35 Track (Apple, Atari) \$ 4150 \$ 995
100ea. DS/DD, 48TPI (IBM, H/P) \$ 626 \$ 170
1000ea. DS/DD, 48TPI (IBM, H/P) \$ 6260 \$ 1400



41CX, Calculator NEW! \$ 325 \$ 275
41C, Calculator \$ 195 \$ 149
41CV, Calculator w/2.2K \$ 275 \$ 219



for the ATARI
RANA 1000 Drive, 320K \$ 449 \$ 369
KOALA, Pad w/Micro Hlus. \$ 100 \$ 75

MODEMS AND ACCESSORIES

	LIST PRICE	OUR PRICE
ANCHOR, Signalmen Mark XI	\$ 399	\$ 269
HAYES, IBM PC Smartmodem 1200B	\$ 599	\$ 419
IBM PC Smartcom II Software	\$ 149	\$ 109
Microdemon Ile w/Smartcom	\$ 329	\$ 239
Microdemon 100 (S-100bus)	\$ 399	\$ 275
Stack Chronograph (RS-232)	\$ 249	\$ 189
Stack Smartmodem 300RS-232	\$ 289	\$ 225
Smartmodem 1200 (RS-232)	\$ 699	\$ 535
IBM-PC to Modem Cable	\$ 39	\$ 29
KENSINGTON, Modem 1200	NEW \$ 595	\$ 385
NOVATION, 103/212Smart Cat	\$ 595	\$ 415
ACCESS 1-2-3 (1200B & Smarttalk XVI)	\$ 595	\$ 399
Apple Cat II 300 BAUD	\$ 389	\$ 249
121 Applinet, 1200 BAUD	\$ 725	\$ 559
Cat	\$ 189	\$ 139
J-Cat	\$ 145	\$ 84
212 Auto Cat	\$ 695	\$ 579
QUADRAM, Quadmodem, Internal IBM (July)	\$ 595	Call
Quadmodem, Stand alone (July)	\$ 695	Call

SOFTWARE—SEE APPLE OR IBM UTILITY SOFTWARE SECTIONS

MONITORS AND ACCESSORIES

	LIST PRICE	OUR PRICE
* AMDEK, 12" Green, #300G	\$ 200	\$ 125
12" Amber, #300A	\$ 210	\$ 149
12" Amber, #310A for IBM-PC	\$ 230	\$ 149
13" Color I, RGB, H Res. (IBM/Apple)	\$ 379	\$ 289
13" Color II, RGB, H Res. (IBM/Apple)	\$ 529	\$ 439
13" Color IV, RGB, 720Hx400V (IBM)	\$ 795	\$ 685
DVM III, Color II or III to Apple II, I, F	\$ 199	\$ 175
* PRINCETON, RGB Hi Res. HX-12	\$ 795	\$ 499
RGB Hi Res. SR-12	\$ 799	Call
* Amber, MAX-12 (for Mono Board)	\$ 249	\$ 199
* QUADRAM, Quadchrome 12" RGB Color	\$ 695	\$ 495
Quadchrome 17" 968x512	\$ 1995	\$ 1595
* ZENITH, 12" Green, ZVM123	\$ 200	\$ 99
12" Amber, ZVM124	\$ 200	\$ 149

PLOTTERS

AMDEK, Amplot II, 6pen, 10x14 Bed \$ 1099 \$ 999

PRINTERS AND ACCESSORIES

	LIST PRICE	OUR PRICE
DOT MATRIX:		
EPSON, RX80T, 100 cps	\$ 499	\$ 339
RX80, 100 cps	\$ 399	\$ 299
FX80, 160 cps	\$ 699	\$ 495
FX100, 160 cps	\$ 895	\$ 689
MX100F/T, 80cps, w/Graftax+	\$ 995	\$ 495
Apple II Graphics Dump Program	\$ 15	\$ 9
Apple II Graphics Dump Program	\$ 399	\$ 299
* MANNESMANN Sprint, 80 col 80cps	\$ 799	\$ 589
TALLY, 180, 120col, 160cps	\$ 1098	\$ 778
OKIDATA, 80, 80col, 80cps, para. SPL	\$ 299	LOW!
82A, 80col, 120cps, para.	\$ 449	\$ 319
83A, 132col, 120cps, para.	\$ 749	\$ 599
84, 136col, 200cps, para.	\$ 1395	\$ 1095
92, 80col, 160 cps, para.	\$ 599	\$ 469
93, 136col, 160 cps, para.	\$ 999	\$ 749
2350P Pacemark, 350cps, para	\$ 6295	\$ 2095
2410P Pacemark, 350cps, para	\$ 2995	\$ 2395
Accessories, Plug 'N Play, Tractors, Otagraph		Call
ORANGE MICRO, Grappier+ for Apple	\$ 165	\$ 119
PRACTICAL, Microdot In-Line 64K, Para.	\$ 349	\$ 259
Microdot In-Line 64K, Ser.	\$ 349	\$ 259
QUADRAM, Quadjet Jet Color Printer	\$ 895	\$ 795
* STARMIC, Gemini 10" X, 120cps	\$ 499	\$ 289
Gemini 15" X, 120cps	\$ 549	\$ 439

LETTER QUALITY:

AMDEK, 5040, 40cps, Para. & Ser. \$ 1675 \$ 1450
* TTX, 1014, 12cps, Para, Ser, Pw/Prnc, 3p \$ 649 \$ 439
JUKI, 6100, 18 cps, Para, 3 pch \$ 599 \$ 459

PRINTER INTERFACES AND BUFFERS:

IBM-PC, Parallel Printer Cable \$ 60 \$ 35
Apple II I/F & Cable for Epson or Gemini \$ 95 \$ 59

QUADRAM:

Microdot, w/Copy, Pk, 8K, MWPB w/PS \$ 189 \$ 139
Microdot, w/Copy, Pk, 64K, MWPB w/PS \$ 319 \$ 239
Microdot, w/Copy, Pk, 128K, w/PS \$ 465 \$ 345
Microdot, Snap-on, BK, Pk, Epson w/PS \$ 179 \$ 145
Microdot, Snap-on, 64K, Pk, Epson w/PS \$ 319 \$ 235

All Microdot are expandable (w/copy to 512K) (Snap-on to 64K)
SUPPLIES: Tractor Feed Paper, Ribbons, Daisy Wheels.

ORDERING INFORMATION AND TERMS: MAIL TO: 12060 SW Garden Place, Portland, OR 97223—Include telephone number and double check your figures for Shipping, Insurance & Handling.
All items qualify for Stock, Cashiers Check, Money Order, Express, 1000 Checks and Government Checks, we immediately honor. Personal or other Company Checks allow 20 days to clear. No C.O.D. Prices reflect a 3% cash discount so ADD 3% to above prices for VISA, MasterCard or American Express. For U.S. Mailing, add 3 1/2% (minimum) for shipping, insurance and handling (ISH) by UPS. UPS ground is standard so add 3% (ISH minimum) more for UPS Blue for U.S. Post, APO or FPO. For Hawaii, Alaska and Canada, UPS is in some areas only, all others are Postal so call, write, or specify Postal. Foreign orders except Canada for ISH add 18% (\$25 minimum) for ISH except for monies add 30% (\$50 minimum) for ISH. All items available and specifications subject to error or change without notice so call to verify. All goods are new, include warranty and are guaranteed to work. Due to our low prices and our assurance that you will get new unused products, ALL SALES ARE FINAL. Call before returning goods for repair or replacement. Orders received with insufficient ISH charges will be refunded. ORDER DESK, HOURS 6 A.M. to 6 P.M. PST, Monday through Friday and 10:00 A Saturday. 9 A.M. here is 9 A.M. in New York.
OUR REFERENCES: We have been in computers and electronics since 1958, a computer dealer since 1978 and in computer mail order since 1980. Banks: 1st Interstate Bank, 5033 64th Ave. We belong to the Chamber of Commerce (503 278-9411) and Direct Marketing Association, or Call Durm and Broadstreet if you are a subscriber.
Epson, RAM™, Fast™ and Generic™ are trademarks of Epson Corporation. PC MasterCard™ and an Atari™ are trademarks of Magnum Computer.

CASH & CARRY OFFERS:
Over-the-counter sales only. Open Monday through Friday, 10:00 until 6:00, Saturdays 10:00 until 6:00.
PORTLAND, OREGON—NEW LOCATION! At Park 217, right at intersection of 217 and 99W. Coming from Portland on 99W, take immediate left after 217 overpass and Texaco Station. Call 621-5595, SEATTLE, WASH.—3540 128th Ave. SE, Bellevue, WA 98006-TE: 641-4736 in Leehamm's Plaza near Factoria Square, SE of Hwy 405 & 90 and at SE 38th & Richards.

LA POINTE SM

Formerly **Computer Exchange**



LOW PRICES TO PROFESSIONALS WHO KNOW WHAT THEY WANT AND KNOW HOW TO USE IT!

© 1984 by Conroy-LaPointe, Inc. All Rights Reserved

256K IBM-PC or XT

320/360K Disk Drives by CDC
90 Day Limited Warranty By Us
Call for Details



SM 1984. Service Mark of Conroy-LaPointe, Inc.

DRIVES AND ACCESSORIES

for the IBM-PC or XT
ALLOY
PC Backup, 1GB, Cartridge Tape Sys. \$2195
PC-STOR 41MB/17MB Disk & Backup Sys. \$5995

AMDEK
Amdek V. 1/2 height, internal, 320/360K
Cable, Amdek III to IBM-PC interface \$329 \$249



CONTROL DATA

320K/360K DS/DD DISK DRIVES
With Detailed Installation Instructions
30 Day Limited Warranty by Factory Authorized Distributor

Same as now installed by IBM **\$185 FULL HEIGHT**
CDC HALF \$165 HEIGHT

CDC, 1/2 Hi Dual Drive Installation Kit \$30 \$16

10 MEG (XT) DISK KITS

Convert your PC to 10 meg and to be XT compatible with one of the following INTERNAL HARD DISK SYSTEMS. Kits are quality engineered to work with DOS 2.0/2.1. Completely XT compatible. All you need is your DOS manual. Easy to install. Includes 10 Megabyte Hard Disk, Controller Card and Instructions.

ComX Internal 10 meg Hard Disk Kit NEW \$ 869

Kammerman Labs
Megaflight 100, 10 mbyte Hard Disk Kit NEW \$869

MAYNARD
10 meg Hard Disk Kit, WSI Sandstar Controller will accept 3 Sandstar modules \$1395 \$1150

QUADRAM
Quaddisk Internal Hard Disk w/Controller
6MB Removable NEW \$2295
6MB Fixed NEW \$1995
12MB Fixed NEW \$2150
27MB Fixed NEW \$2895
72MB Fixed NEW \$6500

TAVA-PC IBM COMPATIBLE

TAVA-PC, 256K, 2 Half Height CDC 360K Drives, Disk Controller, Color Graphics Card and:

- with no Monitor \$2345 \$1995
- with Amdek Amber Monitor 310A \$2575 \$2139
- with Amdek Green Monitor 300G \$2545 \$2139
- with Amdek Color 1+ Monitor \$2274 \$2279
- with 1 floppy, 10MB Hard Disk IBM-XT Compatible by ComX \$3995 \$2795

We find the TAVA-PC to be as compatible with the IBM PC as the Compaq Eagle and Columbia PC World (April 1984) says, "The TAVA-PC strongly resembles the IBM-PC in looks and operation."

SUPPLY CENTER for IBM-PC or XT

AMDEK	MAI 4-in-1 Multiple Board, Color Graphics&Mono, Para Port.	\$499	\$399
AST	ComboPlus, 64K, S/P/CC	\$395	\$265
	ComboPlus, 256K, S/P/CC	\$695	\$495
	MegaPlus II, 64K, S/P/CC	\$445	\$345
	MegaPlus II, 256K, S/P/CC	\$695	\$595
	256K MegaPlus II Expander	\$395	\$295
	SaPaKPlus, 64K, S/P/CC +S/W	\$265	\$195
	SaPaKPlus, 256K, S/P/CC +S/W	\$695	\$495
	Game Port for SaPaK	\$895	\$595
	I/O Plus I, S/P/CC	\$25	\$15
	I/O Plus II, S/P/CC/G	\$265	\$185
	I/O Plus II, 2S/P/CC/G	\$315	\$215
	MonoGraphPlus™ (P/CC for Lotus)	\$495	\$375
	PCNet, Starter Kit, PC002	\$1095	\$895
	PCNet, Circuit Board, PC001	\$799	\$499

* **CCS** SuperVision, 132 col, mono, board Graphics Adapter for Super vision \$250 \$150

Chalkboard, Power Pad (Requires Kit) \$100 \$73
Chalkboard Starter Kit \$50 \$34

* **ComX** EconoRAM™ 256K RAM Card w/Fastrak™ RAM disk emulator and spooler software \$456 \$325

CURTIS UNI-I, Monitor tilt & swivel base \$50 \$39
3 to 9 foot keyboard cable \$40 \$30
Vertical CPU "System Stand" \$25 \$19
Monochrome Ext. Cable Pair \$50 \$35

HERCULES Colorgraphics w/para. \$245 \$169
Graphic Card, Mono \$499 \$349

Key Tronic KB5150, Std. keyboard \$209 \$159
KB5151, Std. keyboard NEW \$255 \$189
KB5151, keyboard NEW \$255 \$189

Koala Koala Pad™ w/PC Design \$150 \$99
Programmer's Guide \$15 \$14

MAYNARD SANDSTAR SERIES
MultiFunction (G) Card, MFC \$89 \$79
Memory Card no RAM \$199 \$169
Memory Card 256K \$499 \$399
HardDisk I/F Module (HOM) \$495 \$395
HardDisk Cable \$30 \$27
Para Port Module (PPM) \$45 \$39
Serial Port Module (SPM) \$95 \$79
Cook Card Module (CCM) \$55 \$48
Game Adapter Module (GPM) \$49 \$43
Memory Module (MX) (MM0) \$122 \$99
Memory Module 256K (MM256) \$422 \$357
XT10 meg Hard Disk & I/F WSI \$1395 \$1150

MICROSOFT

SystemCard 256K	\$625	\$450
Mouse	\$195	\$145
MOUSE SYSTEMS , PC Mouse w/software	\$295	\$195

MAGNUM, PC MasterCard™, 1.53GK, Multifunction S/P/CC with SdRAM™ software which provides printer spooler, RAM disk & many other functions \$4995 \$3950

PLANTRONICS

Color Board & Colormag, 16 color, w/Para \$559 \$395
Color Board & Draftsman, 16 color, w/Para \$559 \$395

PARADISE, MultiDisplay Card NEW \$595 \$435

QUADRAM

Quadlink	NEWEST VERSION	\$680	\$480
Quadboard, no RAM, expand to 384K		\$295	\$215
Quadboard 64K, expand to 384K S/P/CC		\$395	\$279
Quadboard 256K, expand to 384K S/P/CC		\$795	\$525
Quadboard, 384K S/P/CC		\$795	\$625
Quadboard II, no RAM, expand to 256K		\$295	\$215
Quadboard II, 64K expand to 256K S/P/CC		\$395	\$265
Quadboard I, 256K, 2S/CC		\$595	\$395
Quad 512 + 64K plus serial port		\$325	\$265
Quad 512 + 256K plus serial port		\$550	\$420
Quad 512 + 512K plus serial port		\$895	\$625
Quadcolor I, board, 16 colors		\$295	\$215
* Upgrade Quadcolor I to II kit		\$275	\$199

Quaduo, board, Mono S/P/CC \$495 \$395
* Quadochrome, 12" RGB Color Monitor \$795 \$495
Quadscreen, 17" 960x512 Mono Monitor \$1995 \$1595

STE Super RIO with 256K RIO Plus with 256K Graphics Plus \$689 \$499
RIO Plus with 256K \$665 \$499
Graphics Plus \$395 \$285

Tecmar Graphics Master \$695 \$545
1st MATE, 64K S/P/CC \$389 \$275
1st MATE, 256K S/P/CC \$589 \$399
Capitan, 64K S/P/CC \$424 \$324
Capitan, 384K S/P/CC \$795 \$595
Wave, 256K (short board) \$499 \$365
Boss, S/P/CC (short brd.) \$195 \$149

Titan Accelerator PC (8086 + 128K) \$995 \$750
TG PRODUCTS Joystick \$45 \$30
WICO, IBM PC Mouse \$100 \$69



Prices and availability subject to change. Call.

\$49 Call for Larger Quantity Prices

* 9 Each, 64K, 200 ns, MEMORY CHIP KIT
90 Day Warranty by us

\$325 \$295 Two or more.

* **ComX EconoRAM™ 256K BOARD**

Fully Compatible 1 Year Limited Warranty by ComX
With Fastrak™ RAM Disk Emulator and Spooler Software
Works on DOS 1.1, 2.0 or 2.1

★ MEANS A BEST BUY

OUR AD #B7

VISA

MEMBER DIRECT MARKETING ASSOCIATION

NO SALES TAX

NATIONAL ORDER DESK **TOLL FREE (800) 547-1289**

Order Desk Hours: 6AM to 6PM PST

Oregon TOLL FREE (800) 451-5151
Portland: 620-9877

Hot Line For Information On Your Order (503) 620-9878

FREE GIFT

Use of our order forms qualifies you for a free gift with your order. Get on our mailing list now for order forms, and our new newsletter and sales special announcement. Our customers are already on our list.

COUPON

NAME _____
ADDRESS _____
CITY _____ STATE _____ ZIP _____

MAIL TO: 12060 SW Garden Place, Portland, OR 97223



S·Y·S·T·E·M R·E·V·I·E·W

The IBM PCjr

Impressive
but
disappointing

BY ROWLAND ARCHER JR.

The IBM PCjr makes a good first impression. It is slickly packaged, easy to set up and use, and gives an overall impression of quality. It is lightweight compared to the IBM PC, primarily because of its plastic case (the PC's case is metal.) Clearly, IBM took some time in deciding how to pack the system and guide the first-time user. For example, the design of the connectors makes it virtually impossible to plug the wrong peripheral device into a jack. This is a good thing because the jacks, located on the back panel, are labeled sparsely. (See the photo in the "At a Glance" spread on page 258.)

The IBM PCjr's options are also easy to install, requiring at most a flat-blade screwdriver. As with the back-panel connectors, you cannot plug an option into the wrong motherboard connector. I never had to set a DIP (dual-inline package) switch or change a jumper while installing options, a welcome relief from the PC. PCjr's software notices newly installed options and adjusts automatically.

On the minus side, the PCjr's plug-in cards are wobbly, with no card guides or tie-downs. I haven't seen any adverse effects from this, but it is unsettling.

SPECIFICATIONS OVERVIEW

The PCjr is highly compatible with the IBM PC. It uses the same Intel 8088 microprocessor, runs the same PC-DOS version 2.1 disk operating system, and can use many of the same application programs. It comes in two basic models and many extra-cost options are available. The least expensive model retails for \$599; it includes 64K bytes of RAM (random-access read/write memory), a color-video controller for use with your TV set, an RGB (red-green-blue) or composite monitor, a three-voice sound generator, a cordless keyboard, and two slots for plug-in ROM (read-only memory) program cartridges (see photo 1).

No display device is included in the base price. You must either use your TV set, in which case you will need the TV adapter; an RGB monitor, which requires the RGB monitor adapter; or a composite monitor, which requires a cable with an RCA phono plug at one end and the appropriate connector for your

monitor at the other.

The enhanced version of the PCjr costs \$999 and includes all the features of the base model plus 64K bytes more RAM (for a total of 128K bytes), 80-column video display capability, and a built-in half-height 5¼-inch floppy-disk drive that holds 360K bytes. Each of these is also available as a separate option to the base-model PCjr. Additional options include Cartridge BASIC (a ROM cartridge incorporating an enhanced BASIC that is compatible with the PC's BASICA), a TV connector (radio frequency, or RF, modulator), cassette recorder cable (IBM does not sell a cassette recorder), an internal modem, a thermal printer, one or two joysticks, a parallel-printer adapter, and a keyboard cord that replaces the infrared link.

IBM also announced several new software packages concurrently with the PCjr. These packages demonstrate IBM's intention to sell the PCjr to families and schools: they include easy-to-use home applications, arcade-style games, and some game-based math programs.

KEYBOARD

Most reviewers have roundly jeered the PCjr's keyboard. I wish I could report that it seems better after a couple of months of use, but it doesn't. As photo 2 shows, the keyboard has widely separated keys with no legends on them. The definition of each key is printed on the grid between the keys. This lets software vendors provide keyboard templates that give a label for many keys, as Sierra On-Line does for the HomeWord word processor, which I'll discuss later.

Unfortunately, it also means that you have to lean over the keyboard or tilt it toward you to read the legends. The keys themselves have a mushy feel, most unpleasant for touch-typing. I get the impression that IBM designed this keyboard for children, and perhaps that's why I don't like it.

The keyboard's cordless feature is of questionable value. Besides being one more thing to buy batteries for, it is direction sensitive. If you put the keyboard in your lap, its signal will not reach the system unit (IBM's lingo for

the main computer box) unless it is pointing right at it. If you place the keyboard in your lap and sit within the 20-foot acceptable distance from the system unit, it is easy to tilt the keyboard out of contact with the receiver. Contact is also lost if someone or something passes between the keyboard and the system unit. And if the keyboard sits on a table in front of the system unit, being cordless doesn't add much.

The PCjr's keyboard has only 62 keys (the IBM PC has 83). However, it can produce all the PC's key codes through multiple keystrokes (see table 1). For example, on the PC, function code 1 is generated by hitting F1; on the PCjr you must first hit the key labeled Fn, then the 1 key, which is also labeled F1. The PCjr *Technical Reference* manual refers to "the 62-key keyboard and the 83-key keyboard," so perhaps relief is around the corner in the form of an unannounced, full-size keyboard.

The keyboard is the PCjr's major weakness. Alternative keyboards are available already, but if you add the price of a keyboard from an outside vendor, the PCjr's costs creeps closer to that of the IBM PC.

VIDEO

The PCjr's video circuitry is an extension of the IBM PC color-graphics adapter. Its video controller is built into the system motherboard, rather than on a plug-in card like the PC's. Table 2 summarizes the modes available for text and graphics display. In addition to having all the PC color card's modes, the PCjr has some extended modes: 16 colors in 320-by 200-pixel format, and 4 colors in 640-by 200-pixel format. These give the PCjr an edge over the PC in color displays. Note that you need the 128K-byte memory option with the video-display adapter to enjoy 80-column text and the enhanced graphics modes.

As mentioned before, the PCjr comes with outputs for a composite monochrome or color monitor (RCA jack), an RGB color monitor

.....
Rowland Archer Jr. (5420 Loyal Place, Durham, NC 27713) is a manager of software development at a Fortune 500 corporation. He holds an M.S. in computer science from the Massachusetts Institute of Technology.

such as the IBM color display, and a connector for an RF modulator to drive a color TV set. There is no support for the IBM PC monochrome display.

Most programs that run on the IBM PC color-video card will run on the PCjr video controller. However, the two differ in memory usage: the PCjr's video memory comes out of main-system memory rather than separate memory like that of the PC's display-adapter cards. Up to 16K bytes is used in the IBM PC's graphics modes, so some PC graphics programs that run in 128K bytes will not run on a 128K-byte PCjr because it has insufficient memory.

For speed, some programs store text directly into video memory, the area used by the video-controller circuitry to refresh the screen. The PCjr's video memory is located at the top of user memory, while the PC's color-card video memory is at location B8000 hexadecimal. IBM uses a hardware trick to allow programs that access this memory directly on the PC to function on the PCjr. References to B8000 hexadecimal are automatically re-directed by the hardware to the PCjr's video-

(continued)



Photo 1: The IBM PCjr is slickly packaged, easy to set up, and gives an initial impression of quality, although it may disappoint more demanding users.

memory location. No such compatibility with the IBM PC monochrome-display adapter is provided, so programs that access the monochrome display's refresh memory directly, with no support for the PC's color-display card, will not work on PCjr.

There are a few other minor differences between the PC's color video controller and the PCjr's. The PC turns color on by default; the PCjr turns color off. The PCjr includes a keyboard function that shifts the visible part of the display left or right to center it on the screen (this is especially useful on TV sets, which frequently have displays that are off center).

DISK DRIVE

The PCjr uses a half-height 5¼-inch floppy-disk drive that is compatible with the IBM PC's. You can freely interchange disks between the two machines. The drive in my PCjr was manufactured by Qume. It is double-sided double-density with 360K bytes per disk.

If you start with the base-model PCjr, you can add the disk drive later. Installation of the drive is easy: remove the face plate covering the disk-drive hole in the front panel, plug in the controller board, hook up the power and controller cables, and snap the drive into place.

Half-height drives have different timing parameters than full-size drives, and some software (a very few programs) will not function properly on them. In particular, copy-protection schemes that directly program the disk controller may

Table 1: IBM creates all 83 IBM PC keyboard codes with the PCjr's 62 keys. Some commonly used single-key sequences on the PC, such as Page Up and Page Down (PgUp, PgDn), require two keystrokes on the PCjr.

IBM PC Key Code	PCjr Equivalent
F1 — F10	F n then F1 — F10
Shift F1 — F10	Shift F n then F1 — F10
Ctrl F1 — F10	Ctrl F n then F1 — F10
Alt F1 — F10	Alt F n then F1 — F10
Ctrl Break	F n Break
Ctrl End	Ctrl F n then End
Ctrl PrtSc	F n then Echo
Ctrl Home	Ctrl F n then Home
Ctrl Num Lock	F n then Pause
Ctrl PgDn	Ctrl F n then Pg Dn
Ctrl PgUp	Ctrl F n then Pg Up
Shirt PrtSc	F n then Prt Sc
Scroll Lock	F n then Sc Lock
Num Lock	Alt F n then N
PgUp	F n then Pg Up
Pg Dn	F n then Pg Dn
Home	F n then Home
End	F n then End
\	Alt /
'	Alt ' (apostrophe)
|	Alt |
-	Alt -
Numeric keypad numbers	Alt F n then number
Numeric keypad -	F n then -
Numeric keypad =	F n then =
Numeric keypad .	Shift Del
PrtSc *	Alt .

cause a program to fail on the PCjr.

A more bothersome difference between the PC and the PCjr is the lack of DMA (direct memory access) on the PCjr's disk controller. The PC has DMA, which means that the disk controller can transfer a block of data from the disk to memory without intervention from the PC's central processor while

each byte of data is transferred. The PCjr's designers saved money by keeping the circuitry simple and letting the main microprocessor handle the data. The net result is that, while the disks are active, other processing stops. The most annoying consequence of this is that keyboard type-ahead is ignored while the disks are active. This probably would not bother me if I were not used to the fact that I can type ahead on the PC. However, there are times when this is annoying. For example, if you use the Fn key plus Pause to control the display of a disk file, the PCjr frequently beeps when you press the key while the disk is active.

The restriction this places on simultaneous communications and disk-drive activity is perhaps more severe. You cannot download data from a communications line (modem or RS-232C port) directly to a disk file, unless your communications program can notify the remote machine to stop sending data temporarily while it saves its full buffer to disk.

The PCjr manual warns about a design limitation that I never witnessed. Ac-

(continued)



Photo 2: The infamous PCjr keyboard features widely spaced keys and legends that are hard to read from a normal typing angle.

AT A GLANCE

Name

IBM PCjr

Manufacturer

IBM Corporation
POB 1328
Boca Raton, FL 33432

Dimensions

System unit: 13.9 by 11.4
by 3.8 inches high

Weight: 5 pounds 8
ounces; 8 pounds 4
ounces with disk drive

Keyboard: 13.5 by 6.6 by
1 inches high

Weight: 1 pound, 6
ounces with batteries

Features

Intel 8088 16-/8-bit micro-processor operating at 4.77 MHz, 64K bytes of RAM, 64K bytes of ROM, slots to plug in up to 128K bytes more ROM, one RS-232C serial port, 40-column video output for RGB (red-green-blue) or composite color monitor, or television with optional RF (radio frequency) modulator, single-voice beeper, three-voice sound generator with external audio output, cassette port (recorder not supplied), two joystick inputs, and cordless 62-key keyboard.

Software

Cassette BASIC, tutorial disk, and sample disk

Hardware Options

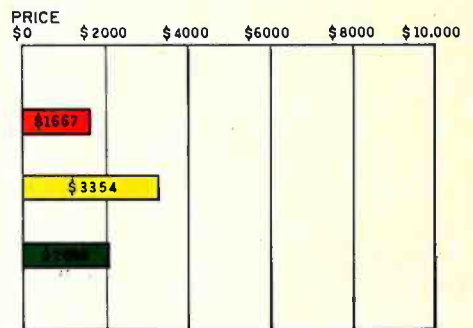
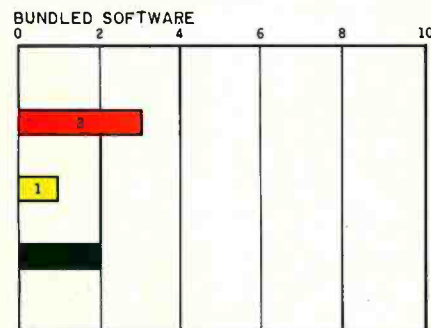
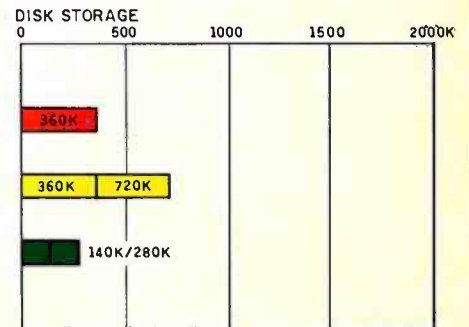
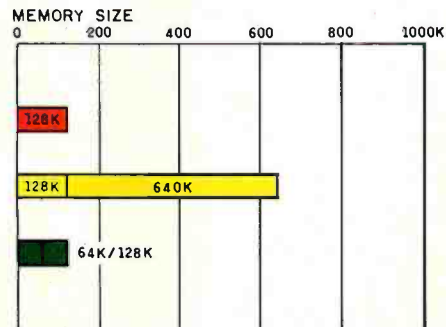
RF modulator for TV connection: \$30
360K-byte disk drive: \$480
64K bytes RAM/80-column video: \$140
Parallel-printer adapter: \$99
Internal 300-bps direct-connect modem: \$199

Software Options

PC-DOS 2.10: \$65
Cartridge BASIC: \$75

Documentation

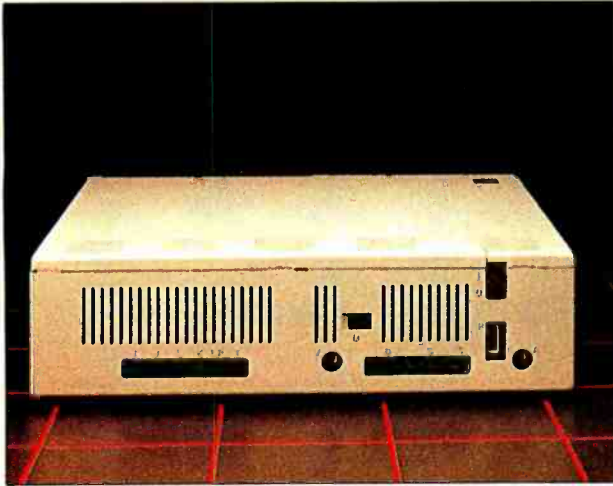
Guide to Operations and Hands-On BASIC



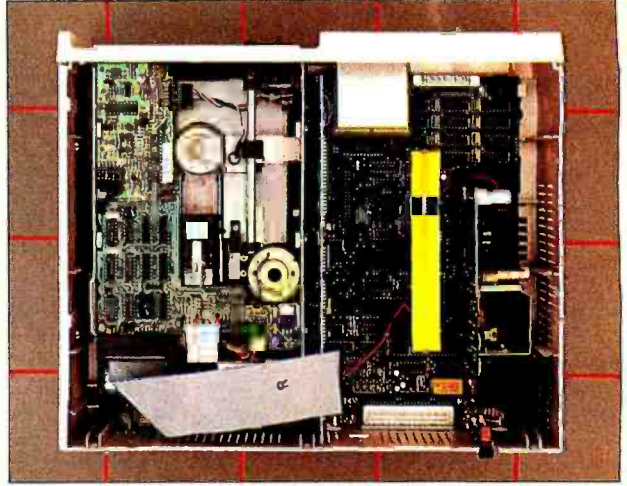
■ IBM PC JR
 ■ IBM PC
 ■ APPLE II E

The Memory Size graph shows the standard and optional memory available for the computers under comparison. The Disk Storage graph shows the highest capacity of a single floppy-disk drive for each system. The Bundled Software graph shows the number of software packages included with each system. The Price graph shows the list price of a system with two high-capacity floppy-disk

drives, a monochrome monitor, graphics and color-display capability, a proprietary serial printer port, 256K bytes of memory (64K bytes for 8-bit systems), the standard operating system for each system, and the standard BASIC interpreter for each system. Note that the IBM PCjr standard system includes the maximum of one floppy-disk drive, an IBM color monitor, and 128K bytes of memory.

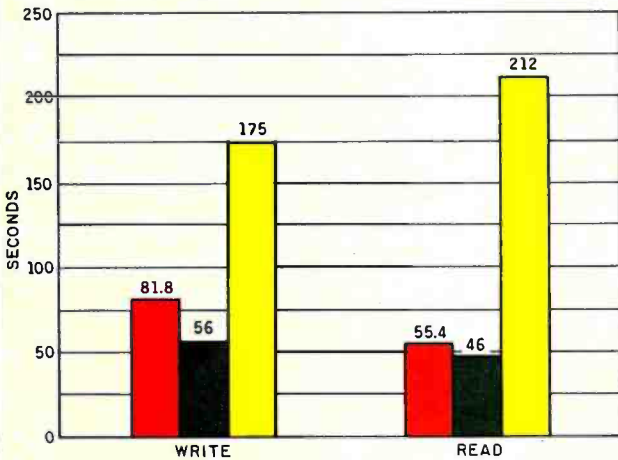


Connectors for a wide variety of input/output devices are minimally labeled on the back of the PCjr.

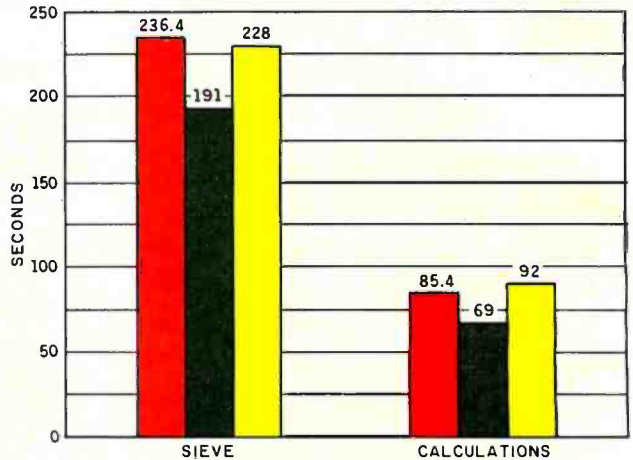


Taking the top off the enhanced IBM PCjr reveals the disk drive and controller card, 64K-byte memory add-on card, and power supply.

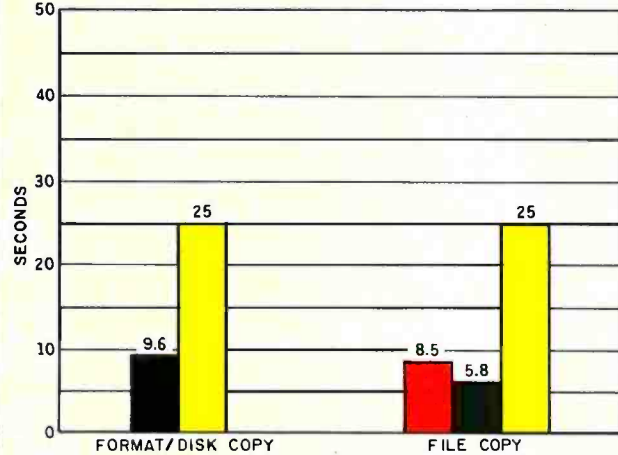
DISK ACCESS IN BASIC



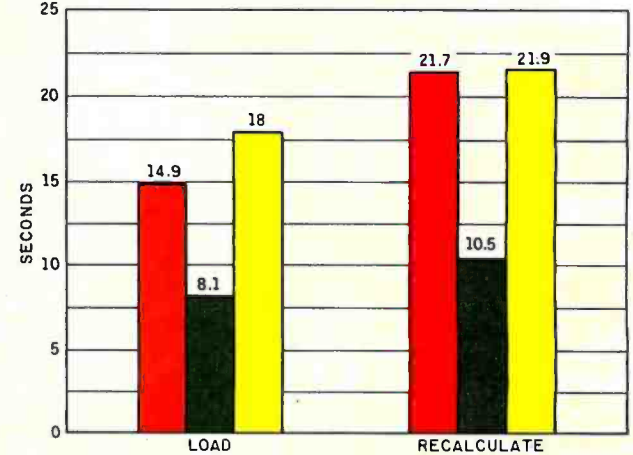
BASIC PERFORMANCE



SYSTEM UTILITIES



SPREADSHEET (MULTIPLAN)



■ IBM PC JR
 ■ IBM PC
 ■ APPLE IIE

The graphs for Disk Access in BASIC show how long it takes to write a 64K-byte sequential text file to a blank floppy disk and how long it takes to read this file. (For the program listings, see "The Chameleon Plus," by Rich Krajewski, June, page 327.) The BASIC Performance graph shows how long it takes to run one iteration of the Sieve of Eratosthenes prime-number benchmark and also how long it takes to do 10,000 multiplication and division operations using single-precision numbers (see the Calculations results). The System Utilities

graphs show how long it took to format and copy a disk (adjusted time for 40K bytes of disk data) and to transfer a 40K-byte file using the system utilities. The Spreadsheet graph shows how long the computers took to load and recalculate a 25-by-25-cell spreadsheet where each cell equals 1.001 times the cell to its left. The spreadsheet program used was Microsoft Multiplan. Note that because the PCjr has only one disk drive, the Format/Disk Copy graph is not applicable and File Copy was done to another part of the same disk.

From Springer-Verlag . . .

Four reasons why many consider Modula-2 the "language that will replace Pascal"*

* BYTE, April 1983

1.

Programming in Modula-2

2nd Edition
Niklaus Wirth

"Wirth's text on Modula is the definitive source . . . It is a modestly small book filled to the brim with information . . .

"Programming in Modula-2 is an essential volume."

—*Journal of Pascal and Ada*

"Read the book—it is well worth your time and effort."

—*Zentralblatt für Mathematik*

Niklaus Wirth, the designer of Modula-2 as well as Pascal, presents a step-by-step approach to programming in general, as he explains the nuts and bolts of what many consider the language of the future.

1983. Cloth \$16.95 #12206-0

2.

Modula-2 for Pascal Programmers

Richard Gleaves

Describing Modula-2 for those familiar with Pascal, **Modula-2 for Pascal Programmers** introduces concepts unique to Modula-2, explains differences with Pascal, and defines basic programming facilities. A glossary and syntax diagram are also included.

1984. Paper \$16.95 #96051-1

3.

Volition Systems P-Code Compilers

"I've had a [Volition Systems] Modula-2 compiler for a month now, and I'm still in love."

—BYTE

"Typically the Modula-2 programs executed in 80-90% of the time required by the comparable Pascal program . . .

"[The Volition Systems p-Code Compiler] is an excellent

product in virtually every respect."

—*InfoWorld*

"The compiler stops at each syntax error in your source code and offers you an opportunity to go directly to the editor to correct your mistake . . .

"[T]he manual is written by Richard Gleaves, who is one of the masters of the manual writing business. It's a delight to read."

—*PC Magazine*

Available for IBM PC (MS-DOS), Apple II/IIe, Apple III, and Sage II/IV. Prices start at \$295.00.

4.

Logitech Native Code Compilers

"[The Logitech Native Code Compiler] comes with System and Terminal modules (including source code) that allow it to adapt to whatever you're running . . .

"If you're used to writing Pascal programs and you're interested in Modula-2, I recommend the Logitech implementation."

—BYTE

"The execution speed is much faster than with an interpreter and file sizes are much smaller than with standard compilers such as MS Pascal."

—*Journal of Pascal and Ada*

Available for IBM PC (MS-DOS), IBM PC (CP/M 86), IBM 3740 (CP/M 86), and Victor 9000/Sirius (MS-DOS). Prices start at \$495.00.

MS-DOS is a trademark of Microsoft, Inc.; CP/M 86 is a trademark of Digital Research, Inc.; IBM is a trademark of International Business Machines, Inc.; Apple is a trademark of Apple Computer, Inc.; Sage is a trademark of Sage Computer Technology; Volition Systems is a trademark of Volition Systems; Logitech is a trademark of Logitech, Inc.; Victor 9000 is a trademark of Victor, Inc.

Send For Your FREE Information Package Today

Springer-Verlag, New York Inc.
175 Fifth Avenue
New York, NY 10010
Attn: David Dwek

Name _____

Address _____

City/State/Zip _____

I am particularly interested in: _____

I own the following personal computer(s): _____

BYTE 8/84-S 861



Springer-Verlag
New York
Berlin
Heidelberg
Tokyo

cording to the documentation, disk errors can occur if you place your monitor or TV set within 6 inches of the disk drive. This includes the obvious position for a monitor—on top of the PCjr. Maybe I was lucky, but I never had a problem when I left mine on top of the system unit. If you heed IBM's admonition, you will find that the PCjr has a large "footprint": i.e., it takes up a lot of room on your desk.

CASSETTE TAPE AND ROM CARTRIDGES

The base-model PCjr supports two modes of program loading: cassette tape and ROM cartridge. Cassette-tape format is compatible with the PC. BASIC has commands to save and load programs and data files on tape.

The ROM cartridge is unique to the PCjr, and it seems to be IBM's preferred method of software distribution for non-disk software. Each ROM cartridge can hold up to 64K bytes of memory. There are two cartridge slots. The ROM in the cartridges can be programmed to replace the ROMs in the system unit. This

means that you can replace the PCjr's "personality" with a completely different ROM-based package.

The *Technical Reference* manual gives Instructions for programming a ROM cartridge to contain new DOS (disk operating system) commands, which will be added to the DOS's vocabulary when the ROM is plugged in. Cartridge BASIC uses this technique. When it is installed, the terms "BASIC" and "BASICA" invoke Cartridge BASIC, rather than causing DOS to look for a file on disk to run.

When ROMs are inserted or removed, the PCjr performs a warm restart sequence. This can be annoying. For example, if you boot a disk that requires Cartridge BASIC, you must insert the BASIC cartridge, causing the boot sequence to start all over again. On the other hand, if you leave the BASIC cartridge in one slot, it will remain available to the system, and you can use the second slot for other ROM cartridges.

SOUND

The IBM PCjr's built-in sound capabilities are superior to the PC's.

The PCjr's sound capabilities are superior to the PC's, though the built-in speaker does not handle low notes as well.

There are two ways to produce sound on the PCjr. One is like the PC's, which uses a timer chip and a small speaker. The PCjr's speaker is a tiny piezoelectric one: it does not handle the low notes as well as the PC's speaker (which is not exactly a woofer itself).

The PCjr's second sound-generation method uses a TI (Texas Instruments) 76496 complex-sound generator chip, capable of producing three voices simultaneously. There is also a white-noise generator for sound effects. All channels can be controlled independently, mixed together, and fed to your television speaker, or through an RCA jack to any external amplifier (such as a spare input on your stereo system). Even though there are four sound sources in the TI chip, there is only one channel of sound output from PCjr, so stereo sound is not available.

Cartridge BASIC supports both the internal, single-voice speaker and the external, three-voice-plus-noise-channel sound output. BASIC's SOUND and PLAY statements can control each of the three voices individually, so successive SOUND statements to different voices result in chords. The volume of each voice can be controlled over a range of 15 increments. The BASIC NOISE statement controls the sound chip's white-noise generator. A creative programmer can have lots of fun creating some great sound effects and music on PCjr.

BASIC

The PCjr comes with a version of BASIC in ROM just like the BASIC in the PC's ROM. This is referred to as Cassette BASIC because it uses a cassette tape recorder (not supplied) for program and data storage. Cassette BASIC has no commands to support the disk drive.

Because the PCjr has limited memory,

(continued)

Table 2: Summary of video-display modes available on the PCjr. The first group contains the IBM PC-compatible modes. The second group contains the PCjr's extended modes.

PC Color-Card Compatible Modes:

Text Modes	Graphics Modes
40 by 25 — B&W	320 by 200 — 4 colors
40 by 25 — Color	320 by 200 — B&W
80 by 25 — B&W (1)	640 by 200 — B&W
80 by 25 — Color (1)	

PCjr Enhanced Color-Video Modes:

Graphics Modes
320 by 200 — 16 colors
(1)
640 by 200 — 4 colors (1)
160 by 200 — 16 colors

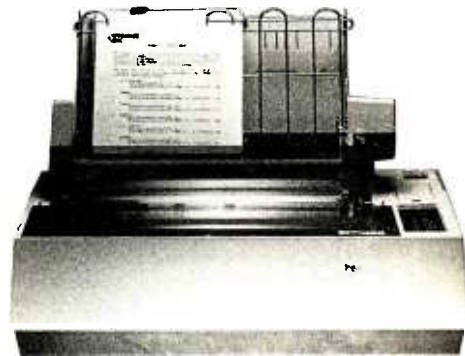
(1) These modes require a 128K-byte PCjr

Table 3: A comparison of memory (bits) available for BASIC programs and data in the PC and PCjr, given 64K bytes and 128K bytes of RAM. The PCjr's Cartridge BASIC is comparable in function to the PC's BASICA.

	IBM PC		IBM PCjr	
	64K byte	128K byte	64K byte	128K byte
Cassette BASIC	61404	62940	45020	62940
Disk BASIC	23563	60891	n/a	n/a
BASICA	13335	60455	n/a	n/a
Cartridge BASIC	n/a	n/a	41744	59694

“PRIMAGES...DARES TO DEFY THE COMMON WISDOM BY OFFERING A PRINTER BOTH FASTER AND LESS EXPENSIVE THAN ITS COUNTERPARTS, WITHOUT SACRIFICING QUALITY.”

DIGITAL REVIEW,* May 1984



In today's market, if you're going to defy the common wisdom, you'd better have an uncommon product.

Like the Primage I daisy wheel printer. Uncommon in that it prints letter quality manuscripts at a brisk 45 cps in multiple languages. Interfaces easily with all leading micros and PCs and utilizes patented new technology to improve reliability. Yet it costs less than printers with less capability.

And it helps to have an uncommon sheet feeder to make full use of the printer's speed. Like our PAGEMATE I, a jam-free, trouble-free sheet feeder. Designed as an integral part of the Primage I system, it too is revolutionary in design when compared to other sheet feeders. Yet it costs about half as much as they do.

Stop in at your local dealer for a demonstration of our remarkable system.

You'll be uncommonly surprised.

**PRIMAGES
INC.**

620 Johnson Ave., Bohemia, NY 11716
516 567-8200

**For your copy of the complete DIGITAL REVIEW report, attach your business card to this ad, and mail to Primages.*

Circle 252 on Inquiry card.

AUGUST 1984 • B Y T E 261

IBM decided to provide the functions of the PC's advanced BASIC (BASICA) in the optional Cartridge BASIC, thus saving more RAM for user programs and data. Table 3 shows the free memory available under the various forms of BASIC on the PC and PCjr, given 64K or 128K bytes of RAM in each machine.

The PCjr's Cartridge BASIC, like BASICA, provides support for disk I/O (input/output), graphics, and communications. Cartridge BASIC also includes some things that are not found in the PC's BASICA, such as support for the PCjr's built-in sound generator, and the

enhanced graphics modes.

Cartridge BASIC includes one command that is really a BASIC program. Typing TERM loads the program from the cartridge and lets you use your PCjr as a simple terminal via the built-in serial port or optional modem. Nothing fancy here—you can set the data rate, data bits, parity, duplex, and screen width, and issue commands to the internal modem. This simple program does not save incoming data to disk or send disk files down the communications line; it doesn't even have a mode for logging received data to the printer.

If you get serious about using the PCjr for telecommunications, you will want a package with more features than this.

DOS 2.10

The disk-drive model of the PCjr runs PC-DOS 2.10. This version of PC-DOS also runs on the PC and PC XT. Prior to the time the PCjr was announced, PC-DOS version 2.00 was the latest revision available. The differences between DOS 2.00 and DOS 2.10 are bug fixes (unspecified by IBM) and support for the PCjr's half-height disk drives. According to IBM, the head-settling time parameter for DOS 2.00 is too fast for some of the half-height drives being installed in PCjrs, leading to disk I/O errors. I tried running several programs under DOS 2.00 and never noticed a problem. Even so, given IBM's warning, I wouldn't use DOS 2.00 on a PCjr for any important data.

JOYSTICKS

IBM sells an optional joystick for the PCjr that works with most of the game programs mentioned on the "At a Glance" page. It appears identical to the joystick made by Kraft Systems. Programmers can also use it from BASIC with the STICK and STRIG functions, which return the joystick coordinates and the status of the joystick push-buttons.

You can connect one or two joysticks to PCjr. They are smooth-acting and comfortable to use. You can set the X and Y joystick axes to spring return to center or to free float. There is also a bias dial for each axis, which can be used to adjust the cursor's response to movement of the joystick.

INTERNAL MODEM

Novation makes the IBM PCjr's internal modem, shown in photo 3. This direct-connect, 300-bps, auto-answer, auto-dial modem is easily installed. It can dial with tones or pulses, and it includes a cable to connect the modem to a modular telephone jack. If you want to have a telephone connected to the same jack, you must purchase a Y modular adapter.

When installed, the modem is automatically designated the COM1 device to BASIC and DOS; the built-in serial port is COM2. If there is no modem in

(continued)

Table 4: The commands supported by the IBM PCjr's optional internal modem. Each command can be typed in full or abbreviated to its first letter.

ANSWER	Modem goes into auto-answer mode
BREAK n	Send a break character for n x 100 ms
COUNT n	Answer after n rings; hang up when dialing after n+3 rings
DIAL m...m	Dial a number; may include subcommands to pause for dial tone, wait 5 seconds, and switch between pulse and tone dialing
FORMAT n	Set parity, data bits, stop bits
HANGUP	Hang up the phone
INITIALIZE	Return to power-up state
LONG RESPONSE	Set message length short or long
MODEM	Modem carrier generated on line
NEW p	Set command character to p
ORIGINATE	Set modem to originate mode
PICKUP	Pick up the phone, voice mode
OUERY	Get modem status
RETRY	Redial if busy
SPEED o	Set bps rate to 110 or 300
TRANSPARENT	Modem commands are ignored and sent through
VOICE	Put modem into voice state
WAIT	Modem idle until next command
XMIT m...m	Send tone pairs m, m, etc.
ZTEST o	Modem test modes

Note: All commands may be abbreviated to their first letter

Table 5: HomeWord word-processor commands.

<u>Print Functions</u>	<u>Edit Functions</u>	<u>File Management</u>
See final document	Copy text	Get document
Print document	Erase text	Save document
Set first page number	Move text	Erase document
	Find text	Merge document
	Find and replace	Convert to/from ASCII file
<u>Layout Functions</u>	<u>Preset Values</u>	
Align text right	Make automatic backup documents	
Align text left	Change top, bottom margins	
Justify text	Change left, right margins	
Center text	Change line spacing	
Start new page	Change tabs	
Set top, bottom margins	Save preset values	
Set left, right margins	Select 40- or 80-column screen	
Set line spacing	Select printer type	
Normal, bold, underlined text		
Headers and footers		

The truth about information management:

The Knowledge Manager beats dBASE over 250 ways.

"...the leading seller is no longer the best."

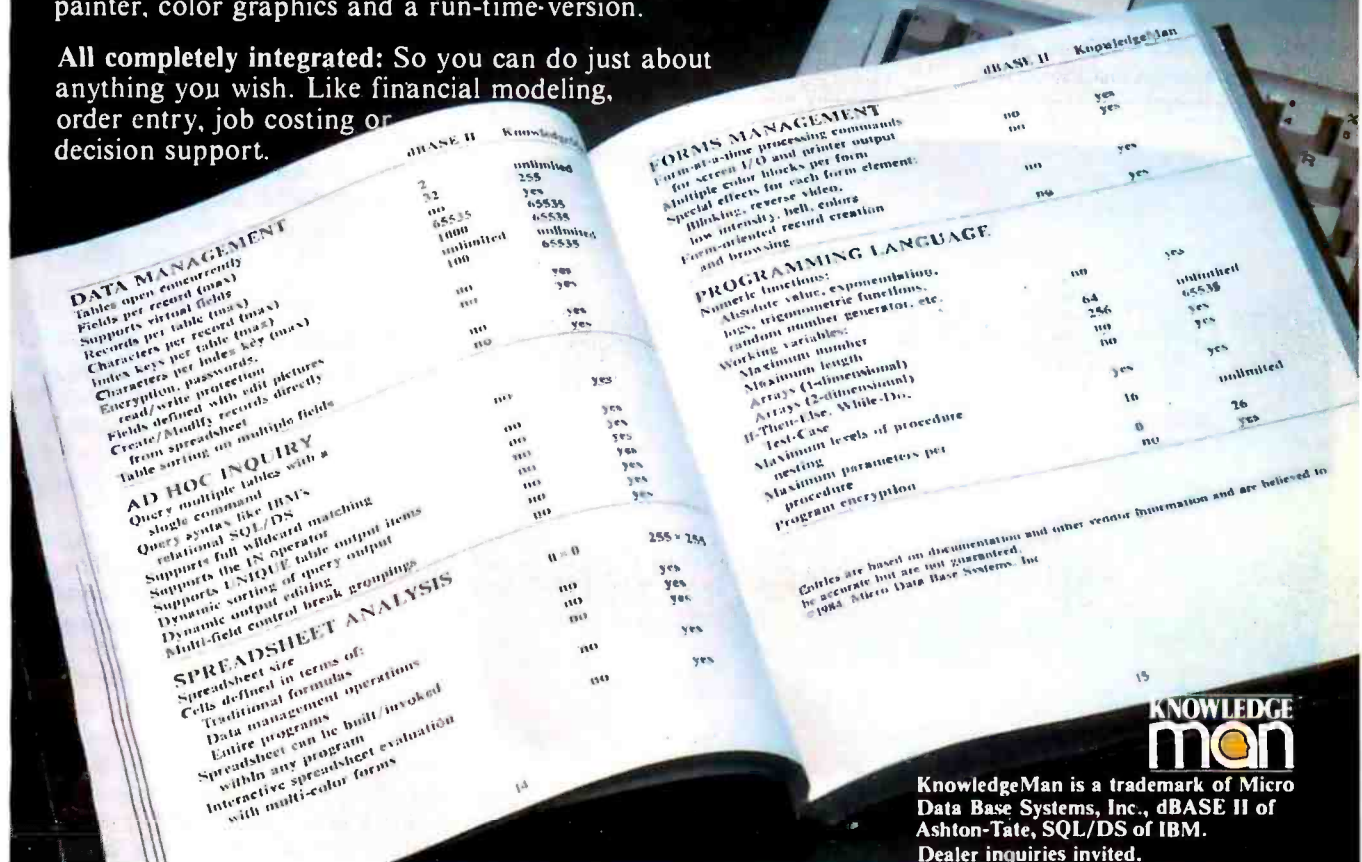
You get more from the Knowledge Manager. Relational data management, ad hoc queries (like IBM's SQL/DS), spreadsheet, math and statistics, printed forms management, screen I/O management, a full-scale programming language. All for less than the list price of dBASE. Plus you can now get a text processor, a forms painter, color graphics and a run-time-version.

Records	dBASE II	KnowledgeMan
1,000	6.15	5.38
2,000	14.93	11.13
5,000	64.16	33.73
10,000	205.50	69.53

*K-MAN V1.05, dBASE II V2.3D, IBM XT, 256K RAM, heavily populated directory.

*John -
"K-man" isn't only
looks superior
to dBASE; I've
checked it against
others & it seems
to be a generation
or two ahead!
J.F.*

All completely integrated: So you can do just about anything you wish. Like financial modeling, order entry, job costing or decision support.




- Please send me:
- Free feature-by-feature comparison
 - Forms painter and graphics information and pricing*
 - Run-time package information and pricing*
- *Forms painter, graphics and run-time package are available as optional components.
- Please accept my order for the Knowledge Manager \$500.00
 - Shipping and Handling† 10.00
(Indiana residents must add 5% sales tax—\$25.00)
- Machine: _____
- Operating Systems:
 PC DOS MSDOS CP/M-86

- Disk Format:
- 8" IBM-3740 SS/SD
 - 5¼" IBM PC SS
 - 5¼" Victor/Sirius
 - 5¼" DEC Rainbow
- †Add \$20.00 if outside U.S., Canada or Mexico
- 192K RAM required, 500K mass storage suggested.
- Check or money order enclosed (must be drawn from U.S. bank in U.S. currency)
- MasterCard No. _____
 VISA No. _____
 American Express No. _____
 Expiration Date _____
 Bank No. (if M.C.) _____
 Signature _____

VISA, MasterCard and American Express orders may be placed by phone (317) 463-2581.

Name _____
 Title _____
 Company _____
 Phone (____) _____
 Address _____
 City _____
 State _____ Zip _____

Send To:

MDBS/Consumer Products
 P.O. Box 248
 Lafayette, IN 47902
 Phone: (317) 463-2581
 Telex: 209147 ISE UR

Or Contact Your Local Dealer.
 PRICES SUBJECT TO CHANGE WITHOUT NOTICE
 Current release is 1.06 as of 4/1/84.

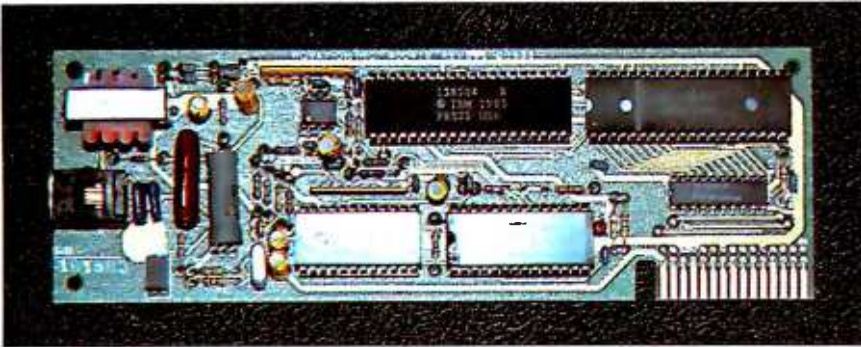


Photo 3: The PCjr's 300-bps direct-connect internal modem option is made by Novation and features auto-dial and auto-answer.



Photo 4: HomeWord, an easy-to-use word processor for the IBM PCjr, features a text-edit area; icons for selecting print, edit, file, and layout functions; and a box containing a graphic representation of the current page's format.

your PCjr, the serial port is COM1. Upon installation of the modem, this change in designation of the serial port forces you to reconfigure programs that access the serial port.

Table 4 summarizes the commands available with the IBM PCjr's internal modem. The PCjr's modem commands are not Hayes compatible, which is unfortunate given the amount of available telecommunications software using the Hayes command format. However, the commands are simple to use; you can enter any command from the keyboard by typing Control-N and then the command mnemonic.

HOMWORD

Among the software released by IBM for the PCjr is Sierra On-Line's unique word processor, HomeWord (see photo 4). HomeWord is easy to use but adequate for most home word-processing needs.

The program includes an overlay template for the PCjr keyboard. If you have some experience with word processors, you can probably figure out how to use HomeWord from the template alone. Unfortunately, the template is made of heavy paper stock and comes folded in half. The crease in the middle keeps it

from lying flat, and it looks like it could easily be torn in half from folding and unfolding.

HomeWord has several interesting features. A menu of icons or symbols appears at the bottom of the screen. You select word-processing functions by moving through this picture menu. For speed, you also can select most functions directly through special key sequences.

On most TV sets, you can only display 40 characters per line and still have readable text. A box in the lower right-hand corner of the HomeWord screen is a shrunken representation of the current page, using single pixels for each letter. This box lets you view the shape of text on your document's pages in the final format. Table 5 summarizes HomeWord's commands.

OTHER APPLICATIONS

IBM has released four arcade games (Mouser, Crossfire, Scuba Venture, and Mine Shaft) in cartridge form for the IBM PCjr. Disk-based games include a couple of adventure games, educational games, and an introduction to Logo called "Turtle Power."

I received several other software packages to try out on the PCjr. They are IBM PC versions, with no apparent modifications for the PCjr. Information Unlimited Software's EasyWriter 1.15 has more features than HomeWord, but it seems dry after HomeWord's dazzling icons and use of color. Software Publishing's PFS:File and PFS:Report are a pair of file-management programs that allow you to store, modify, retrieve, and report on a database. I also ran MicroPro's WordStar version 3.30 on PCjr with no problems. This WordStar accesses the PC's video memory directly, apparently using the hardware trick mentioned earlier.

ACCESSORIES

If pointing the PCjr's keyboard at the infrared receiver is not your cup of tea, you can buy a cord to hook the keyboard to your system unit. The cord is a flat cable about 6 feet long. It is not coiled, and tends to get in the way on the desk. (With cables like this one, maybe cordless keyboards are not such a bad idea after all.)

Another option is a Centronics parallel-printer port, compatible with

the PC's. Photo 5 shows the way this option attaches to the side of the PCjr. The panel on the right-hand side of the system unit snaps off to reveal a 60-pin connector that brings the bus out. The parallel-printer adapter snaps onto the side, connecting to the 60-pin bus.

When the installation is complete, the 60-pin bus is available for the next option. The PCjr *Technical Reference* manual states that up to five option adapters can be supported. However, power usage will be restricted on a machine that has all the internal options connected: only 400 milliamps of +5 V DC (volts, direct current) are available on the external bus, and the +12 V DC and -6 V DC sources are completely used up.

The way the parallel-printer adapter connects to the PCjr foreshadows other, more interesting options to come. The 60-pin bus includes 20 address lines, a bidirectional 8-bit data bus, three interrupt levels (requests 1, 2, and 7), memory and I/O read and write signals, and miscellaneous clock and timing signals. DMA devices (such as disk controllers that don't interfere with type-ahead and RS-232C data input) can be connected. This bus is the key to add-on third-party hardware, and several vendors have already announced PCjr hardware expansions that connect to it.

INSIDE THE PCjr

The PCjr's lid is easy to snap off (see photo on the "At a Glance" page), but there is no power interlock to prevent dangerous AC (alternating current) line voltages from being present when the PCjr's insides are exposed. The switching power supply is on the far left. The power supply is the trickiest card to install in PCjr—it requires mating two easily bent pins on the motherboard with a connector on the card, as well as inserting the card's edge into a connector.

To right of the power supply is the memory/80-column video-expansion card, which is individually shielded. Next is the Novation 300-bps modem. And finally, the disk drive controller is next to the disk drive.

Photo 6 shows the PCjr with all its cards out and the floppy disk removed. The eight chips in the lower left-hand corner contain 64K bytes of RAM. There is no parity checking bit, unlike the PC which includes a 9th-bit parity

check for every 8 bits of memory. In the upper left-hand corner you will see the cassette relay, which is a yellow component. To the left of the relay is the tiny piezoelectric speaker used for internal sound. The large 40-pin chip just below the relay is the INS8250 UART (universal asynchronous receiver/transmitter) chip that controls the serial port. Below the 8250 is another 40-pin chip, the Motorola 6845 video controller. The 40-pin chip below that is a proprietary gate array used in the video section.

On the lower right are the covers for the two ROM program cartridges. Directly above the left-hand slot are the two system ROMs. To the right is the 60-pin system-bus extender (at the edge of the PC board). The large chip just to

its left is the 8088 microprocessor, the PCjr's brain.

MANUALS

The documentation set is impressive. IBM made a real effort to make the computer understandable to novices. Chapters such as the one titled "Taking Control" in the *Hands-On BASIC* manual (jointly published by IBM and McGraw-Hill) deal with computer-fear by stressing that the computer is only a tool, not a diabolical machine with a mind of its own.

Hands-On BASIC uses cartoons and full-color diagrams liberally to make the pages visually interesting. IBM chose a little boy named "PC" for the theme

(continued)



Photo 5: Some options, such as the parallel-printer adapter shown here, attach to the bus connector on the right-hand side of the PCjr.

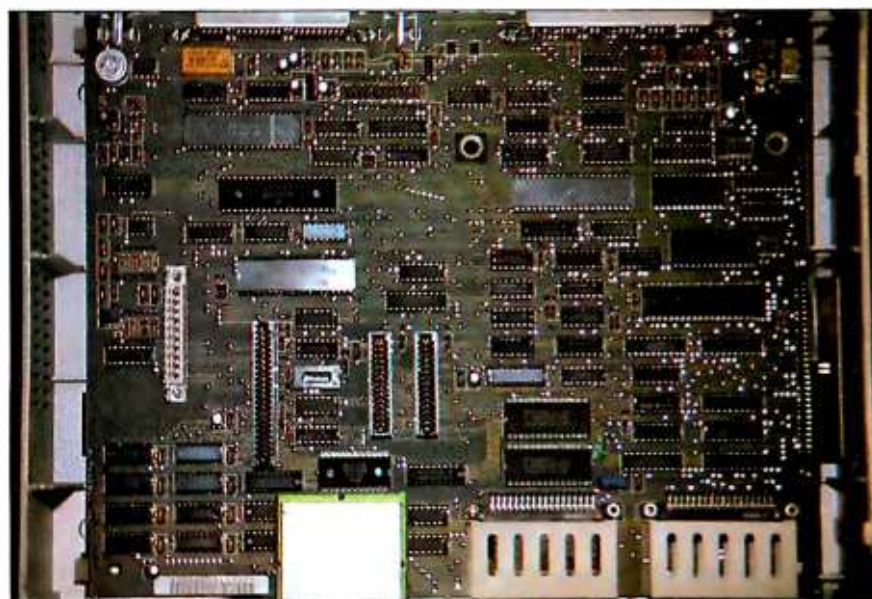


Photo 6: The IBM PCjr's motherboard with all internal add-on adapters, disk drive and power supply removed. (See text for a guided tour.)

character for the PCjr. He appears in some, but not all, of the end-user-oriented manuals.

The *Guide to Operations* tells you how to set up your machine, use the keyboard, install options, and run diagnostics. The writing style is simple and clear. The operations manual includes a keyboard tutorial linked to a program in the PCjr's ROM called Keyboard Adventure (and this keyboard is an adventure). This tutorial guides you through the PCjr keyboard with animated color graphics and a three-voice rendition of the opening to Beethoven's Fifth Symphony.

An interactive tutorial program called Exploring the IBM PCjr is included with disk-drive versions of the PCjr.

Another introductory program called the Sampler provides some sample application programs for the PCjr. It comes on a single floppy disk and includes some simple BASIC programs, seen in menu form in photo 7.

The *Microsoft BASIC* manual comes with Cartridge BASIC. It is almost identical to the manual shipped with the PC. Modifications include new PCjr commands, and references to the PC's disk-based BASIC and BASICA are changed

to references to Cartridge BASIC. This is primarily a programmer's reference, but new programmers should start with *Hands-On BASIC*, which comes with every machine.

If you buy PC-DOS, you get two manuals: one is simply titled *Disk Operating System*, and the other is a small, staple-bound book called *Disk Operating System User's Guide*. The first is the reference manual for DOS users; the second is a get-acquainted guide for first-time users, complete with cartoon characters meant to ease computer anxiety. An extra-cost option is the *DOS Technical Reference* manual, intended for DOS programmers. One advantage of splitting the DOS manual into two parts is that each part fits into its binder, in contrast to DOS 2.0 documentation, which doesn't. The disadvantage is the extra cost for the now-optional technical manual. This new manual set is used for the PC and PC XT as well.

The *Technical Reference* manual follows the same style as the PC's manual. It gives a detailed look at the PCjr's design, including schematics and listings of the ROM BIOS code. IBM obviously knows that much of the PC's

The PCjr's modem commands are not Hayes compatible, which is unfortunate given the amount of available telecommunications software using the Hayes format.

phenomenal success is due to third-party software and hardware vendors that need this detailed information to make additional programs and options available for the machine.

CONCLUSIONS

The PCjr is impressive in many ways. It is also disappointing in some critical areas.

The PCjr's major advantages include: IBM PC compatibility; a large software base (at least for the disk version of PCjr); good graphics, text, and sound capabilities; and an excellent documentation set. The PCjr allows children and adults alike to acquire some computer literacy while learning to operate the machine—and of course, the IBM name ensures continued support and service.

Minuses include the keyboard, a real loser: limited expandability from IBM at this time (no external disk drive or add-on memory beyond 128K bytes total); and the price—it's rather expensive for a home computer, but with its current keyboard, it's not meant for business use.

As this article goes to press, new keyboard and memory options are rumored to be pending from IBM. For now, I must admit that the PCjr is not my choice for a personal computer. It may appeal to children and educational institutions or to hunt-and-peck typists. But if you are in the market for a computer and decide to buy an IBM machine, think carefully about buying a PC, or at least look at the price of a fully expanded PCjr versus a comparably configured PC. ■

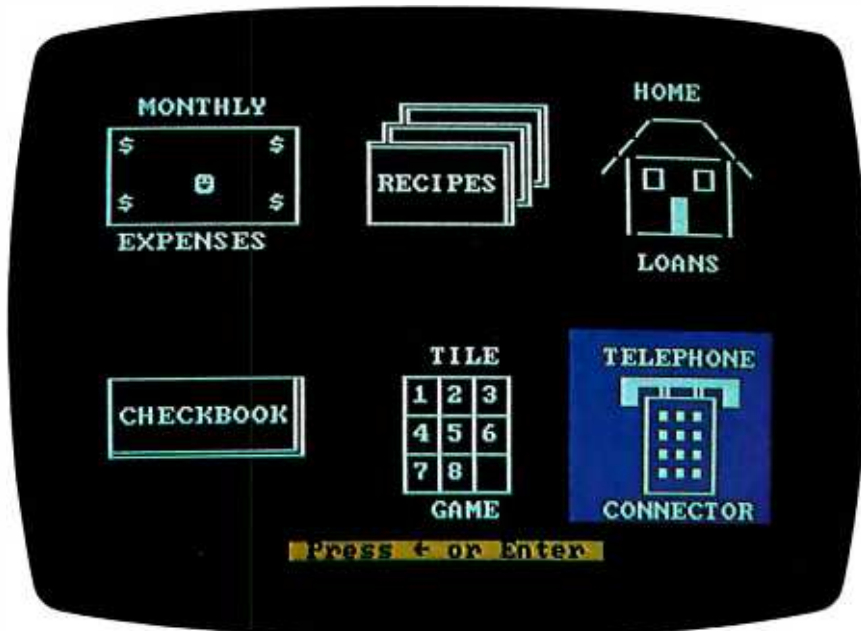


Photo 7: The IBM PCjr Sampler Disk includes a number of BASIC programs demonstrating the kinds of applications that are available. Shown here are the selection icons for a budget program, recipe file, loan-payment computer, checkbook manager, number game, and simple communications program.

COMPUTER WAREHOUSE

CALL TOLL FREE **1-800-528-1054**

SANYO * EPSON SYSTEMS

DUAL DRIVE SYSTEMS **SANYO COMPUTER * EPSON RX-80**

SANYO CRT-36 HI-RES GREEN MONITOR • WordStar • CalcStar • Mailmerge
• InfoStar • SpellStar • MS-DOS (2.11) • Sanyo Basic

555 System with
Dual 160K Drives **\$1499**

555-2 System with
Dual 320K Drives **\$1799**

SINGLE DRIVE SYSTEMS **SANYO COMPUTER * EPSON RX-80**

SANYO CRT-36 HI-RES GREEN MONITOR • WordStar • CalcStar • MS-DOS (2.11)
• Sanyo Basic

550-2 System with
Single 320K Drive **\$1399**

550 System with
Single 160K Drive **\$1199**

PRINTERS

Brother	
OX-15	\$369
HR-25	\$619
C-Itch	
A10-20	\$459
F-10 Parallel or Serial	\$915
55 CPS Serial or Parallel	\$1199
8510 Parallel (Prowriter)	\$319
8510SP	\$439
8510SCP	\$509
8510BPI	\$389
Computer International	
Daisywriter 2000 W/48K	\$985
Comrex	
CR-2 Parallel or Serial	\$439
CR-2 Keyboard	\$150
CR-3	Call

Datasouth	
DS180	\$1155
DS220	\$1469
Diablo	
620	\$739
630API	\$1699
630 ECS	Call
630 ECS/IBM	\$1995
Series 36	Call

Epson	
All Printer Models	Call

Inforunner	
RiteMan	\$249

IDS	
Pnsm 132 Color	\$1499

Juki	
6100	Call

NEC	
2010	\$645
2015	\$645
2030	\$645
2050	\$789
3510	\$1219
3515	\$1219
3530	\$1219
3550	\$1519
7710	\$1649
7715	\$1649
7730	\$1649

Okidata	
All Printer Models	Call

Panasonic	
1090	Call
1091	Call
1092	Call

Qume	
Letter Pro 20 Parallel or Serial	\$629
11/40 W/Interface	\$1369
11/55 W/Interface	\$1569

Silver Reed	
EXP400	\$269
EXP500 Parallel	\$385
EXP500 Serial	\$419
EXP550 Parallel	\$479
EXP550 Serial	\$494
770P	\$825
770S	\$875

Star Micronics	
All Printer Models	Call

Tally	
MT 160L	\$499
MT 180L	\$779
Spirit 80	\$275

Toshiba	
P1340 Parallel or Serial	\$725
P1351 Parallel or Serial	\$1259

Transtar	
120 Parallel or Serial	\$395
130 Parallel or Serial	\$549
T315	\$389

MODEMS	
Hayes	
Smartmodem 300 Baud	\$199
Smartmodem 1200 Baud	\$485
Smartmodem 1200B Baud (IBM)	\$430
Micromodem II (Apple)	\$235

US Robotics	
212A Autodial	\$420
Password 1200	\$310
IBM PC Modem	\$320

VIDEO TERMINALS

ADDS	
A-2 Green	\$475
A-3	\$475
Viewpoint 60	\$489
Viewpoint 90	\$859

Altos	
Smart II	\$849

Qume	
QVT 102 Green	\$519
QVT 102 Amber	\$545
QVT 103 Green	\$819
QVT 103 Amber	\$850
QVT 108 Green	\$599
QVT 108 Amber	\$639

Televideo	
910	\$445
910+	\$519
914	\$515
924	\$639
925	\$700
950	\$909
970	\$989
800A (User Station)	\$989
Personal Terminal	\$385

Wyse	
50	\$495
75	\$565
100 W/14 Inch Screen	\$679
300	\$999

Zenith	
Z-29	\$609

DISKETTES	
Maxell	
MD-1 (Qty 100)	\$175
MD-2 (Qty 100)	\$275

Scotch	
5X SS/DD (Qty 100)	\$200
5X DS/DD (Qty 100)	\$245

Elephant	
5X SS/DD (Qty 100)	\$155
5X DS/DD (Qty 100)	\$218

QUADRAM	
Quadlink	\$449
Quadboard 256K (Expands to 384K)	\$469
Quadboard II 256K (Expands to 384K)	\$469

COMMODORE

64	\$227
1541 Disk Drive	\$239
1702 Monitor	\$239
1526 Printer	\$274
1530 Datasette (only w/64)	\$60

MONITORS

Amdek	
All Monitors	Call
Princeton Graphic	
HX-12	\$499

Sanyo	
CRT-30	Call
CRT-36	Call
CRT-70	Call

Sony	
19" RGB (KX1901A)	\$709
25" RGB (KX2501A)	\$1089

Taxan	
12" Amber	\$125

Zenith	
ZVM-122 Amber	\$95
ZVM-123 Green	\$95
ZVM-124	\$129
ZVM-133 Color/RGB	\$410
ZVM-135 Color/RGB W/Audio	\$459

DISK DRIVES

Rana	
Elite I	\$215
Elite II	\$345
Elite III	\$410
Controller (W/Drive Only)	\$65
1000W/DOS for Atari	\$305

COMPUTERS

Altos	
All Computer Models	Call

Eagle	
PC+2 W/Eagle Monitor & Adapter	Call
Spirit 2 Portable	Call
Spirit XL Portable	Call

NEC	
PC-8201 Computer	\$465
PC-8201A-90 Battery Pack	\$17
PC-8206A 32K Ram	\$299
PC-8271A-01 AC Adapter	\$17
PC-8271A-02 AC Adapter	\$17
PC-8281A Recorder	\$89

Northstar	
All Computer Models	Call

Sanyo	
MBC-550 System	\$1199
MBC-555 System	\$1499
MBC-550-2 System	\$1399
MBC-555-2 System	\$1799
1150 System W/5000 Printer	\$1599

Televideo	
802H	\$4285
803	\$1765
803H	\$2850
806/20	\$4640
TPC-1	\$1539

Zenith	
Z-150 Single Drive	Save 25%
Z-150 Dual Drive	Save 25%
Z-150W/10 Megabyte	Save 25%
Z-160 Single Drive	Save 25%
Z-160 Dual Drive	Save 25%

SONY

Walkman FM/Stereo Cassette (WM-F10) Stereo Cassette Watchman AM/FM Stereo TV (FD30A) B & W TV	Video Recorders Beta Video Recorder (SL2300) \$419 Beta Video Recorder w/Remote (SL30) \$519 Beta Movie Beta Movie Camera (BMC-110K) \$1329
--	---

Order Line: 1-800-528-1054

Order Processing & Other Information: 602-954-6109



2222 E. Indian School Rd.
Phoenix, Arizona 85016

Store Hours: Mon-Fri 10-5:30 Saturday 9-1
Order Line Hours: Mon-Fri 8:30-5:30 Saturday 9-1



Prices reflect 3% to 5% cash discount. Product shipped in factory cartons with manufacturer's warranty. Please add \$8.00 per order for UPS shipping. Prices & availability subject to change without notice. Send cashier's check or money order...all other checks will delay shipping two weeks.



All he could do was hit.

And the Babe's fans loved him for it. Doing one thing very well has its rewards. Some people make history. Some set records. Some win hearts.

Multimate International. In a brief 18 months, a growing "fan club" of users has made us one of the leading software companies in the world. The object of their affection: Multimate, the program that put the power and speed of a Wang[®] dedicated word processor into the IBM[®] PC.

We've carved a niche in office automation. By committing ourselves to word processing for the IBM PC and most plug compatibles. By making sure that Multimate interfaces well with other data management products. By developing a program that will allow users to convert Wang files to the Multimate format. By looking beyond what word processing is. And seeing what it can be.

Multimate International. We've come a long way in a short time by being very good at what we do. We intend to keep it that way.

To find out more about Multimate, the word processor, and Multimate International, the company, call Jordan Caswell at 1-800-243-3142.

The logo for Multimate, featuring a stylized, cursive 'M' followed by the word 'ultimate' in a clean, sans-serif font.

We're putting our reputation into words.

IBM PC is a registered trademark of International Business Machines Corporation.

Wang is a registered trademark of Wang Laboratories.



The Sanyo MBC-550

An inexpensive MS-DOS computer

BY BILL SUDBRINK

In January, I read a classified ad that went something like this:
FOR SALE: Computers,
128K memory, double-density
disk, MS-DOS and IBM
compatible. \$995.

I had been regularly reading the classifieds for three years and knew this price was a typo. The correct price must be \$1995 or \$2995. I decided to call anyway, hoping that \$1995 was right. The salesman told me that \$995 was the correct price. "What's wrong with it?" went through my mind.

"What's wrong with it?" seems to be the reaction of all my friends and classmates upon first hearing the price and the features of the Sanyo MBC-550 series. Because attending college means paying to work instead of working for pay (leaving little money for buying a computer), I went to have a look at the MBC-550 and the two-disk MBC-555. What I found made me an owner the next day.

[Editor's Note: We've included two text boxes that provide additional insight into the Sanyo MBC-550 and 555. James G. Droppo Jr.'s "The Double-Drive MBC-555" is on page 278. John Unger and Jeffrey Phillips discuss "Sanyo MBC-555/IBM PC Compatibility" on page 276.]

The cabinet measures 15 inches wide, 4¾ inches high, and 14½ inches deep. At first glance the cabinet looks a lot like a videodisc player. It has a smooth silver surface with air vents running across each side and a single power switch on the front. The keyboard case has the same finish as the cabinet, and the keys are two shades of grey with white lettering. A black coiled cable connects the keyboard to the cabinet. The cabinet contains a fan, which I didn't discover until several days after purchasing the system: the fan is virtually silent. The floppy-disk drives are also very quiet, with only the occasional click as the read/write head changes tracks.

The cabinet has positions for two floppy-disk drives. In the basic MBC-550 setup (one drive), the second drive position is occupied by a handy disk-storage box, which can hold 12 disks. On the rear of the cabinet is a grounded outlet that is on the same switch

as the main unit. This outlet lets you turn on your system and display with one switch.

MONOCHROME AND/OR COLOR DISPLAY

The MBC-550 comes out of the box capable of driving both monochrome and RGB (red-green-blue) displays. As a matter of fact, it can drive one of each at the same time. The formats of the two displays are the same. The basic video signals are generated for the RGB display and auxiliary circuitry converts the color signals to monochrome signals. Table 1 shows the eight pixel values and their color and monochrome attributes. Figure 1 shows the pin-outs of the RGB socket.

The character-display format is 25 lines by 80 columns; for pixels, it's 640 horizontal by 200 vertical. Both graphics and text may be displayed at the same time. Each character is an array of 8 horizontal by 8 vertical pixels. In ROM (read-only memory), 256 characters are stored, and the lower 127 are standard ASCII (American National Standard Code for Information Interchange). The ASCII character set is pleasing to the eye, with lowercase descenders. I can distinguish no difference between the Sanyo ASCII characters and IBM's. The COLOR command in BASIC lets you display text in any character/background color combination.

Other BASIC graphics commands include LINE (draws a line between any two points on the screen), CIRCLE (draws circles, ellipses, and arcs anywhere on the screen), SYMBOL (puts the standard characters on the screen in any magnification and four orientations), PAINT (fills an enclosed area with a specified color), PSET and PRESET (colors and uncolors specific pixels), and GET and PUT (stores an area of the display into a numeric array and places a numeric array in a specified area of the display).

Display memory is set at cold boot to the highest 16K bytes available. Altering a value at I/O (input/output) address hexadecimal 10 changes the display memory block.

KEYBOARD

The MBC-550 keyboard (see photo 2) is ar-

ranged in the regular QWERTY format with one slightly annoying exception. The Shift keys at lower left and right are moved farther away from the bottom row by the addition of an < > (angle bracket) key to the left and an * (asterisk) key to the right; a jab for the shift key that falls short results in a < or *. Two Shift-Lock keys are situated on either side of the space bar. The Caps lock is on the left and the Graph lock is on the right. Each lock key has an embedded red LED (light-emitting diode) to indicate activity.

The keyboard has a very nice feel for touch-typing, with the home keys (F and J) more deeply dished to mark the position of the home row. The keyboard also has two adjustable legs to let you tilt the keyboard to your own tastes.

In addition to the QWERTY keypad, there are five function keys arranged vertically along the left side of the keyboard and a combination numeric/cursor-control keypad on the right. The function keys are programmed from BASIC with the KEY command.

The numeric/cursor-control keypad is a standard numeric keypad with =, *, -, +, ., and Return keys. Eight of the ten numeric keys can also serve as cursor-control keys. (Numeric key functions are shown in table 2.) A BASIC Break key (Control-C) is in the upper right corner of the numeric pad, out of the way but not inaccessible. A hardware processor reset switch is recessed on the left side of the keyboard.

The keyboard communicates with the computer in ASCII at 1200 bps (bits per second) with even parity, 8 data bits, and 2 stop bits. When a character is pressed while the control key is down, the character is transmitted in parity error. The keyboard has automatic repeat on all keys after approximately one-half second.

PROCESSOR

The MBC-550 uses the 16-/8-bit Intel 8088 microprocessor and an 8288 bus controller. The MBC-550 also has a socket for the 8087

.....
Bill Sudbrink (5100 Barto Ave., Camp Springs, MD 20746) is majoring in computer science at the University of Maryland, College Park.

mathematics coprocessor and is configured to take advantage of it.

The 8088 in the MBC-550 runs at 3.6 MHz, more than 1 MHz slower than the IBM Personal Computer (PC), which runs at 4.77 MHz. This speed difference shows in the processing benchmarks on page 274.

There is no question that Sanyo sacrificed speed in order to cut production costs. In my experience with computers, however, processing speed is really of importance only when dealing with real-time applications such as graphics animation. In these applications, a slow system usually results in poor graphics animation. The simple BASIC test program in listing 1 shows that the MBC-550 is capable of quick, smooth animation.

MEMORY

The Sanyo comes with 128K bytes of 4164 dynamic RAM (random-access read/write memory) soldered to the main board, which has sockets for another 128K bytes to bring the system total to 256K bytes. The last addressable 16K bytes of memory, FC000 to FFFFF (hexadecimal), contain the system

(continued)



Photo 1: The Sanyo MBC-550.

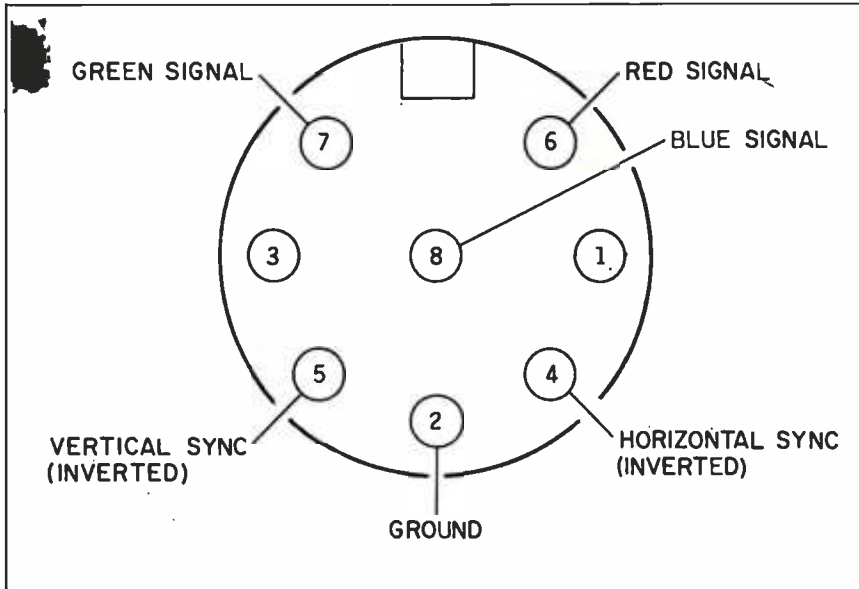


Figure 1: The pin-out of the MBC-550 rear-panel RGB receptacle.

Table 1: The eight pixel values for color and monochrome displays.

Pixel Value	Color Display	Monochrome Display
0	black	off (black)
1	blue	low intensity
2	green	medium intensity
3	light blue	high intensity
4	red	off (black)
5	purple	low intensity
6	yellow	blink off medium
7	white	blink low/high

Table 2: Normal (unshifted) and shifted functions of the numeric keypad.

Cursor Control (unshifted)	Keypad (shifted)
linefeed	1
not used	2
page down	3
right	4
down	5
left	6
home	7
up	8
page up	9
not used	0

ROM. The ROM contains, among other things, the floppy-disk bootstrap, the keyboard decoding, and the character images. The system uses no memory parity checking, so each 64K-byte upgrade requires only eight 4164 chips.

The documentation seems to indicate that memory expansion is limited to 256K bytes. Although there are no card slots in the MBC-550, the address and data buses and all of the memory and I/O signals are available through a 62-pin header on the processor board (see table 3). In the schematics, this header is noted only as an "external port." Interestingly, pin 30B, labeled CLK (clock), receives a signal referred to on the schematics as "OSC IBM BUSS." Maybe there is an IBM-compatible card cage in the future.

DISK DRIVES

Sanyo now supplies only 5¼-inch, single-sided, double-density disk drives with the MBC-550 series. In the February 1984 edition of *Sanyo Newsletter*, a short paragraph mentions that the EDH511 10-megabyte hard disk is available for the MBC-550, but at this writing my local dealers have not heard anything about the new disk. Double-sided disk drives are also said to be on the way.

The Sanyo-supplied drives use regular soft-sectored disks with a formatted storage area of 160K bytes under MS-DOS 1.25. Regular MS-DOS formatting is used, and the disks are transportable among various MS-DOS machines, including the IBM PC. The version of MS-DOS supplied with the MBC-550 supports from one to four drives. As I mentioned before, the drives are pleasingly quiet.

While Sanyo may be slow in producing hardware options for its computer, other firms are not. Two dealers in the Maryland suburbs of Washington, D.C., are offering double-sided, double-density disk drives and MS-DOS 2.0 for the MBC-550. Prices are less than \$250 for the drive and DOS (disk operating system). The double-sided drives are also MS-DOS standard, and they double the formatted storage area to 360K bytes under MS-DOS 2.0. [Editor's Note: At press time, we learned that MS-DOS version 2.11 is now available for the MBC-550.]

(continued)

AT A GLANCE

Name

Sanyo MBC-550

Manufacturer

Sanyo Business Systems Corp.
Computer Division
51 Joseph St.
Moonachie, NJ 07074
(201) 440-9300

Size

15 by 14½ by 4¾ inches;
keyboard, 17¾ by 6½ by 1½ inches

Processor

8088 16-/8-bit at 3.6 MHz
with 8288 bus controller

Memory

128K of 4164 dynamic
RAM; expandable to 256K

Mass Storage

One or two 160K 5¼-inch,
single-sided, double-
density floppy-disk drives

Display

25 rows by 80 columns;
color (RGB) or mono-
chrome

Keyboard

Detached QWERTY with
five function keys and
numeric pad

Software

MS-DOS 1.25, Sanyo
BASIC, WordStar, CalcStar,
EasyWriter

Options

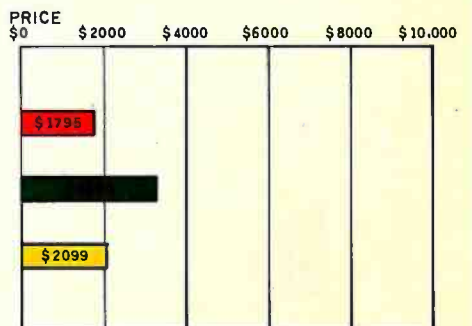
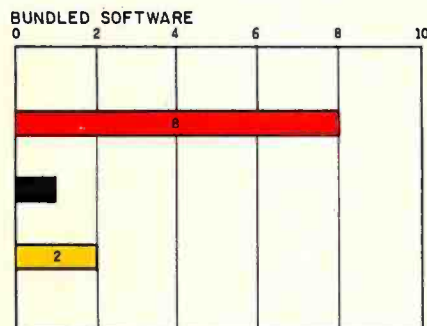
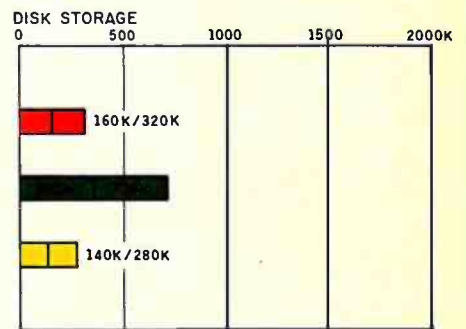
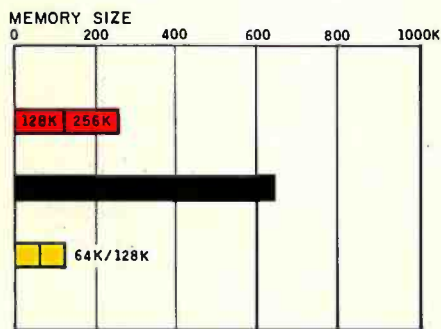
RS-232C serial port (\$100),
Apple joystick, 8087 math
coprocessor, 64K RAM
expansion (\$120),
monochrome monitor
(\$199), color monitor
(\$749), double-sided disk
drive (\$499)

Documentation

Operator's guide, 287
pages; software guide, 492
pages

Price

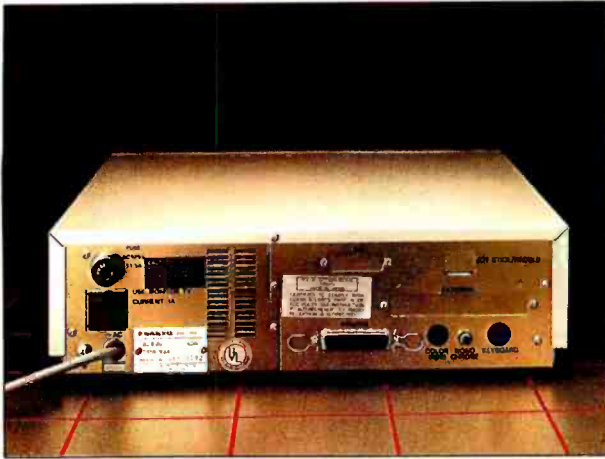
MBC-550 (one drive), \$995;
MBC-555 (two drives, Mail-
Merge, SpellStar, and Info-
Star), \$1495; with monitor
and serial port, \$1795



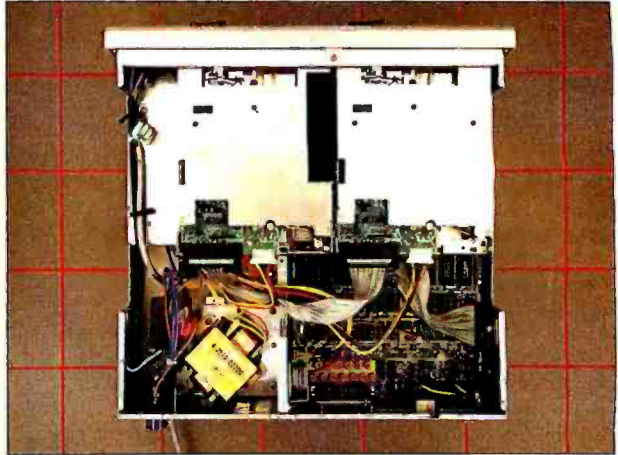
■ SANYO MBC-550 ■ IBM PC ■ APPLE II E

The Memory graph shows the standard and optional memory available for the computers under comparison. The Disk Storage graph shows the highest capacity of a single floppy-disk drive for each system. The Bundled Software graph shows the number of packages included with each system. The Price graph shows the list price of a system

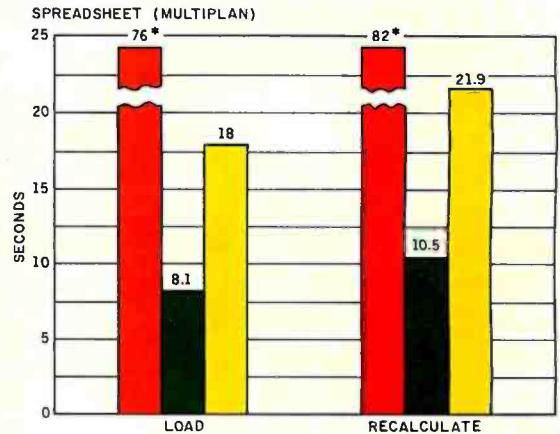
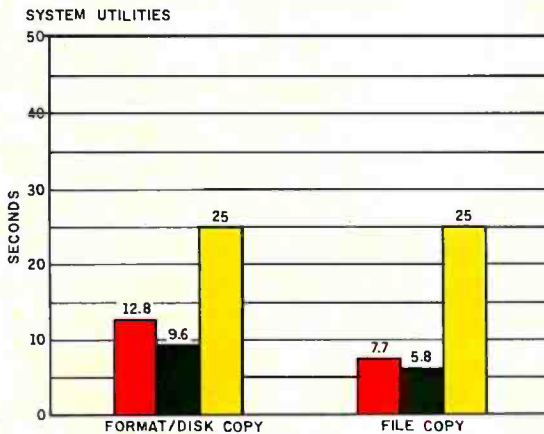
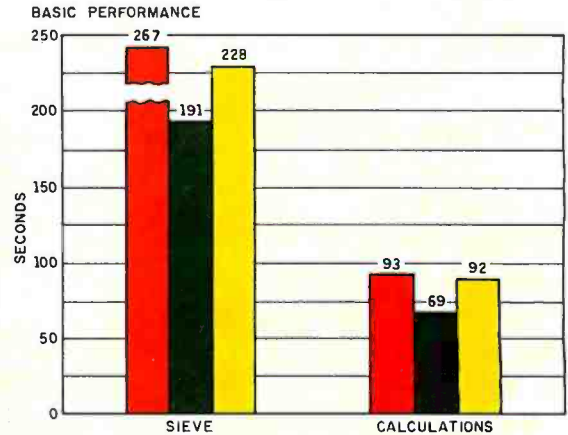
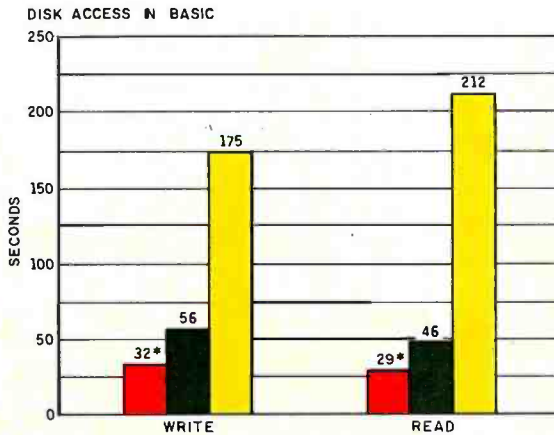
with two high-capacity floppy-disk drives, a monochrome monitor, graphics and color-display capability, a printer port and a serial port. 256K bytes of memory (64K bytes for 8-bit systems), the standard operating systems for each system, and the standard BASIC interpreter for each system.



The rear panel of the Sanyo MBC-550. Note the parallel printer connector.



The inside of the Sanyo MBC-550. Note the two floppy-disk drives at the top (front) and the lack of expansion slots.



■ SANYO ■ IBM PC ■ APPLE IIe

The Disk Access in BASIC graph shows how long it takes to write a 64K-byte sequential text file to a blank floppy disk and how long it takes to read this file. (For the program listings, see "The Chameleon Plus," by Rich Krajewski, in the June *BYTE*, page 327.) The Sieve bar shows how long it takes to run one iteration of the Sieve of Eratosthenes prime-number benchmark. The Calculations bar shows how long it takes to do 10,000 multiplication and division operations using single-precision numbers. The System Utilities graph shows how long it takes to format and copy a disk (adjusted time for 40K bytes of disk data) and to transfer a 40K-byte file using the system utilities. The Spreadsheet graph shows how long the computers take to load

and recalculate a 25- by 25-cell spreadsheet where each cell equals 1.001 times the cell to its left. The spreadsheet program used was Microsoft Multiplan.

Note that in the tests of BASIC disk access for the Sanyo, the test file was written to and read from the default (i.e., nonblank) disk. Sanyo BASIC apparently cannot access other disk drives. In the spreadsheet test on the Sanyo, CalcStar was used. The standard 25 by 25 spreadsheet could not fit into memory. A 25-column by 17-line spreadsheet was used and the times were extrapolated to 25 lines.

WHOLESALE + 8% PRICING

OUR 400 PAGE CATALOG OF 20,000 COMPUTER PRODUCTS

12 TO 21 DAY SOFTWARE RENTALS, AT 20%[†]

FOR NETWORK MEMBERS ONLY!

Listed below are just a few of the over 20,000 products available at our EVERYDAY LOW PRICES! All software below is priced in IBM-PC format. The NETWORK carries software for IBM, Apple, CP/M, Kaypro and over 50 other popular systems.

For as little as \$8 per year you can join the thousands of value wise buyers who have saved more than \$8,000,000 on 25,000 orders in just the last six months and received these 15 unique benefits:

GAMES & EDUCATIONAL SOFTWARE

(Please add \$1 shipping and handling for each title ordered from below.)

	Wholesale		Wholesale
Avant-Garde Air Traffic Controller	\$16.50*	Sierra On-Line Frogger	21.00*
Bluebush Chess (Your Toughest Opponent)	34.00*	Sierra On-Line Crossfire	18.00*
Broderbund Lode Runner	19.75*	SubLogic Night Mission Pinball	24.00*
CBS Goren-Bridge Made Easy	48.00*	Spinnaker Alphabet Zoo	17.00*
Egypt Temple of Apsheh	21.97*	Spinnaker Delta Drawing	20.00*
Infocom Zork I, II, or III	21.50*	Spinnaker FaceMaker	20.00*
Infocom Deadline, Witness or Suspended	27.00*	Spinnaker Hey Diddle Diddle	17.00*
Microsoft Flight Simulator	27.00*	Spinnaker KinderComp	17.00*
Orion 4Bird (Over! Look Alike)	22.00*	Spinnaker Rhymes & Riddles	17.00*
Orion PCMan (Great Pac Man)	21.00*	Spinnaker Story Machine	20.00*
Scarborough Mysteriype	27.00*	Spinnaker Most Amazing Thing	23.00*
Screenplay Asylum (works with mono card too)	15.50*	Virtual Combinatics Micro Cookbook	21.00*

BUSINESS SOFTWARE

(Please add \$2.50 shipping and handling for each title ordered from below.)

	Wholesale		Wholesale
ATI How to use MultiMate	\$42.00*	MicroRim RBase 4000	260.00*
ATI How to use Microsoft Word	42.00*	Microsoft C Compiler	275.00*
ATI How to use Lotus 1-2-3	42.00*	Microsoft Word with Mouse—Latest Version	255.00*
Ashon-Tate DBASE II	21.00*	Microsoft Multiplan	105.00*
Ashon-Tate Framework	CALL	Program Dollars & Sense	85.00*
Ashon-Tate Friday!	154.00*	Osiris The Word Plus	50.00*
Central Point Copy II PC	23.00*	Rossoft Prokey Version 3	74.00*
Conceptual Instruments Desk Organizer	150.00*	Satellite Software WordPerfect	210.00*
Digital Research CP/M-86	30.00*	Softcraft FancyForms	125.00*
Digital Research DR Logo	55.00*	Sofstyle SET-FX	40.00*
Digital Research PL/I Compiler	395.00*	Software Publishing PFS: File	74.00*
Funk Software Sideways	36.00*	Software Publishing PFS: Report	65.00*
Harvard Harvard Project Manager	215.00*	Software Publishing PFS: Write	74.00*
Hayes Smartcom II	68.00*	Software Publishing PFS: Graph	74.00*
Human Edge The Management Edge	145.00*	Sorcim SuperCalc 3	198.00*
Human Edge The Sales Edge	145.00*	SPI Open Access	335.00*
Lotus Development Lotus 1-2-3	CALL	Verbatim Disk Drive Analyzer	25.00*

HARDWARE

(Please add shipping and handling charges listed in italics next to price.)

	Wholesale		Wholesale
Apple Macintosh Base System	1,810.00* (38.10)	Apparat 512K Memory Board with OK	85.00* (2.50)
Apple Apple //c	955.00* (20.97)	Apparat Combo II w/ser/par/game/clock/slwr	123.00* (2.50)
Apple Apple //e	CALL	ABT Six-Pack Plus with OK	203.00* (2.50)
Columbia Desktop & Portable Systems	CALL	ABT MegaPlus II with OK	205.00* (2.50)
Eagle Desktop PC and Spin Portables	CALL	ABT I/O Plus II	105.00* (2.50)
IBM PC 2 DSDD Floppy Drives/Color Card/Mono Monitor	1,340.00* (48.00)	Qua dram Improved Quadboard 384K with OK	197.00* (2.50)
IBM Hard Disk 1 Floppy/10Mb Hard Disk/128K/Color Card/Mono Monitor	2,675.00* (62.00)	Tecmar Captain Multifunction Card with OK	200.00* (2.50)
Sanyo MBC 550*Lowest Cost MS-DOS System	710.00* (15.00)		
Texas Complete IBM compatible (128K/Color Card/Mono Man/2 drives	1,710.00* (38.95)		
Texas Instruments Professional	CALL		

MULTIFUNCTION CARDS

Comex/Brother CR-II 13CPS LO Printer for CR-II	399.00* (8.62)
Comex/Brother Typewriter Keyboard	150.00* (3.25)
Comex/Brother Cut Sheet Feeder for CR-II	180.00* (3.89)
Epson RX-80	267.00* (6.00)
Epson FX-80	415.00* (9.25)
Epson FX-100	600.00* (14.35)
Epson LQ 1500	CALL
Epson IBM-to-EPSON Parallel Cable	21.00* (1.00)
NEC 2050 20CPS Letter Quality Printer	765.00* (16.53)
NEC 3550 33CPS Letter Quality Printer	1,460.00* (31.54)
Okidata ML84P 200CPS 132 Col	720.00* (16.00)
Okidata ML92P 160CPS 80 Col Printer	395.00* (8.55)
Okidata ML93P 160CPS Wide Platen	590.00* (15.20)
Okidata 2410P Pacemaker 350CPS 132 Col	1,850.00* (60.00)
Okidata IBM-to-Okidata Parallel Cable	20.75* (1.00)
Qume Sprint 11/45 45CPS Letter Quality 1,155.00* (24.00)	
Qume IBM Cable and Interface (required)	72.00* (1.00)
Texas Instruments 855 DP/LQ w/Tractor	716.00* (15.50)
Toshiba P-1151 160/100 CPS Dratr/LQ Printer	1,200.00* (32.00)

PRINTERS

Comex/Brother CR-II 13CPS LO Printer for CR-II	399.00* (8.62)
Comex/Brother Typewriter Keyboard	150.00* (3.25)
Comex/Brother Cut Sheet Feeder for CR-II	180.00* (3.89)
Epson RX-80	267.00* (6.00)
Epson FX-80	415.00* (9.25)
Epson FX-100	600.00* (14.35)
Epson LQ 1500	CALL
Epson IBM-to-EPSON Parallel Cable	21.00* (1.00)
NEC 2050 20CPS Letter Quality Printer	765.00* (16.53)
NEC 3550 33CPS Letter Quality Printer	1,460.00* (31.54)
Okidata ML84P 200CPS 132 Col	720.00* (16.00)
Okidata ML92P 160CPS 80 Col Printer	395.00* (8.55)
Okidata ML93P 160CPS Wide Platen	590.00* (15.20)
Okidata 2410P Pacemaker 350CPS 132 Col	1,850.00* (60.00)
Okidata IBM-to-Okidata Parallel Cable	20.75* (1.00)
Qume Sprint 11/45 45CPS Letter Quality 1,155.00* (24.00)	
Qume IBM Cable and Interface (required)	72.00* (1.00)
Texas Instruments 855 DP/LQ w/Tractor	716.00* (15.50)
Toshiba P-1151 160/100 CPS Dratr/LQ Printer	1,200.00* (32.00)

VIDEO CARDS

Amdex MAI Card	310.00* (2.50)
Hercules Monochrome Graphics Card	300.00* (2.50)
Hercules Color Card with Parallel Port	CALL
Paradise Multidisplay Card	332.00* (2.50)
Perseus Monochrome DiSB by Card	206.00* (2.50)
Quadram Quadcolor I Color Card	170.00* (2.50)
Quadram Quadvue Mono Card	210.00* (2.50)
W/ser/Par/Clock	
STB Graphix Plus	240.00* (2.50)
STB Clock Option for Graphix Plus	30.00* (1.00)

ACCESSORIES AND SUPPLIES

Brand Name 5.25DD Diskettes	20.00* (1.00)
Guaranteed for Life!	
Curtis PC Pedestal	54.00* (3.00)
Keytronic KB5151 Deluxe IBM Keyboard	186.00* (4.00)
WP Printer Paper 2600 Sheets	17.00* (10.00)
Microline Parts (included when Iorn)	

*PC NETWORK Members pay just 8% above the wholesale price, plus shipping. All prices reflect a 3% cash discount. Wholesale prices fluctuate rapidly—all prices in this issue have been prepared 60 days in advance. Please call for latest prices. Minimum shipping 2.50 per order.

- Wholesale + 8% Pricing
- Our 400 Page Catalog—Over 20000 Products
- In-stock Delivery On Popular Products
- Experienced Sales Consultants
- Add-on Quantity Discounts
- Free Technical Support
- 12-21 Day Business Software Rentals (optional)
- 12-21 Day Game Software Rentals (optional)
- Special Savings Newsletters "The Printout"
- Discount Book Library—Over 1000 Titles
- Membership Referral Bonus
- Corporate Accounts
- Software Publishing Assistance
- Membership Refund Guarantee
- 10 Day Hardware Return Policy

CALL TOLL FREE 1-800-621-S-A-V-E

In Illinois call (312) 280-0002

Your Membership Validation Number: B391

You can validate your membership number and, if you wish, place your first money-saving order over the phone by using your VISA, MASTERCARD or AMERICAN EXPRESS. Our knowledgeable service consultants are on duty Mon-Fri 8 AM to 7 PM, SAT 9 AM to 5 PM CST.

PERSONAL COMPUTER NETWORK
320 West Ohio
Chicago, Illinois 60610

Call now... Join the PC NETWORK and start saving today!



PC NETWORK • MEMBERSHIP APPLICATION

YES! Please enroll me as a member in the PC NETWORK™ and rush my catalog featuring thousands of computer products, all at just 8% above DEALER WHOLESALE PRICES. I will also periodically receive "THE PRINTOUT", a special up-date on merchandise at prices BELOW even those in my wholesale catalog, and all the other exclusive, money-saving services available to Members. 391

I am under no obligation to buy anything. My complete satisfaction is guaranteed. Please check (✓) all boxes that apply:

- | | |
|---|--|
| <input type="checkbox"/> Basic Membership | <input type="checkbox"/> Special V.I.P. Membership* |
| <input type="checkbox"/> One-year membership for \$8 | <input type="checkbox"/> One-year membership for \$15 |
| <input type="checkbox"/> Two-year membership for \$15 (SAVE \$1) | <input type="checkbox"/> Two-year membership for \$25 (SAVE \$5) |
| <input type="checkbox"/> Business Software Rental Library for \$25 add'l. per year—with 12 day rentals | <input type="checkbox"/> BOTH Business and Game Software Rental Libraries for \$30 add'l. per year—with 21 day rentals |
| <input type="checkbox"/> Games Software Rental Library for \$10 add'l per year on limited quantity merchandise specials | <input type="checkbox"/> *VIP members receive advance notice on limited quantity merchandise specials |

Bill my credit card: VISA MasterCard American Express

Account Number: _____

Exp. Date _____ mo. _____ year

Check or money order enclosed for \$ _____

Name _____ Apt. No. _____

Address _____

City _____ State _____ Zip _____

Telephone () _____

My computer(s) is: IBM PC Apple II TRS-80 Kaypro

Other _____

Signature _____ (Signature required to validate membership)

Copyright © 1984. PC NETWORK INC.

TRENT BEFORE YOU BUY—Members are eligible to join The NETWORK's Business and Game Software Rental Libraries and evaluate products for a full 12 (Regular) or 21 (VIP) days to see if it meets your needs. And The NETWORK's rental charges are far less than other software rental services—JUST 20% OF THE MEMBER WHOLESALE PRICE.

Hardware prices highlighted by ➤ reflect recent major price reductions

Sanyo MBC-555/IBM PC Compatibility

BY JOHN UNGER AND JEFFREY PHILLIPS

As scientists, both of us have done extensive programming in the work environment on mainframe computers and minicomputers using FORTRAN and PL/I. However, our home computing needs are different and include program development, word processing, and remote communications with minicomputers at the office. When we purchased identical Sanyo MBC-555 computer systems, we had no great illusions concerning IBM Personal Computer (PC) compatibility. Dealers had informed us that the Sanyo would not run IBM software requiring graphics and might not run other IBM software. Documentation was known to be poor. Nevertheless, the attractions of the low cost, bundled word processing, database, BASIC software, graphics, and IBM compatibility (in terms of disk format, microprocessors, and operating system) were too good to pass up. If public-domain software developed for the IBM PC could be adapted for use on the Sanyo, then so much the better.

We first ran the MicroPro (WordStar, etc.) and I.U.S. (EasyWriter) packages bundled with the MBC-555; we found them to be completely installed for the Sanyo system, and everything worked flawlessly right out of the package. Working with WordStar was somewhat disconcerting at first, though. Because of the

way the Sanyo writes to the screen, using the scroll feature (Control-QZ) to review text is difficult to adjust to: the text does not scroll smoothly and appears to jump around the screen as the top line is erased and a new line is added at the bottom. This effect is especially bothersome with double-spaced text. Also, the Sanyo appears to write to the screen much more slowly than some 8-bit CPM machines that we've used, but it's about the same speed as the IBM PC. Interestingly, this problem does not seem to be as apparent with the version of EasyWriter that comes with the Sanyo; perhaps I.U.S. uses more efficient code for screen-writing routines.

One of the first programs we attempted to convert was PC-Talk, a "freeware" communications program written in IBM BASIC. (A compiled version would not run on the Sanyo.) The initial problem we encountered was an "out of memory" message during the load. It seems that the Sanyo, supplied with 128K bytes of RAM (random-access read/write memory), can spare only about 40K bytes for BASIC program space. We corrected this problem by adding 64K bytes' worth of memory chips to the main board. All add-on memory is available to programs running under Sanyo BASIC. The remainder of the conversion attempt was

an education in the differences between IBM BASIC and the simpler Sanyo BASIC, which is structured much like 8-bit Microsoft BASIC.

The problem that caused us to abandon the attempt was the failure of PC-Talk to recognize extended keyboard codes such as Home or Shift-Ctrl (which are supposed to translate to the IBM Alt extended code) when typed on the Sanyo. This problem made it impossible to get past the main menu of PC-Talk without destroying the integrity of the BASIC code. It is just as well we did not spend more effort on converting this program because no one in our user group had succeeded in setting the data-transmission rate on the Sanyo using the instructions in the owners manual. Also, the situation has now changed because Sanyo has come up with its own communications software.

A second exercise involved using POKE commands to enter assembly-language subroutines into BASIC programs, as outlined by Hugh Howson in two BYTE articles (references 2 and 3). Going through his examples gave us our first look at the BIOS (basic input/output system) of the Sanyo. We were very encouraged to discover that most of the BIOS and DOS (disk operating system) interrupts found on the IBM PC also are

SERIAL COMMUNICATIONS

The MBC-550 does not come with a built-in serial port. The optional serial board, which costs \$100, can drive either a modem or a printer and is completely under software control. Transmission rates can be varied between 110 and 4800 bps but not by BASIC. Sanyo includes in the user's guide a BASIC routine to alter the data-transmission rate; however, due to rather temperamental timing, the BASIC routine does not work. The assembler routine in the guide works perfectly. The

serial board communicates through a standard DB25 female connector. The connector pin-outs comply with standard printer and modem configurations.

The main component of the serial board is the Intel 8251A serial interface controller chip, which takes data on its parallel bus and converts it into serial order. It also receives data on its serial RxDATA pin and converts it for the parallel bus. The 8251A is completely software controlled. Parity, word size, and stop bits are variable. Parity can be even, odd, or none; word size can be 5, 6, 7, or 8 bits; and the number of stop

bits can be 1, 1½, or 2. You select these characteristics by sending a control word to I/O address 2A (42 decimal). Table 4 shows the 8251A control word coding; listing 2 is an assembly-language program to alter the serial setting.

PARALLEL COMMUNICATION

The standard MBC-550 system includes a Centronics-type parallel interface. The interface can drive many kinds of printers and seems to cooperate with WordStar nicely. I have a C. Itoh dot-matrix printer that has operated perfectly with the MBC-550.

supported on the Sanyo. Specifically, interrupts 0, 1, 3, 10 through 1C, and 20 through 27 are supported. All others halt the processor. Interrupts 15, 18, 19, 1B, and 1C return to the calling program without taking any action. There also are some minor differences. For example, the keyboard interrupt (17) does not have the option of returning a status byte, the video interrupt (10) does not have graphics options, and the memory-size interrupt (12) always returns 16K bytes less memory than you thought you had, apparently to compensate for the 16K bytes of dedicated video RAM. A related conversion attempt involved a screen-dump program written in IBM BASIC with an assembly-language subroutine. This program used the graphics GET statement to access the screen, then used the VARPTR function to pass the address for the screen array through a CALL statement to the assembly-language subroutine. It soon became apparent that on the Sanyo the format of the array output by the GET statement differed radically from that produced on the IBM. In addition, the offset address returned by the VARPTR function was relative to an unknown segment address, making it next to useless. Furthermore, parameters passed through the CALL statement were not correctly utilized by the assembly-language subroutine. We were able to write a clumsy but functional version of the program only by eliminating passed parameters and taking advantage of "proprietary" information regarding the format of the GET array.

After reading articles on C compilers (references 1 and 4), we ordered a copy of the DeSmet C compiler for one of the new Sanyos. The decision to buy this

compiler was not made without some anxiety; although the product is supposedly able to run on plain-vanilla MS-DOS, some of the more interesting features and utility functions have been designed around the IBM PC. However, we were pleased to discover that not only does the fast and handy editor, SEE, work flawlessly, but the entire library of functions for direct screen I/O (input/output) on the IBM PC are completely compatible with the Sanyo. This feature is a direct consequence of the fact that the BIOS interrupt 10 routines are identical between the IBM and Sanyo machines.

Our version of DeSmet C (2.2) is more recent than the one reviewed in BYTE for the IBM, and the benchmarks we've run on the Sanyo show that the Sanyo produces results comparable to those reported for the IBM in the BYTE article. We're pleased with the package and now have the freedom to create not only EXE files from powerful and versatile source code but also machine-language programs using the 8088 assembler that comes with the C compiler.

In brief, the biggest problem with the MBC-555 is the lack of in-depth technical documentation. This lack prevents use of the machine's excellent graphics. Now all we have to do is figure out how to access the fine high-resolution graphics of the Sanyo with C-language functions or, at least, through assembly-language programs.

We were frustrated again when we attempted to run compiled public-domain utility software. Two RAM-disk programs written for the IBM failed to work on the Sanyo, as did an IBM program to play "Mary Had a Little Lamb." (The Sanyo apparently does not support music.) The

moral seems to be: If you expect to run IBM software, don't buy a Sanyo.

If you plan to write your own software using the full power of the 8088 and Sanyo graphics capability, expect to spend a lot of time with the debugger, searching through the DOS, BIOS, and BASIC assembly code in order to glean some insight into the interrupt and port structure. We think that Sanyo should correct the problems with the VARPTR and CALL statements or at least provide the information needed to use them in their present form.

Are we unhappy that we bought Sanyos? Not at all. The MBC-555 has proven to be a versatile computer with great potential at a great price. With a little help from Sanyo, especially in the form of good documentation on the BIOS and details for the rest of the operating system, that potential will begin to be realized.

John Unger (POB 95, Hamilton, VA 22068) and Jeffrey Phillips (1629 Apricot Court, Reston, VA 22090) are geophysicists for the United States government.

REFERENCES

1. Houston, Jerry, Jim Brodrick, and Les Kent. "Comparing C Compilers for CP/M-86." *BYTE*, August 1983, page 82.
2. Howson, Hugh R. "POKEing Around in the IBM PC." Part 1, *BYTE*, November 1983, page 121.
3. Howson, Hugh R. "POKEing Around in the IBM PC." Part 2, *BYTE*, December 1983, page 417.
4. Phraner, Ralph A. "Nine C Compilers for the IBM PC." *BYTE*, August 1983, page 134.

SOUND

The MBC-550 has no complex sound generators. Sanyo BASIC recognizes SOUND and PLAY as reserved words but apparently does nothing with them. When SOUND or PLAY is the first word on a line, the rest of the line is ignored. A simple test shows that

```
10 FOR T=0 TO 10000
20 NEXT T
```

takes 15.8 seconds to execute. When you insert 15 SOUND or 15 PLAY, the loop takes 22.0 seconds to execute.

Dividing the difference, 6.2 seconds, by 10,000 demonstrates that not much is going on in these two statements.

The MBC-550 does have a bell. When accessed through the normal channels, BEEP or PRINT CHR\$(7), the bell sounds rather like a frog being stepped on. When accessed in other ways, the bell makes other amusing sounds. The TXDATA pin of the 8251A that receives the keyboard data drives the bell. The I/O address of the 8251A is hexadecimal 38. Executing the statement OUT &H38.&HFF causes a short "pop" to come out of the speaker. The loop

```
10 FOR X=1 TO 50
20 OUT &H38.1
30 FOR T=1 TO 50:NEXT T
40 NEXT X
```

causes a sound like a machine-gun: "tock-tock-tock-tock." The following routine generates a "crash" or "you've-been-shot" sound.

```
10 FOR X=0 TO 255
20 OUT &H38.X
30 NEXT X
```

The parity, data bits, and stop bits of the keyboard 8251A chip can be controlled

(continued)

The Double-Drive MBC-555

BY JAMES G. DROPPO JR.

I have used the Sanyo MBC-555 as a word processor at home; I use an IBM Personal Computer (PC) in the office. A major advantage for me is the fact that the Sanyo comes with MicroPro software, eliminating any business/home software licensing questions.

My overall impression of the MBC-555 is good. MicroPro's IBM-compatible software works fine on the Sanyo. I am able to write reports, letters, data files, etc., interchangeably between the Sanyo and the IBM PC. As I'll describe, simple BASIC programs are easily transferred. The hardware and software works pretty much as advertised.

An obvious omission in the documentation, which is otherwise good, is the lack of a description of pin-outs for plugs on the back of the computer. With all the information on signal characteristics contained in the manual, pin-out information would be appropriate and quite useful. My color monitor could not be hooked up without a definition of pin-outs so I could make up an adapter cable.

I did not find all the software items I looked for, either. Sanyo BASIC documentation is quite good as far as it goes. The trouble is that not all commands are covered; you are referred to a book on Sanyo BASIC that the Sanyo dealer is supposed to have. I asked my dealer—he did not have such a book. I checked another Sanyo dealer—no book. I checked local bookstores—no book. So the following discussion of compatibility of Sanyo BASIC and IBM PC BASIC was produced without benefit of this additional documentation.

WordStar, SpellStar, MailMerge, InfoStar, and CalcStar are documented in the second volume. Because I already was quite familiar with the MicroPro software, I have not yet had to refer to the second volume. The detailed manual sections and training guides will be useful to new users. The menus in this software are of considerable help in the learning process. Also, the popularity of these packages has resulted in a number of good books,

available in most bookstores, to supplement a beginning user; documentation of these programs is no problem.

THE GOOD, THE BAD

Sanyo makes it clear in its literature on this series that the BASIC supplied is Sanyo BASIC. What this translates to is a BASIC that is close to IBM PC BASIC, but not identical. Files may only be transferred in ASCII (American National Standard Code for Information Interchange) format. The internal coding of BASIC statements is not the same. The procedure for transferring files is to save a version with an "A" option; that is, in BASIC with the program loaded, you enter

```
SAVE "FILENAME.BAS".A
```

and then the program may be loaded with no special options on the other computer. This works when going from the IBM PC to the Sanyo MBC-550, and vice versa.

The BASIC editing mode on the Sanyo is different than on the IBM PC: it works only on numbered program lines and requires hitting the Break key to stop the editing mode. I find it relatively easy to use, but compared to the IBM PC BASIC screen editor, it's limited.

On the positive side of the Sanyo is its more standard keyboard. I find I can hit Delete or Return without a several-second search. The Sanyo also has a handy reset button on the side of the keyboard. Both computers have an extra key between the Shift and Z keys (< > on the Sanyo; \ on the IBM). Just recently I stopped making those annoying shift errors caused by this extra key.

On the Sanyo's negative side is the placement of the disk drives, which follows the Oriental practice of going from right to left. The A drive is on the right and the B drive is on the left. If you're going back and forth between machines, it gets quite frustrating. A lot of disks get put into the wrong drives. Although I felt I could not complain too

much, I *could* do something about it.

I opened up the computer and reversed the disk-selection jumpers on the half-height disk drives. This gave me the same logical order as on the IBM PC. Near the back of the circuit board on the disk drive, drive A has the second and fourth pins jumpered and drive B has the third and fourth pins jumpered. My MBC-555 had two different models of disk drives—one with jumpers readily accessible when the case was opened, one with the circuit board underneath it. The latter required the complete removal of the drive to change the jumper. Changing the jumpers can mean a very simple operation or a relatively major one, depending on the type of drives.

If you have to remove the disk drives in order to change the jumpers, you might be tempted to merely reverse the complete drive mechanisms. This is not recommended because, generally, the final drive on the end of the disk-drive ribbon cable has a special set of termination resistors not used in intermediate drives. Anyway, the ribbon cable within the Sanyo is too short to let you physically switch the drive position.

The drives are single-sided, double-density units that have half the capacity of double-sided, double-density drives used in many IBM PCs. You must format disks on the IBM with the single-sided option for compatibility with the Sanyo. The instruction

```
A > FORMAT B:/I
```

loads the Format program from drive A and gets ready to format one side of the disk in drive B. No special commands are necessary when formatting disks on the Sanyo.

.....
James G. Droppo Jr. (3521 Sylvester St., Pasco, WA 99301) is a senior research scientist in the geosciences department at Battelle, Pacific Northwest Laboratories. He holds a doctorate in atmospheric sciences from the State University of New York at Albany.

Gifford has a lock on multiuser CP/M[®] 8-16.

It's 11:00 P.M. Do you know where your files are?

It's great when multiple local and off site users can run any 8- or 16-bit CP/M or MP/M™ program. It's even better when they can share expensive resources like printers, hard disks, and tape drives. Best of all is when they can share your most precious resource— data. Gifford has been delivering systems with all these features for over two years.

But sometimes data is sensitive. How do you keep people from taking more than their fair share?

Gifford adds a new dimension to CP/M security.

With our new security features, you can control what resources and data are shared.

Gifford's proprietary security enhancements include user login with encrypted passwords, control over access rights of modem users, secure electronic mail, and the ability to restrict users to specified terminals, programs, and directory areas. Plus, an audit log utility that keeps a permanent record of system activity. And you also get all the standard security features of Digital Research's MP/M-86™

You select the level of security needed to get the best balance between file sharing and file safety.

Unleash productivity with Gifford's Virtual Terminals.

With our Virtual Terminals, each terminal on your system can monitor up to four different programs running concurrently. And at the touch of a key you can switch screens instantly from one program to another.

You could look up an address in dBASE II™, jump over to SuperCalc™ to make some projections, then switch instantly to WordStar® to use this information to update a letter. If you forget what's on a screen, just touch a key to refresh your memory. You won't need to go through the distracting process of loading and unloading programs.

And since your Virtual Terminal can run any 8- or 16-bit CP/M or MP/M program, you can choose the best programs for your job from the biggest software library in the world. It's easier than 1, 2, 3!

The Gifford Security Blanket: Total Solutions.

Gifford delivers solutions. This means professional pre-sale consultation, expert system integration with 200 hour system burn-in, complete training, and full after sale support.

For example, our three user CompuPro® based system with a 21-megabyte hard disk costs just \$9,990, and can be easily expanded for \$500 per

user. This includes MP/M 8-16, SuperCalc, and dBASE II.

Other Gifford solutions include systems with hard disks that range from 5 to 300 megabytes, 4 and 9 track tape backup, printers, plotters, and modems. Single- and multiuser 8086, 68000, and Z-80 based systems are available for immediate delivery, with 80286 and 16032 systems on the way.

Two year warranty protection.

In the unlikely event that you encounter a hardware related problem, we'll replace any defective S-100 part within 24 hours FREE for two full years. But chances are, it can be solved on the Gifford service hotline or diagnosed via modem. All at no cost to you.

Lock in on Gifford Security today.

If total support, training, on site service, obsolescence-proof upgradeable S-100 bus architecture, and complete system security sound appealing, cut the coupon or give us a call. We'll send you a free brochure that tells the whole story. Once you get it you'll see why Gifford has a lock on multiuser CP/M 8-16.

Gifford Computer Systems is a Full Service CompuPro® Systems Center.



The powerful Gifford System 321 shown with optional GCS-80 Virtual Terminals.

GIFFORD
COMPUTER SYSTEMS

2446 Verna Court, San Leandro, CA 94577
(415) 895-0798 A division of G&G Engineering
I'D LIKE THE WHOLE STORY.
Please send me your brochure.

Name _____ Title _____
Organization _____ M/S _____
Address _____
City _____ State _____ Zip _____
Phone _____
 Please have a representative call me. BY-S

GIFFORD COMPUTER SYSTEMS □ San Leandro, CA (415) 895-0798 □ Los Angeles, CA (213) 477-3921 □ Houston, TX (713) 680-1944
Amherst, NY (716) 833-4758 □ Telex: 704521

Mac Inker

Re-ink any fabric ribbon **AUTOMATICALLY** for less than 5¢. Extremely simple operation with built-in electric motor. We have a **MAC INKER** for any printer: cartridge/spool/harmonica/zip pack. Lubricant ink safe for dot matrix printheads. Multicolored inks, uninked cartridges available. Ask for brochure. Thousands of satisfied customers.

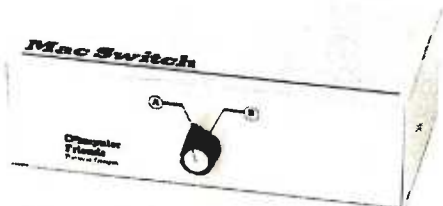
\$54.⁹⁵ +



Mac Switch

Mac Switch lets you share your computer with any two peripherals (serial or parallel). Ideal for word processors—never type an address twice. Ask us for brochure with tips on how to share two peripherals (or two computers) with **MAC SWITCH**. Total satisfaction or full refund.

\$99.⁰⁰



Order toll free 1-800-547-3303

Computer Friends

6415 SW Canyon Court
Suite # 10
Portland, Oregon 97221
(503) 297-2321

REVIEW: SANYO

in assembly language just like the serial port 8251A. The control address for the keyboard 8251A is hexadecimal 3A. Once you alter the attributes of the keyboard control address, however, data

from the keyboard is no longer received properly. The correct value of the keyboard control address is hexadecimal FF. With some experimentation and im-

(continued)

Table 3: The pin-out of the MBC-550 expansion header. In the schematic diagrams, pin 30 (CLK) has a notation that reads "OSC IBM BUSS."

Pin	Signal	Pin	Signal
A01	NMI (inverted)	B01	ground
A02	D7 (data)	B02	reset
A03	D6	B03	+ 5V
A04	D5	B04	unused
A05	D4	B05	unused
A06	D3	B06	unused
A07	D2	B07	- 12V
A08	D1	B08	RO/RT (inverted)
A09	D0	B09	+ 12V
A10	RDY	B10	ground
A11	AEN	B11	MWR (inverted)
A12	A19 (address)	B12	MRD (inverted)
A13	A18	B13	IOW (inverted)
A14	A17	B14	IOR (inverted)
A15	A16	B15	unused
A16	A15	B16	unused
A17	A14	B17	unused
A18	A13	B18	unused
A19	A12	B19	unused
A20	A11	B20	CLK
A21	A10	B21	IR7
A22	A09	B22	unused
A23	A08	B23	unused
A24	A07	B24	unused
A25	A06	B25	unused
A26	A05	B26	unused
A27	A04	B27	unused
A28	A03	B28	ALE
A29	A02	B29	+ 5V
A30	A01	B30	CLK
A31	A00	B31	ground

Table 4: Control-word codes for the 8251A serial interface controller chip. All aspects of the transceiver are subject to software control.

Bit	Value	Function
7 and 6	00	Invalid
	01	1 stop bit
	10	1½ stop bits
	11	2 stop bits
5	0	odd parity
	1	even parity
4	0	parity disable
	1	parity enable
3 and 2	00	5 data bits
	01	6 data bits
	10	7 data bits
	11	8 data bits
1 and 0	should always be 10 for the MBC-550	

GET YOUR MESSAGE THROUGH.

EVEN WHEN YOUR MODEM SENDS IT BY WAY OF THE OKEFENOKEE SWAMP.

When you send data by telephone through nasty environments like this, it can run into problems tougher than just alligators. Problems like impulse noise. Chatter from the switchgear. Static from the atmosphere or bad weather. Distortion due to crosstalk or just plain white noise.

To get your message through, your IBM PC or XT needs the advanced performance features of the PC: IntelliModem™. It's got the best receive sensitivity available today—actually down below -50 dBm. So now you can achieve a high level of data transmission integrity. Even with bad connections.

Get patented modem technology.

The PC: IntelliModem is elegantly simple. Its patented design does it all on a single microprocessor chip, with just one crystal. Other modems take

two, four or more μ Ps (and even more oscillators), and still accomplish less.

How do we do this? By creating architectural innovations in firmware, and by pushing the chip to its limit, close to 12 MHz.

Since it uses fewer parts, the PC: IntelliModem's no-compromise design offers higher reliability, a more compact form factor, and lower costs.



This design elegance leads naturally to more elegant performance. Take line status detection, for example. The PC: IntelliModem's adaptive, decision-directed logic monitors line status more closely than other modems. Even at weak or degraded signal levels. So it can make connections with less chance of error, by detecting signals for dial tone, remote ringback, busy and voice—some of which other modems ignore.

Plan ahead with integrated voice and data.

For opening up a whole new world of integrated voice and data applications, there's nothing like the PC: IntelliModem. Literally. Its easy-to-use software package—PC: IntelliCom™—lets you switch repeatedly between talking or listening and sending or receiving data. All at

Make sure your modem has all these PC: IntelliModem features

Integrated Voice/Data

- Switch between voice and data communications
- Programmable telephone handset jack

Status Reporting

- ▣ Line status detection (dial tone, busy, remote ringback, voice answer, modem answer, incoming call)

- Audio monitor

- Programmable status LED

PC: IntelliCom™ Software Included

- 99-name on-line telephone directory
- Auto-dial, auto-repeat dial, auto-answer
- Link to another number if busy
- File transfer
- Data capture to diskette
- Programmable auto log-on sequences

Compatible with Crosstalk™ and PC-Talk III™

Pulse and Tone Dialing

Receive Sensitivity: -50 dBm
Speeds: 110, 300, 1200 baud

the touch of a single function key. That means now both you and your computer can talk on the same line. Without having to hang up, re-dial or plug and unplug a lot of cables.

So if you're designing microcomputer datacomm products—or just looking for a PC/XT modem for yourself, check out the PC: IntelliModem at your local dealer. You'll get the message. And so will they. Or contact: Bizcomp, 532 Mercury Drive, Sunnyvale, CA 94086; 408/733-7800.

Bizcomp: A history of innovation.

1980	Invented first command-driven modem
1981	Introduced proprietary line-status monitoring
1983	Designed first single- μ P 212A-compatible modem
1983	Introduced first integrated voice/data modem for IBM PC
1983	Granted patent on command-driven modem

BIZCOMP[®]
We've got people talking.

Listing 1: An animation test program for the MBC-550.

```

10 REM SIMPLE ANIMATION WITH PUT AND GET
20 REM USE ARROW KEYS TO MOVE BLOCK AND S TO STOP
30 REM THE BLOCK IS MOVING ONE PIXEL WITH EACH KEYSTROKE
40 REM DIM PATTERN%(25)
50 X=320:Y=100
55 REM INITIALIZE ARRAY
60 GET (1,1)-(16,8),PATTERN%
65 REM CLEAR ARRAY EXCEPT FOR ARRAY SIZE INTEGER
70 FOR A=2 TO 25:PATTERN%(A)=0:NEXT A
75 REM PUT BLOCK INTO ARRAY
80 FOR A=11 TO 16:PATTERN%(A)=6HFE7F:NEXT A
90 CLS
100 PUT (X,Y),PATTERN%
110 IS=INKEY$
120 IF IS="" THEN 110
130 IF IS="S" THEN 190
140 IF (X > 1) AND (IS=CHR$(28)) THEN X=X-1
150 IF (Y > 190) AND (IS=CHR$(31)) THEN Y=Y+1
160 IF (Y > 1) AND (IS=CHR$(30)) THEN Y=Y-1
170 IF (X < 630) AND (IS=CHR$(29)) THEN X=X+1
180 GOTO 100
190 END
    
```

agination, you can make the MBC-550 generate plenty of sound.

SOFTWARE

The MBC-550 comes with five software packages: MS-DOS 1.25, Sanyo BASIC 1.1, WordStar 2.4, CalcStar, and Easy-Writer 1.3. WordStar, CalcStar, and Easy-Writer are all standard releases and don't need to be reviewed here.

Sanyo BASIC is standard BASIC and is code-compatible with IBM BASIC except for some of the graphics commands that IBM's version lacks—WINDOW, VIEW, and SYMBOL. The VIEW and WINDOW commands enable you to set aside areas of the screen for special graphics tasks. The SYMBOL command takes any string of the 255 displayable characters and magnifies or rotates them and places them anywhere on the screen.

Sanyo BASIC has a nice screen editor that you engage by listing the line or lines that you want to edit and then pressing the up-arrow on the numeric pad. The cursor-control and the Delete and Insert keys then enable you to make whatever changes you like, including changing line numbers and creating new lines. When you're through, press the Break key and the editor stores all changes and returns you to BASIC.

In its February 1984 newsletter, Sanyo printed a list of 48 IBM software packages that run on the MBC-550 without modification. The list included seven languages, eight adventure games, ten word processors, and six database-management systems. The MBC-550 can run a lot of software.

CONCLUSION

Having now owned a Sanyo MBC-550 for four months, I am very pleased with this machine. The MBC-550 is more computing machine for the dollar than any other personal computer on the market. Because it offers compatibility with the IBM PC and other 8088-based systems, the MBC-550 will never run short of software. With a large organization like Sanyo behind it and a price one-third that of comparable machines, the Sanyo MBC-550 is a good buy. ■

ACKNOWLEDGMENT

BYTE editors extend special thanks to PT Wolf, of Richard Dean Associates Inc., Newburyport, Massachusetts, for his invaluable assistance in the preparation of this article.

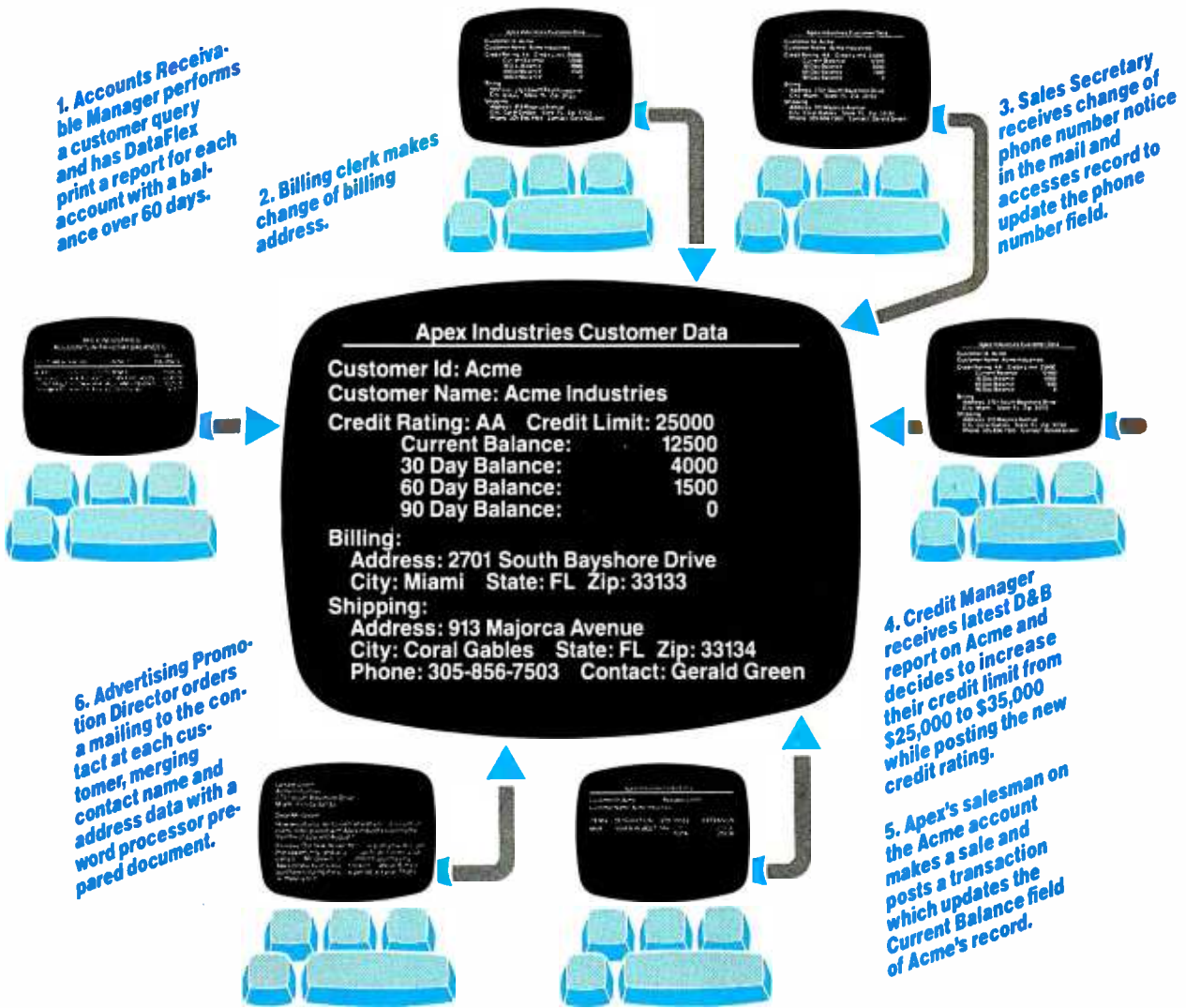
Listing 2: An assembly-language program to alter serial communications functions.

```

SSEG          SEGMENT STACK
              DB 256 DUP (?)
SSEG          ENDS
:
DSEG          SEGMENT
DATA          DB ?
DSEG          ENDS
:
CSEG          SEGMENT
ASSUME CS:CSEG,DS:DSEG,SS:SSEG
START
              PROC FAR
              PUSH DS
              PUSH AX
              MOV BX,DSEG
              MOV DS,BX
              CALL MAIN
              RET
START
              ENDP
:
MAIN          PROC NEAR
MOV AL,0
OUT 42,AL : THE FIRST THREE OUT STATEMENTS ESTABLISH TIMING
MUL AL : ALL MUL STATEMENTS ARE FOR TIMING
OUT 42,AL
MUL AL
OUT 42,AL
MUL AL
MUL AL
MOV AL,64 : 64 IS THE PREPARE TO RECEIVE COMMAND SIGNAL
OUT 42,AL
MUL AL
MUL AL
MOV AL,250 : 250 SETS THE 8251A FOR EVEN PARITY. 2 STOP
OUT 42,AL :BITS AND 7 DATA BITS. SEE TABLE 4.
MUL AL
MUL AL
MOV AL,55 : 55 IS THE LOCK COMMAND SIGNAL
OUT 42,AL
MUL AL
MUL AL
MUL AL
RET
MAIN          ENDP
CSEG          ENDS
              END START
    
```


ALL AT ONCE!

AND NEVER A "LOCKED OUT" USER!



DataFlex is the only application development database which **automatically** gives you true multi-user capabilities. Other systems can lock you out of records or entire files for the full time they are being used by someone else. DataFlex, however, locks only the data being changed, and **only** during the micro-seconds it takes to actually write it to the file! The updated record is then immediately available. The number of users who can access, and change, records at the same time is limited only by the number of terminals on your system or network. Call or write today for all the details on DataFlex... the true multi-user database.

DATA FLEX™

DATA ACCESS CORPORATION
 8525 SW 129 Terrace, Miami, FL 33156 (305) 238-0012
 Telex 469021 DATA ACCESS C1

AUTHORIZED INTERNATIONAL DISTRIBUTORS

HOLLAND
 ADINFO 020-644605

AUSTRALIA
 Australian Business Solutions
 03-699-8377

Australian Microcomputer Solutions
 052-22-2099

Intelligence (Aust) Pty. Ltd.
 02-267-1711

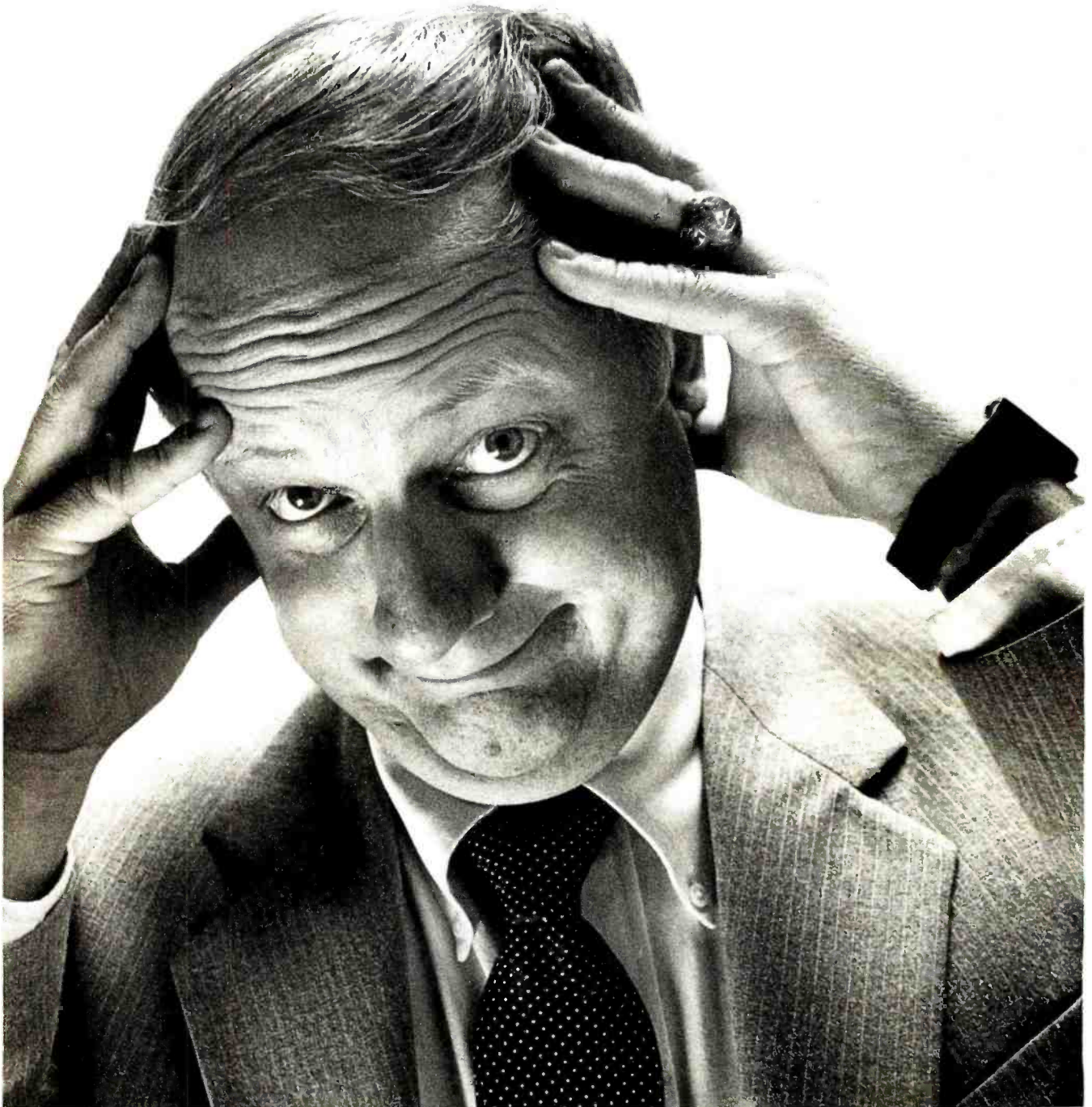
ENGLAND
 Equinox Computers 01-729-4460

SWEDEN
 Offensivt Datorstod AB 030-006-2626

JAPAN
 SOFTEC 04808 (5) 6565

Compatible with CP/M-80, MSDOS networks, MP/M-86, Novell Sharenet, PC-Net, DMS Hi-net, TurboDOS multi-user, Molecular N-Star, Televideo MmmOST, Action DPC/OS, IBM PC w/Corvus, OMNINET, 3Com EtherSeries and Micromation M/NET.
 MSDOS is a trademark of Microsoft. CP/M and MP/M are trademarks of Digital Research.

UNTIL NORTRONICS,[®] HEADS COULD REALLY



CLEANING READ/WRITE BE A HEADACHE.

Now meticulous head care is easy as loading a program.

Take our word for it. We're the world's leading manufacturer of advanced technology magnetic recording heads. And we know, what you can't see *can* hurt you.

Dust, cigarette smoke and oxide contaminants can make a mess of your head. And that means data loss, downtime—and unnecessary service charges.

Unfortunately, cleaning read/write heads can also be a headache. That is, until now.

We've developed user-friendly head care software that leaves our competition in the dust.

Nortronics has designed head care software that completely eliminates the hassles associated with cleaning floppy disk heads in word processors, personal and small business computers.

You can follow the user-friendly instructions in Nortronics' software booklet. Or make it even easier—and use Nortronics' software diskettes.

Just load the program. And take a load off.

Cleaning is simply a matter of loading the program into RAM—spraying a portion of Nortronics' non-abrasive cleaning disk with our special solution—inserting the disk—and following the friendly commands.

There's no guesswork. No danger of ineffective or improper cleaning procedures. No problems engaging secondary drives.

The program steps the read/write head to a fresh cleaning band—spins the disk—and 30 seconds later, after all debris is safely removed, the drive automatically shuts off.



Each disk has four cleaning bands per side. That's enough for eight cleanings on a single-sided system—or four on a double-sided system.

A free Flip'N'File/15 makes our smart cleaning kit an even smarter buy.*

The Nortronics Diskette Head Cleaning Kit includes the software diskette—our special head cleaning fluid—two non-abrasive cleaning diskettes—and a reusable diskette jacket.

Best of all, it's packed in a free

Flip'N'File/15 that becomes a handy storage box for your diskettes.

And for your convenience, all elements of the Kit are also available separately.

*Flip'N'File/15 is a trademark of Innovative Concepts, Inc.

Nortronics offers a complete line of computer care supplies.

In addition to the 5 1/4" Diskette Head Cleaning Kit, Nortronics provides superior quality cleaning kits for 3 1/2" and 8" disk drives—for data cassette tape drives—and for data cartridge back-up tape drives.

There's a Disk Drive Analyzer, too. And Screen Cleaning Kits. Anti-Static Sprays. Even Line Conditioners.

There's everything it takes to help you keep your system performing at its best.

For more information, call toll free. Phone (800) 328-5640. In Minnesota (800) 742-0687.

We'll help you discover Nortronics—before you discover your head's messed up.

Nortronics Company, Inc.; Consumer Products Division; 8101 10th Avenue North; Minneapolis MN 55427.

©Nortronics is a registered trademark of Nortronics Company, Inc.

NORTRONICS

CompuPro...

for Performance, Quality and Reliability

Anyone can sell you a box full of hardware. But is it too much computer? Too little? Will it run the appropriate software? What about service? If you need the right answers both before and after the sale, call your nearest Full Service CompuPro System Center.

For product information, see pgs. 201, 249.

ALABAMA

Birmingham
CPC Computers
(205) 879-5976

ARIZONA

Scottsdale
S-100
(602) 991-7870

CALIFORNIA

Bakersfield
Creative Computing
(805) 835-1118

Berkeley
American Computers
& Engineers
(415) 849-0177
Track Computer Center
(415) 845-6366

Burlingame
Mentzer Computer
Systems
(415) 340-9363

Canyon Country
Creative Computing
(805) 251-9877

Chatsworth
Priority One Electronics
(818) 709-6789

Hayward
Best Computers
(415) 886-4732

Irvine
Priority One Electronics
(714) 660-1411

Los Angeles
American Computers
& Engineers
(213) 477-6751
Gifford Computer
Systems
(213) 477-3921

Mountain View
ACC
(415) 969-4969

Oakland
Track Computer Center
(415) 444-8725

Pacific Palisades
System Interface
Consultants
(213) 454-2100

Pasadena
Omni Unlimited
(818) 795-6664

Petaluma
Advanced Information
Management
(707) 763-7283

Pleasanton
Best Computers
(415) 463-2233

Sacramento
Logic Systems
(916) 922-3377

San Leandro
Gifford Computer
Systems
(415) 895-0798

San Rafael
Computer House
(415) 453-0865

Santa Barbara
Data Bank
(805) 962-8489

Santa Cruz
Cochlin Computer
Systems
(408) 429-6728

Santa Maria
Data Bank
(805) 922-1333

Santa Rosa
Matrix Computers
(707) 542-0571

Simi Valley
Micro Power Unlimited
(805) 584-6789

Sunnyvale
Pragmatic Designs Inc.
(408) 736-8670

COLORADO

Lakewood
Rocky Mountain
Microsystems
(303) 232-4545

FLORIDA

Gainesville
Online Computing
(904) 372-1712

Orlando
Data/Office
(305) 629-6776

Satellite Beach
Binary Magic, Inc.
(305) 777-7080

Tampa
Micro-Computer
Technology
(813) 985-0919

West Palm Beach
Steve's Computer
Works, Inc.
(305) 683-5900.

HAWAII

Kahului Maui
Capacity Plus
Computers
(808) 871-7984

ILLINOIS

Athens
Computers Plus
(217) 636-8491

La Grange Park
Small Business
Systems, Inc.
(312) 579-3311

Mundelein
Computers 'n Stuff
(312) 949-8585

Skokie
Lillipute Computer
Mart, Inc.
(312) 674-1383

INDIANA

Terre Haute
General Software, Inc.
(812) 234-9421

KANSAS

Ellinwood
Genesys Systems, Inc.
(316) 564-3636

MARYLAND

Bethesda
JR Systems
(301) 657-3598

MASSACHUSETTS

Boston
New England
Electronic Exch.
(617) 491-3000

Chestnut Hill
Key Micro Systems
(617) 738-7306

MICHIGAN

Ann Arbor
Waldorf Associates, LTD
(313) 996-0646

MISSISSIPPI

Pascagoula
Automated Accountants
(601) 769-2937

MISSOURI

Kansas City
BBRL
(816) 753-5900

NEW YORK

Amherst
Gifford Computer
Systems
(716) 833-4758

Oer Park
Datapro Systems, Inc.
(516) 595-1311

New York

**Park Plaza Computer
Center, Inc.**
(212) 759-5820

**Park Plaza Computer
Center, Inc.**
(212) 505-8200

**Park Plaza Computer
Center, Inc.**
(212) 344-5151

**Park Plaza Computer
Center, Inc.**
(212) 595-5353

Staten Island
John D. Owens Assoc.
(212) 448-6283

NORTH CAROLINA

Greensboro
General Semantics
Computers
(919) 378-1500

OREGON

Portland
Microwest Computer
Products
(503) 238-6274

PENNSYLVANIA

Philadelphia
Forefront Technology
(215) 386-1500

Reading
Fraser Business
Equipment
(215) 378-0101

RHODE ISLAND

Coventry
Key Micro Systems
(401) 828-7270

Warwick
Systems &
Solutions, Inc.
(401) 732-2913

TEXAS

Austin
CPA Systems, Inc.
(512) 458-9281

Informa, Inc.
(512) 459-4216

Informa, Inc.
(512) 474-4449

Omegax Systems
(512) 476-6069

Dallas

Datar Systems
(214) 521-0915

Ft. Worth

**Dataworth Computer
Systems**
(817) 877-4041

Houston
Gifford Computer
Systems

Informa, Inc.
(713) 861-7612

Irving
Dator Systems
(214) 986-0422

San Antonio
RFCanon, Inc.
(512) 657-0444

Seguin
CPA Systems, Inc.
(512) 379-0660

VIRGINIA

Woodbridge
Office Networks Corp.
(703) 690-3312

WASHINGTON

Bellevue
North Ridge Computer
Systems
(206) 453-0596

Seattle

**American Computers
& Engineers**
(206) 583-0130

WISCONSIN

Madison
Beam International
(608) 233-2326

Milwaukee
Byte Shop of Milwaukee
(414) 281-7004

AUSTRALIA

Bankstown
Automation Statham
Pty., Ltd.
(02) 709-4144

CANADA

Coquitlam, B.C.
CSC System Center, Ltd
(604) 941-0622

Vancouver, B.C.
Dynacomp Business
Computers, Ltd.
(604) 872-7737

THE PHILIPPINES

Quezon City
Corona International.
Inc.
78-34-71

UNITED KINGDOM

Swansea
Comcen Technology,
Ltd.
(0792) 796000

CompuPro®

A GODBOUT COMPANY

3506 Breakwater Court, Hayward, CA 94545



Four Logos for the IBM PC

Several new Logos offer turtle graphics of varying quality on the IBM PC

BY MARK BRIDGER

This is not, of course, the famous Big Blue IBM logo; this is the Logo programming language, specifically the four versions currently available for the IBM Personal Computer (PC) and/or PCjr. Until recently, the only Logos available ran either on mainframes with lots of memory or on 8-bit machines, such as the Apple and the Commodore, with barely enough memory—at most 64K bytes. The widespread availability of 16-bit machines like the IBM PC with adequate memory (128K bytes or more) and color graphics enables you to enjoy the power and fascination of a full Logo implementation.

AN OVERVIEW

In terms of structure and ancestry, Logo is a cousin to LISP—the language generally used by artificial intelligence researchers. LISP, which was invented in the early 1960s by J. McCarthy, is a language whose basic data structure is a list. A list is an ordered collection of objects, which may be names, numbers, or other lists. Both Logo and LISP (short for list processing) can manipulate lists in many different ways. The full implementation of LISP contains many features not found in Logo (see references 2 and 6).

The most dramatic difference between Logo and other programming languages—including LISP—is its *turtle graphics*. Originally, the turtle was a motorized metal and Plexiglas creature, controlled by the programmer, which could lower its pen to draw a trace of its path on the floor. Instructions for the turtle were coded in Logo, and you could draw quite complicated pictures with relatively few commands. When CRTs (cathode-ray tubes) became widely used on computers, the turtle appeared on them as a small triangle, and its path as a line of pixels (dots) on the screen. Logo and turtle graphics have been considered virtually synonymous for quite some time, and it is fair to say that most people who use Logo do so to use the turtle. Schools use Logo and turtle graphics extensively as a means of teaching programming and geometry and fostering creativity (see references 3 and 5).

Like BASIC and LISP, Logo is an interpreted

language. This means that when you run a Logo program, an interpreter translates each line into the strings of zeroes and ones that are machine language. Even if you repeat a line or the program goes to an instruction it has already translated, the interpreter must translate it into machine code all over again. This means that an interpreted language produces relatively slow-running programs, but it has advantages over compiled languages. A compiler translates a complete program, line for line, into machine code and then saves it as an autonomous stand-alone program, needing no interpreter. Pascal, FORTRAN, and C are compiled languages. While compiled programs execute very quickly, they have a disadvantage: to change a compiled program, you must change the source code using a text editor and then recompile it. Only then can you see if the changed program works the way you want it to. With an interpreted language you just change the text and run.

One last point: Logo is a structured language, like Pascal and C. There are no line numbers in Logo—commands execute sequentially and special commands control repetition. You can organize instruction sequences that are used several times in your program into procedures, give them names, and invoke them by these names. Thus, Logo doesn't need line numbers because the interpreter tells the machine what to do and when to do it based solely on the logical structure of the written program.

THE LOGOS AVAILABLE

I will discuss four Logo packages in this review, Dr. Logo, IBM Logo, PC Logo, and Waterloo Logo. I will look at various features of the language, give some examples, and try to com-

(continued)

.....
 Mark Bridger (Math Department, Northeastern University, Boston, MA 02115) is an associate professor of mathematics at Northeastern University. He has a B.A. from Columbia University and a Ph.D. in mathematics from Brandeis University. When he isn't playing with his computer, Mark enjoys carpentry, gardening, and playing bluegrass music, particularly on the mandolin.

pare how each of these products implements those features.

GRAPHICS

The turtle, represented on the screen by a small triangle, responds to the basic commands: FORWARD (distance), BACK (distance), RIGHT or LEFT (angle), and PENUP or PENDOWN, with distance and angle as specified numbers. You can also set the BACKGROUND color, the PALETTE, and the PENCOLOR. In addition, the various Logos provide other graphic enhancements as follows. **WRAP/FENCE/WINDOW:** With the WRAP option, if the turtle leaves the screen on the right, it reappears on the left at the same height; similarly, if it leaves on the left, top, or bottom, it reappears on the opposite side. FENCE prevents the turtle from leaving the screen at all, while WINDOW allows the turtle to leave and keep going even though you can no longer see it. All the

Logos except Waterloo provide these three options. Waterloo allows the turtle to operate in FENCE mode only.

PAINT or FILL: This is similar to IBM BASIC's PAINT command. It fills in the closed area that contains the turtle with a specified color. Only Waterloo and IBM Logos provide this feature. Waterloo Microsystems claims that a new version of its Logo will be able to paint in user-selected textures.

HIGH RESOLUTION: The standard graphics mode for Logo is 320 by 200 pixels in four colors; however, PC Logo lets you choose 640 by 200 pixels with one color on a black background. This results in crisper, more detailed pictures, but only in one color. (This color comes from directly programming the IBM Color Graphics Adapter and does not apply to the PCjr.)

PICTURE SAVING: All four Logos offer procedures for saving a picture on either disk or the printer. The only

printer supported is the Epson/IBM. The screen dump occurs via the DOS 2.0 GRAPHICS command in PC and IBM Logos (but only under 2.0).

ARCS/CIRCLES: Procedures for drawing arcs and circles are built into Waterloo Logo and are among the listed utility programs for IBM Logo. However, if you have Dr. Logo or PC Logo, you must write your own.

MUSIC: All four Logos provide some sort of tone and duration primitive commands, along with complete instructions for their use in producing music of a sort from the IBM PC's rather meager audio system. Waterloo and PC Logos provide sample programs that play tunes ranging from "The Star-Spangled Banner" to a Bach Partita (one of my favorites, but it sounds like an anemic Moog synthesizer on the PC).

SPEED: I performed some benchmark tests on the Logos, using the Hilbert (HIL, or actually Peano) Curves program (see listing 1 and reference 1). Since graphics is a primary use for Logo, and since drawing repeated and recursive designs is very popular, this program is a pretty fair representation of a Logo application. The first time I drew a level-6 curve, I left my 8087 chip turned on and produced the rather lopsided results found in table 1.

The reason for PC Logo's speed is easy to figure out. Logo, like BASIC, assumes—unless told otherwise—that its variables are real. In particular, the turtle moves through real coordinates processed by floating-point calculations. A machine with an 8087 Numerical Data Processing chip (the one that sits next to the central processor 8088 chip) handles real variables like lightning. If you have an 8087, you can expect PC Logo, the only Logo to provide support for it, to be much, much faster in graphics and all real-number manipulations. If you're a speed demon, PC Logo is probably the way to go.

On the other hand, there is something to be said for watching the way the turtle actually draws your picture. You can learn and savor the act of creation—sometimes speed may not be a major concern if you have children using Logo. If you turn off the 8087 chip, IBM wins (see table 1). You have to admit that 12 or 15 minutes is a long time to watch a picture being drawn.

(continued)

Listing 1: HIL, a Hilbert Curves benchmark program in Logo.

```

TO HIL :COLOR
SETBG 0           : SETS BACKGROUND TO BLACK
SETPAL 0         : CHOOSES PALETTE 0
SETPC :COLOR     : SETS PEN COLOR TO INPUT :COLOR
FULLSCREEN      : USES WHOLE SCREEN FOR GRAPHICS
HOME            : SENDS TURTLE TO STANDARD POS.
CLEARSCREEN     : CLEARS SCREEN
PENUP          : TURTLE WON'T DRAW WHEN MOVED
SETX 150        : MOVE TO X=150, Y UNCHANGED
SETY -100       : MOVE TO Y=-100, X UNCHANGED
PENDOWN        : TURTLE IS NOW IN LOWER RT.
                : CORNER OF SCREEN.READY TO DRAW
HILBERT 3 6 1   : BIGGEST CURVE FITTING SCREEN
END             : PROCEDURE HIL ENDS
    
```

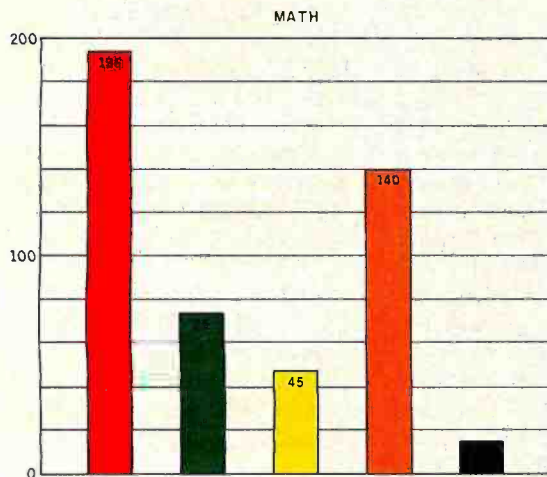
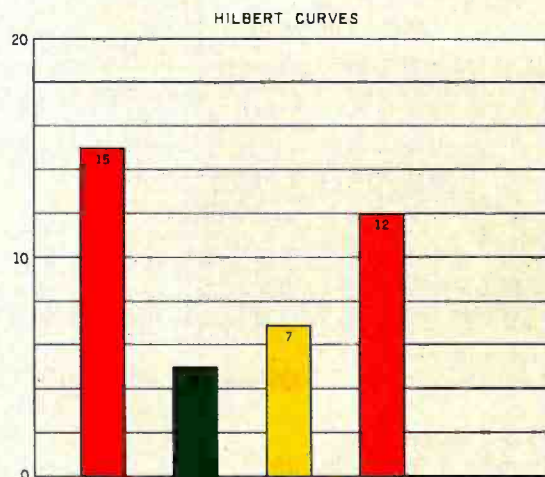
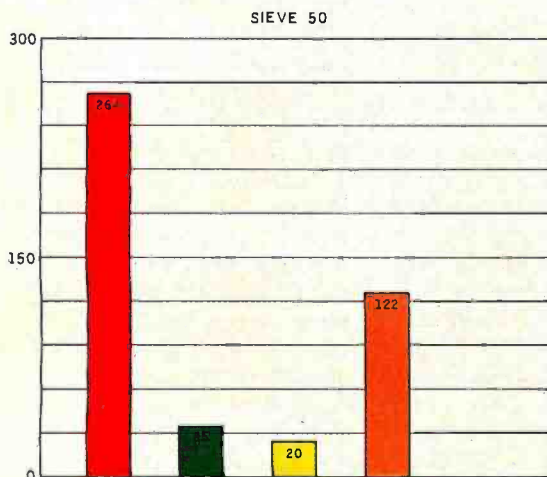
:THE NEXT PROCEDURE DRAWS THE CURVE. EACH HILBERT CURVE IS :DRAWN BY DRAWING FOUR HILBERT CURVES OF A LOWER LEVEL WITH :DIFFERENT ORIENTATIONS, CALLED PARITIES. NOTE HOW THIS :PROCEDURE "CALLS ITSELF" — THIS IS RECURSION.

```

TO HILBERT :SIZE :LEVEL :PARITY
IF :LEVEL = 0 [STOP] : LEVEL 0 CURVES DO NOTHING
LEFT :PARITY*90      : ROTATE PARITY RIGHT ANGLES
LOCAL "L            : CREATE LOCAL VARIABLE L
MAKE "L :LEVEL-1    : SO YOU DON'T HAVE TO RECOMPUTE
HILBERT :SIZE :L (-:PARITY) : DRAW LOWER ORDER CURVE
FORWARD :SIZE       : DRAW CONNECTING SEGMENT
RIGHT :PARITY*90    : CHANGE ORIENTATION AGAIN
HILBERT :SIZE :L :PARITY : ANOTHER LOWER ORDER CURVE
FORWARD :SIZE      : ANOTHER CONNECTOR
HILBERT :SIZE :L :PARITY : SAME AS PREVIOUS
RIGHT :PARITY*90   : ANOTHER TURN
FORWARD :SIZE     : THE LAST CONNECTOR
HILBERT :SIZE :L (-:PARITY) : THE LAST CURVE
LEFT :PARITY*90   : THE LAST TURN
END               : PROCEDURE HILBERT ENDS
    
```

:See TURTLE GEOMETRY (Abelson and diSessa, MIT Press) for :this and other turtle graphics projects.

AT A GLANCE



■ DR. LOGO ■ IBM LOGO ■ PC LOGO
■ WATERLOO LOGO ■ BASICA

A COMPARISON OF four Logos for the IBM using three benchmark programs (see table 1). Sieve 50 finds the primes up to 101 (see listing 2). The Hilbert-Curves program (listing 1) measures how long it takes to draw a set of curves. One thousand iterations of the MATH program (listing 3) measure each language's ability to perform real-number multiplication and division. Execution time indicated on the y axis is in seconds.

Name	Dr. Logo	IBM Logo	PC Logo	Waterloo Logo
Manufacturer	Digital Research Personal Computer POB 579 160 Central Ave. Pacific Grove, CA 93950 (408) 649-5500	IBM Corp. (distributor) Boca Raton, FL 33432 (software prepared by Logo Computer Systems Inc.)	Harvard Associates Inc. (distributor) 260 Beacon St. Somerville, MA 02143 (617) 492-0660 (software prepared by Gold Hill Computers Inc.)	Waterloo Microsystems Inc. 175 Columbia St. West Waterloo, Ontario N2L 5Z5 Canada (519) 884-3141
Price	\$150; additional backup disks cost \$25	\$175	\$150	\$125
Computer Needed	IBM PC with at least 192K bytes of memory, color graphics adapter, one disk drive, and monitor	IBM PC XT or PCjr with at least 128K bytes of mem- ory, color graphics adapter, one disk drive, and monitor	IBM PC XT or PCjr with at least 64K bytes of mem- ory, 128K for full imple- mentation, color graphics adapter, one disk drive, and monitor	IBM PC XT (PCjr soon) with at least 128K bytes of memory, color graphics adapter, one disk drive, and monitor
Contents	User's manual/tutorial, language disk and backup (CP/M operating system; kernel pro- vided); copy-protected	User's manual and tutorial, Logo quick-reference card, and language disk; not copy-protected	User's manual/tutorial, language disk, and demonstration utilities disk; not copy-protected	User manual, Logo language disk, and demonstrations disk (DOS-file compatible); not copy-protected

SUPER SAVER

64K RAM Chips

(Min. 100) \$4.49 ea.



IBM PC 256K, Disk Drives, FDC, Monitor and Adaptor \$2350.00

SANYO 555-2 System with 128KB Memory, 2 160KB Slimline Drives, Keyboard, MS-DOS and Micropro Software \$1399.00

TAVA Standard Unit with 128 KB Memory, Floppy Drive Controller, Videoadapter, 2-320KB Slimline Drives, Monitor, Keyboard, Parallel Port & Serial Port \$1750.00

10MB Hard Disk Sub System for TAVA®, IBM®, and COLUMBIA® Qty. \$899.00

Disk Drive for IBM PC \$149.00

Color Graphics Card for IBM PC \$199.00

Printers by Epson, Okidata, Brother Call

Floppy Drive Controller for IBM PC \$169.00

Color Monitor HX-12 by PGS \$459.00

Shipping and Handling extra. All transactions based on cashier's check or wire transfer.

SCIENTIFIC RESEARCH CORP.

714/261-9137

REVIEW: FOUR LOGOS

LIST PROCESSING

Here are some examples of lists. Notice that in Logo you enclose the lists in brackets.

```
[CURLY LARRY MOE] (list of three
                    names)
|| (empty or
   null list)
|[1 3 5 7 9 11] (list of
                 numbers)
|[1 2 3 IBM PC] (mixed list
                 of 5 items)
|HEIDEGGER KANT |ORTEGA
GASSET| 81| (list of 4
             items: two
             names,
             another list,
             and a
             number)
```

You can add an object to the front of a list with the command FPUT and to the back with LPUT. Note that names require a preceding double quote in Logo. FPUT "MARX [DARWIN FREUD] yields the list [MARX DARWIN FREUD], while LPUT "D'ARTAGNON [ATHOS PORTHOS ARAMIS] produces [ATHOS PORTHOS ARAMIS D'ARTAGNON].

You can also form a list from individual objects using the LIST command. (LIST "COMPILE "LINK "EXECUTE) outputs the list [COMPILE LINK EXECUTE]. And you can concatenate (string together) two lists with SENTENCE. SENTENCE [1 2 3][3 TWO ONE] yields [1 2 3 3 TWO ONE].

Given a list, you can extract its first object using FIRST (similar to CAR in LISP)

and form a list containing everything else using BUTFIRST (similar to CDR in LISP). FIRST [LARRY MOE CURLY] produces LARRY, while BUTFIRST [LARRY MOE CURLY] yields [MOE CURLY]. You can work from the other end of the list using LAST and BUTLAST.

One attractive feature of lists in Logo that you don't have with arrays in most other languages is that list elements can be anything, whereas usually array elements must all be the same type. On the other hand, you can easily access and change any array element, but you can attack lists only from one end or the other. For example, suppose you want to remove the 3 from the list L = [1 2 3 4 5 6]. To get to the 3, you have to rotate the list twice. First, MAKE "L (LPUT FIRST :L BUTFIRST :L) yields L = [2 3 4 5 6 1]. Then, MAKE "L (LPUT FIRST :L BUTFIRST :L) yields L = [3 4 5 6 1 2]. (MAKE is a Logo command that assigns a name to a list, "L is the name of a list, and :L is the contents of "L.) You can now remove the 3 with a BUTFIRST. MAKE "L BUTFIRST :L yields L = [4 5 6 1 2]. Then rotate back. MAKE "L (FPUT LAST :L BUTLAST :L) yields L = [2 4 5 6 1], and MAKE "L (FPUT LAST :L BUTLAST :L) yields L = [1 2 4 5 6].

Logo also provides a REPEAT statement, so that you can write the whole procedure in the following way:

```
REPEAT 2 [MAKE "L (LPUT FIRST :L
                BUTFIRST :L)]
MAKE "L BUTFIRST :L
REPEAT 2 [MAKE "L (FPUT LAST :L
                BUTLAST :L)]
```

(continued)

Table 1: A comparison of four Logo systems for the IBM PC using five benchmark tests. A complete description of the tests is given in the text. The HIL benchmark is given in listing 1. The SIEVE benchmark is given in listing 2. The MATH benchmark uses real-number multiplication and division and is given in listing 3. The TRIG benchmark uses sine and cosine functions and is given in listing 4. The ALPHABET benchmark (listing 5) prints the alphabet on the screen over and over. All times are in seconds.

Language	SIEVE 50	HIL	MATH 1000	TRIG 1000	ALPHABET 100
Dr. Logo	264	15	196	233	27
IBM Logo	35	5	75	535	13
PC Logo	20	7	45	74	196
with 8087	19	1	19	16	210
Waterloo Logo	122	12	140	292	35
BASICA			13	43	9

FINALLY!

Software mail order service
you can depend on!

EXPRESS BUSINESS SOFTWARE

Now **you** can take advantage of the same personalized
service enjoyed by America's largest corporations . . .
at the same low prices!

	LIST	SALE
ADVANCED DATA INSTITUTE		
Aladin	595	425
ALPHA SOFTWARE		
Data Base Manager II	295	179
ASHTON-TATE		
dBase II	495	379
ATI		
Training WordStar	75	55
Training dBase II	75	55
AXEL JOHNSON		
AutoCode	195	139
CDEX		
Advanced Lotus 1-2-3	70	55
CONDOR		
Condor 3	650	339
DIGITAL MARKETING		
Milestone	295	249
Footnote	99	84
Datebook II	295	179
Notebook	150	98
FOX & GELLER		
dGraph	295	169
dUtil	99	58
HUMANSOFT		
DB Plus	125	84
IUS		
Easy System II	395	239
General Ledger	595	349
Accounts Receivable	595	349
Accounts Payable	595	349

	LIST	SALE
LEXISOFT		
Spellbinder	495	239
LIFETREE		
Volkswriter Deluxe	295	169
LIVING VIDEO TEXT INC.		
Think Tank (IBM)	196	165
Think Tank (Apple)	150	119
MDBS		
Knowledgerman	500	329

MONEY SAVERS		LIST	SALE
OPEN ACCESS		695	399
LOTUS		499	315
PROKEY 3.0		130	95
WORD PERFECT		499	319
SUPERCALC 3		395	239
CROSSTALK		195	105
MULTIMATE		495	295
QUICKCODE		295	169
HARVARD PROJECT MGR.		395	329

	LIST	SALE
MICROPRO		
WordStar	495	245
SpellStar	150	99
CorrectStar	250	175
MailMerge	250	126
Professional Pak	645	365
InfoStar	495	248
MICRORIM		
R Base 4000	495	319
Extended Report Writer	150	119
Clout	195	165

	LIST	SALE
MICROSOFT		
Multiplan	250	159
Basic Interpreter	350	249
Word/Mouse	475	319
Chart(Mac)	125	99
Cash Plan(IBM)	150	119
OASIS		
Word Plus	150	105
Punctuation & Style	150	95
PEACHTREE		
Peachtext 5000	425	329
PERFECT SOFTWARE		
Perfect Writer	349	218
Perfect Writer/Speller	399	298
PETER NORTON		
Norton Utilities	80	54
PRENTICE-HALL		
Execuision	395	299
SELECT INFORMATION SYSTEMS		
Select Word Processor	295	199
SORCIM		
SuperCalc 2	295	154
TYLOG		
dBase Window	249	155
VISICORP		
Visicalc IV	250	159
WESTMINSTER SOFTWARE		
Pertmaster	695	499
WOOLF SYSTEMS		
Move It	150	85

We can't fit all of our huge inventory in this ad, so please call for products you don't see here.

CALL FOR OUR FREE CATALOG TO ORDER CALL TOLL-FREE:

TERMS:

- Call for shipping changes and support policies.
- Full guarantee against manufacturers defects
- Allow 3 weeks for checks to clear
- Prices may change
- Call for availability
- NO CASH REFUNDS! Due to our low prices. ALL SALES FINAL.

(800) 235-3020 (USA)
(800) 235-3021 (CA)
(415) 382-9085



EXPRESS BUSINESS SOFTWARE

94 Galli Drive, Suite E, Novato, CA 94947

- SAME DAY SHIPMENT ON MOST ORDERS
- Prompt UPS service
- Authorized Purchase orders accepted
- Dealer, institutional and quantity discounts available
- No surcharge for credit card purchases
- VISA & Mastercard accepted
- COD

These procedures are used later in the SIEVE program.

PROPERTY is another Logo list-handling feature. You can give any identifier one or more property names with single values for each property. For example,

```
PPROP "THISCAR "BRAND [Volvo]
```

gives the identifier THISCAR the property BRAND whose value is Volvo. You can then select from a list those identifiers that have certain values for certain properties and PACKAGE them under some name. The use of PACKAGE is also handy for collecting related procedures in order to save them together in a disk file.

All the Logo languages under review implement the standard list-handling features described above except for one: PC Logo doesn't have the PACKAGE command. Dr. Logo is notable because it provides some nice extra commands: SHUFFLE, which creates a random permutation of the elements in a specified list; SORT, which sorts a list into ascending alphanumeric order; and

PIECE, which picks out a segment of list elements—for example, the third through twelfth elements.

The Dr. Logo instruction book has a very amusing example: a random recipe generator, which makes highly fantastic dishes by picking out random elements from lists of foods and cooking procedures.

The PC Logo utilities disk comes with a famous Logo program called Animals in which the computer tries to guess what animal you're thinking of by asking yes/no questions. Initially, it has only a small stock of questions: if it fails to guess your animal, it gives up and asks you for the answer. Then the program asks you for one question that would help it to distinguish its guesses from the correct answer in the future. It stores this question and uses it in future games; thus, the computer *learns*.

There is no doubt that speed is important for list handling. You can't learn anything waiting for the machine to move objects around lists. In keeping with what seems to be a tradition, I coded

a variation of the Sieve of Eratosthenes algorithm for finding prime numbers in Logo (see "Eratosthenes Revisited: Once More through the Sieve" by Jim and Gary Gilbreath, January 1983 BYTE, page 283). While Logo is certainly not an appropriate language for doing a sieve, the very cumbersomeness of the routine gives a good workout to Logo's list-handling abilities.

Look first at listing 2 and note that the sieving program is made up of sub-programs. SIEVE sets up the list and calls STRIKEOUT. STRIKEOUT finds the first nonzero entry in the list (using SKIPZEROS), makes PRIME the corresponding odd number, and then removes every PRIMEth number from the list using STROLL—a combination of strike and roll. The program records the various primes and prints them out. The only arithmetic occurs in computing $PRIME = counter + counter + 1$, and in determining how many times to do STROLL (N divided by PRIME times). The benchmark results for the SIEVE program are in table 1.

EDITING AND DEBUGGING

You create programs and procedures (they are the same thing in Logo) two ways: typing line by line directly on the screen or working in an "editor" that allows you to go back and forth among the lines, entering, changing, and deleting as you wish. All the Logos support these two modes, but the editor is more important for developing and changing long programs. It is essential to be able to see and move several lines of instructions at a time, and the editor that makes this the easiest is best.

All editors must provide certain basic features: the ability to overwrite or insert characters, to delete or add lines, and to skip from line to line. Logo considers a line to be equal to all the characters up to and including the next carriage return. If there are more characters than will fit on a physical line on the screen, the text should wrap around and continue on the next line, while preserving its integrity as a logical line for the Logo interpreter. All the Logo editors except Waterloo work this way. In Waterloo Logo the line continues even if it goes off the screen and becomes invisible (like the turtle with a WINDOW option). In order to see what

(continued)

Listing 2: SIEVE 50, an iterative version of the Sieve of Eratosthenes prime-number benchmark.

```
TO STROLL :K
  IF :K 0 [MAKE "ODDS LPUT 0 BUTFIRST :ODDS]
  IF :K 1 [REPEAT (:K- 1) [MAKE "ODDS LPUT FIRST :ODDS BUTFIRST :ODDS]]
  END

TO SKIPZEROS
  IF FIRST :ODDS 0 [STOP]
  MAKE "COUNTER :COUNTER + 1
  IF :COUNTER :N [STOP]
  MAKE "ODDS LPUT FIRST :ODDS BUTFIRST :ODDS
  SKIPZEROS
  END

TO STRIKEOUT
  SKIPZEROS
  IF :COUNTER :N [STOP]
  LOCAL "PRIME
  MAKE "PRIME :COUNTER + :COUNTER + 1
  MAKE "PRIMES SENTENCE :PRIMES :PRIME
  REPEAT INT (QUOTIENT :N :PRIME) [STROLL :PRIME]
  STROLL (REMAINDER :N :PRIME)
  STRIKEOUT
  END

TO SIEVE :SIZE
  MAKE "N :SIZE
  MAKE "PRIMES {}
  MAKE "ODDS {}
  REPEAT :N- 1 [MAKE "ODDS SENTENCE :ODDS 1 + LAST :ODDS]
  MAKE "COUNTER 1
  STRIKEOUT
  PRINT :PRIMES
  END
```


"VEDIT is the front-runner for the definitive quality screen editor."

TODD KATZ - PC MAGAZINE

BYTE MAGAZINE - JERRY POURNELLE

'VEDIT's by all odds the most flexible programming editor I've ever seen.'

'One of its best features is multiple buffers; that is, you can store chunks of programs in various places and pull them out into your main file when needed.'

INFOWORLD - TIM DANELIUK

'The performance of this product is nothing short of outstanding!'

'VEDIT is a 'Virtual' text editor. The amount of memory in your computer does not limit the size of the file you can edit.'

SEXTANT - FREDERICK ZIMMERMAN

'VEDIT's 'Visual' mode, where you will spend most of your time, has a multiplicity of valuable one-or-two-keystroke commands which make it very easy to enter and modify text.'

PROGRAMMER'S JOURNAL - FRANKIE DETESTO

'VEDIT is a pleasure to use. Other text editors would do well to judge the power of their features in comparison to VEDIT.'

MICROCOMPUTING - THOMAS BONOMA

'If you've ever thought about a program (or a writing) editor, think no more. No, not IBM's Personal Editor; that doesn't measure up to VEDIT.'

'Take a look at it; you'll see why thousands of users swear by it, and are even using it as their only editor.'

BYTE MAGAZINE - H. BRADFORD THOMPSON

'If this review gives you an appetite for simplicity while editing, then VEDIT is well worth considering.'

'The CompuView people urge you to contact them if you have trouble, and my experience indicates that they mean it.'

'One of VEDIT's best features is its speed in visual mode...most operations seem instantaneous.'

MICROCOMPUTING - GENE HEAD

'...what I've mastered has shown me what a fine piece of software this really is. As my needs expand I expect VEDIT will continue to meet them.'

'If you write source code, I doubt if you could find a better value in the editor market.'

INSIDE THE IBM PC - PETER NORTON

'Two excellent programs assisted the mechanics of writing. VEDIT, from CompuView of Ann Arbor, Michigan, was the text editor program used - I prefer it to several word processors that I have bought and put aside.'

INFOWORLD - READER RESPONSE

'It is certainly my choice for day-to-day editing. In fact, I hardly ever use a word processor anymore, since anything that can be done with a word processor I can easily do with VEDIT.' - Morton F. Kaplan

PC MAGAZINE - TODD KATZ

'At present there are three major entrants into the screen editor category for the PC...VEDIT is the front runner for the definitive quality screen editor.'

'(VEDIT) is very compact and quite powerful with high-quality documentation.'

'VEDIT has a superior, example-filled manual designed to help the text editor newcomer take better advantage of its many features.'

VEDIT is available for virtually every 8080, Z80 or 8086 microcomputer made. To order please specify your microcomputer, operating system and disk format.

VEDIT - Disk and Manual

8080, Z80 or IBM PC . . . \$150

CP/M-86 or MS-DOS . . . \$195

Manual Only \$ 18



CompuView

PRODUCTS, INC.

1955 Pauline Blvd. Ann Arbor, Michigan 48103

(313) 996-1299 Telex - 701821

CP/M is a registered trademark of Digital Research Inc. MS-DOS is a trademark of Microsoft. IBM is a trademark of International Business Machines. Quotes from InfoWorld review Copyright 1983 by Popular Computing, Inc. a subsidiary of CW Communications, Inc., Framingham, MA - Reprinted from InfoWorld. Quotes from Byte review Copyright 1983 by Byte Publications, Inc. Quotes from Sextant review Copyright 1983 by Sextant Publishing Co.

Circle 76 on inquiry card.

MTI Diablo Sale!

Diablo 620 API (Up to 26 cps) Diablo 630 API (Up to 40 cps)



with
All-Purpose Interface for
Apple II, IBM PC, TRS-80, Commodore IEEE 488
Centronics "Parallel" and RS232C "Serial".

Famous Diablo letter-quality printing.

The best letter-quality printers on the market. At MTI's best prices. Whether you buy or lease our equipment, you'll find MTI is the one source for all the computer and data communications equipment, applications expertise and service you'll ever need. Call MTI today.

New York: 516/621-6200, 212/767-0677, 518/449-5959
Outside N.Y.S.: 800/645-6530
New Jersey: 201/227-5552
Ohio: 216/464-6688

"QED" Discounts
VISA & MasterCard



Diablo[®] Authorized
Distributor

Applications Specialists & Distributors, New York, New Jersey and Ohio.
DEC, Intel, Texas Instruments, H.P., Dataproducts, Lear Siegler, Diablo
Esprit, C. Itoh, Intecolor, Racal-Vadic, MICOM, Ven-Tel, Develcon, PCI
U.S. Design, Digital Eng., Cipher, MicroPro, Microsoft, Polygon & Select.

REVIEW: FOUR LOGOS

you wrote, you must scroll the screen horizontally with several manual cursor moves and keystrokes. This is extremely annoying, especially with the Waterloo editor that supports lines only 40 columns wide. (The others all allow 80-column lines in text mode.) Ironically, Waterloo Logo does have line wrap outside the editor if you are entering a program line by line on the screen.

While Dr. Logo and IBM Logo have perfectly adequate and easy-to-use editors, PC Logo is really the clear winner in this category. It has SEARCH and REPLACE commands as well as the ability to move or copy large blocks of text from one place to another. PC also has various useful editorial functions assigned to nearly every key on the IBM PC keyboard including the function keys. The Waterloo editor has a nice way of moving a text block after you highlight it, but this doesn't compensate for its lack of line wrap.

A final word about editors: you can use almost any screen editor or word processor to create Logo programs. However, there are two complications: first, you must leave Logo to use your editor and return to Logo to run the program; second, your version of Logo must be able to read the file that your editor/word processor creates. The first complication is at worst an inconvenience, but the second is very serious for Dr. Logo. Dr. Logo operates under the CP/M-86 operating system. If your editor is DOS-based, as many are, the files it creates cannot be read by Dr. Logo. Furthermore, you won't be able to copy any Logo programs into your system unless the programs are on a CP/M-86 formatted disk, which is unlikely if they weren't created for using Dr. Logo. Most IBM PC users operate under DOS, so it is wise to be wary of products using other operating systems. They may work quite well but not have the compatibility you desire. (Waterloo Logo also has its own operating system, Port, but it is possible to use DOS files with Port provided the disk is formatted with 8 sectors per track.)

Because you must debug programs that don't work properly, debugging features are important. For effective debugging, the four Logos provide a PAUSE command. When you insert it in a program, PAUSE creates a temporary

(continued)

Business as Usual?

Business as usual these days means a computer that's up and "humming." But if your computer were stolen or damaged, you wouldn't have business as usual.

YOU'D HAVE TROUBLE!

You can get fast replacement for your entire system and be back in business in a hurry by protecting your computer with SAFEWARE Personal Computer Insurance. It's the only coverage designed specifically for personal computers used for business — in your office, shop or home.

SAFEWARE protects ALL hardware, ALL purchased software and ALL media against theft, accidental damage, natural disaster, power surge, etc., regardless of use, after a low \$50 deductible.

(Not without
your computer
it wouldn't be.)

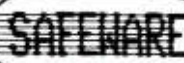
Fast, courteous claims handling prevents your losing valuable business computing time.

Find the premium price for the coverage you need listed in the table below, available for as low as \$35 per year. Fill in the coupon today. Your coverage will begin as soon as your payment is accepted. Or, for even faster coverage, call our toll-free number.

1-800-848-3469

(In Ohio call 1-614-262-0559)

Phones open 8 a.m. to 8 p.m.
Monday through Saturday



Total Hardware, Media & Software System Value	Annual Premium
Up to \$ 2,000	\$ 35
\$ 2,001-\$ 5,000	\$ 60
\$ 5,001-\$ 8,000	\$ 75
\$ 8,001-\$11,000	\$ 90
\$11,001-\$14,000	\$105

Call toll-free for rates on higher coverage.
Coverage differs in Texas.

It is an underwriting requirement that you insure your system for its full value.
Call for student rates.

Mail to: SAFEWARE, P.O. Box 02211, Columbus, OH 43202.

Before I'm out of business,
please issue my SAFEWARE Insurance Coverage.

Name _____

Street _____

City _____ State _____ Zip _____

System value \$ _____ Check Enclosed VISA MasterCard

Card # _____ Exp. Date _____

Signature _____

No risk. You may return contract for full refund within 10 days. Coverages and units are subject to the terms, conditions and exclusions in the contract.

NYT

DID PICASSO DO IT?



Paint a Picture of Peripheral Profit.

Boost your sales with the all-new PKASO/U, the state-of-the-art interface that upgrades the Apple II, II+, IIe, and III and any parallel printer to a complete text and graphics system. PKASO/U (pronounced "Picasso," the "U" is for Universal) lets you quickly and easily demonstrate to your customers how to use each and every capability of their printers. And gain additional features to turn every printout into a masterpiece.

Sell More Printers by Demonstrating More Features.

PKASO/U lets you exhibit a wider range of capabilities from any parallel printer you team up with the Apple, including many exclusive features not offered by any other interface:

- Magic Screen Dumps: instant, single-command snapshots of *any* image on the Apple screen, graphics or text.
- Print the graphics screen *any* size — from inches to feet — another PKASO/U exclusive.
- Instantaneous, single-command Lo Resolution Screen Snapshots, only from PKASO/U.
- Super Resolution — higher resolution graphics from your dot matrix printer than possible on the screen, only from PKASO/U.
- 4-way Rotation of image — 90°, 180°, 270°, 360° — positioned anywhere on the page.
- Direct or Reverse Printing — black

- on white or white on black.
- Full color for printers with color capability.
- 16-level gray scale for black and white photographic images, only from PKASO/U.
- Aspecting, with separate width and height adjustments for any size and aspect ratio.
- Windowing, the printout of any selected portion of a graphics image in any size — equal, enlarged or reduced, another PKASO/U exclusive.
- Low-cost clock/calendar option for time/date stamping, available soon.

Eliminate the "I'll Wait" Excuse with Future Compatibility Feature.

Show your customers how their Apple can be instantly linked with all major parallel printers of today and *tomorrow*. Unlike other printing interfaces which are limited by ROMs or DIP switches with pre-set configurations, PKASO/U is completely configurable for either present or yet-to-come

Promote ShuffleBuffer for a Complete Upgrade.

The new Buffer with a Brain, ShuffleBuffer, feeds the printer while the computer performs other tasks. It's the only buffer that can rearrange stored data, mix and merge, match and patch, repeat and reprint. Your in-store demonstration model will sell itself.

Centronics-interfaced printers. An only-from-PKASO/U exclusive.

Cut Customer Expenses with Color Ribbon Savings.

PKASO/U pays for itself in color ribbons saved. Exclusive Mosaic Mode suspends color dot overprinting, prints dots next to each other (not on top of each other) to achieve desired shades. Since fewer dots are printed, less ink is used, and ribbon life is doubled.

Do it with PKASO/U.

Show your customers the detailed User Manual and fully-documented Demonstration Diskette; let them plug in the cables (included) and start producing masterpieces. The printouts will close the sale, so be sure an in-store demonstration model is displayed prominently. Call us directly at (215) 667-1713.



PKASO/U DID IT.



Interactive Structures, Inc.
146 Montgomery Avenue
Bala Cynwyd, PA 19004
(215) 667-1713

PROGRAMMERS: Save time & money. Write better programs.

THE PROGRAMMER'S SHOP helps you find products, services and support - at good prices. We provide:

- Free product literature
- Product comparisons
- Over 300 products
- Newsletters

AND: • Bulletin Board • Special disk formats • Good prices • Rush orders • Volume purchasing help • VISA/MC, COD, POs • Programmer's Referral List • Special Reports • Find a publisher • Tech help • "Pioneer Program"

Save effort and frustration - find what you need.

UNIX™ for the IBM PC

COHERANT by Williams is fast, coresident with PCDOS, well documented - for "C" developers. \$475

VENIX by Venturecom is a "true" UNIX. It fits needs for development and for business use. \$775

XENIX by Microsoft is a rich system, has applications available and a "High" 74 COBOL. \$1325

UNIX is a trademark of Bell Lab.

For CP/M-80

ECOsoft C is now complete, rich, fast, has library source, trig \$225

Edit programs with VEDIT (\$119), MINCE (\$149) or "C"SE with source (\$75)

Other Key Products

C86 by CI (\$339), Lattice (\$359) from Lifeboat or Microsoft, and Williams C (\$475) are in a tight battle. Which is best for integration with Fortran? 8087? support libraries? speed? debugging?

FORTTRAN - 86 from Microsoft (\$259) is improving with libraries for graphics (\$175), screen (\$265), and statistics (\$275).

LISP by Integral Quality (\$155) is well rounded while GC Lisp (\$465) supports syntax closer to "Common LISP."

GraphiC "C" library with source - for PC, Corona, printers, plotters, Hi-Res, 8087 option, with source \$195

PLINK-86 is a program-independent overlay Linker to 32 levels for all MS Languages, C86 and Lattice. \$315

Featured Product:

The *Instant-C*™ Interpreter C programming three times faster

Instant-C™ is an optimizing interpreter for C that makes programming much faster. It eliminates the time wasted by compilers and loaders. Many repetitive tasks are automated to make programming less tedious.

- Two seconds elapsed time from completion of editing to execution.
- Symbolic debugging; single step by statement.
- Follows K & R—works with existing programs. Comprehensive library with source.
- Full-screen editor integrated with compiler; compiler errors set cursor to trouble spot.
- Compiled execution speed; 40 times faster than interpreted Basic.
- Can generate .EXE, .CMD files.
- Integrated package; nothing else needed.
- Works under PC-DOS, MS-DOS, or CP/M-86.
- Immediate execution; ideal for learning C.

Rational Systems, Inc. (617) 653-6194 *Instant-C* is \$500.

For a catalog, comparisons, prices, or for an info packet on AI, or Editors, "C", BASIC, PASCAL, FORTRAN, or COBOL — or just for straight answers —

Call **800-421-8006**

THE PROGRAMMER'S SHOP™

128-B Rockland Street, Hanover, MA 02339
Mass: 800-442-8070 or 617-826-7531

REVIEW: FOUR LOGOS

halt so that you can print out the values of the variables on the screen and see what's going on. Then you can resume processing with the CONTINUE command.

Dr. Logo and PC Logo also provide a TRACE command which, if typed in before executing the program, displays the names and values of all variables and procedures as the program encounters them in execution. With recursive procedures, Dr. Logo prints out the level of the procedure call, too. If you combine TRACE with PAUSE, you can save time and keystrokes in debugging. However, Dr. Logo goes further and provides WATCH and DEBUG as well. WATCH puts the procedure into "one step" mode, executing only one line at a time; you then press enter to start the next line. DEBUG splits the screen, displaying the results of TRACE on the top half and the program's actual output on the bottom half. You can also invoke a combination of TRACE, WATCH, PAUSE, and DEBUG. This package of utilities makes debugging in Dr. Logo by far the most convenient.

ARITHMETIC

Except for some dedicated fans, very few people choose Logo for number crunching (extended arithmetic calculations using real numbers). Of course, turtle graphics uses real-number manipulation implicitly, but this is so tied up with screen output that it becomes a separate category. To please the number crunchers, I did a few benchmarks using only standard arithmetic and trigonometric functions, because Waterloo and PC Logos don't have logarithmic or exponential functions. This lack is quite surprising in the case of PC Logo since its 8087 support should make all types of transcendental functions easy and fast. For the sake of comparison, I also ran an exact analog of each arithmetic program in IBM BASICA and added the times to the chart. Table 1 includes the results for a program called MATH 1000, which uses multiplication and division as shown in listing 3. The TRIG 1000 program results in table 1 come from sine and cosine calculations as given in listing 4.

Notice that even without the 8087, PC Logo is the fastest for real-number manipulations. Its speed on trigono-

(continued)



Why people choose an IBM PC in the first place is why people want IBM service...in the first place.

After all, who knows your IBM Personal Computer better than we do?

That's why we offer an IBM maintenance agreement for every member of the Personal Computer family. It's just another example of blue chip service from IBM.

An IBM maintenance agreement for your PC components comes with the choice of service plan that's best for you—at the price that's best for you.

Many customers enjoy the convenience and low cost of our carry-in service. That's where we exchange a PC display, for example, at any of our Service/Exchange Centers.

And for those customers who prefer it, we offer IBM on-site service, where a service representative comes when you call.

No matter which you choose for your PC, an IBM maintenance agreement offers you fast, effective service.

Quality. Speed. Commitment. That's why an IBM maintenance agreement means blue chip service. To find out more about the specific service offerings available for your PC, call 1 800 IBM-2468, Ext. 104 and ask for PC Maintenance.

Blue chip service from **IBM**

metric functions using the BIOS explain why it produces graphics so quickly. You have to wonder why PC Logo is slower than GEM Logo in the IBMPC Curves benchmark when the BIOS is not present. I suspected that there might be some inherent slowness in getting information to the screen, so I tested the Logos with a simple program that just displayed the alphabet many times. The results of running ALPHASET (see listing 5 and table 1) were striking. For some strange reason, probably a bug, PC Logo actually slowed down the more alphabets it printed. (Note that this bug has now been corrected and PC Logo's screen output is notably faster.)

MEMORY AND PERFORMANCE

PC Logo is the coldest yore of the four that needs as little as 54K bytes of memory but it sacrifices some features (including high-resolution graphics and an 80-character screen) with that little memory. GEM Logo requires 128K bytes, while the other two require a minimum of 192K bytes. How much memory the language can use (and how efficiently the language can use it) is probably of greater

interest than how much it needs.

Logo stores lots of procedures and instructions in different in-data structures called *cells* (see reference 4). Supposedly the number of nodes that exist determines how much space you have for writing and running programs, meaning a node means the same thing for each Logo. Since it is unlikely that you would or clearly exhaust memory simply by writing a long program (it would have to be very, very long, the amount of memory you need to run the program is crucial).

The recursive program that uses stack memory is the most common memory gobbler (see text box, "Recursion: Therein Lies a Trap" page 303). GEM Logo is by far the most effective user of stack memory and PC Logo the least. Furthermore, GEM can use as much as 256K bytes of memory—more than any of the others—while PC Logo can use only 128K bytes (perhaps accounting for its small stack). Waterloo can use as much as 192K bytes, while GEM Logo implies that 256K bytes, or more "enhances" its performance. On entry GEM Logo says it has 30K's nodes free, while GEM claims

to have 110K. Since I have a 1280-byte system, what could "enhances" mean?

INSTRUCTIONS, DOCUMENTATION, AND EXTRAS

All the Logos come with instructions for start-up and for writing programs, as well as documentation for all the commands and procedures available. They also have fairly adequate indexes. The reference manuals for GEM, PC and GEM Logo are thick loose-leaf books with complete instructions for getting started. GEM Logo provides color plates showing the graphics output, while GEM supplies a separate spin-it-bound notebook devoted to the turtle. The first part of the PC manual is an elementary tutorial; the package also includes a separate disk with examples and utilities containing the famous *Cyranurik* game (which illustrates Heron's law of inertia), a curve-sketching program, and several others. In contrast, Waterloo Logo provides only a demonstration disk and a rather slim booklet listing and describing briefly its primitive procedures and its differences from Apple Logo. Waterloo Microsystems, apparently leery that its Logo is sufficiently close to the Apple system so that you either already know how to program in Logo or will purchase an Apple tutorial, the company did suggest to me that a more extensive manual will appear in the future.

In the GEM and GEM Logo instruction manuals, procedure descriptions each begin a page, contain one or more examples, and are arranged alphabetically. The PC manual is rather but arranges its procedures by type (e.g., list manipulation, graphics, input/output, etc.) and then alphabetically within the group. Finding a description is rather slow and often means using the index. Waterloo and GEM also provide reference cards listing various procedures with brief descriptions of their syntax.

For the serious programmer, GEM and PC Logo provide some nice extras. GEM offers a DOS services and machine-language subroutines. PC Logo lets you set the BIOS registers and call interrupts. You can extend its writing somewhat awkwardly, to load and call a machine-language routine by using the DOS stay-resident service in your sub-routine and setting an interrupt vector to point to the procedure. GEM provides (unlike)

Listing 3. MATH XXX, a self-number multiplication and division benchmark.

```
TO MATH N
  MAKE 'COUNTER 1
  MAKE 'I 1
  REPEAT N MAKE 'O 'COUNTER * COUNTER + 1 WITHIN + 1 WITHIN
  COUNTER MAKE 'COUNTER COUNTER + 1
  PRINT O
END
```

Listing 4. TRC XXX, a trigonometric function (sine and cosine) benchmark.

```
TO TRC N
  MAKE 'COUNTER 1
  MAKE 'O 1
  REPEAT N MAKE 'O (SIN COUNTER) - COS COUNTER + 1 * COUNTER
  MAKE 'COUNTER COUNTER + 1
  PRINT O
END
```

Listing 5. ALPHASET, a test from many programs.

```
TO ALPHASET N
  MAKE 'A 'A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
  MAKE 'COUNTER 1
  REPEAT N (TYPE A TYPE COUNTER MAKE 'COUNTER COUNTER + 1)
END
```


TOLL FREE ORDERS ONLY! **800-631-0962**
 (INSIDE CALIFORNIA) **800-521-6162**

Customer Service **HOTLINE**
 (408) 559-6556

GUARANTEED the LOWEST!

OUR PRICE GUARANTEE - It's Simple! We'll beat any ad in this magazine - same terms - call TOLL FREE for details!

DCC DISCOUNT COMPUTER CENTERS
 OUR CUSTOMER SATISFACTION GUARANTEE: If for any reason your DCC purchase fails to meet manufacturers specifications within 30 days of purchase, please return it to us for a full refund or exchange of your choice! Sorry, software excluded due to copyright laws.

OKIDATA
 160 cps
92P (80 col) \$410
93P (132 col) \$689

IBM PC-2 only **\$1679**
 with 1 drive 64K
 2-360 Kb drives, 256K
\$1995
IBM XT
 256K, 10 mg. hard disk
 1-360 Kb drive only **\$3995**

GEMINI
\$269
 120 cps, graphics
EPSON FX80
 160 cps, full graphics
\$475

COMPUTERS

IBM PC & XT... See special advert!!
 COLUMBIA w/\$3000 retail software!
 VP Portable - 256K ridiculously
 1600-1 2 drives low!!!
 1600-4 Hard Disk please call!!
 VISUAL New 16 Ib. IBM Compatible
 256K. 2 drives \$Call

MONITORS

IBM MONOCHROME 249
 COLOR 569
 AMDEK 300G 129
 300A 145
 310A 165
 AMDEK COLOR II, III, IV Low!!!
 TAXAN 12" G 109
 12" A 115
 420RGB 439
 PRINCETON HX-12 469
 SR-12 649
 MAX-12 199
 ZENITH 122 - 12" G 109
 12" A 130
 124 MONO - IBM 169
 133 RGB 449
 135 RGB/COMP 475
 QUADCHROME 489

MODEMS

HAYES 300 199
 1200 479
 1200B 419
 MICROMODEM II 229
 ANCHOR MARK XII 269

PRINTERS

****DOT MATRIX****
 EPSON RX 80 100 cps 294
 RX 80 FT 100 cps 339
 RX 100 100 cps, 132 col 575
 FX 80 160 cps 475
 FX 100 160 cps, 132 col 675
 LO 1500 200 cps NEW! 1180
 OKIDATA 82A 349
 92P 410
 93P 684
 2410 1995
 MANN TALLY SPIRIT 80 275
 150 L 579
 GEMINI 10-X 269
 15-X 349
 C-ITOH PROWRITER 329
 ****DAISY WHEEL****
 BROTHER DAISY WHEEL
 HR-15 429
 HR-25 675
 HR-35 (36 cps) 1099
 JUKI 6100 429
 DTC 380 Z 949
 DIABLO 620 829
 36 1276
 630 1689
 TTX 1014 SER/PAR/TRACTOR 399
 DYNAX DX-15 429
 SILVER REED 550P 560
 NEC 3550 1699
 15 LQ P 559

DRIVES

IBM 360 KB 189
 TANDON 100-2 360KB 185

IBM SOFTWARE

****SPREADSHEETS****
 LOTUS 1-2-3 289
 SYMPHONY 449
 SUPERCALC 3 239
 MULTIPLAN 149
 ****IBM WORDPROCESSORS****
 WORDSTAR PRO PACK 339
 PFS WRITE 79
 MULTIMATE 269
 WORD W/MOUSE 295
 VOLKSWRITER DELUXE 179
 ****IBM DATA BASE****
 dBASE II 284
 dBASE III 417
 PFS FILE 79
 CONCORD III 340
 R-BASE 4000 299
 FRIDAY 189
 ****IBM MISC****
 CROSSTALK 129
 COPY II PC 29
 MASTERTYPE
 PROKEY 3.0 85
 HARVARD PROJECT MGR 249
 SIDEWAYS 49
 NORTON UTILITIES 55
 PFS REPORT 79
 DOW JONES 249
 SET FX 55
 ****IBM GAMES****
 FLIGHT SIMULATOR 34
 PINBALL 45

IBM - BOARDS

FROGGER 39
 ULTIMA III low!!!
 ZORK low!!!
 MANY, MANY OTHERS \$Call

HERCULES GRAPHICS 315
 HERCULES COLOR New! 199
 AST SIX PAK W/64K 249
 MEGAPLUS 259
 STB RIO W/64K 239
 GRAPHIX PLUS 309
 EVEREX GRAPHIC EDGE 399
 H.D. CONTROLLER 299
 MDNO CARD 249
 QUADRAM QUADBOARD W/64K 249
 QUADBOARD I 199
 QUADLINK 449
 IBM MONOCHROME 249
 COLORGRAPHICS 219
 PLANTRONICS COLOR PLUS 359
 MA SYSTEMS PC PEACOCK 39
 GRAPHICS 239
 TECMAR GRAPHICS MASTER 489

IBM ACCESSORIES

64K RAM CHIPS 200ns 46
 150ns 50
 IBM KEYBOARDS 179
 KEYTRONICS \$151 NEW! 199
 5150 189
 MICRO-SOFT MOUSE low!!!
 MOUSE SYSTEM-MOUSE low!!!
 KOALA PAD 85
 KRAFT JOYSTICKS 45

APPLE - BOARDS

ORANGE MICRO GRAPPLER 115
 BUFFERED 185
 MICROMAX GRAPHMAX 139
 VIEWMAX 80 159
 VIEWMAX 80e W/64K 199
 MICROSOFT 16 RAM CARD 75
 SOFTCARD 239
 SOFTCARD PREMIUM PAK 475

ACCESSORIES

64K RAM chips SALE 46
 VERBATIM SS/DD diskettes 21
 DSDD diskettes 29
 DYSAN SS/DD diskettes 29
 DSDD diskettes 39
 DISK MINDER-PLEXI (75) 29
 DISK MINDER W/KEY (100) 34
 SURGE PROTECTOR Compugard 59
 PTI POWER BACK-UP 200W 329
 300W 549
 FINGERPRINTS-EPSON all models 48
 PRINTER DUST COVERS all models 10
 MONI-BASE Monitor Stands 19
 COMPUTER PAPER all makes ... Low!!!
 PRINTER STANDS Plexiglass 29/39

ATARI/C-64

C-64 CARDCO + G 79
 ATARI MP1150 94
 APE FACE 69
 PRINTER INTERFACES all \$Call

DRIVES-IBM™
 360 Kb DS/DD **\$189**
PANASONIC
\$159 1/2HI

AST \$229
SIX PAK w/64K
PLUS \$249

LOTUS
Symphony \$449
 Place your order today
 and save!!!
1-2-3 \$289

WORDSTAR
PRO PACK
 • Wordstar
 • Correct star
 • Star index **\$339**
 • Mail merge

dBASE II \$294
 IBM or APPLE
dBASE III \$417

DCC DISCOUNT COMPUTER CENTERS

an established mail order/retail distribution network

BUYER FRIENDLY TERMS! • DELIVERY We ship immediately! Most orders delivered within 5 days! Add 3% (15% min) for UPS shipping, handling, insurance Calif. residents add 6.5% sales tax. 2nd day UPS available at extra charge. • PAYMENT Visa, M/C, cashiers checks, money orders, personal checks accepted. (Allow 10 business days for personal/company checks to clear). WE NEVER CHARGE EXTRA FOR CREDIT CARDS! C.O.D.'s welcome (20% p/p deposit) with cash, certified check or money order. • WARRANTY All items shipped are new, include FACTORY WARRANTY and are GUARANTEED TO WORK. DCC is an AUTHORIZED DEALER and SERVICE CENTER for most major brands. • RETURNS Must be accompanied by RMA number (supplied by DEALER) and may be subject to a 20% restocking fee. Prices and availability subject to change without notice. All items limited to stock on hand. • MAIL ORDER PRICES NOT VALID AT RETAIL OUTLETS DUE TO REGIONAL PRICING RESTRICTIONS. Minimum order \$50.

1707 S. BASCOM AVE • CAMPBELL, CA 95008 • (408) 559-6556
 1243 W. EL CAMINO • SUNNYVALE, CA 94081 • (415) 465-4494

FREE - VISA/MC!



VISIT OUR DISCOUNT SHOWROOMS!

Recursion: Therein Lies a Tail

When a procedure has the command to perform itself as one of its instructions, this is recursion. Consider the very simple Logo program:

```
TO STAR
TYPE |*|
STAR
END
```

When invoked, this program types an asterisk and invokes itself again; then it types an asterisk, then invokes itself again, ad infinitum—you can stop it only with a Logo BREAK command. Not every language supports this kind of antic: FORTRAN and BASIC do not, while Pascal, C, LISP, and Logo do.

When you call or invoke a procedure by name in a program, certain information—the location of its commands in memory and the value of its variables—is placed in a special region of memory called the stack. You can picture the stack as just that: a stack of memory locations. The last item to be “pushed” or placed on the stack goes on top of the items already there; you can access only the most recently added item; and you must remove or “pop” it in order to reach those beneath it. Each time you call a procedure, its vital information is “pushed” onto the stack. Each time the computer finishes processing a called procedure, this information is “popped”

Table 2: This table shows the point at which the STAR2 program dies in each Logo, which will give you an idea of the relative stack size available.

Language	Time (seconds)
Dr. Logo	514
IBM Logo	2386
PC Logo	106
Waterloo Logo	763

off the stack. The information on the previously “pushed” procedure is now on top of the stack.

If you analyze the behavior of STAR, it appears that you never reach an END. Before the first STAR can end, it must complete the second STAR, which can't END until STAR number 3 finishes, which can't end until. . . . Therefore, the vital information about each copy of STAR never “pops.” The stack will grow forever until the memory allocated to it runs out and the system crashes.

The remarkable thing is that this crash never occurs. Because there are no instructions (other than the END statement) following STAR's recursive call to itself, recursive language compilers and interpreters recognize the simple repetition (or iteration) of one fixed procedure. They

handle it by recording one fixed copy of the procedure and executing it over and over again. Such a situation is called “tail” recursion because the recursive call is placed at the end or tail of the procedure.

Consider the following two variants of STAR:

```
TO STAR1 :N      TO STAR2 :N
TYPE :N          TYPE :N
TYPE |*|         STAR2 :N+1
STAR1 :N+1      TYPE |*|
END              END
```

STAR1 is simply another example of tail recursion, this time with a variable N. N is a counter, which is printed with an asterisk during each repetition. I tried STAR1 in all four Logos, and it continued for more than 4000 repetitions.

STAR2 is another story. An instruction exists after STAR2's call to itself: the command to print an asterisk. This command is never executed because STAR2 never gets past invoking itself an infinite number of times. The interpreter doesn't recognize that STAR2 is intended to do exactly the same thing as STAR1; it just sees that the recursive call is not the last command in the program, so it pushes the whole mess on the stack and keeps going. Consequently, STAR2 is a good way to measure the stack size allocated or usable by the various Logos. The last number that STAR2 prints gives the

.BLOAD and .CALL routines—they work the same way as in BASIC—to load and run machine-language code. These will be provided in a future update of PC Logo. IBM and PC Logos also include the commands .EXAMINE and .DEPOSIT, which are the (polite) Logo versions of PEEK and POKE. Both IBM and PC Logos have procedures to redirect input/output characters and numbers to and from disk files.

Waterloo Microsystems (Waterloo Logo) and Harvard Associates (PC Logo) offer a flat licensing fee for school systems or other nonprofit groups that intend to use Logo. This enables the nonprofit user to make and use as many copies as needed for the group. Extra copies of documentation can be purchased separately. IBM also has educa-

tional discounts available to schools and universities. Only Digital Research has no similar plan at this time; furthermore, its Dr. Logo is the only one that is copy-protected. Digital Research does, however, supply one backup.

HARDWARE

All four Logos run on either the IBM PC or XT, although you can't load Dr. Logo onto a hard disk because it is copy-protected. While you can theoretically operate Logo without a color-graphics adapter, there is hardly any point in using it without turtle graphics. All the Logos require at least one disk drive, but Waterloo Logo appears limited to one because there is no procedure to change or reference an alternate drive from within the language.

IBM and PC Logos both run on the PCjr at this time. Waterloo Microsystems claims that by the time you read this its Logo will also. Digital Research has no immediate plans for PCjr compatibility.

PC and Dr. Logos support the use of lightpens, while Dr. and IBM Logos support joysticks.

CONCLUSIONS

As you can see, it is hard to pick a clear-cut winner from these four contenders. IBM Logo has the best balance of speed, features, and documentation. All the procedures work as advertised, and the ease of interfacing with machine language makes up for some of Logo's innate weaknesses. The amount and efficient use of stack space are strongly in its favor, as is its ability to use as much

relative size of the stack. Table 2 gives the comparative stack sizes; in other words, it shows the last number printed before STAR2 dies. As you can see, IBM Logo has, by far, the largest effective stack.

It is interesting to try to determine exactly how clever the interpreter is in detecting tail recursion. Consider now the following variant:

```
TO STAR3 :N
TYPE :N
TYPE [*]
IF :N>O [STAR3 :N+ 1]
END
```

The last instruction is once again a call to the procedure itself, but a spurious IF :N>O precedes it in the actual instruction line. This is effectively tail recursion, but does the interpreter know? Only the IBM interpreter correctly interprets this as tail recursion and continues to execute the program; all the others die at around the same number of repetitions as they did with STAR2.

How important is stack space and its conservation? Logo depends to a great extent on recursive procedures, because it lacks the built-in control structures "WHILE . . . END" and "REPEAT . . . UNTIL;" found in other structured languages. Listing 6, MSIEVE, is a recursive version of the Sieve (thanks due to Meredith Lesly). MSIEVE 100, for example, looks for primes less than or equal

to 100. PC and Dr. Logos die well before 100 while Waterloo continues only to about 400. IBM does MSIEVE 1100 but finally dies by MSIEVE 1500. If you call NODES after MSIEVE dies, you find that there are 21,104 nodes left (from 30,881 initially); IBM Logo has really run out of stack spaces, not memory. It is interesting that MSIEVE is also, in a certain sense,

tail-recursive, but it is unrealistic to think that an interpreter could rearrange it as an iterative process. You can prove mathematically that any recursion can be recast as an iteration, but interpreters are not mathematicians.

A point of interest: SIEVE (iterative) and MSIEVE (recursive) take about the same time to execute.

Listing 6: MSIEVE, a recursive version of the Sieve benchmark by Meredith Lesly.

```
TO SIEVE :N
PRINT SIEVE2 BUTFIRST IOTA :N
END
: throws away I and starts
: sieving process

TO SHRINKIT :N :LIST
IF EMPTY? :LIST [OUTPUT :LIST]
LOCAL "T MAKE "T (FIRST :LIST) / :N
OUTPUT SENTENCE (IF :T = INT :T [I] (FIRST :LIST))
SHRINKIT :N BUTFIRST :LIST END
: eliminates multiples of
: first element of list

TO SIEVE2 :LIST
OUTPUT IF EMPTY? :LIST [:LIST]
[SENTENCE FIRST :LIST SIEVE2 SHRINKIT FIRST :LIST :LIST]
END
: collects primes into list

TO IOTA :N
LOCAL "T
MAKE "T I
REPEAT :N-1 [MAKE "T SENTENCE :T I + LAST :T]
OUTPUT :T
END
: creates list of first N
: integers
```

as 256K bytes of memory. It could use a few more features in the editor, high-resolution graphics, and 8087 support. Nevertheless, IBM Logo is an impressive piece of software.

PC Logo comes in a close second with many extra enhancements. 8087 support, high-resolution graphics, and access to system-level interrupts. Its editor is very nice, especially the SEARCH and REPLACE commands, and no quotes are necessary to call up a procedure. It could use more stack space for recursive procedures and a greater ease of machine-language interfacing.

Dr. Logo, in third place, is still a very appealing product. Its debugging facilities are a pleasure to use and its manual is very easy for a beginner to read. Its list-handling facilities are

superior. On the other hand, the interpreter is sensitive to whether you type upper- or lowercase letters in your identifiers—very annoying. Also, Dr. Logo's incompatibility with DOS can be a drawback, especially since it prevents reading Logo programs saved on DOS disks.

Bringing up the rear is Waterloo Logo, which has the fewest features. In fairness you can say that it works quite well—I didn't detect any bugs and someone drawing pictures will appreciate the ARC, CIRCLE, and PAINT commands greatly. It is quite close to Apple Logo, but its editor is cumbersome, its manual quite Spartan, and, like Dr. Logo, it has no machine-language or file-handling capabilities.

If you want Logo to experiment with

turtle graphics or for your students or children to play with, then any of these packages is quite adequate. However, if you want some special features or need to do any serious program development, then IBM Logo or PC Logo is your best choice. ■

REFERENCES

1. Abelson, H., and A. diSessa. *Turtle Geometry*. Cambridge, MA: MIT Press, 1980.
2. Allen, I. "An Overview of LISP." *BYTE*, August 1979, page 10.
3. *BYTE*. Logo Issue, August 1982.
4. Kildall, G., and D. Thornburg. "Digital Research's DR Logo." *BYTE*, June 1983, page 208.
5. Papert, S. *Mindstorms*. New York: Basic Books, 1980.
6. Winston, P., and B. Horn. *LISP*. Reading, MA: Addison-Wesley, 1981.

Apple's® new baby has



Microsoft BASIC
on Apple's new Macintosh

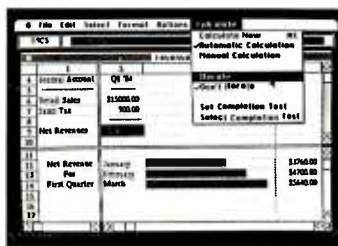
It's called Macintosh.™ And it has a lot of our personality.

We're called Microsoft.® And our part of Macintosh is five new programs that are bright, intuitive, outgoing, understanding and born to perform.

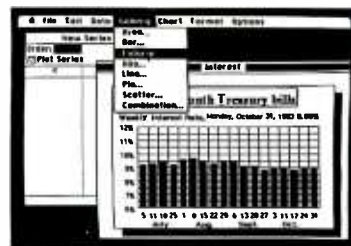
Our pride, your joy.

Taking advantage of Macintosh's mouse and rich graphics, we've designed software that works like you, even thinks like you.

All our programs share the same plain English commands. So what once took days to learn, now takes hours or minutes to learn with Macintosh.



Microsoft Multiplan



Microsoft Chart

Meet the family.

Our financial whiz is MULTIPLAN®, an electronic spreadsheet that actually remembers how you work. Even offers suggestions on spreadsheet set-up.

When it comes to writing, nothing will travel faster than

our best features.

our WORD, available this Fall. Using the mouse, it will let you select commands faster than you can say "cheese."

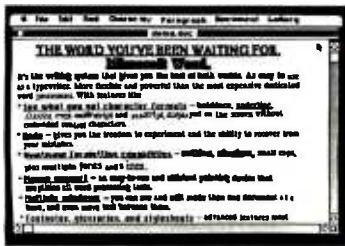
Our most artistic child will be CHART. Available late this Summer.

It gives you 45 presentation-quality chart and graphic styles to choose from.

Later this year, we'll offer our most manageable child, FILE, an advanced personal record management program.

MICROSOFT
The High Performance Software

And BASIC, the language spoken by nine out of ten



Microsoft Word



Microsoft File

microcomputers world-wide, is the granddaddy of them all.

Now enhanced to take full advantage of the Macintosh mouse, windows and graphics.

So call 800-426-9400 (in Washington State, Alaska and Hawaii call 206-828-8088) for the name of your nearest Microsoft dealer.

MICROSOFT

When Lotus™ wanted better graphics for 1-2-3, they chose a better graphics card—HERCULES.™



And then we became a standard.

When the IBM® PC was introduced over 2 years ago, the talented people at Lotus realized that it was limited by a lack of high resolution graphics. They knew that this was going to have an adverse effect on 1-2-3's graphics. And Lotus didn't want anything to hold back their revolutionary software.

So they turned to Hercules.

Lotus recognized that the Hercules Graphics Card delivered the performance they wanted. It offered high quality text and high resolution graphics on IBM's monochrome display. It completely replaced the IBM monochrome card. And it didn't cost an arm and a leg.

Since then, Hercules has sold a lot of Graphics Cards. So many that the Hercules Graphics Card has become the high resolution standard for the IBM PC. And this means that there is more high resolution graphics software available for Hercules than for any other graphics card you can buy.

Software like Microsoft® Word. Our high resolution makes Word's text much sharper and easier on your eyes. And there are other programs for business graphics, computer aided design, terminal emulation and programming.

Call for our free information kit. See why the company that made the first graphics card for the IBM PC still makes the best.



Hercules. We're strong on graphics.
800 255 5550 Ext. 408

Address: Hercules, 2550 Ninth St., Berkeley, CA 94710 Ph: 415 540-6000 Telex: 754063 Features: IBM monochrome display graphics resolution of 720x348; parallel printer port; text mode software compatibility; free software for programming; 2 year warranty. Foreign distributors: Compuserve/Canada; Reflex/U.K.; Computer 2000/W. Germany; Edisoft/France; SourceWare/Australia. Trademarks/Owners: Hercules/Hercules Computer Technology; Microsoft/Microsoft Corp; IBM/International Business Machines; Lotus & 1-2-3/Lotus Development.



The Juki 6100 Printer

A low-cost
printer
offering high-
quality output
and moderate
speed

BY G. MICHAEL VOSE

Like many personal computer owners, I've waited for years for the price of letter-quality printers to drop below the \$1000 barrier. I've daydreamed about the neatly crafted manuscripts I could send around the publishing world once fully formed character printers become easily affordable. (I have little need for graphics, but I enjoy the crisp, manicured, typewriter-quality look of output from a daisy-wheel printer.)

Well, that day has arrived and now I'm faced with yet another problem—choosing from amongst the many low-cost, letter-quality printers that have become available in the past six months. I can't be content daydreaming about spiffy manuscripts; now I have to evaluate pitch setting, line spacing, speed, and special-character handling. Choosing a printer is getting as complicated as buying a computer.

Letter-quality printer technology has evolved quickly. To bring these printers to market under \$1000 requires a sacrifice in speed, but no sacrifice in features. Taking a close look at one low-cost, letter-quality printer, the Juki 6100, may help you to make some sense out of this confusing market.

The Juki 6100 from Juki Industries is an 18-cps (characters per second), fully formed character printer. It originally sold for \$699 but now carries a suggested list price of \$599.

SIZE AND FEATURES

Measuring 20½ by 6 by 14 inches, the Juki 6100 is 2 inches lower, 1 to 2 inches shorter, and 1 inch narrower than the NEC Spinwriter or the Diablo 630. At 27½ pounds, it weighs about 10 to 12 pounds less than the NEC or the Diablo. The housing is a two-color, high-impact plastic with a clear plastic dustcover above the platen.

The 100-character print wheel (Royal/Adler compatible) on the Juki offers 110 (10 pitch), 132 (12 pitch), and 165 (15 pitch) characters per line. It can also provide 82 to 220 proportionally spaced characters per line.

The Juki 6100 features bidirectional printing with friction paper feed (an optional bidirectional tractor-feed mechanism costs \$149) and uses IBM Selectric typewriter ribbon car-

tridges (available at most office supply stores). It accepts either single-strike carbon-film or multistrike cloth ribbons. The maximum paper width is 13 inches.

The Juki 6100 comes with a standard Centronics-compatible parallel interface; an RS232C serial interface is optional. It uses Diablo 630 escape codes to control its various special functions (bold, underline, etc.). The front-panel controls for the 6100 include a three-position sliding toggle switch for selection of pitch settings and a membrane pad for the color-coded Reset, Pause, and FormFeed switches, plus three LEDs (light-emitting diodes) to indicate the machine's status. The power switch is on the left rear panel of the machine. The printer can be configured to use 110- or 220-volt AC power at 50 or 60 Hz.

PERFORMANCE

The 6100 is rated at 18 characters per second. My benchmark tests showed this to be an uncannily accurate claim. I used six of the benchmark programs developed for BYTE (see "The Art of Benchmarking Printers" by Sergio Mello-Grand, February BYTE, page 193). The unit I tested averaged 17.96 cps (see table 1) in bidirectional operation. Some word-processing programs drive printers unidirectionally, however, and table 1 also lists the speeds of the Juki 6100 in its one-way mode: the difference is nearly 2½ cps, or a 14 percent decrease in speed. This means that a 1000-word document would print bidirectionally in 5.57 minutes but require 6.51 minutes to print out unidirectionally.

I ran the benchmarks at 10 pitch using a Courier 10 print wheel. Since the limiting factor in daisy-wheel printer performance is the speed at which the print wheel can turn from letter to letter, the pitch setting shouldn't affect the outcome of the benchmarks in bidirectional mode. In unidirectional mode, performance would be slightly better in the higher pitch modes due to fewer carriage returns.

(continued)

.....
G. Michael Vose is BYTE's senior technical editor for features. He can be contacted at POB 372, Hancock, NH 03449.

AT A GLANCE

Name

Juki 6100

Manufacturer

Juki Industries of America
299 Market St.
Saddle Brook, NJ 07662
(201) 368-3666

Type

Fully formed character printer

Size

20½ by 6 by 14

Equipment Needed

Computer with parallel or serial interface

Features

Diablo 630 control codes, sub- and superscripts, bold/shadow printing, underlining, double-striking

Documentation

44-page operation manual

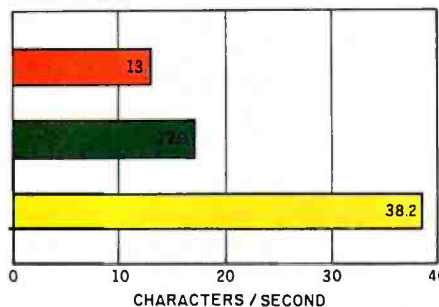
Price

\$599 (suggested retail)

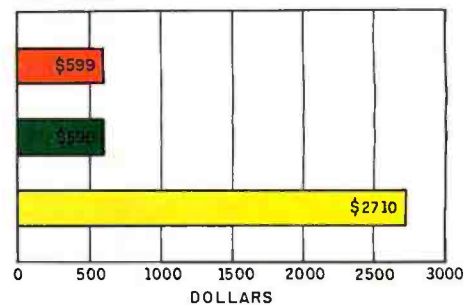


The Juki 6100 letter-quality printer.

PRINT SPEED



LIST PRICE



■ BROTHER HR-15
 ■ JUKI 6100
 ■ DIABLO 630

This is the Juki 6100 This is the Juki 6100
 This is the Brother HR-15. This the Brother
 This is the Diablo 630 This is the Diablo 6

The Juki 6100 printer (using a Courier 10 daisy wheel) is compared with the Brother HR-15 (using a Prestige 1012 daisy wheel) and the Diablo 630 (using a Courier Legal 10 daisy wheel). The pitch for all printers is 10 characters per inch. The print speeds were determined

by timing how long it takes the printers to print the Shannon test (573 characters; see "The Art of Benchmarking Printers," by Sergio Mello-Grand, in the February BYTE, page 193). The prices shown are the list prices, including tractor-feed mechanism.

The 6100 operates at a noise level comparable to most letter-quality printers, approximately 62 decibels. This is certainly not quiet, but neither does it qualify as a major disruption in the average office or laboratory setting.

NUTS AND BOLTS

The Juki 6100 uses an Intel 8051 microcontroller with on-board ROM (read-only memory) software to control the positioning of the print head, the selection of print-wheel characters, and the implementation of its word-processing functions, which include sub- and superscripts, bold/shadow printing, double-striking, and underlining. A 2K-byte print buffer, using static RAM (random-access read/write memory) chips, is standard and is expandable to 8K bytes. A circuit board located inside the rear panel holds these electronics.

The 6100's print-head mechanism is a simple design that uses a linear induction motor to ensure accurate head positioning. The head can be moved in 1/120-inch increments along the platen. The head rides in a carriage that travels along a rectangular steel guide bar. The head motor is attached to the printer's electronics by a single ribbon cable.

Lifting the cover from the Juki 6100 involves removing just four Phillips-head screws. All major parts of the printer are quickly and easily exposed to make ser-

ving the printer a simple task. Juki Industries announced in May that it has signed a third-party maintenance agreement with Xerox Americare.

USABILITY

Using the Juki 6100 is simple. Set-up requires only the attachment of the power cord and the cable from your computer. You can then select a variety of special printer characteristics by setting the 10-position DIP (dual in-line pin) switch located just behind the LED/membrane front panel. The choice of functions includes automatic linefeed, impression level to control the strength of the hammer strike, continuous or cut paper, paper length (either 11 or 12 inches), line spacing (either 1/8 or 1/4 inch), and eight different international character sets (requiring special print wheels).

The DIP switches are easy to reach with a pen or small screwdriver. Once the DIP switches are set for your particular computer configuration, the printer operates under software control. For example, to use the Juki 6100 with an IBM Personal Computer and a word-processing program, you select a Diablo 630 printer driver, install it according to the instructions with the word-processing software, and the software takes care of sending the appropriate escape codes to engage the printer's functions. To engage these functions

Compared to other low-cost, fully formed character printers, the Juki is faster and sturdier, but also noisier and more expensive.

from a BASIC program, you LPRINT the escape character codes provided in the Juki manual.

The 44-page operation manual provides all the information an experienced computer user will need to run the 6100. It is probably too terse for the newcomer, but novices can enlist the aid of a friend or dealer, or they can call a Juki America regional office for assistance. The manual's English is occasionally obtuse (e.g., "When data in the buffer decrease to 220 BYTE, data are sent from CPU till next buffer full."), but the information can be found with some digging. Tables provide pin-out information for both the parallel and serial connectors. The description of how to change print wheels and ribbon cartridges is clearly explained with line drawings used to enhance the text.

CONCLUSIONS

The Juki 6100's principal strengths are its affordability and its simplicity. At \$599, it rivals dot-matrix printers in price while providing superior print quality. When discounted (you'll see ads listing the 6100 for as little as \$449, less shipping), it is an honest-to-goodness bargain. I've compared the Juki to other low-cost, fully formed character printers and found it to be faster and sturdier, but also noisier and more expensive. It's a good buy unless you need a faster printer that can generate a lot of text in a hurry.

The Juki 6100 would be ideal for a business with a small volume of correspondence (20 to 30 letters daily) or for a writer using a computer for word processing. It is superb for applications in which first-class text appearance is required. ■

Table 1: Benchmark results for the Juki 6100 printer. The benchmarks are from the February BYTE (see the text).

	Bidirectional		Unidirectional	
	Time seconds	cps	Time seconds	cps
Shannon Test (80)	33.88	16.91	38.07	15.05
Shannon Test (60)	33.68	17.01	37.71	15.19
First Order English	58.84	17.00	65.93	15.17
Fourth Order Shakespeare	48.76	16.32	53.64	14.84
First Order UNIX Manual	58.14	17.20	85.25	11.73
Spreadsheet Simulation	68.65	23.31	79.28	20.18
	Average cps:	17.69	Average cps:	15.36

ADAM

In Jules H. Gilder's article on Coleco's Adam (April, page 206), Mr. Gilder did a disservice to Coleco in recommending that the purchase of Adam be delayed until all the bugs are fixed and Coleco delivers on all its promises. I represent the market for the Adam Personal Computer and I believe that the Adam works well and is just what we need. BYTE also did a disservice by publishing his bias.

It seems that the whole story is that Adam costs less than \$750 complete and the nearest competitor costs three times as much. How many families are now without an Adam because of the Gilder story? It is too bad that the industry looks down on Coleco's Adam because it doesn't generate the profit of other personal computers.

STEVEN M. LITTLE
Santa Barbara, CA

We are glad to hear that Adam finally works well. Mr. Little, however, does a disservice to both Jules Gilder and to BYTE when he claims that our review was biased. Mr. Gilder carefully tested the machine and accurately reported his results. To do otherwise would have been a disservice to our readers.

—RICH MALLOY
Product-Review Editor

THE ZENITH Z-100

We read with interest Ken Skier's review of the Z-100 in the January issue of BYTE (page 268). Our DISK-TRAN series of programs meets the need for transferring files between different format media for both the Z-90 and Z-100 to read and write in various disk formats.

GEORGE J. SELLERS
Computer Consultants to Business
Cumberland, MD

TWO APLS

I'd like to convey my appreciation for Jacques Bensimon's article on APL. "STSC APL*PLUS and IBM PC APL" (March, page 246). I also wish to comment on the difficulties with APL's right-to-left notation. I believe this unfortunate choice, along with cryptic symbols, is responsible for the delayed acceptance of this language.

For the past three years, I have been developing a programming system that uses a syntax similar to APL but reads from left to right, following convention for standard text. This system, called BETA/65, also uses more familiar BASIC names for functions and keywords. This system is now available to users of Ohio Scien-

tific Challenger computers.

In BETA/65 notation, as in APL, arguments of monadic functions appear on the right, as users expect. There is increased interpretive overhead with this convention. Interpretation of a monadic function (operator and operand) requires 170 cycles compared with 102 cycles for dyadic functions. However, monadic functions appear less frequently in programs and, when present, typically require several hundred cycles for execution. Hence, the additional overhead is usually not apparent to the user.

The cycle times quoted above are based on interpreter implementation with the 6502 microprocessor. A hardware implementation of this interpreter seems feasible. Such a high-speed interpreter combined with a numerical coprocessor would be a formidable computing machine.

An advantage of APL-like languages that was not mentioned is the direct correspondence of code text to execution sequence. This differs from algebraic notation (used by FORTRAN, BASIC, and C), which executes according to a function-precedence list. Use of direct notation should simplify work for compiler writers. Also, extensions to the primitive instruction set can be more easily assimilated into the language.

D. G. JOHANSEN
La Honda, CA

PEACHTEXT 5000

I just read the review of Peachtext 5000 by Stevanne Ruth Lehrman (April, page 186). I haven't had a chance to do much work with all of the features of my newly acquired copy of this software, but I did notice one error in your article of which readers should be aware. Peachtext 5000 no longer includes a box of 10 blank disks, as described in its catalog. I opened the package obtained from my Heath/Zenith dealer and instead of finding the disks, I found a note saying that the bonus had been discontinued.

LEE A. BEATRICE
Somerville, MA

STATISTICAL SOFTWARE

I read with great interest the excellent article, "Statistical Software for Microcomputers" by James Carpenter, Dennis Deloria, and David Morganstein (April, page 234).

A precommercial version of our product, SPS, running under Apple DOS was used for the review and it was being compared to a set of already commercialized statistics packages.

The data in the tables is accurate for the precommercial Apple version of the program. The

data in table 13 on ratings of main features (page 251), however, is not representative for the commercial versions. For example, the average number of significant digits produced by SPS Version 3A.0 is 17 using all 6 independent variables in the Longley data set when this model is computed using the commercial IBM PC version running under DOS 2.0. We provide two multiple regression routines, one that utilizes a Gauss-Jordan elimination algorithm and one that uses a Singular Value Decomposition (SVD) algorithm. We obtain this 17-digit accuracy with the SVD routine, which should be used, as our manual points out, with highly collinear data since the algorithm works with original X matrix and not (X'X). In fact, even more accurate results would have been obtained for the precommercial version if the SVD procedure had been used for the Longley data.

Perhaps the ratings that SPS received in table 13 would be upgraded if the commercial version had been reviewed. We do provide a table of contents, index, and sample runs in the documentation, as well as the ability to select cases, join and sort files, and perform a wide range of transformations.

Our SPS package is currently available on CP/M, MS-DOS and PC-DOS formats. Although the Apple DOS version is no longer available, a version is still available for the Apple II and IIe machines using a CP/M card.

RICHARD TILMANN
DBI Software Products
Mt. Pleasant, MI

I commend BYTE and authors Carpenter, Deloria, and Morganstein for their comprehensive article on statistical software in the April issue. It is the first article of its kind to appear in any of the nationally circulated microcomputer magazines, and it provides valuable information to personal computer users interested in statistics.

Your readers who use the IBM Personal Computer (PC) may also be interested in SIGSTAT, the Special Interest Group for Statistics. SIGSTAT is part of the Capital PC User Group, a nonprofit association of nearly 2500 IBM PC users in the Washington, DC, area.

SIGSTAT members review statistical software for the IBM PC and report their findings in the *Monitor*, the monthly newsletter of the CPCUG. It costs \$25 per year for a subscription (send a check to Capital PC User Group, POB 3189, Gaithersburg, MD 20878).

Our electronic bulletin board operates 24 hours per day at 300 or 1200 bits per second (bps) (no parity, 8 data bits, 1 stop bit). The telephone number is 301-596-3369. The bulletin board has reviews of statistical packages and some demonstration and public-domain soft-

ware. Because it is difficult to fill the many requests for past reviews, we prefer that interested PC owners download the reviews from this bulletin board. We encourage PC owners to upload their comments about statistical software and to contribute nonproprietary programs to SIGSTAT. We do not accept pirated packages for the bulletin board and do not condone illegal copying of copyrighted software.

For readers who do not have access to PC telecommunications, send a 5¼-inch double-sided disk with a preaddressed, postage-paid mailer to the address below. SIGSTAT will copy onto the disk past software reviews, the list of currently available commercial statistical packages, and any public-domain statistical software we have at the time.

HARRY J. FOXWELL
Burke, VA

I was pleased to read the recent review of statistical software by James Carpenter, Dennis Deloria, and David Morganstein in the April issue. Their comparative analysis of 24 packages was very informative, especially the extensive list of tables.

I am curious, however, why the micro version of SPSS (Statistical Package for Social Sciences), SPSS-11, was not included in their analysis. It has purportedly been on the market since the middle of 1983 and runs on the DEC Professional 350. Although I have no actual experience with this package, it seems more ap-

pealing than those surveyed for several reasons. First, the mainframe SPSS has been in existence for over 14 years and, therefore, has withstood the test of time. Any of the initial bugs were located and corrected long ago. Due to their familiarity with the language, experienced SPSS users would prefer to work with this package on microcomputers.

Aside from the micro version of SPSS, I would be interested in knowing when the other major mainframe statistical software packages, e.g., SAS and BioMed, will be offered to the micro industry. This reader is anxiously awaiting a comparative analysis of their statistical software for microcomputers.

PAUL E. BURKHARDT
Stockbridge, MA

THE RAINBOW 100

David B. Suits neglected to share some of the Rainbow 100's really impressive features in his review (April, page 170), so I thought I would oblige.

Did you ever multitask on a single terminal with two computers? On my desk at work, my Rainbow looks like a mild-mannered VT52 or VT102 to my host minicomputer software. Because the terminal emulation is all contained on the ROM, there's no extra software to buy. After I start up a job stream in the Rainbow's line (terminal) mode, I can then slip back to local

mode and wrap up some documentation or glance through a spreadsheet. I then return to the minicomputer, still processing, which has kept my place as a terminal while I was away personal computing.

When Mr. Suits was reviewing the documentation, he didn't discover the Rainbow's virtual disk, which is the memory drive (MDRIVE). With CP/M-86 version 2.0 and 128K bytes or more of RAM, you can configure 64K-byte increments of the RAM as a storage unit or drive. With my 256K bytes of RAM, I can set up a 128K-byte slice of memory, PIP over my Rainbow editor (RED) or Multiplan programs and the response is like lightning. When I'm done, I copy any edited files back to disk and "remove" the drive.

MELINDA HAYES
Owensboro, KY

Some misconceptions were presented to your readers in David Suits's review of the Rainbow 100. I'd like to comment on some of these.

It is not quite true that the Rainbow cannot read double-sided floppies; however, there is a catch to it. A double-sided floppy has two write-enable cutouts that inhibit the drive completely when both are present. Therefore you must cover the right-hand cutout for the upper drive and the left-hand one for the lower with some self-adhesive label (a postal stamp will do) to simulate the single-sided disk.

When you want to use the other side of the

(continued)



HIGH PERFORMANCE LEADER

EPROM PROGRAMMERS & UV ERASERS

GANG MULTIPROGRAMMER™

- Programs over 400 devices
- Detachable keyboard (opt.)
- Stand Alone - RS232
- Bipolar • Microchips (opt.)
- 3 Voltage EPROMS (opt.)

\$15-G \$995

other systems under \$600

ORDER NOW Toll Free 1-800-53-BYTEK

BYTEK® Computer Systems Corp.
4089 S Rogers Circle
Boca Raton FL 33431



UV MULTIERASER™

- Built-in safety switch
- Removable anti-static UNITRAY™ (opt.)
- 1 Hour Timer (opt.)

\$67
BUV-3C



(305) 994-3520
Telex: 5109527637

Distributor Inquiries Welcome

REVIEW FEEDBACK

disk, you have to move the sticker.

The Rainbow also reads and writes VT180(ROBIN) floppies; however, its reading is prone to errors. Various Rainbows behave differently, and some produce fewer errors. Also, when writing the VT180 floppy, it has to be in the drive when the system starts, otherwise the first attempts will cause error reports.

RUDI W. STANGE
Eching, West Germany

KAYPRO 10

Steve McMahon's review of the Kaypro 10 (May, page 206) neglected to mention an important feature available for this machine, the CO-POWER-88 board by SWP Microcomputer Products Inc., of Arlington, Texas.

Available as a factory option or directly from SWP, the CO-POWER-88 upgrades the Kaypro so it can run MS-DOS and CP/M-86.

FRED L. HELMS
SWP MICROCOMPUTER PRODUCTS
Arlington, TX

ECO-C COMPILER

We would like to thank BYTE for publishing Dr. David D. Clark's review, "Two More Versions of C for CP/M" (May, page 246), which included our Eco-C compiler. We think it was a well-written and fair review of Release 1.52. However, we would like to inform your readers about several important changes in Eco-C since Release 1.52 was first distributed.

Dr. Clark mentioned our free update policy for the first year the compiler was on the market. We did this because we knew that we would be enhancing the compiler over time. The release that Dr. Clark mentioned (but did not review) reduced the limitations of Eco-C to

bit fields and the #line preprocessor directive. That release (2.04) also improved code generation, especially on function calls. While most of the benchmarks have rather modest improvements (e.g., 5 to 10 percent), the Fibonacci benchmark dropped from 187 seconds to about 79 seconds.

We also dropped the price of the Eco-C compiler last year to \$250 rather than the \$350 mentioned in the article. At the time we reduced the price, we sent a letter to all licensed Eco-C users offering credits ranging from \$70 to \$100 on some of our other products.

The latest release (3.0) also increased the number of library functions to 120, added new compile-time switches (including multiple, non-fatal, error messages), and implemented several new optimizers. We began shipping this release free of charge to all licensed users on May 1 of this year.

Your readers are probably wondering why our compile times are slower than the other two compilers. Part of the reason is that subset compilers typically work with data types that fit nicely into a central processor register pair (no longs, floats, or doubles), which greatly simplifies a number of tasks for the compiler (e.g., symbol-table manipulation). Code size will also be smaller in most cases (e.g., even our integer printf() must handle the long data type). Another reason is that Eco-C does not require the source file to fit into memory, resulting in more disk I/O (Input/output). Other nonsubset compilers face similar problems.

The overall compile-assemble-link (CAL) times presented in Dr. Clark's review do show a speed advantage for subset C compilers. However, the Eco-C Release 3.0 CAL times are similar to other full C compilers. See Christopher O. Kern's article "Five C Compilers for CP/M-80" (August 1983, page 110). We are currently testing a new assembler and linker that cut the CAL times almost in half.


Equally (more?) important are execution times. Eco-C now does the Eratosthenes "vanilla" sieve in 29.2 seconds while the Fibonacci ("fib") drops to 75.3 seconds. Adjusting for clock-speed differences in the Kern article, Eco-C times are first in the "vanilla", "fib", and "string-length" benchmarks. (We cannot duplicate the other Kern benchmarks since the input data is unknown.)

Finally, we appreciate Dr. Clark's inclusion of a floating-point benchmark: it represents the first such benchmark aimed specifically at a C compiler and one that deserves more attention. Unfortunately, the reader has no idea whether the Eco-C time is good or bad, since neither subset compiler can run it. Release 3.0 runs this test in 41.2 seconds generating less than 21K bytes of code (versus 48 seconds and 22K bytes for Release 1.52). As a reference, a competitor's compiler generates more than 24K bytes of code and executes the benchmark in 113.3 seconds: a 275 percent time difference in Eco-C's favor. Dr. Clark is correct that we put a lot of effort into the floating-point package.

It would also be interesting to see a benchmark for the long data type, since it is heavily used in some functions (e.g., random file I/O). Our long tests suggest considerable advantage for Eco-C here, too.

JACK PURDUM, PH.D.
ECO SOFT INC.
Indianapolis, IN ■

REVIEW FEEDBACK IS a new column of readers' letters. We welcome responses that support or challenge BYTE reviews. Send letters to Review Feedback, BYTE Publications, POB 372, Hancock, NH 03449. Name and address must be on all letters.

300 BAUD	MODEMS	1200 BAUD
HAYES SMARTMODEM 1200 \$479		
SIGNALMAN . . Free 'SOURCE' sign-on		
*MARK 12 300/1200 Auto Dial/Ans . \$279		
MARK 7 300 Baud Auto Dial/Ans . . \$99		
VOLKSMODEM 300 Baud \$59		
US ROBOTICS . . 300/1200 Auto Dial/Ans		
'AUTO 212' dx \$399		
*PASSWORD' with cables, spkr . . . \$339		
S-100 \$319		
*Hayes Compatible'		
DOT MATRIX	PRINTERS	LETTER QUALITY
GEMINI 10x 120 cps graphics \$289		
PROWRITER 120 cps hi density \$359		
COMPUTERS		
IBM Kaypro Leading Edge	SCALL HARD DISKS PORTABLES	Columbia P.C. Corona P.C. TAVA P.C.
IMAGE COMPUTERS		
P.O. Box 1164, Cardiff, CA 92007		
CALL TO ORDER: (619) 942-7373		
VISA  VISA/MC (619) 436-7669 ADD 3%		

Circle 154 on inquiry card.

CP/M CROSS SOFTWARE for the NS16000

INCLUDES:

- * Cross Assembler *
- * Cross Linker *
- * Debugger *
- * N.S. ISE Support *
- * Librarian *
- * Pascal Cross Compiler *

U.S. Prices start at
\$500 for Assembler only

SOLUTIONWARE

1283 Mt. View-Alviso Rd.
Suite B
Sunnyvale, CA 94089
408/745-7818 • TLX 4994264

Circle 285 on inquiry card.

Apple II/IIe®

Robotic Development Package



**2 Axis
Stepper Motor System** \$420
(35 oz. in.)

- A6 T/D Plug-In Interface
- R2 D23 Dual Axis Driver
- (2) Size 23 Motors
- Positioning Command with Ramping from Applesoft® BASIC

Also Available with:
(2) Size 34 Motors (220 oz. in.) & R2 D34 Dual Axis Driver **\$684**

ROGERS LABS (714) 751-0442
2710 S. Croddy Way, Santa Ana, CA 92704

Circle 269 on inquiry card.

Kernel

THIS MONTH THE KERNEL welcomes Dick Pountain's BYTE U.K. column, which opens our window on Europe. The inaugural column reports on Inmos's Transputer and the programming language Occam.

Jerry Pournelle offers a series of observations from Chaos Manor, once again assailing the Macintosh, taking issue with AT&T's software pricing, and sharing enthusiasm for his new lap-size portable. In BYTE West Coast, John Markoff and Ezra Shapiro present an interview with some of the original designers of the Macintosh who were not present for the interview published in our February issue. William M. Raike's report from Tokyo describes the Akihabara electronics bazaar, the Fujitsu FM-11, and the Sharp MZ-5500. Bill also offers another short program in C as a bonus.

COMPUTING AT CHAOS MANOR: BETWEEN CONVENTIONS <i>by Jerry Pournelle</i>	313
CHAOS MANOR MAIL <i>conducted by Jerry Pournelle</i>	334
BYTE JAPAN: PASOCOM PAGODAS <i>by William M. Raike</i>	339
BYTE WEST COAST: MACINTOSH'S OTHER DESIGNERS <i>by John Markoff and Ezra Shapiro</i>	347
BYTE U.K.: MICROPROCESSOR DESIGN <i>by Dick Pountain</i>	361

WILLIAMS

COMPLETE MS-DOS™ SANYO COMPUTER SYSTEM

\$1399



Hardware

- SANYO MDC555**
- 16 Bit 8088 CPU
 - Socket for Optional 8087 MPU
 - 128K Expandable to 256K RAM
 - Centronics Printer Port
 - 2 1/2"-Height Double Density Drives
 - SYOMBC555 - Single Sided 160K ea.
 - SYOMBC5552 - Double Sided 360K ea.
 - 10 Programmable Function Keys
 - Speaker and Joystick Ports

HIGH RESOLUTION MONITOR

- Your choice of RGB 13" Color or 12" Monochrome Green or Amber Monitor

PRINTER

- Your choice of 120 cps Dot Matrix or 12 cps Letter Quality Printer
- All necessary cables are included

Software

- MS-DOS™ Operating System
- SANYO BASIC

MicroPro Software:

- WordStar®
- SpellStar®
- CalcStar®
- DataStar®
- ReportStar®
- InfoStar®
- MailMerge

CABLES INCLUDED!

COMPUTER

MONITOR	PRINTER	SYOMBC555 Single Sided Drives w/MS-DOS V1.0™		SYOMBC555-2 Double Sided Drives w/MS-DOS V2.11™	
		GEMINI 10X 120 CPS Dot Matrix	12 CPS LETTER QUALITY*	GEMINI 10X 120 CPS Dot Matrix	12 CPS LETTER QUALITY*
12" GREEN SCREEN HI-RES MONITOR BHSYODM812CX		TOTAL VALUE:\$2033.85 \$1399 BHPDB555SP1	TOTAL VALUE:\$2329.85 \$1549 BHPDB555SP2	TOTAL VALUE:\$2433.85 \$1599 BHPDB5552GRDM	TOTAL VALUE:\$2729.85 \$1749 BHPDB55526RLQ1
12" AMBER SCREEN HI-RES MONITOR BHSYODM6212CX		TOTAL VALUE:\$2033.85 \$1399 BHPDB555SP3	TOTAL VALUE:\$2329.85 \$1549 BHPDB555SP4	TOTAL VALUE:\$2433.85 \$1599 BHPDB5552AMDM	TOTAL VALUE:\$2729.85 \$1749 BHPDB5552AMLQ1
13" HI-RES RGB COLOR MONITOR BHSYODM7500		TOTAL VALUE:\$2618.85 \$1699 BHPDBSY055575DM	TOTAL VALUE:\$2814.85 \$1849 BHPDBSY055575LQ1	TOTAL VALUE:\$2918.85 \$1899 BHPDB555275DM	TOTAL VALUE:\$3114.85 \$2049 BHPDB555275LQ1

Shipping Charges: Outside California, include \$42.00 - Inside California, include \$25.00

*Silver Reed EXP500P or equivalent

Enhancements and Accessories:

- BHPDBSYD126K 128K RAM Expansion \$119.00
- BHSYOMBC232 RS232 Serial I/O Port \$100.00
- BHWBR06115 S6 outlet noise/surge suppressor \$29.95
- BHHULT51401 Single sided soft sector diskettes (Package of 10) \$19.95
- BHHULT52401 Doublesided soft sector diskettes (Package of 10) \$29.95
- BHINC0351314 Flip 'n File 50 diskette holder \$24.95



PRIORITY



ELECTRONICS

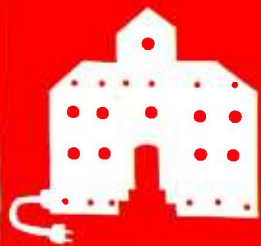


9161 Deering Ave., Chatsworth, CA 91311-5887

ORDER TOLL FREE (800) 423-5922 - CA, AK, HI CALL (818) 709-5111
Special Sale Prices for prepaid orders only. VISA, MC, Check, or Money Order. California residents at 6 1/2% Sales Tax. Financing available on approved credit. Sale prices valid through August 31, 1984. We are not responsible for typographical errors.

Circle 254 on inquiry card.

ORDER TOLL FREE (800) 423-5922 - CA, AK, HI CALL (818) 709-5111



C·O·M·P·U·T·I·N·G A·T· C·H·A·O·S M·A·N·O·R

Between Conventions

Trump Card

Gold Card

Turbo Pascal

First BYTE Show

Macintosh

Writing Machines

Lap-size Portables

Format Conversions

Financial Games

Sweet-P Notes

R:Base Database

AT&T Software

Dynamic RAM

It has been a month. First there was the L-5 Society annual convention, at which I got doused with beer during a fundraiser. The next weekend was the Science Fiction Writers of America's annual Nebula awards ceremony. The week after was Contact, an annual meeting of science-fiction writers and anthropologists. No sooner had I returned from that but I was on an airplane to Chicago for the first BYTE Computer Show. All told, I think I've been at Chaos Manor about 12 days since I turned in the last column.

Next week I leave for a speech in Cincinnati on my way to COMDEX in Atlanta, followed by the annual meeting of the American Association for the Advancement of Science. I know I'll never cover all of what goes on in the micro world no matter how much time I have, but this is getting ridiculous.

Meanwhile, my apologies: this column is going to be choppy than usual; there's a lot to cover.

TRUMP CARD

The name went through several iterations: the first few Steve Ciarcia tried had already been trademarked. I sometimes wonder if there's a single catchy English word that hasn't been registered by someone or another. In any event, the board I reported on last January on page 61 as Quicksilver is now out as the Trump Card.

I still don't have one, but Steve brought a production model to the BYTE Show, and we talked Emil Bohach of Small Business Systems, the local CompuPro Systems Center, into letting us plug Steve's board into his PC. Trump Card has an on-board Z8000 chip running at 10 MHz. There's also a BASICA-compatible compiler that you load from disk. Steve plugged in the board and it worked as advertised: it compiles BASICA programs at an astounding rate, and after compilation they run about 100 times as fast. I didn't get to see the on-board C compiler work.

Trump Card was written up by Steve in the May and June issues of BYTE. I can practically guarantee that if you have a PC, you'll want Trump Card. More when I get mine. I can hardly wait.

GO FOR THE GOLD

For a couple of years we've had an Applicard in the Apple II+ the boys keep in the back room. The Applicard has an on-board Z80 and turns the rest of your Apple into a terminal so that you can run the Z80 under the CP/M operating system. It also speeds things up something wonderful. Our Applicard has always worked fine, but it did have one problem: we had considerable difficulty teaching the operating system how to find the serial I/O (input/output) port. I think Barry Workman finally got The File Transporter talking to the Apple, but it was no simple task.

Last January, Mrs. Pournelle got an Apple IIe to match the one that Apple gave to her school. Shortly after, we acquired a copy of Digital Research's new Gold Card. The Gold Card does the same thing that the Applicard does, but it has no difficulty finding both serial and parallel ports. Moreover, the STAT function works as you expect it to, so that you can make logical-to-physical port assignments.

Gold Card comes with CP/M+, sometimes known as CP/M 3.0. You also get CBASIC and a built-in conversion to make your Apple an 80-column machine if you like. I'm no great fan of CP/M+—I don't think it has enough additional features beyond CP/M 2.2 to make it worth installing—but it does no great harm to have it on an Apple.

Gold Card installation is simple, and once it's installed, you can boot the machine either under CP/M or as a normal Apple. The Gold Card is invisible when you're running Apple DOS (disk operating system). Our Gold Card has worked without glitches for several months now.

TURBO YET AGAIN

Phillippe Kahn, president of Borland International, always manages to call me just as I'm writing this column.

He called today to tell me about a speedy way for Turbo Pascal users to communicate

(continued)

.....
Jerry Pournelle holds a doctorate in psychology and is a science-fiction writer who also earns a comfortable living writing about computers present and future.

BY JERRY POURNELLE

with him. One of the Borland staff, generally Phillippe himself, logs onto the CompuServe net every day. You can leave messages and be certain he'll get them.

Access is through the Programmer Special Interest Group. The simplest way is, after you log on, to do GO PC5158, which will put you into a Turbo Pascal bulletin board where you can read messages and replies. Due to the large number of calls he gets and his limited staff, he'd really prefer people to communicate this way rather than over the phone. Borland will still try to give telephone support.

A couple of readers report difficulties getting Turbo to run with CP/M+. However, Phillippe himself has a Morrow system running CP/M+, so it isn't the CP/M that's doing it. He suspects a nonstandard BIOS (basic input/output system) may be at fault. Borland will refund the purchase price if you can't get it to work with your system.

I've also heard a couple of complaints from readers who bought the first edition of Turbo Pascal. I liked it a lot, and now find they've got to pay \$29.95 for the second edition. I confess I have little sympathy for them. Borland is giving previous purchasers a hefty discount: book publishers don't do that. When you buy a new edition of a textbook, you pay full price. Of course, Borland could have charged \$99.95 for Turbo Pascal: the company could then charge initial purchasers \$5.95 for the update, and everyone would think they were great guys.

As for me, I congratulate Borland for taking the micro community a giant step in the right direction.

One of the neatest things about Turbo Pascal is the overlay structure. You can have multiple overlays: the compiler automatically reserves space for the largest overlay, thus ensuring that all the smaller ones will fit. Furthermore, you can have nested overlays, as many deep as you like (until you run out of memory space: each overlay reserves space for the largest overlay that it calls). For 16-bit systems, Turbo can make use of the whole heap space, which means you can have large dynamic arrays. A Turbo program is limited to a maximum of 64K bytes of code size (as is Pascal MT+), but this turns out not to be as serious as it might be because Turbo

produces such tightly efficient code. Given the easy-to-use overlays, efficient code, and integrated editor, I think Turbo is the best Pascal compiler on the market. It's also the cheapest.

Kahn says he's pretty sure the Turbo Modula-2 compiler will be on sale before the end of 1984. I hope so.

THE BYTE SHOW

I've mixed emotions about the Chicago BYTE Computer Show.

First, the good news: a lot of people showed up. The BYTE staff, including Editor in Chief Phil Lemmons, Steve Garcia, me, Product-Review Editor Rich Malloy, and Senior Technical Editor Gregg Williams were on hand to answer questions. *Popular Computing's* Editor in Chief Pamela Clark was there, too. We had a good dialogue with the attendees. I sat down outside the BYTE booth at 10:00 on Saturday morning and talked with crowds until I had to leave at 2:00, and there were always lots of people to ask questions and tell me things I didn't know. The other BYTE people had much the same experience.

More good news: the seminars were interesting and well organized. The presentations were excellent. We had a couple of complaints about schedule conflicts—two of the most interesting panels were on at the same time—but that was all. People who come to computer shows for the panels seemed universally happy.

Now the bad news: there weren't anywhere near enough exhibitors. I heard a lot of explanations for this. My own view is that it was a classic comedy of errors: everyone thought it was someone else's job to let potential exhibitors know about the show. Whatever the problem, we've been told Next Time For Sure. It better be: I really hate having to face disappointed BYTE readers. Fortunately, most were not unhappy, and I had some great conversations.

The BYTE Shows have high potential value, and I think they should continue. The BYTE staff has been asked for suggestions on improvements. I've been pressing for mini-booths: small, low-cost space for first- and second-time exhibitors, much as Jim Warren had for the West Coast Computer Faire. BYTE has always been the micro enthusiast's magazine, and BYTE Shows with mini-booths would be right in line with that

tradition. Alas, I'm not in charge, and all I can do is keep asking. I'll do that.

Late update: the L.A. show had mini-booths, and I thought it was great.

PEOPLE WILL TALK . . .

For me, the main value of the BYTE Shows is the chance to talk with readers. Now true, I get a lot of mail and thus have some feedback; but that's no substitute for face-to-face contact, and at the Chicago BYTE Show I was able to speak with literally hundreds of you.

There were a lot of questions, but two were most frequent by miles. Readers wanted to know what I think of Macintosh and what system I recommend for writers.

MAC RECONSIDERED

I have a problem with the Macintosh: I don't recommend that you get one now—but now is May 1984, and by the time you read this, things will have changed drastically. I don't know what I recommend "now," meaning as you read this column. It all depends on what's available.

As I write this, the Macintosh is a bargain only if you can get it at the heavily discounted price offered to faculty and students of the favored 24 universities in the Macintosh "consortium." (Incidentally, I'm told that when you see a list of the universities within the consortium, you'll see only 23: one university made anonymity a condition of joining, and Apple can never use that university's name in any press releases or advertising.)

There are several reasons why you wouldn't want the Mac at full price just now. Some are inherent in the machine: negative features that must be overcome with something positive. The other reasons may well be temporary; they're fixable, but only if the Macintosh survives, and despite all the Machype, I'm not as convinced of that as everyone else seems to be.

First, the "permanent" problems. The chief one is that the Macintosh is a rather ill-designed machine. The Caps-Lock key is where the Control key ought to be; there is no Escape key; the Control key is badly placed. There are no cursor arrow keys, meaning that touch-typists must remove their hands from the keyboard and use the mouse even

(continued)

You'll be sorry

if you buy an IBM® PC
multifunction
or graphics board
before August 17.



PARADISE

S Y S T E M S , I N C

Circle 244 on inquiry card.

IBM is a registered trademark of International Business Machines Corporation, Inc.

www.americanradiohistory.com

for small cursor movements.

The mouse itself has only one button. This, we are told, is to prevent user confusion: one button is enough. However, to use the mouse you must often do Shift-click (hold down the Shift key as you press the single mouse button) or Command-click (ditto for the Command button and mouse). This makes a two-handed operation out of what should be a one-handed affair. It would have been easy enough to put copies of the Shift and Command keys on the mouse itself. Of course, that would have cost a bit more.

The single disk drive is a real pain. For the past six weeks, I've heard stories of a new Copy routine that would use more of the Macintosh's memory and thus require fewer disk swaps for copying a disk; but I have not seen the new routine, and as of May 15 there had been no firm date set for delivery. Similarly, every week someone announces that the second disk drive will

be available next week, but so far none have been delivered.

The operating system has bugs. There are a lot of ways you can trash a disk and lose all your text files. This is inexcusable, and sufficient to prevent me from using the Macintosh as a word processor. My time and energy are too valuable to gamble with. I am told there are fixes to most of the disk trashing, but since none of them are documented, they are not available to "the rest of us."

The Macintosh documents are nearly worthless. Every now and then the Macintosh will deliver messages about "Fatal Error #2" and the like, but that's interpreted nowhere. The Macdocuments are pretty, with lots of visual appeal, but they don't tell you enough about the machine. Neither, incidentally, does Doug Clapp's book *Macintosh Complete* (Soft Talk). This \$19.95 book is unreserved in its praise of the Mac but tells you little that isn't in the Mac-

documents. It's often deliberately cryptic. A better book is Cary Lu's *The Apple Macintosh Book* (Microsoft), which costs less (\$18.95). Though it is incomplete (any book published simultaneously with the announcement of the Mac would be), it does have a lot of useful information. However, neither book, nor the Macdocuments, will interpret the Mac error codes.

The Macintosh disk drives are painfully slow. It takes the better part of forever to load software. It's so difficult to make backup copies that one is tempted not to make them: this can result in unrelieved grief if you're then caught by one of the disk-trashing bugs.

There's nowhere near enough memory. As I write this, only two languages are available for the Macintosh: FORTH and Microsoft BASIC. I know little about the FORTH; but when you've loaded the Microsoft BASIC, you have only 14K bytes of work area left. That means you

(continued)

The only Project Planning System that gives you this flexibility:

Project Title	Sample Project Data
Main Menu	
1	--> INPUT
2	--> EDIT
3	--> RANK / PROCESS
4	--> DISPLAYS
5	--> REPORTS
6	--> VERSION
0	--> TO EXIT

enter selection: 7 . . .

Quick·Plan

The Executive Project Planning System

- Quick·Plan runs on MS DOS for: IBM PC, DEC RAINBOW+, WANG PC, HP 150, Data General DT
- Requires: 384K of core, graphics option- 132 wide printer

For more information call or write:

Mitchell Management Systems Inc.

FORMERLY STRUCTURAL PROGRAMMING INC.
Westborough Office Park, 2000 West Park Drive, Westborough, Mass 01581 USA
Telephone (617) 366-0800 FAX 716-347-1054

Powerful Single Board Computer Includes CP/M Plus (3.0 banked)



\$599

Assembled, Tested
Includes CP/M 3.0 on disk
with all manuals

Model MSC-1CO

All Features Fully Supported By CP/M Plus

- Z80A, 4 MHz, No wait states
- 128Kb Banked RAM, 60Kb TPA
- 80 x 24 line high speed video
- Disk Controller (up to 4 drives)
- 8" SS/SD, DS/DD (1.2 Mb)
- 5" SS/DD, DS/DD, QHD (1.2Mb)
- Use 5" and 8" simultaneously
- Both 5" and 8" connectors built-in
- Two programmable RS232C ports
- Centronics printer port
- 16 bit TTL I/O port
- Parallel keyboard input port
- Clock calendar with battery backup
- Expansion bus for enhancements
- Requires only +5V 1.2A, +-12V 0.1A

MSC-1CO + 5" QHD (1.2 Mb) drive \$975

Manufactured by:

Southern Pacific Limited, 1-3-18 Santomi Bldg.
Tsurumichuo, Tsurumi, Yokohama, JAPAN 230
TEL: 045-501-8842 TLX: 3822320 SPACIF J

USA Distributor:

ARTISOFT, Inc., 2450 East Speedway, Suite 4
Tucson, Arizona 85719, TEL: (602) 327-4305

LOGITECH MODULA-2.

The only Modula-2 native code compiler for 8086/8088-based machines and VAX® systems.

Compiled machine code means *very fast* program execution. LOGITECH MODULA-2 means very fast, very effective professional program development. Here's how:

All the strengths of Pascal, plus improvements in every respect.

Wirth's Pascal language is favored for its support of structured programming, elegant syntax, and ease of use.

Modula-2 is Wirth's second generation programming solution. All the best features of his Pascal language have been incorporated; Modula-2 adds major features for true modularity, support for multi-tasking, syntax improvements, and features for increased portability (to name just a few).

Designed for structured, modular programming, LOGITECH MODULA-2 extends Pascal's strong type checking features to include type checking between program modules.

Modula-2 is easy to learn. Programs are easy to write, read, and maintain.

A complete program development system.

LOGITECH MODULA-2 includes a complete implementation of Wirth's design, plus additional LOGITECH modules (including display handling and dynamic string handling).

A complement of powerful debugging tools—including compile-time error checks and symbolic debugging—are included.

Professional support from the people who wrote LOGITECH MODULA-2.

LOGITECH's commitment to Modula-2 as a professional development tool is backed by the most professional support available for Modula users. Because the support team includes the developers of our Modula-2 implementation, you are assured of fast, high-level answers to the toughest questions.

Continuous support of Modula-2 and related libraries includes regular notice of updates, and low user update costs.

As the leading producer of Modula-2 for VAX systems and 8086/8088-based micros, LOGITECH is committed to protecting and enhancing your language investment.

LOGITECH MODULA-2 FEATURE SUMMARY:

- Complete Wirth Modula-2 implementation.
- True modular programming; full support for large program development. Supports multi-level overlays.
- Development environments: MS™ -DOS, PC® -DOS, CP/M-86®; VAX/VMS® (cross compiler for 8086/88, compiler for VAX).
- Compiles 8086/8088 native code for fastest execution. (Compiler available for VAX).
- 8087 support for floating point arithmetic.
- Multi-tasking; includes co-routines and interrupts.
- Provides low-level software/hardware access.
- Includes symbolic debugger.

Trademarks: MS—Microsoft Corporation; MODULA-2/86, MODULA-2/VMS, MODULA-2/VX86—LOGITECH, Inc. Registered Trademarks: PC—International Business Machine Corporation, Inc.; CP/M-86—Digital Research Inc.; VAX, VMS—Digital Equipment Corporation

Circle 181 on inquiry card.

LOGITECH MODULA-2.

LOGITECH MODULA-2.

Don't start another project without considering the power, portability, modularity and speed offered by LOGITECH MODULA-2.

LOGITECH's complete Modula family:

- MODULA-2/86™ native code 8086/8088 compiler: \$495
- MODULA-2/VMS™ VAX-resident compiler: \$1,500
- MODULA-2/VX86™ VAX to 8086/8088 cross compiler: \$4,500

To order, or for more information, call or write:



LOGITECH

Chris Cale, 805 Veterans Blvd.
Redwood City, CA 94063 (415) 365-9852
In Europe contact: Willy Steiger,
LOGITECH SA Switzerland (021) 77 45 45.



"if you don't like wasting money"
P.O. Box 920152, Norcross, GA 30092

**IBM PC's now available.
Best Price \$**

Send \$1.00 for our catalog.

COMPUTERS

TELEVIDEO

TS 803	\$1970
TS 804	\$3550
TPC I (8 BIT 2 Drive Port)	\$1700
TPC II (IBM Comp 2 Drive Port)	\$1895

CORONA

PC21 Desk 2 Drive	\$2299
PPC21 Port 2 Drive	\$2249
Call for other models.	

IBM-PC's

IBM PC 1 Drive	\$CALL
IBM PC 2 Drive	\$CALL
IBM XT 10MB	\$CALL
Call for other models & accessories.	

PRINTERS

BROTHER

HR-5 Par/Ser	\$199
HR-25 Par/Ser	\$680
Call for other models.	

MANNESMANN/TALLY

MT 160L	\$599
MT 180L	\$815
Call for other models.	

OKIDATA

84 Par	\$990
92 Par IBM	\$455
93 Par IBM	\$715
Call for other models.	

MODEMS

HAYES

Smartmodem 300	\$215
Smartmodem 1200	\$499
Call for other models.	

RIXON

R212A 1200	\$425
Call for other models.	

SOFTWARE

dBASE II-CPM/IBM	\$315
LOTUS 1-2-3-IBM	\$342
SUPERCALC 3-IBM	\$250
MULTIPLAN-CPM/IBM	\$159
WORDSTAR-CPM/IBM	\$268
WORDSTAR PRO PAK-CPM/IBM	\$379
INFOSTAR PLUS-IBM	\$330

Disk Format Service

Call 404/255-3811 for details

TERMS: Cash & major credit cards.
SHIPPING: \$3.00 minimum charge.
PRICES: Prices subject to change.

1-800/241-4783

CHAOS MANOR

have to write cryptic BASIC programs or none at all. Shades of the old days with 4K-byte memory boards!

I now find you can use the CLEAR command to get up to 29K bytes of workspace. It's an undocumented feature.

The "desk calculator" feature within the Mac is useless. This is a pity, because I must keep a TI calculator next to my desk in order to do the myriad computations required in daily life, and I'd hoped to replace the TI with the Macintosh. No way, though: the Mac's calculator has no memory, no change-sign key, and, of course, no scientific functions or notation. Moreover, it's very hard to use. Mice are *not* the best way to input numbers. I presume that one could write a calculator routine in BASIC, but what's the point? Both it and BASIC would have to be loaded—at painfully slow speed. You'd be better off with a lap computer like the NEC PC-8201A, which has BASIC in ROM.

As I write this, there is no application software for the Macintosh. Microsoft Multiplan was recalled, as it should have been—the version we bought crashes at the slightest mistake, losing everything you've calculated. Each week I hear announcements of an incredible pile of new software to be delivered next week, but when the next week comes, none of it is available. I've given up believing the breathless new announcements. More: the spate of announcements, followed by nondelivery, makes me wonder whether interfacing software into the Mac's operating system is more difficult than Apple wants us all to believe. Perhaps I'm an excessive worrier. Perhaps not.

SOME LOVE IT

There's a good side to the Macintosh; good enough that if Apple fixes the fixable defects, it may truly be "the computer for the rest of us."

First off, I don't know anyone—including me—who doesn't think it's fun to play with. MacPaint, with its spray can and paintbrush; MacWrite, with the ability to change type fonts and sizes; and the cut-and-paste utilities combine to let you create some remarkable graphics. The days of the illuminated manuscript have returned. It takes a long time to print a letter written with MacWrite, but it looks spectacular.

Second, for those who must write short illustrated documents, Mac is superb.

Third, the Mac attracts people who hate computers. A typical case: businessman gets Mac; finds he can't do much with it; takes it home; wants to experiment with it, but finds he can't get near it because his wife and children, who previously hated computers, have taken it over and will not let go. There is, apparently, something about mice and pull-down menus and icons that appeal to people previously intimidated by A> and the like. Experienced users may know that the Mac won't do very much, but beginners can make it do something, and that's important.

Experienced hackers tend to divide into two groups: a sizable number think the Macintosh is a ridiculously priced Etch-A-Sketch, but just about as many think it's wonderful. They don't do anything useful with it, mind you; but they cease not to explore, and they're in love with all the exciting new concepts and features. I think they're more in love with the idea of the Mac than with the actual machine, but that's irrelevant. The important fact is that knowledgeable computer wizards think the Macintosh is wonderful; they believe that it will soon have lots of excellent application software; and they passionately detest anyone who has doubts or misgivings about the Mac. This is, they say, the computer for "the rest of us"—even though they've long ceased to think of themselves as one of "the rest."

THE MACDILEMMA

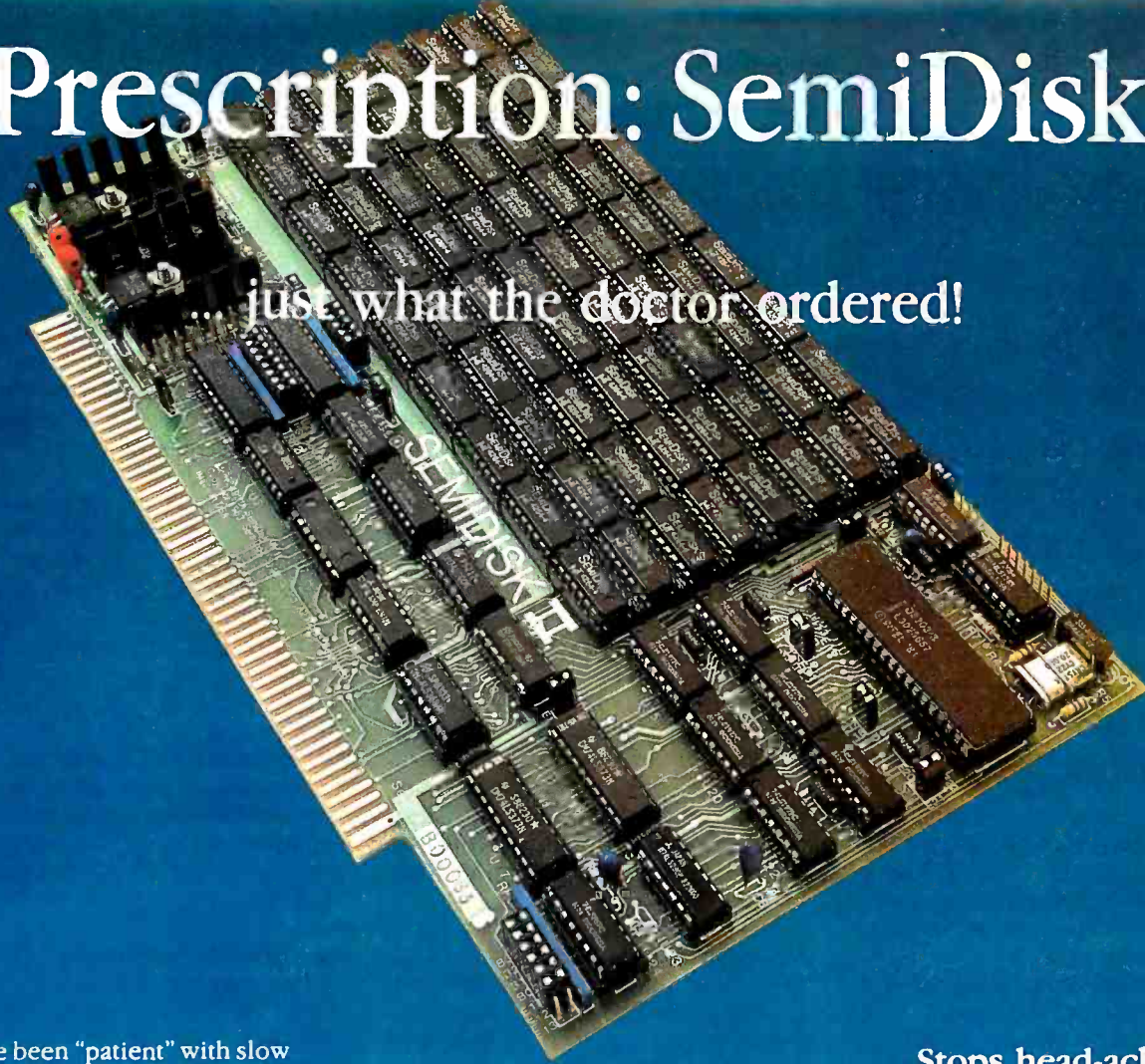
For all the enthusiasm, the Macintosh is not really all that advanced. The Modula Computer Company offers an American version of Lillith with black-and-white graphics capabilities better than Macintosh; and it has Niklaus Wirth's Modula-2 operating system, complete with mouse, pull-down menus, scroll bars, and most of the other Macgoodies. At least two firms are developing new Modula-2-based bit-mapped screen systems; one, the Sage, will use the 68000 chip, have a megabyte of memory plus two disk drives, and sell for about twice what Apple wants for the Macintosh.

Apple has decided to maximize profit rather than market share. That may

(continued)

Prescription: SemiDisk.™

...just what the doctor ordered!



If you've been "patient" with slow disk drives for too long, SemiDisk will relieve your suffering.

Fast-acting.

The SemiDisk, a super-fast disk emulator, stores and retrieves data much faster than either a floppy or hard disk. This is especially useful with programs such as editors, assemblers, compilers, spelling checkers, and large capacity data base managers.

Easy to apply.

Installation is as easy as plugging the SemiDisk into an empty slot of your computer, booting up normally, and running the installation software provided. No assembly language programming is required.

Comes in regular and extra-strength.

SemiDisk I is the standard model for S-100, for use with CP/M® 2.2. SemiDisk II is just as easy to use,

and offers extra speed and flexibility for custom S-100 applications. There are also SemiDisks for TRS-80 Model II, IBM PC, and Epson QX10.

Contains gentle buffers.

CP/M®80 installation software includes SemiSpool, which temporarily stores print data in the SemiDisk, and continuously feeds the printer as it becomes ready for data. This buffering action allows the computer to be ready for other uses immediately after issuing a print command, while the printer is printing.

No blackouts: A cure for emulator amnesia.

The optional Battery Backup Unit (BBU) plugs into the SemiDisk, and supplies power even when the computer is off. It contains a battery which keeps the data alive during prolonged power outages of four hours or more.

Stops head-aches.

Unlike a hard disk, which can 'crash' its head on the rapidly rotating disk surface, and a floppy, which grinds the disk constantly, the SemiDisk has no moving parts to break or wear out. No buzzing, clicking, grinding, or other noise. Just ultra-fast, silent data transfer.

Won't bruise your wallet.

And now the really good news! SemiDisk's price won't raise your blood pressure.

	512K	1Mbyte
SemiDisk I, S-100	\$995	\$1795
SemiDisk II, S-100	\$1245	\$2095
SemiDisk, TRS-80 II	\$995	\$1795
SemiDisk, IBM PC	\$945	\$1795
SemiDisk, Epson QX10	\$995	

SEMIDISK

SemiDisk Systems, Inc.
P.O. Box GG, Beaverton, Oregon 97075
503-642-3100

I have strong opinions about machines and editor programs, but in reality, any text editor is much better than typewriter and paper.

not be a wise decision during this critical period. Part of the excitement of the Mac was that it truly was "the computer for the rest of us": which implied that "the rest of us" could afford it. Alas, that didn't happen. At \$2500 plus tax for the basic machine, Macintosh is no bargain; and when you've bought it, you're not done.

The Mac needs an external disk—hard or a second microfloppy—and more memory. It needs, but can survive without, a better keyboard. You'll spend at least \$750 for a second drive and memory update, and if Apple prices these items the way the Mac itself was priced, you'll spend twice that. Moreover, not all these items are available; and some hardware improvements will be developed only if a lot of Macs are sold.

No machine is useful without software. Apple has chosen to make "software developer" status a lot harder to get than was implied in presentations at the West Coast Computer Faire and other hobbyist/hacker meetings. To be eligible for the "developer" discount and support, you must already be in the software business—which means automatic exclusion of the innovative hobbyists who weren't interested in more traditional machines but were turned on by the Mac.

Then, too, the machine has a closed architecture, and the Macdocuments are incomplete. You can buy, for \$150, *Inside Mac*, a pile of xeroxed loose-leaf fact sheets (including interpretation of the error codes), but even these aren't complete. At present there is no assembler, and when the assembler becomes available, you will need two Macs in order to run it with the debugger. All in all, Apple has told the hobbyists to

drop dead. This may not be wise. TI tried it. Long live the TI-99.

SO WHAT SHOULD WE DO?

If the software does come flooding forth—after all, there are all these announcements, and there must be some substance behind them—then Macsales may soar. Hardware developers will come up with fixes for the major problems. This will generate even more sales and more software.

As that base market expands, other developers will get into the field. Last fall at COMDEX we saw nothing but IBM PC clones; if the Mac proves popular, we'll see Mac-compatible machines everywhere; and since there's a considerable profit margin in the Macintosh price, competitors will be able to offer more features for the same money or, more likely, much the same features for a lot less.

So, at the moment there's no compelling reason to get a Macintosh. If you're in the mood to enthrall a recalcitrant spouse or child who now hates computers, perhaps it's worth the price; but you can get a lot more utility for what the Macintosh costs.

Things may be different later, but by then the clones will be appearing. Alexander Pope said, "Be not the first by whom the new are tried. Nor yet the last to lay the old aside." It's still good advice. Pournelle's Rule is: "If you're in the mainstream, the best business system is last year's state-of-the-art development system." Whether or not Macintosh is in the mainstream, it's still a development system. I'd wait.

WRITING MACHINES

Half the people I meet want to know about the Mac. The other half are eager to learn about writing machines. "What," they ask, "do you recommend for a professional writer?"

The easiest answer is "That depends," but I have a better one. "Almost anything."

Assuming that a writer is making a living, any decent computer system will raise productivity enough to pay for itself. Obviously, I have strong opinions about machines and editor programs; but in reality, any text editor is much better than typewriter and paper.

There are three major considerations for a professional. First, do you like the

keyboard and screen presentation? If you don't, you will probably get used to it; but you are going to be sitting there a long time, and it's worth extra bucks to get something aesthetically appealing. Borrow the money if need be, but get a machine with a good "feel" to the keyboard and well-shaped characters on the screen. Make sure the physical layout is suitable. I wear bifocal spectacles and thus dislike the usual screen, which sits too close so that I have to tilt my head back in order to read the display. My screen has big letters, sits far away, and is at natural eye level. I'd pay a lot to keep that setup.

The second principle is Pournelle's Law: "If you don't know what you're doing, deal with people who do." Buy your system from someone local, preferably a dealer who's been in business awhile; someone you can get at with a baseball bat if need be. If you're not buying brand-name equipment, be sure your dealer is familiar with the manufacturer and has reason to trust it.

Third, be sure your system can run WordStar.

I suppose that sounds like heresy. Not really, though. I'm not recommending that you write your books with WordStar; just that you be sure your new system will run it. There are several reasons for this. First, you may someday have to collaborate with another writer; and while it's unlikely that you'll both use the same text editor, it's very likely that you'll both know how to use WordStar.

Then, too, there are all those WordStar utilities. As an example, we're doing final editing of the first book in the Pournelle's Users Guide series. (Baen Books, and watch for it: the cover by Robert Tinney is worth the price of the book.) After all the tirades I've launched against books without an index, I've no choice but to make one for mine. That's no mean task, so we've turned to the computers to aid us. By judicious use of the utilities furnished with Oasis Systems' The Word Plus, plus SuperDex, the indexing program distributed by Spite Software, we've made great progress—but SuperDex wants the book in WordStar format.

That's no great problem. WRITE now comes with FILTER.COM, a program that will take a number of WRITE files

(continued)

WIN HIGH



Before you work anywhere, take a look at the tools we work with.

NASA's space shuttle. For Air Force officers working as electrical or aerospace engineers, the challenge is just beginning. In fact, from laboratories to lasers to launch pads, we have exciting projects and management opportunities very few employers can offer.

For example, we are developing experiments that will be an important part of the space shuttle's cargo in the years to come. Experienced Air Force engineers will work as shuttle mission planners and as astronaut flight controllers.

If you have an electrical or aerospace engineering degree, or soon will have, we may have a challenging future for you as an Air Force officer. It's a future that demands the vision and commitment of people like you. And it's vital to our country.

For more information about Air Force engineering opportunities, mail the card. Or call toll-free 1-800-423-USAF (in California 1-800-232-USAF). Better yet, send your resume to HRS/RSAANE, Randolph AFB, TX 78150. There's no obligation.

AIR FORCE

A great place for engineers.

and concatenate them into one enormous WordStar file; or, of course, take a WordStar file and convert it into a series of linked WRITE files. FILTER is blindingly fast, too; so fast that for long WordStar files it's quicker to use FILTER to convert to WRITE, let WRITE reformat the file, and then reconvert back to WordStar, rather than use the WordStar

global reformat command. We do have to use WordStar to generate the paper copy that the index refers to, though. Hence, the necessity for a system that runs WordStar.

There are many other word-mashing utilities, such as Footnote, and nearly all of them want to work on WordStar text files.

THE REAL QUESTION

A lot of those who ask my advice don't state their real question, "What's the cheapest computer you recommend?" Fortunately, there's a simple answer to that one.

For those without much money, there's no real choice. Unless you're willing to steal your software—a practice I don't recommend—you need a Kaypro, which has become both the VW and Chevrolet of the micro industry. Kaypro machines are rugged, reliable, and not very pretty. They come with plenty of software and will run more. Given my druthers, I'd scrape up the extra bucks for a Kaypro 4, but you can live with the 2; and when you've outgrown it, you can still sell it for half what you paid.

There are, I expect, a number of other low-cost reliable machines on the market. I can't know about everything. I do know the Kaypro line, and I have no difficulty recommending the machines.

Incidentally, a few months back I reported problems with the hard disk in the Kaypro 10. That turned out to be characteristic of some of the early machines: the software in ROM would falsely report disk errors when there were none. All those early ROMs have been replaced, and after its quick trip to the factory, our 10 has behaved flawlessly. My friend Norman Spinrad chose a Kaypro 10 as his writing engine, and he's quite happy with it.

Norman made his choice after playing around with most of the computers here at Chaos Manor. For a while, I thought he'd get an Otrona. The Otrona's built-in screen is too small for day-after-day writing, but its amber screen is excellent. You could do a lot worse than get an Otrona Attache, external amber screen, and external hard disk. The big screen and hard disk form part of a permanent base, and the Attache can be carried on trips. Incidentally, WordStar comes with both Kaypro and Otrona machines; and WRITE, my favorite text editor, is available for both.

REAL PORTABLE

It started with Pamela Clark. I noticed that wherever she went she carried her TRS-80 Model 100 lap-size portable. Then Phil Lemmons showed up with the NEC version. Both raved about how

(continued)

Microshop

COMPUTER PRODUCTS

Low Prices ★ Low Prices ★ Low Prices ★ Low Prices

MONITORS

Amdek 300	\$139.00
Amdek 300A	\$159.00
Amdek 310A	\$179.00
Amdek Color I	Best Price
Amdek Color II	Best Price
PGS - HX - 12	Best Price
PGS - MAX - 12	Best Price
PGS - SR - 12	Best Price

PRINTERS

Epson FX 80	\$499.00
Epson FX 100	\$699.00
Okidata 92 A	\$465.00
Okidata 93 A	\$765.00
Okidata ML 84	\$950.00
Okidata 2410	Best Price
Toshiba P1351 & 1340	Best Price
NEC Spinwriters 3550	\$1850.00
NEC Spinwriters 7730	\$1999.00
C-Itch Starwriter 40CPS	Best Price
C-Itch Printmaster 55CPS	Best Price
Also available DX-15, HR-25, HR-35 & Starmicronics	

DRIVES

Tandon TM 100-2	\$215.00
Slimline Drives - Your Choice - Toshiba, Hitachi, Panasonic	\$189.00

IBM PC INDIVIDUALLY CONFIGURED CALL FOR LOW PRICES

MULTIFUNCTION BOARDS

AST I/O +Ser & Par	\$179.00
AST Six Pack 64K	\$269.00
AST Mega Plus 64K	\$269.00
AST Combo 64K	\$269.00
Quadboard 64K	\$269.00
Hercules Graphic	\$359.00
Plantronics	Best Price
Paradise Multifunction Card	Best Price
Orchid - Blossom	Best Price
64K Ram Upgrade Kit	\$50.00

MODEMS

Hayes Smart Modem 1200	Best Price
Hayes Smart Modem 200	Best Price
Hayes 1200B Plug in Modem Card	Best Price

HARD DISK FOR IBM PC

10 MB Hard Disk Sub System includes Software, Controller Cables, etc.	
Internal	\$999.00
External	\$1099.00

Many other products available, Please call for low - low prices!

Microshop

2640 Walnut Ave., Unit K, Tustin, CA 92680
 (714) 838-7530, 838-7531, 838-7532
 (714) 838-9503, 838-9504

Prices & availability subject to change without notice
 IBM PC is a registered trademark of IBM Corp.

HIGH TECHNOLOGY AT AFFORDABLE PRICES

Dot Matrix Printers

C. Itoh Prowriter (8510).....	\$ 369.88
C. Itoh Prowriter-2, (136 col).....	589.88
C. Itoh Prowriter BPI.....	439.88
C. Itoh HotDot.....	509.88
C. Itoh HotDot-2 (136 col).....	729.88
DMX-80 (Panasonic).....	269.88
Epson RX/FX/LQ Series.....	CALL
Inforunner Riteman.....	309.88
Mannesmann Tally 180-L.....	879.88
Mannesmann Tally Spirit-80.....	329.88
Okidata Microline 82A/83A.....	CALL
Okidata Microline 84 Step II.....	CALL
MacIntosh Microline 92.....	CALL
Okidata Microline 92.....	469.88
Okidata Microline 93.....	699.88
92/93/84 Plug-n-Play ROMs for graphic compatibility with IBM-PC.....	CALL
Star Micronics Gemini 10X.....	299.88
Star Micronics Gemini 15X.....	429.88
Star Micronics Delta 10.....	439.88
Star Micronics Delta 15.....	589.88
Star Micronics Radix 10/15.....	CALL
Toshiba P-1351.....	1689.88
Toshiba P-1340.....	CALL

Letter-Quality Printers

C. Itoh A-10 Starwriter (18 cps).....	\$ 549.88
C. Itoh F-10 Starwriter (40 cps).....	1079.88
C. Itoh F-10 Printmaster (55 cps).....	1379.88
NEC 2010/2030 (18 cps).....	749.88
NEC 2050 for IBM-PC (18 cps).....	899.88
NEC 3530 (33 cps).....	1429.88
NEC 3550 for IBM-PC (33 cps).....	1779.88
NEC 7710/7730 (50 cps).....	1939.88
Qume Series Printers.....	CALL
Silver Reed EXP-770 (25 cps).....	979.88
Silver Reed EXP-550 (17 cps).....	559.88
Silver Reed EXP-500 (12 cps).....	439.88
Smith Corona Memory Correct III Messenger (12 cps) w/interface module.....	589.88
Star Micronics PowerType (18 cps).....	CALL

Modems

Hayes Micromodem IIe.....	\$ 259.88
Hayes Smartmodem 300.....	239.88
Hayes Smartmodem 1200.....	559.88
Hayes 1200B (IBM-PC).....	479.88
Novation AppleCat 300 baud.....	229.88
Novation AppleCat 1200 baud.....	419.88
Novation SmartCat 103, 300bd.....	169.88
Novation SmartCat 212, 1200bd.....	409.88
Novation Access 1-2-3 (IBM-PC).....	409.88
USR Password, 1200 baud.....	369.88
USR Password, 300 baud.....	159.88
USR Telpac Software (IBM).....	79.88

Monitors

Amdek 300G (green).....	\$ 144.88
Amdek 300A (amber).....	159.88
Amdek 310A (TTL, amber).....	179.88
Amdek Color-1+.....	319.88
Amdek Color-2+ (12" RGB).....	459.88
NEC JB-1205M (amber).....	159.88
NEC JB-1201M (green).....	159.88
Princeton Graphics HX-12.....	509.88
Princeton Graphics Max-12.....	199.88
Quadram QuadChrome.....	529.88
Roland DG-121 (green/amber).....	149.88
Roland DG-122 (green/amber).....	179.88

IBM-PC Peripherals

64K Memory (4164/200ns) 9/pkg.....	\$ 79.88
AST SixPak Plus (64K).....	299.88
Hercules Graphics Card.....	379.88
Keytronics 5151.....	219.88
Microsoft Mouse (parallel).....	149.88
Mouse Systems PC-Mouse.....	219.88
Paradise MultiDisplay.....	479.88
NEW! Quadram 384K Quadboard.....	CALL
Quadram Quad 512 + (64K).....	239.88
Quadram QuadColor-1.....	219.88
Quadram QuadColor-2.....	229.88
Quadram Parallel Card, RS-232C Card or Clock/Calendar Card.....	79.88

STB Graphics Plus II.....	379.88
STB Super RIO Plus (64K).....	319.88
Tandon TM 100-2 (DSD).....	229.88
1 Titan Cygnus I/O (parallel).....	149.88
Titan Cygnus I/O (RS-232).....	169.88
TG Joystick.....	59.88

Apple II Peripherals

ALS CP/M Plus Card (CP/M 3.0).....	\$ 329.88
AMT MicroDrive (half height).....	219.88
Rana Elite-1 Disk Drive.....	259.88
TBL Cooling Fan.....	59.88
TBL Disk Drive Controller.....	69.88
Titan Accelerator II.....	469.88
Titan Memory Boards.....	CALL
Videx VideoTerm.....	239.88
Videx UltraTerm (80/160 column).....	289.88
Videx Enhancer II.....	109.88
IIc Microline 92.....	CALL
IIc Printer Cables.....	CALL

MacIntosh Peripherals

MacIntosh Microline 92.....	CALL
Kensington MacIntosh Starter Pak (swivel stand/surge protector/dust cover).....	69.88
Kensington MacIntosh Modem.....	CALL
MacIntosh Software.....	CALL

Accessories

EPD Lemon/Lime/Orange/Peach.....	CALL
Flip-n-File Diskette Box.....	CALL
Grappler+ Printer Card & cable.....	109.88
Kensington MicroSaver (4-plug).....	59.88
Monitor Stand (tilt/swivel).....	39.88
Pkasso-U Printer Card & cable.....	129.88
Printer Cables.....	29.88
Quadram Microfazer Print Buffers.....	CALL
Trace 80 col Sound Trap.....	129.88
Trace 132 col Sound Trap.....	189.88
80 Column Printer Stand.....	39.88
132 Column Printer Stand.....	49.88

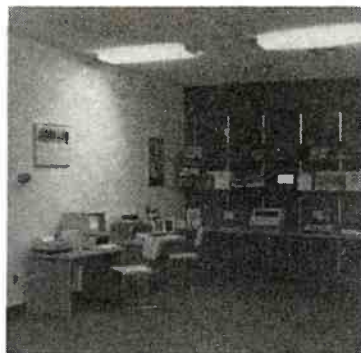
ADVANCED LOGIC SYSTEMS • ALLOY • AMDEK • ANADIX • AST • CCS • CARDCO • C ITOH • COMREX • COLUMBIA DATA PRODUCTS
 CURTIS MANUFACTURING • DATA PRODUCTS (IDS) • DIABLO • DTC • EAGLE COMPUTER • EASIFEED • EPD • EPSON • FRANKLIN COMPUTER
 HAYES MICROCOMPUTER PRODUCTS • HERCULES COMPUTER TECHNOLOGY • INFORUNNER • INTERACTIVE STRUCTURES • JMM
 JUKI • KENSINGTON MICROWARE • LEADING EDGE • LQ • MANNESMAN TALLY • MA SYSTEMS • MICROSOFT • MILFORD NULL MODEM
 MOUSE SYSTEMS • NOVATION • NEC • OKIDATA • ORANGE MICRO • PARADISE SYSTEMS • PERFECT DATA • PRINCETON GRAPHICS
 QUADRAM • QUME • QCS • RANA SYSTEMS • ROLAND DG • SILVER REED • SMITH-CORONA • STAR MICRONICS • TANDON • TECMAR
 TITAN • TOSHIBA • USI • US ROBOTICS • VIDEX

The right place for the right price

If you live in the New England area (or plan to visit there), you should drop by our **Discount Computer Store**. We're about one hour's drive from Boston, the ocean or the White Mountains. From Boston, just go up Route 3 to Nashua, NH, and take Exit 7W (Route 101A). We're 5.1 miles from that exit, in Amherst NH. Take the next right after you see the Dexter Shoe factory outlet store.

In fact, we're near a lot of New Hampshire's factory outlet stores, and with no sales tax you can save a bundle on computer equipment, shoes and whatever else strikes your fancy. We have several systems on display, as well as printers, modems and monitors, all at the same prices you see in our ads. And if you can't fit a purchase into your car, don't worry...we'll ship it free anywhere in the 48 contiguous states.

No matter where you live—Boston or San Francisco—You don't have to strike out into the wilderness to save money. Take a short drive or drop us a line for the best advice and the best price on peripherals today.



TECHNICAL SALES DESK

(603) 881-9855

TOLL-FREE ORDER DESK

(800) 343-0726

Hours: 9:00 to 5:30 EST, Mon-Fri

- FREE UPS ground shipping on all orders over \$50 (under \$50 add \$2.50 handling)
- Shipments fully insured at no extra charge
- MasterCard, VISA, American Express, Diners Club & Carte Blanche credit cards accepted
- No surcharges on credit card
- Credit cards are not charged until your order is shipped from our warehouse
- CODs accepted up to \$1000 (add \$10 for COD handling). Payable with certified check, money order or cash.
- Full manufacturer's warranty on all products sold
- 1-year extended warranty service is now available for many products (just ask us)
- Sorry, no APO/FPO or foreign orders

HIGH TECHNOLOGY AT AFFORDABLE PRICES

THE BOTTOM LINE

MILFORD, NH 03055-0423 □ TELEPHONE (603) 881-9855



much time these things saved: you could work anywhere, even on an airplane.

At the BYTE Show, the Great Salt Lake Computer Company had a blowout sale on NEC PC-8201A lap-size portables, and I couldn't resist. Before I knew it, I'd plunked my plastic down and carried off the machine, which I immediately dubbed Percy.

It's wonderful. On the way home from Chicago, I managed to write half of my *Popular Computing* column and part of this one. Oh, sure, Percy's built-in text editor is a bit limited, but by gollies it's good enough for text entry. I wrote about 4000 words on that airplane.

Getting the text out was the simplest thing in the world. Percy's documents are very complete. In particular, they explain how to set the data rate, data bits, and stop bits for his built-in RS-232C port. The Golem, my CompuPro-8/16 boat-anchor system, boasts a program

called BAUDCOM that does the same thing for his RS-232C serial port. All I had to do was connect the two ports with a cable, set the system to 9600 bps, and let fly. The PIP utility on the Golem worked perfectly as the collector; I simply went

PIP M:MYTEXT.TXT=TTY:

and then followed instructions on how to send a file from the NEC PC-8201A. The only tricky part was to send, from Percy's keyboard, a Control-Z character when he indicated that he was done sending the file. That immediately signaled "end of file" to the Golem, and he closed the file. Mission accomplished.

The only real trouble with Percy is that he won't hold more than 7000 words of text before his memory is full. One solution to that is the NEC cassette recorder you can buy with the PC-8201A. This rides in checked luggage, to be dragged out in your hotel room. The problem

with that is that cassette transfer is slow. I don't really trust cassettes anyway, and there's no way to edit the text you've produced. I thought about that for a while.

Then I did some experimenting: I tried sending text from Percy to Adeline the Otrona Attache. That worked. I also made a discovery: Percy fits nicely alongside Adeline in her ballistic nylon carrying case. This means I can stuff the NEC portable into the Otrona's bag until I'm on the plane; then retrieve the portable for in-flight use while the Attache rests in the overhead rack. When I get to my hotel, I'll transfer the newly written text from Percy to Adeline, where I can edit away with WRITE.

One note of caution: it's well known in the trade that the Japanese are about to introduce a new generation of lap-size portables. I have enough upcoming trips to justify buying Percy—especially at sale price—just for use in the next six weeks, by which time I'll have got my money's worth. Others with fewer trips and deadlines might want to wait a bit to see what's coming.

BOTCHI?

I get pretty involved at the West Coast Computer Faire. Sometimes that's regrettable. For example, while I was distracted with something else, there was put into my hands the damndest document I ever did see. It's called a Data Passport. It was accompanied by a flyer proclaiming, "We Speak Botchi."

All this comes from an outfit called Data Conversion Inc. The company claims to have the smartest data-transformation droids in the universe. For example, the flyer reads, "We're not your average bunch of yahoos. There is no data conversion problem we can't handle. Called MASTER DATASMITHS, our droids have a certain arrogant pride."

What Data Conversion Inc. claims is the ability to transform and convert data from any media format to any other, and to do it "faster, less expensively, and more reliably than anyone else on the planet. Maybe even the Galaxy." Eight-inch, 5¼, 3½. it makes no difference: these chaps can convert it.

They also have the oddest contract I've ever seen. For example, if the conversion attempt fails, they will either refund your money or keep trying "until

(continued)

IF POWER FAILS, DATASAVER® TAKES OVER!

PROTECTION - saves data during power failures.
- saves hardware from overvoltage transients.

PORTABILITY - allows mobile or extended holdup time using auxiliary 12 volt battery.

FEATURES - internal battery provides 5 min. + operating time - AC line conditioning
- audible and visual alarms, interrupt signal - compact, desktop styling
- no installation required.

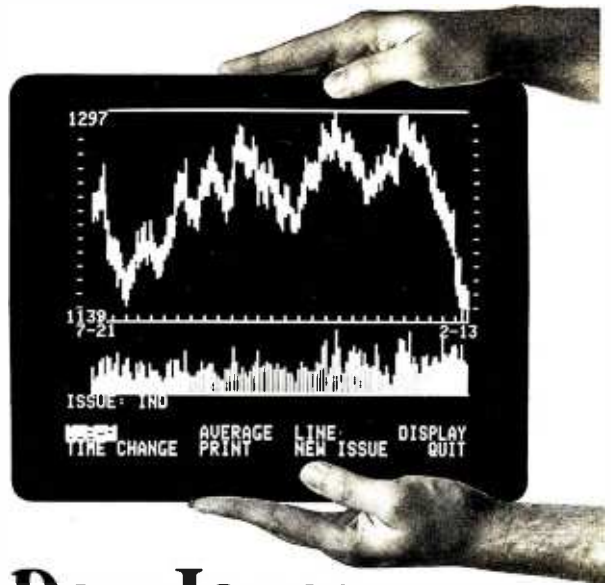
200 WATT - \$495 / 90 WATT - \$350
For special applications and product information, call 805-541-4160.

Instant power order line
805-541-4161

CUESTA SYSTEMS, INC.
3440 Roberto Court, San Luis Obispo, California 93401

INSTANT AC POWER

2 Reasons Investors Are Getting "Street" Smart.



Dow Jones Investor's Workshop™

If you venture on Wall Street, you have to know the territory. Now a new software product from Dow Jones improves your "Street" smarts.

The Dow Jones Investor's Workshop™, developed especially for the Apple IIc, brings you:

- The latest stock quotes (delayed a minimum of 15 min.) and business news from Dow Jones News/Retrieval®, the leading online information service.
- Reports that show you exactly what your portfolio is doing, at the touch of a few keys.
- Charts* that give you a clear picture of your stocks' performance, helping you know when to buy and when to sell.

Also Runs on the IIe and II Plus

The Dow Jones Investor's Workshop runs on the Apple® IIe and II Plus, as well as the IIc. It's so easy to use, you'll be creating charts and reports moments after you're up and running. With a suggested retail price of \$149 and full support from our toll-free Customer Service hotline, the Investor's Workshop is a value any investor can appreciate.

Now you can be "Street" smart.

**Dow Jones
Software™**



The Apple® IIc

For more information call **1-800-345-8500 ext. 240** (Alaska, Hawaii and foreign call 1-215-789-7008 ext. 240) or...

send this coupon to: Ms. Lynn Filippone, Dow Jones & Co., Inc., P.O. Box 300, Princeton, N.J. 08540.

Name _____

Address _____

City _____ State _____ Zip _____

Phone Number(s) _____

*The chart in this ad (and, incidently, in most Apple ads for the IIc) is a Price and Volume bar chart that shows the performance of the Dow Jones Average over a six-month period. You can also construct Moving Averages and Trend Lines.

Dow Jones News/Retrieval is a registered trademark of Dow Jones & Co., Inc. Dow Jones Investor's Workshop is a trademark of Dow Jones & Co., Inc.

Apple and the Apple logo are registered trademarks of Apple Computer, Inc.

Copyright © 1984 Dow Jones & Company, Inc. All Rights Reserved.

the stinking droids get it right." In another section, they proclaim that "if any part of this contract is held to be brain damaged, the remaining terms remain in force." They say they're willing to collect their fees in Planet Earth U.S. Dollars, monopolies, or antigravity belts. I haven't the foggiest notion of whether they can actually convert data

or not; all I have to go on is the flyer and Data Passport. I find the documents impressive: professional writing, layout, and printing. Despite the humor, the contract is clear, precise, and fair. Since the arrival at Chaos Manor of New Generation Systems' Disk Maker I've had no sticky data-conversion problems, so I've no longer a need for the

Master Datasmiths' services; but if I did, I wouldn't hesitate to let them take a whack at it. Incidentally, they advertise that the first disk conversion is free.

MILLIONAIRE AND OTHER VICES

The word is that so many hackers at the Benton Harbor facility of Heath Company were playing Millionaire that the supervisors had to put severe restrictions on when the game could be played. I believe it. Millionaire is addictive.

Millionaire is a stock-market simulation, and it's worth playing just to learn about margins and options; indeed, I suspect that students would learn about as much from playing Millionaire and Blue Chip Software's companion games Tycoon (commodity-market simulation) and Baron (real-estate investment) as they ever learn from Econ 101. (For my sins, I was once required to teach Econ 101, so I have some right to that opinion.)

In any event, Millionaire is easy to learn and fun to the point of addiction. Try it. You'll like it.

PETER FLYNN'S NOTES

There's no way to bring order to Chaos Manor. That doesn't stop Peter Flynn, our new editorial assistant, from trying. Peter's job is undefinable: basically, he gets paid to be interrupted. One of his primary missions, though, is to make notes for my upcoming columns. From time to time I'll include some of them.

THE SWEET-P STORY

Peter's notes begin: "A couple of months ago I brought out the Sweet-P Plotter for reviewing. Ignoring the directions, I proceeded to test out the unit with the AUTOCAD software. Everything seemed to work fine. After carefully examining several drawings, I noticed stray lines between points that should not have been connected. When I took apart the printer the problem was obvious. The solenoid spring was not exerting enough force to properly return the pen to the upright position.

"I sent a letter to Enter Computer requesting a new spring. A couple of days later they called, and after listening to my description of the problem, asked me to send the plotter back for repair. Instead I put it away, since the BYTE

(continued)

Graphics with Gray Matter.



New GRAPHICS-PLUS GP-29. Big Features. Little Cost.

The GP-29 delivers the graphics and text versatility of powerful, expensive terminals at significant cost savings. And you can buy the GP-29 as a ready to use terminal or as a retrofit board for the Zenith Z29.

Expand your applications with dual plane graphics. Create images with "shades of gray." Overlay two separate images. Animate the images. Store multiple images in local memory.

The GP-29 gives you low cost graphics you never imagined possible. 1024 x 500 hi-res and 512 x 250 lo-res selectable resolution. 128k of display memory. And our dedicated graphics processor provides selective vector erase, area erase, area fill, area move, arc drawing, pan and zoom.

You also get Tektronix 4014 compatibility as well as DEC VT100 and VT220 compatibility.

Enhanced Text Too!

The GP-29 offers four selectable display formats: 80 and 132 columns with 24 or 49 lines. Off-screen scrolling memory. Storage for pages and pages of text. Off-line editing capability. Double high and double wide characters and much, much more.

Plus, you get operator convenience features like "plain English" set-up menu, easy to use programmable keys, local function keys, transparent mode and non-volatile memory. And a serial printer port is standard. Call or write today to place your order.

GP-29 retrofit for Zenith Z29 . . . \$ 995.
GP-29 complete terminal 1695.
Optional long-persistence CRT . . . 95.

**Northwest
Digital Systems**

P.O. Box 15288, Seattle, WA 98115
(206) 524-0014

GP-19 board for the Zenith Z19 terminal is also available for \$695.

deadline was coming up and I had other things to do.

"Two months later while organizing the attic storage I stumbled into the Sweet-P shipping box. My fascination with plotters convinced me to ship it out for service. After packing up the unit, I called Enter Computer for a return authorization number. Instead, I got Bill Winklepleck on the phone who walked me through an inspection and attempted repair. After opening the unit, he had me stretch the spring. However, the one we have is shot. No amount of stretching will rejuvenate it.

"While I was replacing the cover, it occurred to me that the Sweet-P is one elegantly designed piece of equipment. With help over the phone, almost any novice should be able to repair one.

There is not even any easy way one can electrocute oneself. Mr. Winklepleck is sending a new set of springs."

He did, too. Alas, one of the staff couldn't resist opening the box and managed to lose the spring, so we had to get another.

The Sweet-P is an excellent piece of machinery, easy to hook up and use; and it's no great trick to replace that bad spring, assuming that people around here will mind their own business long enough to let it be done . . .

R WAY

We're looking for a new database. Things have got into a mess, and we're hoping to get some inventory and file location control.

One product Peter examined was

R:Base, from Microrim of Bellevue, Washington. You've probably noticed the ads, which contrast "d way" with "R way" of doing things. Peter concludes: "Powerful but not worth the effort if all you need is simple file management. Good if it is to be used very often. The tutorial will not easily teach a complete novice. The structure of commands will take a lot of getting used to for someone not accustomed to large databases. If there is someone in an office who will undertake the work to learn this program, he/she will be well rewarded for the effort (provided that the office has use for relational information)."

My own examination of R:Base was pretty superficial, but I agree with Peter.

(continued)

ITEMS DISCUSSED

Applicard Not available
 Personal Computer Products Inc
 16776 Bernardo Center Dr.
 San Diego, CA 92128
 (619) 485-8411

Baron \$59.95
 Millionaire \$59.95
 Tycoon \$59.95
 Blue Chip Software
 6744 Eton Ave.
 Canoga Park, CA 91303
 (818) 346-0730

COBOL Syntax Checker \$7500
 UNIX System V for 68000 . . . \$43,000
 AT&T
 222 Broadway
 New York, NY 10038
 (800) 828-8649

Data-Conversion Service Contact
 Data Conversion Inc. for rates
 6310 Caballero Blvd.
 Buena Park, CA 90620
 (714) 522-7762

FILTER.COM
 (on disk with other filters) . . . \$32.50
 Workman and Associates
 112 Marion Ave.
 Pasadena, CA 91106
 (818) 796-4401

Gold Card Not available
 Digital Research
 POB 579
 Pacific Grove, CA 93950
 (408) 649-3896

Kaypro 2 \$1295
 Kaypro 4 \$1995
 Kaypro 10 \$2795
 Kaypro
 533 Stevens Ave.
 Solana Beach, CA 92075
 (619) 481-4318

Macintosh \$2495
 Apple Computer
 20525 Mariani Ave.
 Cupertino, CA 95014
 (408) 996-1010

NEC PC-8201A \$599
 NEC Home Electronics
 1401 Estes Ave.
 Elk Grove Village, IL 60007
 (312) 228-5900

Otrona Attache \$2995
 Otrona Corp.
 4755 Walnut St.
 Boulder, CO 80301
 (303) 940-3445

R:Base \$495
 Microrim Inc.
 1750 112th Ave. N.E.
 Bellevue, WA 98004
 (206) 641-6619

S-100 1-megabyte Board \$2449
 Z-100 High-Performance Memory \$2250
 Macrotech International Corp.
 9551 Irondale Ave.
 Chatsworth, CA 91311
 (818) 700-1501

SuperDex Document
 Indexing System \$59.95
 Spite Software
 13531 SE Foster Place
 Portland, OR 97236
 (503) 224-0137

Sweet-P Plotter \$695
 Enter Computer
 6867 Nancy Ridge Dr.
 San Diego, CA 92121
 (619) 450-0601

TRS-80 Model 100 \$799
 Radio Shack
 1800 One Tandy Center
 Fort Worth, TX 76102
 (817) 390-3011

Trump Card \$995
 Sweet Micro Systems Inc.
 50 Freeway Dr.
 Cranston, RI 02910
 (401) 461-0530

Turbo Pascal \$49.95
 Borland International
 4113 Scotts Valley Dr.
 Scotts Valley, CA 95066
 (408) 438-8400

WordStar \$495
 MicroPro International
 33 San Pablo Ave.
 San Rafael, CA 94903
 (415) 499-1200

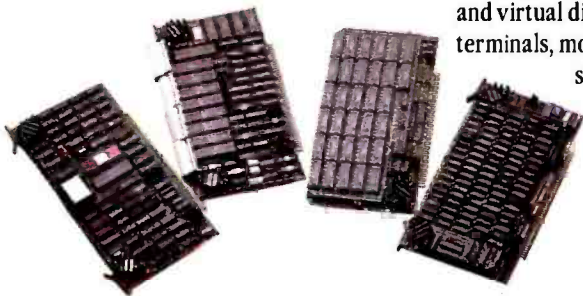
THE MI-286 DUAL CPU BOARD IS AT LEAST TWICE AS FAST AS COMPUPRO'S 8085/88... AND IT'S A DIRECT REPLACEMENT!

The 20-second revolution. It only takes about 20 seconds to bring your S-100 system up to its ultimate speed/power potential. Just pull out the old fashioned 8085/88 board and plug the MI-286 in its place. That's all there is to it. You're off and running with more power than ever before.

The 80286 and Z-80H. The MI-286 is the first dual-CPU board using the new, high speed Intel 80286 coupled with a Z-80H. It is designed for use with a variety of operating systems, including MP/M 8-16. It will support all your current 8086/88 and Z-80/8085 software. It can accommodate an optional 80287 math co-processor. In short, it gives you the best of both worlds.

Add more users. The MI-286. It improves throughput so dramatically you can add those extra users you've always wanted. It carries S-100 technology to its logical limit. And it only costs \$1395!*

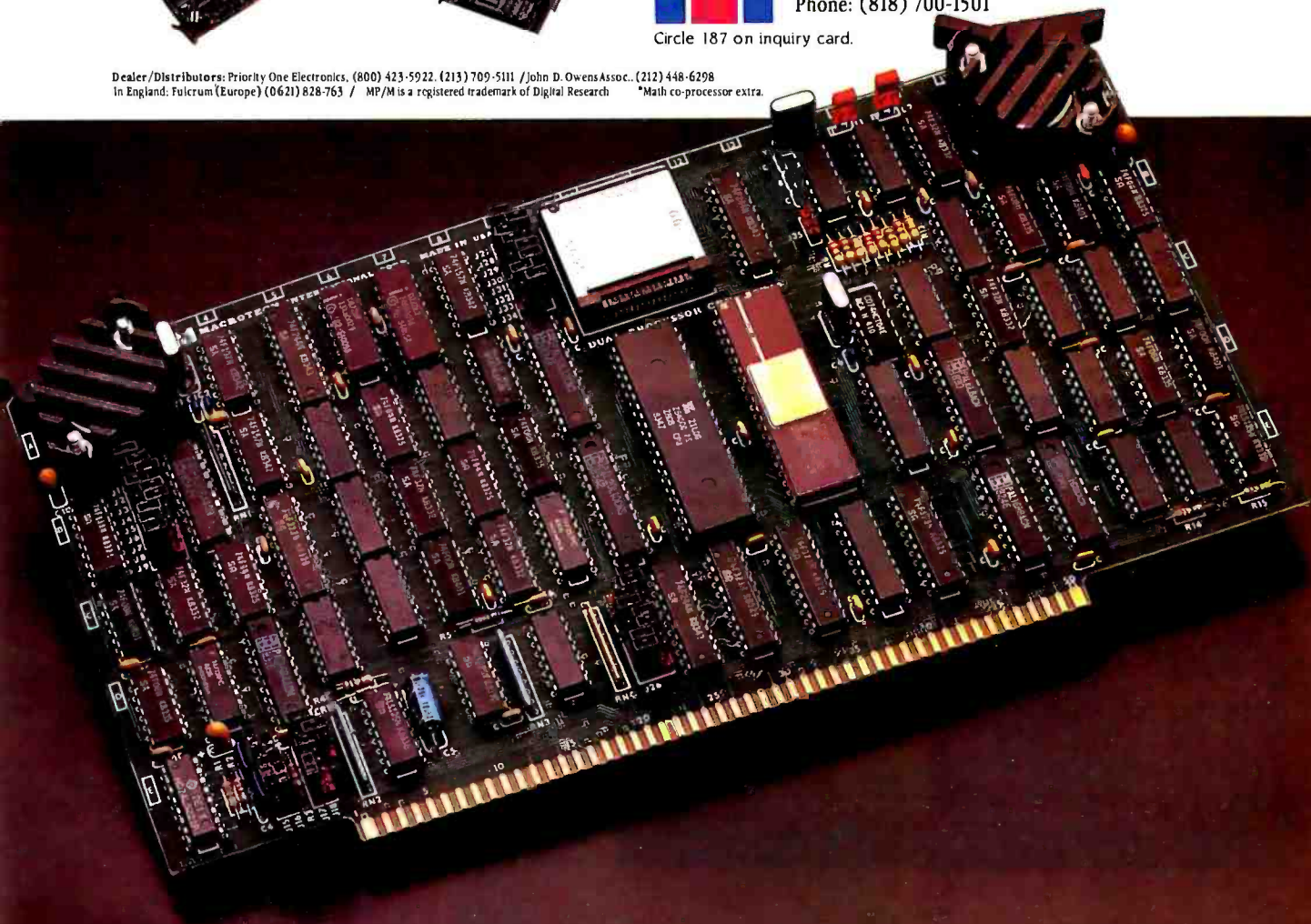
Upgrade your S-100. The MI-286 is only one of Macrotech's products designed to maximize the performance of your S-100 system. The MAX Dynamic Memory gives you up to 1 Mbyte of memory for your system memory and virtual disk applications. ADIT lets you control up to 16 different terminals, modems or printers from a single slot in your S-100 bus. And our static board is the S-100 world's first 1/2 Mbyte static memory. Call or write us today, and find out how easy it is to upgrade your S-100 system.



Macrotech International Corp.
9551 Irondale Avenue
Chatsworth, CA 91311
Phone: (818) 700-1501

Circle 187 on inquiry card.

Dealer/Distributors: Priority One Electronics, (800) 423-5922, (213) 709-5111 / John D. Owens Assoc., (212) 448-6298
In England: Fulcrum (Europe) (0621) 828-763 / MP/M is a registered trademark of Digital Research *Math co-processor extra.



PC vs JC



Most Choose PC,
but
Most Need JC.

PC, personal computer has become a commodity product. It is just like a personal car. It has limitations and problems. People expect PC to do more than it can do.

JC is a growing computer. The superb architecture can offer you painless expansion for your organization. If your computer must be able to grow as you grow, JC is your only choice.

JC computers have been available thru our world-wide dealer network since 1979. The installed base of computers is now reaching 10,000 units. Our latest addition features a **multi-user, multi-processor system**, based on our 80186 master/slave processor modules. It runs under TurboDos* 1.4 operating system with PC/DOS emulation.

JC users agree that our computers truly offer **expandability, low cost, and high performance.**

If you want to know more, contact us. Let one of our professional dealers help you. They will hold your hand until you get solutions, not problems.



JC SYSTEMS

HIGH PERFORMANCE COMPANY

JC INFORMATION SYSTEMS, INC.

469 Valley Way
Milpitas, CA 95035
(408) 945-0318
TWX 910-381-7041

*TurboDos is a trademark of Software 2000, Inc.

*PC/DOS is a trademark of IBM Corporation.

When I get *Footfall* finished, I'm going to do a systematic comparison of database programs; that will probably include some of the integrated packages that combine word processor, database management, and spreadsheet calculator into one monster program. Until then, I suppose we'll just have to limp along.

MAYBE WE SHOULDN'T WORRY

I remain impressed as all get-out with AT&T's hardware, especially the desktop 3B2 (see last month's column). I'm not so impressed with the rest of what the company's doing.

Today I received two AT&T press releases. The first announces a COBOL Syntax Checker. This thing will run on the UNIX System V (AT&T's standard "commercial" UNIX). Its mission is to "reduce the chances of a program being rejected due to syntax and simple semantic errors. As a result, expensive mainframe central processing unit (CPU) time is reduced."

"The product, available in source code under license agreement with AT&T, is priced at \$7500 for the first CPU and \$3750 for each additional CPU."

More on that in a moment. The second press release announces UNIX System V for the Motorola 68000 microprocessor chip. Under a series of agreements with Motorola (68000), National Semiconductor (16032 and 32032), Intel (iAPX186), and Zilog (Z80000), each firm is supposed to port UNIX System V to its own chip. Motorola was the first to finish.

The press release then quotes AT&T software systems vice-president Tom

Crowley: "The microcomputer market has been eagerly awaiting the results of last year's announcement [of the agreements]. The wait is now over. With this product, the power and versatility of UNIX System V will now be available for a wide range of microcomputers employing the MC68000."

Then comes the kicker. "The product, available in source code under license agreement with AT&T, is targeted to the growing number of resellers who are building hardware and software products around UNIX System V. Priced at \$43,000 for the initial CPU and \$16,000 for each additional CPU . . ."

That's source code, though. I called the follow-up number on the press release: after four hours, I still wasn't able to get a consistent story on the license fees computer manufacturers would pay for UNIX object code. It turns out to depend on the number of end users and can go as high as \$3500-\$7000 per machine sold.

Foo.

The mountain has labored, and didn't even produce a mouse. This may fly in the microcomputer market, although if it does, the microcomputer people aren't paying much attention to the micro world.

For that matter, who wants a COBOL Syntax Checker for \$7500? I wouldn't want one at any price, but I know darned well that I could write a pretty good COBOL Syntax Checker to run on a micro. I'd write it in Turbo Pascal or Modula-2, and it sure wouldn't cost \$7500.

Maybe Apple was right in going for profit rather than market share. With

bizarre prices like those, AT&T is no threat to anyone in the micro world. Can you imagine Concurrent CP/M selling for \$3500 a shot? Absurd. But I guess the minicomputer world puts up with it.

For instance, a couple of years ago I read about a database program for sale. The price was \$795 for the MS-DOS version; \$600 to \$2000 for the 68000 UNIX version; \$12,000 to \$48,000 for the DEC PDP-11 version; \$24,000 to \$48,000 for the VAX; and \$48,000 to \$96,000 for an IBM mainframe.

Given that I could buy a pretty good micro for \$5000, my question when I read that was, what could I get running this on an IBM mainframe that I couldn't have got from 20 micros? Or what does the DEC PDP-11 do for me that I can't do with a 68000? If I went the micro route, I'd have hardware and all for the price the mainframe or minicomputer EDP shop manager paid for the software alone.

The article didn't tell me the reasons for this odd price structure. I assume it's what the traffic will bear; I doubt the database-management system required 50 times as much work for the mainframe version as it did for the 68000 version. Yet, apparently, these prices are traditional among mini and mainframe users, and no one sees them as alarming.

I expect AT&T is in for a shock.

JUST LOTS OF MEMORY

A while back the Macrotech troops came over, and as I watched, they pulled all the memory boards out of the Golem and dropped in their 1-megabyte

(continued)

Only one microcomputer statistics package has all these features:

- Real relational database management
- Programmable report generation and data transformation.
- A full range of graphics, univariate, and multivariate statistics (including MANOVA and multidimensional scaling)
- As many digits of accuracy as any mainframe statistics package

Do any competitors come close? Write or call us for detailed brochures and published comparative reviews. SYSTAT — The System for Statistics

SYSTAT™

MS-DOS,™ PC-DOS,™ CP/M,™ UNIX™
603 MAIN STREET EVANSTON, IL 60202

(312) 864-5670

dynamic memory. After a couple of false starts—the Golem is, after all, running CP/M-8/16 enhanced by Tony's black-magic improvements, and the timing was a bit tricky—everything fired up and ran.

The Golem has a hard disk, 8-inch disks, a 5¼-inch disk, and a megabyte of RAM (random-access read/write memory) disk; if their board will drop into that and run, it should go with any CP/M system.

It's been running for a month now. No glitches, and it's a *lot* of memory. Macrotech is no longer the cheapest source of memory; AT&T will sell you memory at \$2200 a megabyte, somewhat less than Macrotech asks for the 1-megabyte board. On the other hand, AT&T makes memory only for AT&T machines, so the lower price won't do you much good; meaning that, as a practical matter, Macrotech provides the most bang for the buck.

We also have one of Macrotech's big

boards in Zorro, our Z-100. The company provides software to let you use some of that memory as RAM disk, something the Z-100 sorely needs. That's been running for over a month, too, with no problems. If you need memory and don't want to pay the price for static, Macrotech is no bad place to turn to. I've been talking to key people there for a couple of years now, and they've always been straight-arrow aboveboard. If they have problems with a product, they tell me.

I still have minor misgivings about dynamic memory, and now that I've given the Macrotech board a fair test, I'm going back to my CompuPro static-memory boards; but I admit that's probably pure prejudice. The Macrotech board will stay aboard Zorro, so we'll have more tests.

THE BEHINDER I GET

Every Monday the BYTE staff in Peterborough sends me a huge Federal Ex-

press box of my mail from the previous week. It's always full of good stuff, but lately there's been (along with about 10 pounds of mail) more software than ever. I note there's a trend toward integrated software, which combines a spreadsheet, editor, and database. We're trying to select a package.

Meanwhile, Shirley, the CompuPro four-user Model 10, is alive and well, although not much used until the architects and construction people get through building the new upstairs office suite; after that, Shirley will become the prime machine for John and Peter. I'll reserve one of the user ports for myself, simplifying communications and access to the downstairs troops.

We have the TI Professional PC, which has one of the nicest keyboards I know of and a lot of excellent features; and I'm told that the Zenith Z-150 IBM PC-compatible should arrive in the next day or so. I hope to do some hard comparisons of the two systems; they both have some excellent features, and I have every reason to think that, depending on your needs, one of these is the clone to buy if you want a PC-DOS system. The Zenith is somewhat more compatible with the IBM; the TI Professional has a bunch of interesting features, including voice recognition. A full report Real Soon Now.

There's still the Sage IV; I'm expecting some S-100 boards from Lomas; the software pile is growing; CompuPro has announced that Tony Pietsch's new S-100 IBM-compatible video board, with both color and high resolution, will be shown at the Atlanta COMDEX next week; I'm learning more about Percy; Alex has been happy with the U.S. Robotics 300/1200-bps modem we got at the Priority One blowout sale; and I love Thinktank, except for the stupid copy-protection scheme, which, incidentally, I've just learned to defeat.

I'm really trying to keep up. ■

Jerry Pournelle welcomes readers' comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE Publications, POB 372, Hancock, NH 03449. 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.

Printer sharing systems for multiple computers and printers.

Add MultiSpool—the hardware spooler that's truly flexible.

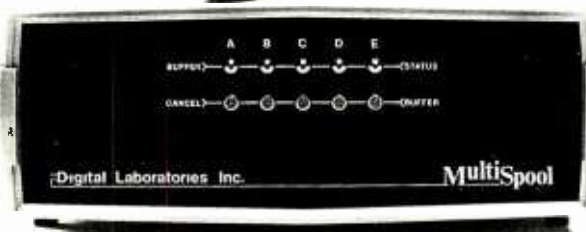
Now, thanks to MultiSpool, there's no more need to buy individual spoolers, no more wasted computer time or memory. With its enormous memory-sharing power, this dynamic six-port switching device not only lets you network any combination of computers and printers; it also provides the spooling function within that network.

With its 60K of buffer memory, controlled by 4K of memory management firmware, MultiSpool can orchestrate up to five computers or

five printers simultaneously. Only this degree of flexibility can meet the ever-changing port-expansion needs of today's multiuser environment.

Note, too, that MultiSpool mixes four serial and two Centronics-compatible ports. It also handles X-on, X-off protocols and DTR. So, with the unit's dipswitch, you can configure each port to accommodate either a computer or printer; and you can define the discipline of that port.

Best of all, MultiSpool sells for just \$995.00—even less if you don't need all six ports. And that, we're sure, is music to your ears.



Digital Laboratories Inc.

600 Pleasant Street, Watertown, MA 02172. (617) 924-1680



Model PC-200 DOS/BASIC 2.00 PC-DocuMate © 1983, SMA, All Rights Reserved

The \$14.95 Peripheral

That Puts Your Computer's Commands Where They Belong And Your Manuals On The Shelf.

Now, you can command new computer productivity. Discover how much easier your personal computer is to use when the commands are at your fingertips. PC-DocuMate™ keyboard templates can save you time and frustration. You can recall needed commands, options and formats. Quickly. Professionally designed and comprehensive. Each PC-DocuMate template has been designed by a software expert. Commands are logically and functionally organized so you can get the most from your software. And our templates are comprehensive reference aids which use both sides to document a product or a system. Completely.

Durable and guaranteed. PC-DocuMate templates are silk-screened onto durable, non-glare plastic to our exacting specifications. Each template is printed on both sides and color-coordinated to complement your PC. And your satisfaction is guaranteed. Fully. Or your money back. Save time and enjoy greater productivity. Order your PC-DocuMate without delay. Lower prices for better design. With PC-DocuMates, you get two-sided templates for less than a single-sided template from other manufacturers. And you get a better designed template. Order direct or ask your local dealer.

PC-DocuMates now available... IBM PC/XT & COMPAQ — \$14.95

- DOS/BASIC 2.0 & 2.1 • DOS/BASIC 1.1 • Lotus 1-2-3 • Symphony • dBASE II • dBASE III • Framework
- WordStar • MultiMate 3.20 • VisiCalc • Multiplan 1.00 or 1.06 • Volkswriter Deluxe • SuperCalc³ • PeachText 5000
- EasyWriter II • Turbo Pascal • WordPerfect • Do-It-Yourself

COMMODORE 64 — \$12.95

- BASIC & more • Calc Result • EasyScript • Quick Brown Fox • Do-It-Yourself
- (CBM 64 templates are printed on one side only)

IBM PCjr. — \$12.95

- DOS/BASIC 2.1 • MultiMate • dBASE II • Do-It-Yourself

APPLE IIe — \$14.95

- WordStar • VisiCalc • dBASE II • AppleWriter II • Quickfile • Do-It-Yourself

If your favorite software package is not shown here, you can order our "Do-It-Yourself" template (which includes a special pen and eraser) and develop your own custom keyboard template.

Our Guarantee. Use your template for 20 days. If you are not completely satisfied return it to us (undamaged) for a full refund.

HOW TO ORDER: Send personal check, money order or Master Card/VISA credit card information. Please add \$1.50 for shipping and handling per order; foreign orders must add \$5.00 per unit (except Canada). US funds only. Sorry, but no COD's. NC residents add 4% sales tax. Corporate quantity discounts available. Dealer inquiries invited. And for faster service on credit card orders...

Call Toll Free
1-800-762-7874

(In North Carolina) 919-787-7703



SYSTEMS MANAGEMENT ASSOCIATES
3700 Computer Drive, Dept. Y-2
Raleigh, North Carolina 27609

The following trademarks are acknowledged... IBM Corp., IBM PC/XT & PCjr., Ashton-Tate: dBASE II, dBASE III, Framework; Information Unlimited Software, Inc.: EasyWriter II; Lotus Development Corp.: Lotus 1-2-3, Symphony; SoftWord Systems, Inc.: MultiMate; Microsoft Corp.: Multiplan; PeachTree Software, Inc.: PeachText 5000; Sorcim Corp.: SuperCalc³; Liltree Software, Inc.: Volkswriter; MicroPro International Corp.: WordStar; QuikText, Quick Brown Fox; Handic Software, ab: Calc Result; Commodore Business Machines, Inc.: EasyScript; VisiCorp: VisiCalc; Apple Computer, Inc.: Apple IIe, AppleWriter II, Quickfile; Borland International, Inc.: Turbo Pascal; Satellite Software International, Inc.: WordPerfect.

SCIENTIFIC COMPUTING

Dear Jerry.

I suppose I shouldn't be as surprised as I am by your reply to Jay Pasachoff's letter in the April BYTE (page 404). I'm still waiting to see in your columns or anywhere in the microcomputer industry a serious appreciation for the computing needs of scientists and engineers. After all, we've paid our dues: computers weren't invented by programmers but by a bunch of guys who called themselves "radio engineers." Indeed, anyone who understands the needs of the scientific user would never state that FORTRAN is good only for "quick and dirty answers to specific problems" or that BASIC is just as good.

Among the many limitations of Pascal or Modula-2 for scientific work is the lack of a straightforward way to do complex arithmetic. Contrary to the view of most programmers, who often have a mathematical or engineering background and should know better, complex numbers are not an aberration but are at the core of engineering mathematics. It is ironic that microcomputers, whose performance depends so strongly upon complex arithmetic, can't do that same arithmetic in a convenient manner. Unless they have a full-feature FORTRAN compiler, that is, a commodity as scarce as oyster toenails.

I suggest that you try to write a general-purpose complex matrix-inversion subroutine in BASIC, Pascal, or Modula-2 or, better yet, evaluate a Hankel function of a complex variable. It will give you a new appreciation for FORTRAN.

STEVE MAAS
Torrance, CA

If, God forbid, I were ever to have to evaluate a Hankel function of a complex variable, I would probably turn first to APL.

Fortunately, I don't have such specialized problems. However, skilled programmers tell me there are ways to accomplish complex arithmetic in Pascal and more particularly in Modula-2. The library routines are not all that easy to write; but once written, they can be employed in a straightforward manner.

It's undoubtedly easier to write the programs you describe in FORTRAN. However, the structure (or lack thereof) makes FORTRAN programs hard to understand and harder to maintain; and the lack of type checking allows some pretty subtle bugs to creep in. If you know that the FORTRAN routine you've written does what you want and nothing else, fine; but I'm not sure how to know that.

It's a philosophical difference: but I'd rather

wear a straitjacket while programming and have the compiler catch my errors, than program in free form, have it compile fine, and then later discover the program isn't doing what I thought it would.—Jerry

A MOST FABULOUS OBJECT

Dear Jerry.

I enjoy your column . . . Umm . . . Each month I wait in eager anticipation with my knuckles hard and white. As the mail arrives each day . . . No, no, this is all wrong. How about, some times, as I'm thumbing through BYTE, trying to decide what I have time to read. I find myself reading your column. Yes, I think that's it—clear, honest, a little bit slang yet to the point.

In April (somewhere after December for people in lead time) you mentioned something that really caught my attention. I believe it may be at least a partial cure for my serious psychological problem. You see, I have this passion for . . . no . . . oh . . . please . . . here it comes again, that terrible madness . . .

I must have that Omnisphere! Give it to me!! You must, even now I can see you, fascinated, thoroughly enjoying its mystical glow. I must have it! Oh, umm . . .

Sorry, uh, I'm okay now, it just happens now and then. Oh, you don't need to worry, I'm not really dangerous or anything, but I might stay more calm if you were to give me the address of the Orb Corporation. I would like one of my own.

Please, keep up the good work (play if you like) and by all means enjoy the Omnisphere a bit for me. Oh, one more thing, the white zone is for booting and unbooting only, no . . . The red zone is for loading and . . . Oh, uh, well . . .

MICHAEL AICHLMAYR
Tacoma, WA

Actually, I don't blame you. It really is the most fabulous object in the entire universe . . . and does have a calming effect. I'll go touch mine for you.

The Omnisphere is available from The Orb Corporation, 125 Elm St., New Canaan, CT 06840, (203) 966-4392. It is not cheap. I also understand there may be a waiting list.—Jerry

WRITING TOOL

Dear Jerry.

For two years now I have been looking at computers and reading computer magazines. To familiarize myself with the basics, I bought an Atari 400 at the time they still cost more than \$250. I have learned programming in BASIC on the Atari, Apple, and the IBM PC. Still, I am

unable to make an intelligent decision about buying a computer.

I am a technical writer and editor of a technical trade journal. My needs, I thought, were simple. I wanted a creative tool that would allow me to get organized and help me with my work, which is substantially more than simple word processing. Is that too much to ask from a computer? Whenever I walk into a computer store, I am overwhelmed by the enthusiastic sales pitch extolling the virtues of letter-quality print, spreadsheets, and graphics programs spitting out bar and pie charts.

In the course of my work, I do normal algebraic calculations and make numerical lists and plot curves, eventually integrating them into my articles. Occasionally, I do surveys and come up with relatively simple statistical curves and trend analyses that also must be integrated into the articles. Finally, I have a moderate database requirement, keeping track of a few hundred companies. Based on my research and the current state of the art, it seems that I would need many different software programs and would not have a chance to integrate them. To the best of my knowledge, I would forever be swapping disks, trying to keep track of what is where in what form and on what file.

It should be worthwhile for somebody to come up with integrated software to do this kind of work. Besides writers, it would also apply to college students. That ought to be worth something. In any case, would you advise me if there is anything that comes close to my requirements? That is, of course, within my budget of \$3000-\$5000.

TAMAS FRECSKA
Cincinnati, OH

As the customer base grows (seemingly without bounds), there's getting to be a lot of software for the IBM PC and clones. I'd expect you to be able to find a package to meet the needs you describe. We're about to see a wide blossoming of integrated software. Realistically, the best will probably be generated for IBM PC systems and work-alikes.

Of course, that kind of computer power isn't free; to save you swapping disks, for instance, you'll need a hard-disk system. Now that we have ours, I can't think how we lived without it.

There are literally dozens of systems within the price range you quote; to recommend one is to be unfair to the others. Moreover, we can speak only of systems we've had here at Chaos Manor. Systems we're happy with include CompuPro, IBM PC, and Zenith. I don't have, but people I respect recommend, the TeleVideo and Corona PC clones. For development work, the Eagle systems are good, but

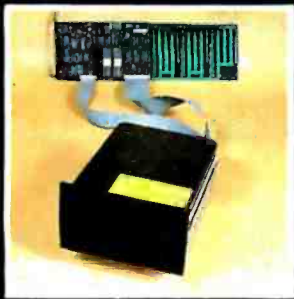
(continued)

THE RACE FOR SPACE

Maynard's in the lead with an expanding universe of space-saving systems for your PC!

Modular disk drive systems by Maynard Electronics drive technology to the limit to deliver unmatched performance with PC-DOS compatibility including self-booting off the hard disk.

10MB Winchester Internal Hard Disk Drive System!



This dynamic system lets you upgrade your PC or compatible to XT effectiveness, is internally installed, and does not require an additional power supply! The 10MB Hard Disk Drive System is equipped with the SandStar (TM) Hard Disk Controller Card which can accept up to three additional modular functions. Or, configure your system with the Hard Disk Controller Module and the SandStar Floppy Drive Controller Card which runs 5 1/4" and 8" Floppy Drives while still leaving four expansion slots for additional boards! Or, if you prefer, arrange your system with the Hard Disk Controller Module and the SandStar (TM) Memory Card which lets you add from 64K to 576K of memory using only one card slot!

additional modular functions. Or, configure your system with the Hard Disk Controller Module and the SandStar Floppy Drive Controller Card which runs 5 1/4" and 8" Floppy Drives while still leaving four expansion slots for additional boards! Or, if you prefer, arrange your system with the Hard Disk Controller Module and the SandStar (TM) Memory Card which lets you add from 64K to 576K of memory using only one card slot!

Maynard's SandStar (TM) Cards and Modules can put you lightyears ahead...

With technology racing into the future, serious computer users need to set their sights beyond obsolescence. Through the use of versatile SandStar (TM) Cards and Modules, Maynard has been able to engineer hardware to keep pace with tomorrow's needs. With Maynard's Disk Drive Systems and SandStar (TM) Cards and Modules, you won't be left behind in the race for space. For more details, call your dealer or distributor today.

NEW! "The Apollo" 30MB Internal Hard Disk Drive.



This powerhouse comes with 30MB of on-line storage using PC DOS without any special software drivers. Discover new worlds of data efficiency and versatility. Our 30MB system includes the Hard Disk Controller Card or any of the other SandStar (TM) Cards with Hard Disk Controller Module.

NEW! "The Gemini" Hard and Floppy Drive System.



Now, for the first time, add the Gemini to your one drive system and take full advantage of internal Hard Disk power along with two internal Floppy Drive units. The Gemini comes with a sleek 10MB Half-Height Hard Disk Drive, a Half-Height Floppy Disk Drive (DS/DD), the

SandStar (TM) Floppy Drive Controller Card with the Hard Disk Controller Module. Boost memory capacity dramatically while using no more space than a standard floppy drive! The Gemini can also be configured with either the SandStar (TM) Hard Disk Controller Card or the SandStar (TM) Memory Card with the Hard Disk Controller Module.



MAYNARD ELECTRONICS

430 E. Semoran Blvd.
Casselberry, Florida 32707
305/331-6402

We make modern times better.

* Serial Port, Parallel Port, Hard Disk Controller, Clock Calendar, Game Adaptor, and Prototyping Modules are available.

the documents are insufficient to allow me to recommend them to new users as business systems.

If I were editing a trade journal, I'd probably go for a CompuPro Dual Processor system with a hard disk. That way, you'd have access to the best of the 8-bit software as well as the new 16-bit that's being developed. On the other hand, full PC compatibility for CompuPro systems is still in the Real Soon Now category.

Do take the plunge. It's not so much a matter of getting the best system as getting one that's good enough; and there are a lot of them that are plenty good enough.—Jerry

TANDON AND WORDSTAR

Dear Jerry,

I have been meaning to write for some time and was finally spurred into action by the letter on Tandon disk drives ("Needed: Spare Parts," April, page 398).

I guess I was just lucky. When the drive door on my Tandon 5¼-inch floppy-disk drive broke (at an extremely critical time, naturally), I called Tandon. The first person I talked to referred me to someone in another department. That person said, "Oh, you need a new door assembly.

I'll just stick one in the mail for you, free of charge." It arrived a few days later, installed quickly, and I've had no further problems (knock on wood). In the meantime, I needed the drive desperately, and my husband fixed it with a piece of wood. He cut out a wedge-shaped piece that could be pushed in to "close the door." This worked perfectly (see figure 1).

I'd like to put in some good words for WordStar. I learned word processing on WordStar, so I can't compare it to other word-processing software, but it has features that are absolutely vital for what I do. One thing is that I don't want my documents to be automatically reformatted if I change margins. I need to be able to have different-size margins within a single document so I can have part of the document formatted at 10 characters per inch (right margin 65), with inserts at 12 characters per inch (right margin 80). I am also writing documents where physical layout and appearance are important, so the "what you see is what you get" feature is essential. Moreover, I've done a lot of typing of business letters and reports, and I think that secretaries who type those documents take a great deal of care at the time they are typing to have the letter look nice. In my opinion, WordStar more nearly approximates the job that is already being done than other word processors without the on-screen formatting capability. I would not recommend a program without this capability to anyone in a normal business environment. IBM has already demonstrated enough disdain for the secretaries of this world by not adopting the Selectric keyboard for the PC, without word-processing software adding to the burden.

NANCY JACOBSEN
Forest Knolls, CA

I'm glad Tandon was nice to you; the company took more than six weeks to deliver a shipment of door-latch parts to Barry Workman even after he'd paid for them. Meanwhile, your husband's invention may be a boon to mankind.

We've had stories of Tandon problems from China to New Zealand. Eventually things are fixed, but it takes time, and for those in foreign lands it can get awfully expensive.

As I've said in previous columns, WordStar 3.3 is something more than an adequate word processor. Do understand, though: WRITE is capable of changing margins, spacing, and such like "on the fly"; and there's a "print to screen" feature to show you what it will look like when printed out. However, I agree: if you're doing fancy formatted layouts, you'll want a "what you see is what you get" editor. Recall that most of my output is standard 60-character lines.—Jerry

COMPUTER SECURITY

Dear Jerry,

Do you think it will ever be possible to alert our high priests to the simple solution to computer break-ins? It appears to me that the whole security problem is due to one innocent device: the dial-up modem. I have never had any trouble with anyone breaking into my computer;

they would first have to break into my home. At work I occasionally use a timesharing computer, which has dedicated terminals scattered throughout the company and will answer a dial-up modem. If the modems were not available, we would not have to worry about someone breaking into the computer. They would first have to get past the security guards.

Dial-up modems are quite convenient, and they do allow computers to communicate with each other. This could be provided in a secure system by giving the modems restricted power. For example, a salesman may call the office computer. The computer, recognizing the modem, would allow him to check current prices or stock or enter an order. When the salesman returns to the office, he would use a dedicated terminal to check and then permanently record the orders he entered. The modem has no access to sensitive information, and the salesman should check the orders before any bogus ones corrupted the company's database.

The idea of limited-power modems is not new. Many of the remote CP/M systems, and most bulletin-board systems, employ this technique. The remote CP/M systems have masked out the SAVE, ERA, and REN commands and don't have the assemblers, debuggers, or compilers on line. The caller has only those powers given by the system operator. The intelligent operator has blocked out any commands that could corrupt the system.

The idea of somebody getting into my company's computer and messing around with sensitive information makes me nervous, and I am positively horrified by the idea of calling a defense computer and messing around with it! Perhaps administrators of such systems would implement a special program to greet curious hackers. This program might give them a sales pitch or some other public information. The advertising people might even like that idea.

TOM RUBY
Freeport, IL

There are many ways that a systems hacker can thwart the break-in artist; but until recently no one thought that a desirable thing to do. For many years, it was traditional for computer nets to be completely open. Anyone could read anyone else's files or watch over someone's shoulder while they worked. This was true even on the unclassified portions of the Pentagon's ARPA (Advanced Research Projects Agency) net. The benefits of allowing bright users total access were that they would spot and fix bugs, thereby making the net operate more efficiently.

In the past few years, there have emerged a number of "crackers" who take malicious joy not only in penetrating computer systems but in altering files and even in crashing the systems. They set up Trojan horse shells that look to the casual user like the normal operating system; these collect passwords. Some of these "crackers" are quite clever and find ways to access parts of the system that the systems programmers never intended.

As an example, it's possible to install into
(continued)

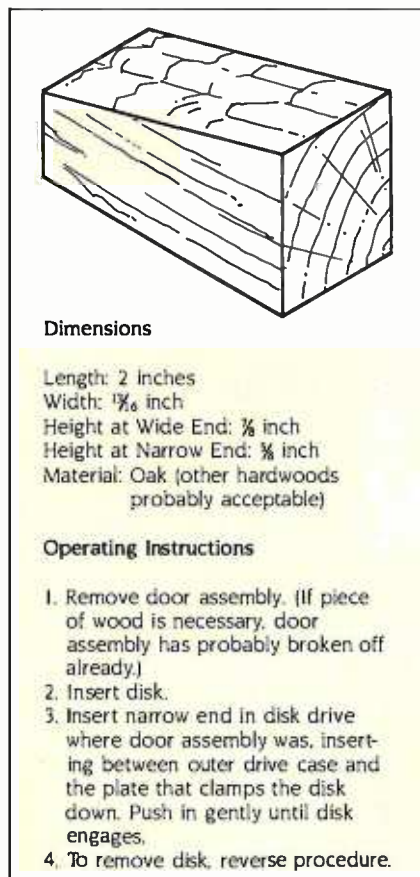


Figure 1: A piece of wood successfully used for temporary operation of Tandon disk drives.

SPSS/PC™

NEW!
IBM PC and
DEC PRO 350

Statistical and Reporting Software

SPSS Inc. a leading producer of statistical software for over 15 years, with more than a half million manuals sold in 80 countries, is making micro waves with SPSS/PC and SPSS/Pro.™ Two powerful new statistical and reporting programs which were designed for the IBM Personal Computer and the DEC Professional 350.

POWERFUL STATISTICS

- Crosstabulations
- Analysis of variance
- Multiple regression
- Over 25 integrated procedures

TOTAL INTEGRATION

- File management of large or small data sets
- Input & output to popular PC programs
- Flexible data transformations

CUSTOM DISPLAYS

- Automatic or custom reports
- Fully labeled tables
- Plots & graphs

EASY TO LEARN

- Simple English commands
- Tutorial & demonstration diskette included
- Comprehensive documentation for all levels of users

SPSS inc.

444 N. Michigan Avenue
Chicago, Illinois 60611
(312) 329-2400

For the DEC Professional 350, and soon for the IBM PC with hard disk. To discover how SPSS can help you make waves, call us for the full story. (312) 329-2400.

SPSS, SPSS/PC and SPSS/Pro are trademarks of SPSS Inc. for its proprietary computer software. IBM PC is a trademark of IBM Corporation. DEC and DEC Professional are trademarks of Digital Equipment Corporation.

© Copyright 1983. SPSS Inc.

your system, from outside, a program that will send me copies of your files while you think that you are playing a game of chess with me. That's not easy to do, of course, and it's harder on small micros than on big machines with highly complex operating systems. UNIX systems are particularly vulnerable to penetration since UNIX wasn't designed with security in mind.

Systems people are working on software solutions, but at the moment the only sure answer to the "cracker" problem is to be very careful what you allow telephone access to. Physically remove disks with sensitive information before plugging in the telephone connection; physically disconnect the cable to the hard disk if need be.

It's too bad; it was a lot more fun back in the wide-open days.—Jerry

MICRO CORNUCOPIA AND L-5

Dear Jerry,

I bought a Kaypro 4 and have increased its speed to 5 MHz and added a better monitor ROM. These changes were made possible by the people at Micro Cornucopia, POB 223, Bend, OR 97709, (503) 382-8048.

Micro C is a small journal the company puts out for people with single-board computers such as the Kaypro, Xerox, Big Board, and Slicer. Columns on each of these machines are included, plus columns on C, Pascal, FORTH, and SBASIC. Micro Cornucopia provides lots of technical information and has user disks for each of the above systems, consisting of the "good" public-domain software usually configured for that specific system. All in all, they are a great bunch of people and have terrific products.

Has anyone set up an L-5 bulletin board? Do you have any way of communicating with the L-5 Godbout system? I would like to help, but I'm not quite sure how to go about it. I would think a lot of people in L-5 have computers. Maybe we could form a computer tree.

VINCE BINDER
Pullman, WA

I too have heard good things about Micro Cornucopia, but I've not been able to try any of the products yet.

The Kaypro remains the entry-level system I recommend for nearly everyone.

I wish someone would set up an L-5 Society bulletin board; I keep being told it will happen Real Soon Now, but it doesn't, and I haven't either the time or the skill.—Jerry

SMALL IS NOT NECESSARILY BETTER

Dear Jerry,

I always look forward to your latest offerings. I was especially interested in April's column concerning software support. My accounting package went down last Wednesday afternoon. It is now 5:30 a.m. Monday and I am no closer to having any help—let alone an answer. I too tried to contact a software vendor. However, I

am a lowly end user (ranks with sea slug I guess) and no one would talk with me. The frustration is so totally overwhelming that words fail me.

I believe our experiences are quite common in this industry. The small-scale business user like me is in a vulnerable position when computer problems arise. I am not a computer whiz; I have neither the time or inclination. But I do want my computer to be the tool it should be. Unfortunately, I am at the mercy of a bunch of computer whizzes that often do not understand or care about users' problems. The giants like AT&T will take over the industry because the small companies can't even decide on a method of talking to a customer—let alone solving his problem. AT&T and IBM are portrayed as giants walking the earth swallowing all in sight; I feel that they are giants simply because they do have some method of servicing the end user.

It does reassure me in some perverse way that you too experience these problems. Perhaps at one of the next big meetings of computer industry whiz kids someone will address this problem.

R. MAX MCCART

Sigh. One day the industry will grow up; meanwhile, I can only advise people to read those disclaimers and understand that software companies really don't promise much. The best defense is to deal with reputable dealers who will refund your money if they've sold you an unsuitable product.

A lot of us at conferences address this problem, and indeed we've made progress in the past few years; which only shows how bad things were in The Old Days.—Jerry

COMPURO SOFTWARE

Dear Jerry,

Since you are a well-known CompuPro owner, a number of us who own a CompuPro or are considering it follow your columns. You might want to pass on the following bit of information about better system software for those of us who don't have access to the consultants and gurus that you do. Lanier Computer Systems, 25 Laurel Dr., Langdale, AL 36864, offers a BIOS for CP/M-80 (BIOS 80, \$35) and one for CP/M-86 (BIOS 86, \$50). Each supports track-buffered I/O in which the disk-controller chip reads an entire track in one disk revolution. BIOS 80 requires 96K bytes and buffers four disk tracks. Any additional memory is used as a memory disk.

We find that the BIOS 80 is much faster than our original CP/M-80 BIOS from Sorcim. Compiling a one-line BDS C program took 3.75 seconds using BIOS 80.

IEEE Micro (December 1983) has an article on floppy-disk transfers that says a two- to five-time improvement in access time is typical in CP/M systems that use track-buffered I/O.

LAURA WALLACE
Bedford, MA

The Lanier BIOS is great for those who bought systems some time ago. I believe that CompuPro is now shipping Tony Pietsch's HMX (CP/M 2.2) and TMX (CP/M-8/16) BIOSes, which

have track buffering and are very fast; so new purchasers probably needn't bother.

I've gone completely over to CP/M-8/16 on my CompuPro, and I love it.—Jerry

WORDSTAR TRICK

Dear Jerry,

There are a fair number of us around here who use WordStar still, and I thought your column might be one way to pass on a useful trick I have figured out for the scientific fraternity struggling with equations, superscripts, subscripts, and other such things.

WordStar allows you to embed control characters to roll the printer up and down, but the result (even with ^OD to turn it all off) tends to be unreadable on the screen. Further, I find on my Oz-driven Prowriter that by the time a line has been rolled up and down a few times the horizontal registration starts to wander.

I therefore hit on the use of WordStar's overprint line feature to solve it. The idea is that a complete line is used for superscripts, another one for the body, and another line for subscripts. This gives a vertically expanded display on the screen with all the columns in the right place and no messy things like backspaces to figure out. It's quite simple.

WordStar's printer driver should be installed for the half-linefeed option. Start a line on the screen with the superscript toggle (^P^T), fill it with spaces to the desired line length, finish it with another ^P^T, and go down to the next line with a ^P^M instead of a carriage return. Fill the next line with spaces again and terminate it with another ^P^M. Then start a line with the subscript toggle (^P^V), fill with spaces, and end with another ^P^V and a carriage return. The lines terminated with a ^M show up with a hyphen in the last column. The resulting three physical lines are treated as one logical line by WordStar for line counts, page breaks, etc. Filling in the equation just involves turning off insert and the control-character display (^OD) and putting the equation or whatever straight into the screen "template."

$$y = (x_{i+1})^2 + (y_i^3)^{(K+1)}$$

just fill it in directly on the screen. Admittedly, all those spaces do pad out the resulting file somewhat, but I think the entry benefits make it all worthwhile.

IAN BOAG
Palmerston North, New Zealand

Thanks for the tip. Nice to see that BYTE gets so far afield.—Jerry ■

.....
 : A Horrible Confession
 : I was overwhelmed by mail. In a blinding
 : moment of sanity, I threw out everything
 : dated prior to March 1, 1984. Alas, there
 : were some self-addressed, stamped
 : envelopes in the pile.
 : I do read all my mail, but alas, even with
 : assistance there is too much to answer. I'll
 : keep trying, though.
 :

ベスト

Pasocom Pagodas

Akihabara

Software shortage

Sharp MZ-5500

Fujitsu FM-11

DIR emulator

BY WILLIAM M. RAIKE

By the time you read this, air conditioners will be competing with personal computers for AC power, and no doubt some of us again will experience that indescribable feeling of having just one more appliance come on that will trip the breakers just *before* we save the last hour or two's worth of text editing. But as I am writing this, air conditioning is the last thing on anyone's mind: spring in Tokyo has arrived at last. The winter's dirty snowbanks have been replaced by windblown piles of cherry blossom petals, and colorful kimonos are again in evidence during strolls through the fashionable Ginza and Aoyama districts.

AKIHABARA

Kimonos are not, however, particularly noticeable in the raucous Akihabara area. (The accent is more on the "ha" than on the "ba," and the name literally means "autumn leaf field.") In fact, almost nothing is noticeable in Akihabara unless it (a) has a power cord and/or battery and at least one solid-state component, or (b) is blasting away at 90 decibels or more. This district of Tokyo, upon which at least three train lines and one subway route converge, covers roughly a three-by-four-block rectangular area devoted mostly to retail consumer electronics. In addition to video, stereo, and more mundane appliances, nearly every building has at least one floor just for personal computers, and a growing number of establishments, such as Laox and Yamagiwa, have separate full-blown department stores, dedicating four or five floors to computers alone. These "pasocom pagodas" are to be found elsewhere in Tokyo, too (places like the Omron Micom Base, near Ginza), but if anyone were to make a pilgrimage to some imagined computer deity, their quest would have to end up at Akihabara.

Some knowledge of Japanese is helpful but not essential to make the most out of a visit to these showrooms. Terms such as keyboard, disk drive, monitor, RAM, and display are pronounced nearly the same in Japanese as in English; the unwary are liable to be a bit nonplussed, though, by the Japanese penchant for turning English words into contractions: per-

sonal computer becomes "pasocom" (pronounced pah-so-con), microcomputer is shortened to "micom" (my-con), operating system becomes simply "OS" (oh-ess), while software and hardware get transmogrified into "softo" and "hado" (skip the rs, please). But don't expect a sophisticated or particularly well-informed sales staff. You can find capable people, particularly in places specializing in so-called "OA" (supposedly office-automation equipment, but actually anything with two floppy-disk drives and a price of more than \$1000), or in some smaller, more competitive systems houses, but they're rare. For instance, in one establishment, after a fruitless 10-minute search for a system disk to fire up a Fujitsu FM-11, I was informed that the machine had "only been here for a little over two months, so no one really knows how to operate it." (I was able to check out the FM-11 elsewhere, and it's an interesting machine; read on.)

An even more fascinating, and much more picturesque, subarea within Akihabara, not more than 50 yards from the train station, is the electronic component bazaar. Contrary to popular misconceptions, and despite the giant Japanese industrial combines, Japan is still, at heart, a nation of small shopkeepers, and that orientation is obvious in the Akihabara bazaar. Both the ground floor and second floor (8000 square feet or so) consist of a honeycomb of small booths, each about 5 feet square (including the space behind the counter for the proprietor to sit down). One booth sells only ICs (integrated circuits), the next only capacitors, followed by one with nothing but resistors. A booth selling knobs, switches, and lamps is flanked by one offering power sup-

(continued)

.....
William M. Raiké, who holds a Ph.D. in applied mathematics from Northwestern University, has taught operations research and computer science in Austin, Texas, and Monterey, California. He holds a patent on a voice scrambler and was formerly an officer of Cryptext Corporation in the United States. In 1980, he went to Japan looking for 64K-bit RAMs. He has been there ever since as a technical translator and a software developer.

plies and another supplying meters. Customers crowd the narrow corridors; proprietors seem to have memorized their entire inventories, nearly all of which are on display, and apparently shoplifting is rare enough not to be a problem.

Discounts are the rule in Akihabara, both for consumer goods and components: 10 percent is offered routinely, and 20 percent, sometimes more, is usually obtainable. Prices are reasonable, particularly on components rather than complete devices. On my most recent trip (to pick up an RS-232C cable, about \$13.50), the asking price for 256K-bit dynamic RAM chips (Toshiba TMM 41256-20) was about \$55 per chip; Hitachi 200-ns (nanosecond) 256K-bit dynamic RAM chips were less, about \$42.50. An 8086 processor cost about \$16.50, while 64K-bit *static* (not dynamic) RAM chips with 150-ns access time were going for a little over \$40 each. For a hobbyist, designer, or small company,

the bazaar and numerous other shops nearby are ideal sources for everything from cords to cases and components to cards.

SOFTWARE SHORTAGE

It would be nice to report on all sorts of software found here, but with the exception of the Japanese-language word processors and, naturally, games, the pickings are slim. Not surprisingly, you can forget about selling any significant number of systems here (hardware and/or software) unless Japanese-character displays, data entry, and text processing are available and of high quality. User-friendly interfaces are highly important here because a minimum of 3000 different characters or so are required. Japanese-language versions of SuperCalc and Multiplan exist and have been announced for CP/M-86 and MS-DOS. The zillions of Japanese-language word processors produced is revolutionary when you consider that, even to-

day, Japanese-language typewriters are not common in most offices. And low-priced (and not-so-low-priced) dedicated word processors are appearing on an almost weekly basis. This culture is leapfrogging from doing ordinary business correspondence by hand to a situation in which word processing will be the rule. But for the most part, you can count the number of other generally available applications or development software packages on your fingers and toes.

SHARP MZ-5500

One of the more interesting machines to appear recently has been the Sharp MZ-5500 system, offered in three versions: 128K-byte basic memory either without a drive or with a single built-in floppy, or 256K-byte RAM (random-access read/write memory) with two 320K-byte drives. The most striking feature is their advertised list prices in Japan—about \$970, \$1285, and \$1730, respectively—but discounts will be inevitable.

The MZ-5500 is a 16-bit system, supplied with CP/M-86 as standard and MS-DOS to be an available option. Running an 8086 at a conservative 5 MHz, it supports an optional 8087 math coprocessor and includes an 80C49 to handle the keyboard chores. RAM is expandable to 512K bytes, and a mouse is optional. The standard system also incorporates 96K bytes of video RAM, expandable to 192K bytes, which ought to satisfy most graphics requirements. Japanese-language processing options are extensive, including a 128K-byte Japanese-character ROM (read-only memory) and a 256K-byte dictionary ROM board that permits input of about 80,000 words in phonetic form. A notable feature is a dedicated large-scale integrated circuit as a "window-display controller" that enables up to four screen windows to be defined and manipulated on a color-priority or logical basis. It is capable of producing some impressive and quick 3-D graphics. The usual parallel printer port and two RS-232C serial channels are provided. And the brochures say that a 10-megabyte hard disk will be available Any Day Now.

For reasons unknown to me, hard disks for microcomputers are not common here, though a limited number pro-

Say goodbye to the Tower of Babel with...

XENO-DISK™

The disk production system for your PC!

Read, write, format and duplicate 70 disk formats on your IBM-PC or compatible under MS-DOS. Developed from our popular Xeno-Copy™ utilities. Now supports popular 8" and 96 TPI formats.
XENO-DISK..... \$379.50

Also available:

- XENO COPY™ \$99.50
Read and transfer 70 formats to PC/MS-DOS (one way transfer)
- XENO-COPY PLUS™ \$149.50
Read and write 70 formats (bi-directional file transfer)
- ADVANCED™ Option add \$50.00
Supports 8", 96 TPI, parameter input for other formats. Included in XENO-DISK.

RUN CP/M-80 PROGRAMS ON YOUR PC . . . \$99.50!

80MATE™, our CP/M emulator, will run almost any CP/M-80 program under MS-DOS. No need for expensive co-processor boards!

See your dealer or call for information.



Dept. B, 6022 W. Pico Blvd.
 Los Angeles, CA 90035
 (213) 938-0857



vided for IBM PC and PC work-alikes are imported from the U.S.; one exception is a (presumably 5-megabyte) drive for Apple II systems with a list price of nearly \$2700. Also, a company named ICM sells a 10-megabyte hard disk for NEC machines: its list price is \$1600. Rumors are circulating, however, that several major manufacturers plan to introduce IBM PC-compatible machines soon.

In the MZ-5500 software department, BASIC is available in several flavors, along with a Japanese word-processing package and the Today integrated word processor/graphics/spreadsheet package. Kanji (Japanese-language) CP/M-86 also supports a RAM-drive feature, enabling up to 416K bytes of RAM to be allocated as drive M: and permitting fast file access. Various CP/M-86 utilities are provided, including a program for reading disks recorded under CP/M-86 in formats such as IBM PC, NEC PC-9800, and other Sharp formats and converting them to MZ-5500 format.

Sharp has announced a whole range of development software from cooperating vendors, presumably with the documentation translated into Japanese, but the list prices range from the unbelievable to the ridiculous. Examples include Digital Research's C compiler for about \$950, SuperSoft C-86 for over \$1100, CBASIC compiler for \$950, and Level II COBOL for \$2000. Those levels are far above the corresponding mail-order prices from the U.S. which would seem to leave plenty of room for vendors that are enterprising enough to supply at least their documentation in Japanese.

FUJITSU FM-11

The most recent in the FM series of Fujitsu personal computer systems, the FM-11, seems to be a winner. Having had the temerity to name their big mainframes the FACOM series, apparently the people at Fujitsu didn't think twice about coming out with a personal computer model called the BS. The companion AD2 model is an 8-bit system, but the BS runs a 16-bit MBL8088-2 processor at 8 MHz, plus an MBL68B09E video coprocessor, comes with 256K-byte standard RAM (expandable to 1 megabyte), 192K-byte standard video RAM, and two 5¼-inch double-sided, high-density, double-track floppies with a megabyte *each*, and a stan-

dard Japanese-character ROM for 3400+ characters. A mouse is optional. The system includes a parallel printer port and one serial port. Fujitsu has announced availability of an optional 20-megabyte hard disk.

The FM-11 BS, like the Sharp machine, is supplied with CP/M-86. It's bundled with a Japanese-language word processor called JWORD, along with FBASIC-86. MS-DOS is an announced option. The advertised list price is about \$1775.

C ACROSS THE SEA

Most implementations of the C language under CP/M-80 offer I/O (input/output) redirection to permit a program to receive input and send output either to the console or, by means of a command-line parameter supplied when the program is invoked, to or from a file. The C program in listing I is a useful addition to CP/M that emulates the CP/M directory command DIR. Used in conjunction with pipes, also not difficult to

simulate under CP/M using C, this program permits considerable flexibility in obtaining sorted or otherwise organized directories either at the console or in the form of CP/M files; the same technique illustrated in the program also can be used within other application programs to obtain easy and convenient access to a disk directory.

When the listing is compiled and assembled to produce CDIR.COM, entering CDIR (or variants such as CDIR *.COM or CDIR WS*.* using wild-card characters) produces a list of the current files on either the default or designated disk drive, one name per line. On the other hand, entering CDIR >DFILE redirects the directory listing to a file named DFILE, available for subsequent processing. The program in listing I produces a list of only the files under the current user number, although you can easily modify it to bypass this restriction. Also, the filenames that are out-

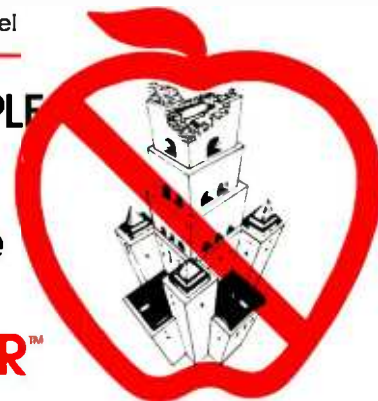
(continued)

Say goodbye to the Tower of "APPLE" Babel!

From IBM to APPLE to IBM to APPLE

File Transfers
are easy as pie
with

APPLE-TURNOVER™



READ, WRITE, and FORMAT Apple® II DOS 3.3 and Apple CP/M disks in your PC or most compatibles.

No need for exasperating serial links or modem madness. Leave your Apple where it is. All formatting and file-transfers are easily accomplished on your PC.

The APPLE-TURNOVER package consists of a half-sized card, friendly supporting software, and complete documentation. \$279.50.

See your dealer or call for information.

Vertex
systems, inc.

Dept. B, 6022 W. Pico Blvd.
Los Angeles, CA 90035
(213) 938-0857

INNOVATION IN MICROCOMPUTER PRODUCTS

Apple is a registered trademark of Apple Computer Inc. IBM is a registered trademark of International Business Machines Corporation.

Listing 1: A program in C that emulates the CP/M directory command DIR.

```

/* cdirc - Output a CP/M file directory. Syntax as in the DIR command. */
#include 
main(argc, argv)
int argc; char *argv[];
{
    char arg[51], fcb[36], *names[255], *p; *q;
    int i, astflg;
    char *lookup() *unpack();
    if (argc == 1) strcpy(arg, " *.*");
    /* all files unless there is a command line argument */
    else
        if (!badnameargv[1]) exit(); /* check for file name error */
        for (ip = argv[1], q = arg; *p; p++, q++) *q = *p;
        *q = '\0'; /* arg contains cmd line argument */
        if (!*q == ":") strcpy(arg, " *.*"); /* handle B: as B:.* */
    }
    makfcb(arg, fcb); /* set up a CP/M file control block */
    astflg = 0;
    for (ii = 1; i <= 8; i++) /* expand * in file name to ?s */
        if (fcb[i] == '*') astflg = 1;
        if (astflg == 1) fcb[i] = '?';
    }
    astflg = 0;
    for (ii = 9; i <= 11; i++) /* expand . in extension to ?s */
        if (fcb[i] == '.') astflg = 1;
        if (astflg == 1) fcb[i] = '?';
    }
    i = 0;
    while (ip = lookup(fcb) != 0) names[i++] = unpack();
    /* get matching directory entries and put the
    i-th name in the char array names[] */
    while (!) printf("%s\n", names[i]); /* output all names found */
}
char *lookup(file) /* find next directory entry matching the file control
block pointed to by the argument */
char *file;
{
    static int i, bdosfn = 17; /* function 17 = look for 1st match */
    bdosfn = 0x80; /* set DMA address to default buffer */
    if (i &= bdosfn) bdosfn = -1; return 0; /* no match */
    bdosfn = 18; /* function 18 = look for subsequent matching entries */
    return (i * 32 + 0x81); /* location of matching directory entry */
}
char *unpack(pdir) /* unpack the directory entry at pdir and return a
pointer to the name of the file */
char *pdir;
{
    char *pname, *p; int i;
    p = pname = sbrk(15); /* get space in which to put file name */
    for (ii = 1; i <= 12; i++)
        if (i == 9) *p++ = '.';
        if (i * p == *pdir++ & '\177') *p++ = ' ';
    /* skip blanks and zap high bits to 0 */
    *p = '\0';
    return pname;
}
badnameargv[] /* return 1 if arg string is a bad filename, 0 otherwise */
char *arg;
{
    return (strlen(arg) > 15 ? 1 : 0); /* check total length only */
#include 

```

This culture is leaping from doing ordinary business correspondence by hand to a situation in which word processing will be the rule.

put are not prefixed with the name of the drive on which they reside; that too can be changed easily.

Most of the main routine is occupied with (very limited) parsing of the command line and with expanding * wild cards to sequences of ? characters. The makfcb(arg, fcb) function is supplied as a library routine with The Software Tools works C/80 compiler; it creates a CP/M file control block corresponding to the filename pointed to by arg. The lookup(file) function calls the required CP/M BDOS (basic disk operating system) service routines in order to return a pointer to the next directory entry (if any) that matches the specified file. The argument to lookup is a pointer to a file-control block. Finally, unpack(pdir) uses the standard dynamic-memory allocation function sbrk() to obtain space for the filename, then extracts the filename from the directory entry pointed to by pdir, its argument.

One feature of C illustrated by the lookup() function is the use of the internal static variable bdosfn and its initialization. When called the first time, lookup must use BDOS function number 17 to look for the first matching filename but subsequently must use function number 18 to continue the directory search from where it left off the last time. Declaring bdosfn to be a static integer enables the lookup function to "remember" not to repeat the search from the beginning of the directory, because static variables retain their values between function calls while still keeping bdosfn "private" (local) to the lookup() function.

AHEAD

My next column will contain a full report on the annual Tokyo Microcomputer Show held at the end of May. ■

Circuit-Board-Design Without the Tedium

smARTWORK™ lets the design engineer create and revise printed-circuit-board artwork on the IBM Personal Computer.

Forget tape. Forget ruling. Forget waiting for a technician, draftsman, or the CAD department to get to your project. smARTWORK™ software turns your IBM Personal Computer into a professional, high-quality drafting tool. It gives you complete control over your circuit-board artwork — from start to finish.

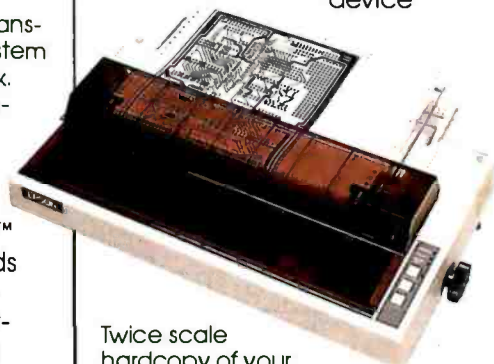


smARTWORK™ transforms your IBM PC into a CAD system for printed-circuit-board artwork. Display modes include both single-layer black and white and dual-layer color.

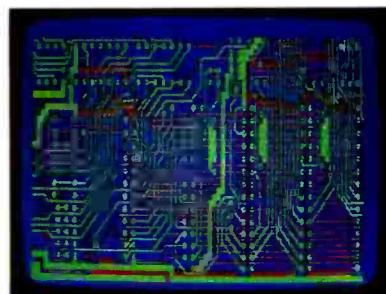
What makes smARTWORK™ so smart is that it understands electrical connections. Conductor spacing is always correct, lines don't become too narrow, and connecting lines do not intersect other conductors. smARTWORK™ can automatically find and draw the shortest route between two conductors. Or you can specify the route.

smARTWORK™ is the only low-cost printed-circuit-board artwork editor with all these important advantages:

- Complete interactive control over placement and routing
- Quick correction and revision
- Production-quality 2X artwork from pen-and-ink plotter
- Prototype-quality 2X artwork from dot-matrix printer
- Easy to learn and operate, yet capable of sophisticated layouts
- Single-sided and double-sided printed-circuit boards up to 10 x 16 inches
 - Multicolor or black-and-white display
 - 32 user selectable color combinations; coincident points can be displayed in contrasting colors.
 - Can use optional Microsoft Mouse as pointing device



Twice scale hardcopy of your artwork is produced using the Epson dot-matrix printers or the Houston Instrument DMP-41 pen-and-ink plotter. Quick 1X check plot is also available from Epson printers.



Dual-layer color display of a 2" by 4" section of a 10" by 16" circuit board

The Smart Buy

At \$895, smARTWORK™ is an exceptional value, particularly when compared to conventional engineering workstation costs.

Call or write us for more information on smARTWORK™. We'll be glad to tell you how smARTWORK™ helps us design our own circuit boards and what it can do for your business.

Send a purchase order, or major credit card number, and smARTWORK™ can be working for you next week.

System Requirements

- IBM PC or XT with 192K RAM, 2 disk drives and DOS Version 2.0
- IBM Color/Graphics Adapter with RGB color or b&w monitor
- Epson MX-80/MX-100 or FX-80/FX-100 dot-matrix printer
- Houston Instrument DMP-41 pen-and-ink plotter (optional)
- Microsoft Mouse (optional)



"smARTWORK" and "Wintek" are trademarks of Wintek Corporation.

WINTEK CORPORATION, 1801 South St., Lafayette, IN 47904-2993, Phone: (317) 742-8428, Telex: 70-9079 (WINTEK CORP UD)

Your System Deserves The Best!

Key Tronic Keyboards.

To enhance the performance of your personal computer or computer terminal, ask your dealer for a plug-compatible Key Tronic keyboard.

Key Tronic Corporation is the world's largest independent manufacturer of computer keyboards.

Key Tronic keyboards are engineered for performance and reliability, and are backed by a 14-year tradition of manufacturing excellence. All Key Tronic plug-compatible keyboards feature:

- **Familiar typewriter key locations and legends**
- Low-profile design
- Solid-state capacitive switches
- Positive tactile feedback

Each production element, from printed circuit boards to keytops is generated in-house to insure high quality.

So ask your computer dealer for a hands-on demonstration of a Key Tronic keyboard.

Call Toll Free 1-800-262-6006 for the retailer closest to you. (7 am-3 pm Pacific Time). Warranty information may be obtained by writing to the address below.



KB 5151 and 5151jr — *The Professional Series*

KB 5151 is plug-compatible with the IBM® PC and XT. KB 5151jr is plug-compatible with the IBM PCjr®. Both are available in **DVORAK** and foreign layouts, and special models are made for the handicapped. Suggested Retail Price: \$255.00

key tronic
Professional Series



"THE RESPONSIVE KEYBOARD COMPANY"

Department E • P.O. Box 14687 • Spokane, WA 99214 (U.S.A.) • (509) 928-8000
Circle 173 on inquiry card.



KB 200
Plug-compatible with
the Apple II*, and models
are available for the handicapped.
Suggested Retail Price: \$298.00



KB 100
Plug-compatible with
the Dec VT-100*
Suggested Retail
Price: \$379.00



KB 500
Replacement keyboard
for the Radio Shack
TRS-80 Color
Computer*
Suggested Retail Price:
\$89.95



KB 925
Plug-compatible with
the Televideo 925*
Suggested Retail Price:
\$324.00



KB 5150 and 5150 jr — *The Professional Series*
KB 5150 is plug-compatible with the IBM* PC
and XT. KB 5150 jr. is plug-compatible
with the IBM PC jr.* Both are available in
DVORAK and foreign layouts, and a special
model is made for the handicapped.
Suggested Retail Price: \$209.00



*IBM and PC jr. are registered trademarks of IBM Corporation.
*Apple II is a registered trademark of Apple Computer, Inc.
*DEC VT-100 is a registered trademark of Digital
Equipment Corporation.

*Televideo-925 is a registered trademark of Televideo
Systems, Inc.
*Radio Shack is a registered trademark of Tandy
Corporation.

THE AT&T INTERNATIONAL BUSINESS NETWORK: IT COSTS LESS TO SEND YOUR FACTS BY FAX.

SAN FRANCISCO



TOKYO

An exact copy of the original.
That's fax. And fax is the
only system that can transmit
blueprints, legal documents, and

signed contracts almost any-
where in the world.

This unique ability makes fax
one of the most exciting electron-
ic mail technologies available today.

All you need is a telephone
and a facsimile machine.

And in as little as 25 seconds,
an exact duplicate arrives at its
destination.

With fax, faster is cheaper.

And different machines have
different capabilities, different
speeds.

With the AT&T Network, you
can transmit *up to* 400 words on
a 1-minute call.

Most telex machines transmit
at a standard 66 words per minute.

Any fax machine can match
that rate. And most beat it easily.

In fact, you can save as much
as \$8.00 per page with AT&T's
lowest rates compared
with sending the same
page via telex. With
some fax machines, you

don't even have to be there.

They can be programmed
to transmit during Discount and
Economy periods. Telex has no
daily reduced rate periods.

Since fax is a copy of the
original, you don't need a typist.
No special operators.

And since there's no retyping,
no redoing of any kind, fax is free
of transcription errors.

So if your international
customer or business associate
needs a document, a blue-
print, or a signed contract in a
hurry, you can fax it on the spot.

Transmitting facts with fax.
Another cost-effective service
for your business from the AT&T
International Business Network.

International service to and from continental U.S.
FOR A FREE BROCHURE, CALL TOLL FREE:

1 800 874-8000





Macintosh's Other Designers

Three original
designers
discuss the
earliest days

BY JOHN MARKOFF
AND EZRA SHAPIRO

The Apple Macintosh computer has attracted so much attention that it's curious so little has appeared on the formative days of the development project. To set the record straight, BYTE West Coast Editors John Markoff and Ezra Shapiro interviewed three of the original members of the Macintosh design team: Jef Raskin, Bud Tribble, and Brian Howard. (The fourth member was hardware designer Burrell Smith.) Two of the three left Apple before the Macintosh was introduced: Tribble switched to a new career in medicine, and Raskin started his own company, Information Appliance Inc., in Palo Alto, California. However, their recollections of the development effort provide an interesting perspective on the Macintosh as a product.

BYTE: We thought we could start by asking each of you to introduce yourselves and to tell about your role in the Macintosh project.

HOWARD: I'm Brian Howard, and I joined the Macintosh project almost in its infancy to help out with documentation and publications for it. Since it turned out that there wasn't much to write about in the early days, I started to help Burrell Smith build all the original prototypes and to document the hardware, and I more or less stayed on in the hardware vein.

TRIBBLE: My name is Bud Tribble or Guy Tribble, depending on what city you know me in. I knew people at Apple for a long time. Jef [Raskin] before Apple, and Bill Atkinson down at UCSD. I heard from Jef that he was working on a new project at Apple; specifically, he was starting up a research section at Apple, and that he had some interesting ideas for making a computer that was different from what had been on the market previously. Since I was interested, I came down and talked to him. He showed me a big notebook that was the *Macintosh Document*, which had been worked on by Brian and Jef.

BYTE: What year was it?

TRIBBLE: I think it was 1980.

RASKIN: Sounds about right. We already had the *Book of Macintosh* at that time—400 pages.

TRIBBLE: And it was an extensive description of a cheap, user-friendly machine that went beyond what was the state of the art then (the Apple II) in terms of a personal computer. I

got so excited that I told the program I was in at school—a fairly prolonged M.D. program with a Ph.D. in neurophysiology—that I wanted to take a year off, or maybe more. Finally they let me take the year off with the option of going back.

When I got here Jef's group was made up of Jef, Brian, myself, and Burrell Smith. I think Joanna [Hoffman] joined just after I did.

Burrell had already mocked up a Macintosh computer. It consisted of a 6809 processor, 64K bytes of memory, and a screen linked to an Apple II, and you could download programs into it. Jef had written down his extensive ideas about what it should look like in the end and some ideas about user interface. My first order of business was to just get this thing to be able to assemble and cross-assemble on the Apple II, to get a basic BIOS or operating system up on the machine, and also to worry about other kinds of things—whether it should have a modem, include serial interfaces, and what kind of mass-storage device it should have.

I was very impressed with the amount of work already done, before even having a machine, in deciding on a philosophy for the machine. I was also impressed with the caliber of that core group, especially Burrell.

BYTE: Who put the *Book of Macintosh* together?
RASKIN: I think I wrote almost all of it. Macintosh started out as my dream of what a personal computer might be. I was already thinking about it at UC San Diego back in the early seventies when I developed the "flow language," a language that was so simple that it had no error messages at all; it was impossible for a user to make a syntactic or semantic mistake. Students loved learning programming on it. Working on that and other projects had taught me that one could do things more simply than had been done and that computers had a long way to go before they were pleasant to use.

(continued)

.....
Ezra Shapiro (McGraw-Hill, 425 Battery St., San Francisco, CA 94111) is BYTE's West Coast bureau chief. John Markoff (1000 Elwell Court, Palo Alto, CA 94303) is a BYTE senior technical editor.

What I wanted with Macintosh was a low price. I wanted it to be all in one piece with no connecting cables, a minimum number of parts, and a minimum number of interconnects so that it would be highly reliable. Brian and I built many cardboard models and did dozens of drawings. So if the fact that it's two pieces is one of the great success factors, it's certainly not from something that I can take any credit for. I also wanted it to have a monochromatic screen that could be bit-mapped, rather than a character generator.

As a matter of fact, when I started working at Apple, the Lisa was a character-generator machine and I was the only voice saying it should be bit-mapped, and I convinced the crew working on it. I guess I was also this disembodied voice that changed it from a three-button mouse to a one-button mouse at Apple—that was a big fight.

Macintosh was started very close to the time Lisa was. Two totally separate tracks.

BYTE: *Two separate philosophies?*

HOWARD: Actually, I think Lisa had been worked on in some form for almost a year.

RASKIN: But it was a very different machine then.

HOWARD: It was going to be a bit-slice piece of hardware. They were going to do a Pascal p-machine chip set.

TRIBBLE: Since Jef was on the initial user-interface committee for Lisa, he was putting in his ideas, and at the same time he was managing the initial Macintosh project.

RASKIN: One thing I strongly believed was that Lisa was much too large and expensive a machine for a company of Apple's style and type. Lisa was definitely headed toward the business market, and I thought that it was a severe mistake to make a machine that would, in price and capability, compete head-on with Wang, DEC, IBM, and DG.

BYTE: *As a researcher, did you have an input into those marketing questions?*

RASKIN: I never hesitated to speak my mind.

HOWARD: Also, "researcher" was partly a title that was created to explain that there wasn't a production item related to his ideas.

BYTE: *Let's take a popular myth and tell me to what degree it's wrong. The myth is that Lisa*



Photo 1: Brian Howard

and Macintosh technology come in some sort of straight line from inside the corporate sanctum of Xerox PARC [Palo Alto Research Center].

RASKIN: Yes and no. I always thought that Babbage and Turing and Van Neumann hadn't gone quite far enough in generalizing the idea of a computer. I remember clearly enunciated—sort of the Turing principle—that memory could hold anything. A symbol is a symbol and you can interpret it in different ways. But then at PARC they had cleverly gone on to generalizing the screen. Any point is the same way as any other point. Characters just happen to be one kind of picture we can generate. The keyboard is the same way.

One of my first thoughts was that Macintosh should be the most absolutely general machine that you could conceive at that price, so that you could do anything on it you could do with any machine with that amount of hardware.

I tried for over a year to get Steve Jobs to see what they were doing at PARC because I felt that they were at least seven years ahead of their time. They had the Altos going then, with bit-mapped keyboards and screens. You could do anything you wanted on them. They also had the mouse on it. Although I couldn't stand the mouse, I was the only person at Apple who had even seen one, and certainly the only person who had ever used one. Finally Steve Jobs, Bill Atkinson, and a few others went to Xerox PARC and came back enthused.

BYTE: *What's the other side? In what sense is Macintosh a departure from what was being done and thought of at PARC?*

RASKIN: Theirs was all based on Smalltalk and had a different model of what the user interface would look like. I thought they had a lot of good ideas.

The difference between Apple and PARC is that Apple was designing things to be sold in large quantities and PARC designs things to play with. While they weren't concerned with questions of production, I very much was.

BYTE: *Why did you initially settle on the 6809 microprocessor?*

RASKIN: It's a very pleasant microprocessor. It seemed like it would be available in great abundance. It's much, much cleaner, and it doesn't segment memory into 256K-byte parcels.

TRIBBLE: Bill Atkinson was heavily involved with developing QuickDraw and working on the Lisa project. While I was working on the 6809, writing software to run on a bit-mapped screen, he was developing this neat bit-bit software to do characters and graphics on the Lisa screen on the 68000.

I realized that in terms of the cost of the machine, the microprocessor is a small percentage; it didn't make sense to limit ourselves to the 6809, and if we could use the 68000, we [also] could take advantage of a large portion of the software that was out for Lisa. I was thinking of lower-level things like the QuickDraw software. This represented a major investment; I didn't want to do it over again for the 6809.

I also figured out that the project simply could not be done fast enough on a 6809. I got together with Burrell Smith and said, "Can you hook up a machine with only 64K bytes of memory," which is what the Macintosh was supposed to have then, "and run with the 68000?" That was kind of a trick because 64K bytes done on a 64K-bit chip is only 8 bits wide and the data bus on the 68000 is 16 bits wide. It required multiplexing and demultiplexing, while at the same time trying to keep chip counts to a minimum. Burrell Smith came up with a design that did all the timing and did the multiplexing and demultiplexing in a minimalist type of way.

Burrell did nonstop wire wrapping, and I wrote programs on the Apple II to emulate the timing that Burrell was

(continued)

YOUR PC IS NOT THE ONLY ONE GETTING THE BYTE (IF YOU'RE NOT BUYING FROM US).

PRICE STOCK SERVICE SUPPORT

We want to help you save money. It's that easy. We don't believe in high prices and fat margins. That's why we're dedicated to give you **the best prices in the market on in-stock items**. That means we ship immediately from one of the largest on-line inventories anywhere. We believe that a deal is no deal without **follow-up service after the sale**. We warranty all products sold for ninety days and have an average turnaround on repairs of less than 48 hrs. **Expert support** is crucial, both before and after the sale. Whether it's a question of compatibility, or a tricky installation, the answer is as close as your phone. **CALL FOR PRICES 1-800-446-7995.**

IBM PC enhancement products. Call for APPLE product prices.

Floppy Disk Drives:

EPSON FX-80 (160cps, 10") \$199
TANDON TM100-2 (IBM's 1st choice)
HEY T! OWNERS!!! Add a B drive with our **HALF HEIGHT SPECIAL!!!** Two half height drives, cable, brackets, 1 year warranty all for just... \$349
 Individual **HALF HEIGHTS** **each \$179**

Printers:

EPSON FX-80 (160cps, 10") \$499
EPSON FX-100 (160cps, 15") \$699
EPSON RX-80T (100cps, 10") \$279
EPSON RX-100 (100cps, 15") \$499
OKIDATA ML92 (160cps, 10") \$459
OKIDATA ML93 (160cps, 15") \$729
OKIDATA ML84 (200cps, 15") \$889
OKIDATA PACEMARK 2410 (350cps, 15") \$2399
DIABLO P38 (400cps, 15") \$1799
GEMINI10X (120cps, 10") \$279
GEMINI 15X (120cps, 15") \$429
DATAPRODUCTS 8000 SERIES (dot matrix, LQ) CALL
TOSHIBA P1340 (LQ dot matrix, 10") \$799
TOSHIBA P1351 (LQ dot matrix, 15") \$1499
TI-855 (LQ dot matrix w/font cart) \$799
EPSON LQ-1500 (LQ dot matrix) CALL
DIABLO 630API (40cps LQ) \$1749
DIABLO 630ECS (192 chars on wheel) \$2099
NEC 2050 (durable, low cost LQ) \$979
NEC 3550 (33cps LQ) \$1749
NEC 7730 (55cps LQ) \$1999
C. ITOH STARWRITER (40cps LQ) \$1099
C. ITOH PRINTMASTER (55cps LQ) \$1499
QUUME SPRINT 1140 (40cps LQ) \$1399
QUUME SPRINT 1155 (55cps LQ) \$1599
BROTHER HR-25 (20cps LQ, 15") \$699
DYNAX DX-15 (17cps, LQ, 10") \$499

Hard Disk Drives:

SYSGEN 10MB HARD DISK (w/streamer) \$2499
SYSGEN 20MB HARD DISK (w/streamer) \$2999
SYSGEN IMAGE (back-up for XT) \$ 849
TECMAR 10 + 5, 15 + 5, 33 + 5MB exp chassis from \$2699
PEACHTREE PERIPHERALS 10MB internal hard disk \$1099
INFAX removable 10 & 20 MB flexible media drives CALL

Multifunction Boards:

ORCHID BLOSSOM (64-384K S, PC/C, opt PC Net) BEST PRICE
AST 6-PAK (64-384K S, PC/C, opt G) from \$279
AST MEGA+ (64-512K*, S, C/C, opt S, P, G) from \$269
AST I/O PLUS (S, C/C, opt S, P, G) from \$129
QUADBOARD I (64-256K, S, P, C/C) from \$279
QUADBOARD 384K (64K-384K, S, P, G, C/C) from \$289
TECMAR CAPTAIN (64-384K, S, P, C/C) from \$269
BABY BLUE II (64-256K, Z80B, 2S, PC/C) from \$499
 *all of these boards include utility software
MAYNARD CONTROLLER CARDS from \$189

Display Cards:

PERSYST 808 (finally clear text on a color monitor) CALL
STB GRAPHIX PLUS (mono, color, par) \$399
PROFIT MULTIGRAPH (mono, color, opt par) \$399
TECMAR GRAPHICS MASTER (640x400 + mono) \$499
QUAD COLOR I and II (color, h/res opt)ea \$219
AMDEK MAI (mono, color, par, w/HALO) \$399
PARADISE (mono, color, par) \$429
HERCULES (h/res mono, runs LOTUS) \$359

Monitors:

AMDEK COLOR IV (720x480 bright colors) \$549
AMDEK COLOR II+ (color monitor) \$399
AMDEK 300 A and G (Amber or Green) \$149/\$139
AMDEK 310A (Amber, 1/2 IBM's price) \$179
PGS SR-12 (690x480 non-interlaced) \$699
PGS HX-12 (690x480 interlaced) \$479
PGS MAX-12 (720x350 mono) \$189
TAXAN RGBvision (h/res color monitor) BEST PRICE

Modems:

HAYES 300 baud external \$209
HAYES 1200 (300 or 1200 baud ext) \$489
HAYES 1200B (300 or 1200 baud int w/soft) \$419
HAYES Compatibles CALL

Chips:

64K RAM CHIP MEMORY UPGRADE (set of 9) \$49
 200ns; full 90 day warranty

Networks:

ORCHID PC NET PLUS STARTER KIT \$849
ORCHID PC NET PLUS NODE CARDS \$399

Miscellaneous:

INTEL 8087 COPROCESSOR (high speed math) \$199
ISOBAR SURGE PROTECTORS (4 & 8 plug) \$59/\$79
KEYTRONIC 5151 KEYBOARD (sep. cursor keys) \$ 849
MOUSE SYSTEMS (optical mouse, runs LOTUS) \$199
POWER BACK-UP (200 & 425 watts) \$269/\$499
ORCHID PC TURBO (80186 coprocessor) CALL
MICROFAZER (8-128K print buffer) from \$139
BRET SALTER'S new debug board w/software CALL

Software:

SYMPHONY (new from LOTUS) BEST PRICE
FRAMEWORK (new from ASHTON-TATE) CALL
MULTIMATE (emulates WANG dedicated WP) \$299
WORDSTAR PRO-PAK (new version) \$369
PFS Write, Report, File and Graph each \$99
dBASE II (from Ashton-Tate) \$389
KNOWLEDGEMAN (version 1.06) \$299*
RBASE 4000 & 6000 from \$329*
POWER BASE (relational, hierachical) \$399*
CIP (new and fantastic!) CALL*
DAYFLOW (new type of database) CALL*

*New dBASE alternatives

LATTICE C COMPILER (version 2.0) \$299
DIGITAL RESEARCH (all products) CALL
MICROSOFT (all products) CALL
DOW JONES (all products) CALL
IUS A/R, A/P, G/L \$299
HOWARD TAX PREPARER \$189
FINANCIER II \$119
DECISION RESOURCES CHART MASTER \$259
BPS BUSINESS GRAPHICS \$259
Z-SOFT PC PAINTBRUSH w/FRIEZE GRAPHICS \$99
PROKEY VERSION 3.0 \$99
SET-FX for your EPSON \$45
NORTON UTILITIES \$59
COPY II PC by CENTRAL POINT \$35
COMPUERVE STARTER KIT \$35
SEAWAYS by FUNK SOFTWARE \$49
HAYES SMART COM I \$109
CROSSTALK XVI by MICROSTUF \$109
RELAY communications package \$99
NEW MACINTOSH PRODUCTS CALL

NEW IBM PRICES!!

IBM PC w/256K, 2 360K drives, controller \$1995

IBM PC w/256K, 2 360K drives, controller, AST 6-PAK, HERCULES GRAPHICS monochrome adapter, AMDEK 310A monochrome monitor and BROTHER HR-25 LQ printer w/cable \$3499

IBM PC w/256K, 2 360K half height drives, 10MB PEACHTREE PERIPHERALS internal hard disk, controller, AST 6-PAK, TECMAR GRAPHICS MASTER h/res color and mono adapter, AMDEK COLOR IV h/res color monitor, EPSON FX-100 w/cable \$5199

(These systems are brand new, shipped fully tested and burned in, fully warranted for 90 days AND ARE ALWAYS IN STOCK!)

PROGRESSIVE MICRO DISTRIBUTORS

"IBM PC System Enhancement Is Our Business ... Personal Service Is Our Commitment."

FOR ORDERS ONLY

1-800-446-7995

for further information and technical support

1-404-446-7995

7000 Peachtree Industrial Blvd.

Norcross, Georgia 30071

All prices are subject to change. IBM is a registered trademark of International Business Machines.

Circle 203 on inquiry card.

programming into the programmable-array logic chips. And at the end of four days, we had a board with the 68000, 64K bytes of memory, and a bit-mapped screen and keyboard up and running the QuickDraw software. At that point we went to Steve [Jobs] with the working model, and he said, "Okay. Let's do it this way."

RASKIN: I was against the 68000 at first because I wanted a low-priced machine and the 68000 would bump up the cost. Burrell and Bud convinced me that the 68000 was the way to go, especially because of the software. It was clear that we could never catch up on the work that Bill had done.

BYTE: *What's the history of the Mac mouse?*

RASKIN: Jobs gets a hundred percent credit for insisting that a mouse be on the Mac.

HOWARD: When we chose the 68000, we did it partly so that we could use the low-level graphics routines and so on. Then the question starting coming up whether we also wanted to make use of the user interface as defined for the Lisa or maybe some parts of it. At some point, if you take enough of it, then the mouse has to come with it because that's definitely designed into the user interface in the Lisa.

RASKIN: I wasn't too antagonistic toward using the Lisa user interface since I had had a strong hand in that. It had many of the features that I wanted.

To give a little history, I had a conversation with Mike Markkula long before this about wanting to make a low-priced machine. A concept called "Annie" was developing then, and he said, "Can you design a machine to sell for \$500?" I came back a week later and said, "Not one that would really be functional, but I can design one to be sold for \$1000." I didn't like the names Annie or Lisa—that is a sexist kind of approach—so I proposed that Apple name projects after varieties of apples, and I called mine Macintosh.

HOWARD: Sort of a fruitist attitude.

RASKIN: Steve Jobs had named the company Apple so you get started off on a fruit image. There was a Pippin for a while and some other internal apple names.

After Steve Jobs got stronger on the project, he kept edging it toward a more expensive machine. That was the main



Photo 2: Bud Tribble

reason I didn't want the 68000, because there was no way I could have met the charter of a \$1000 machine. It's my opinion to this day that if we had built such a machine it would have been dynamite because no one was even thinking in that price range with that kind of capability.

I happen to enjoy the 68000 far better than the 6809. It's a nice processor to work with. And they're both nicer than the ancient 6502. But as we started making those changes, the price started escalating very rapidly.

TRIBBLE: It was a domino effect. After the 68000, we started talking about putting on a mass-storage device that would be more commensurate with that—a more expensive disk drive.

BYTE: *You originally had started with a 5 1/4-inch drive.*

TRIBBLE: Before that there was going to be a small tape drive and that drove the price up. The screen went from a 256- by 256-pixel screen up to an intermediate screen and finally to where it is now. The memory started out at 64K bytes, but all of a sudden we got QuickDraw, which was 20K bytes, and all this Lisa software and extra pieces lying around. So the ROM [read-only memory] went from 4K bytes to 64K bytes in steps. And the price of the machine went up with that. The RAM [random-access read/write memory] went from 64K bytes to 128K bytes eventually. The keyboard became detached, which also drove up the price of the machine.

All of these things were edging the design, and the price, closer to Lisa. I think Jef was reacting against the danger of pricing the machine out of people's reach. I take some of the blame for going along with a lot of these changes because I was closely allied with Bill Atkinson, who was working on Lisa, and we thought along the same lines. The other thing is that I was, and still am, a technological junkie and like fancier bits in my computer. Not that I didn't have an appreciation for Jef's idea for a computer that people could afford.

BYTE: *Is that the central tension in the design process of Macintosh?*

HOWARD: That's a tension in any design in any project. Especially with a hardware group, there is always a tendency to use chips that are a little bit more on the leading edge of what's possible, to run things just a little bit faster, and to get a little bit more resolution out of the screen. Without strong direction from above, all projects have that tendency to float upward on the scale.

It's a little misleading now [to think that we thought] Macintosh could be sold profitably at \$1000, but partly that's because it's taken about three years to get it out on the market. Three years ago, the price differential was much more astounding that it is now. Of course, the price of all those chips has dropped dramatically since we were working with them originally.

BYTE: *Is Burrell Smith as unusual a hardware designer as we have heard by reputation?*

RASKIN: I think he is very, very good. Bill Atkinson thought he had a great deal of talent. I talked to Burrell and decided he was as good a digital designer as I had ever met.

TRIBBLE: My orientation was more toward software. But I found it extremely easy to communicate with Burrell, and part of that was that the turnaround time with Burrell for trying out new hardware ideas was like the turnaround time I was used to for trying out new software. He would do it overnight. If I came up with an idea from the software standpoint and said to Burrell, "Wouldn't it be nice if we had this in the hardware?," he would come back the next day and say, "We can do that if you make this slight change in the software." In a very short time, we would get the whole thing going.

(continued)

Two ways to show off your IBM PC.™



There's no better way to show off your IBM PC – or any other micro – than with the new line of Toshiba printers. They offer state-of-the-art features, high reliability and low price.

P1351

The new Toshiba P1351 printer has a unique high-density 24-pin dot-matrix print head. It lets you print crisp, clean letter copy at 100 cps, draft copy at 192 cps. And with the software-selectable downloading fonts, you get to pick from a variety of type styles.

The P1351 has more stuff to show. Like 180 x 180 dots-per-

inch high-resolution graphics, 132-column-width platen (great for spreadsheets and Lotus™ 1-2-3™ data processing and graphics), Qume SPRINT 5™ emulation, and a choice of either a forms tractor or automatic sheet feeder.

P1340

For considerably less, the new P1340 gives you just a little less. But it still has the same high-density 24-pin dot-matrix print head, the 180 x 180 dots-per-inch graphics resolution, and the Qume SPRINT 5 emulation. In addition to true proportional spacing and a

built-in forms tractor. Whichever printer you choose, nationwide service within 24 hours by Western Union technicians is available.

So the choice is yours. But when you choose Toshiba, you know you're putting on the best show possible.

For more information, call toll-free: **1-800-457-7777**, Operator 32.

IBM PC to P1340 and P1351 graphics utilizes PaperScreen and the IBM PC with color graphics adapter. IBM PC is a trademark of International Business Machines. Lotus and 1-2-3 are trademarks of Lotus Development Corporation. SPRINT 5 is a trademark of Qume Corporation.
©1984 Toshiba America, Inc.

In Touch with Tomorrow

TOSHIBA

Information Systems Division, TOSHIBA AMERICA, INC.

RASKIN: That is one thing that I was pushing for very hard—the interaction of hardware and software. You don't build a hardware box just to suit some hardware engineer and then try to cram software into it. You design your hardware to support the software, you design the software to put the two together, and they grow together.

HOWARD: The constant interaction was one of the most fun things about the early Macintosh project in general. No decision was made by any one person and handed down to somebody else. The original Mac room was one big room—any discussion that took place involved everybody in the room. Even after we moved, constant group meetings coalesced everywhere. People would run in and help shape the idea.

RASKIN: I tried to keep the spirit of the group, and also my personal spirit, very playful. We were always playing music and frisbee, and shooting dart guns.

BYTE: *To what extent was Macintosh in the early days influenced by the Apple III experience?*

RASKIN: Tremendously—to get as far away from it as possible!

HOWARD: The team size was definitely reinforced by the Apple III. It was clear that a large team would tend to go off in the direction of writing mountainous amounts of code and things that were not well focused. That was part of our incentive for keeping the group small.

BYTE: *Back in the days of the Book of Macintosh, was Macintosh a closed system in the sense that the outside world wouldn't have easy access to the bus?*

RASKIN: No. I believed in having a bus brought out on an edge connector.

BYTE: *What happened?*

TRIBBLE: Rod Holt, who was involved with the analog design [and who was] doing the FCC certification on the Apple II, kept bringing up the point that if you bring out an 8-MHz, or whatever, bus to the outside world you're in trouble. I retrenched and said that what we needed were fingers to come out that could be used for testing purposes.

RASKIN: As a matter of fact, in the original Macintosh specification it was called the Bus Diagnostic Port. That was part of the original definition.

TRIBBLE: Then Rod said, "If we put in a knock-out plastic port, the FCC is going to say 'Obviously you are inviting people to knock that out, and we're not



Photo 3: Jef Raskin

going to certify you." I think he was being a little paranoid.

It came to pass that there was no way to get into the Macintosh at bus speeds. But I went through Burrell's hardware manuals and found a serial chip that could run at 1 megahertz, which was the SCC chip. So I said to Burrell, "You've got to design this thing in." I think it's adequate. What I was worried about was not having enough bandwidth to talk to a hard disk or a network.

BYTE: *Do you think you've got it?*

TRIBBLE: I think we've got it. The bandwidth on most Winchester disks is a few megahertz. The bits come streaming out of the disk at a few megahertz, and with the SCC chip we can go in at close to 1 megahertz. We lose a small factor there, but most of the wait time on the hard disk is head motion anyway.

RASKIN: If you can get at the bus itself you have so much more control. I still think it was a mistake to not put those fingers there, even behind a hidden port.

HOWARD: Just putting in fingers doesn't come for free, though. As soon as you say it's okay for the outside world to start hanging junk on your high-frequency signals, you have to somehow isolate yourself from what they do—enough so that your machine will still work with things hanging out there. You have to take all that into account.

RASKIN: I still think you should put it on, call it a diagnostic, and use it for diagnosis. You take no responsibility because it's not a user part, but if some OEM wants to use your board or your machine and take that responsibility,

that's okay. I didn't see it as something that a user would casually plug into.

TRIBBLE: I ended up leaning toward a more closed system because, as software manager, it became appealing to me to have every single one of the machines that were out there all exactly the same. If software ran on one machine, it would run on all the others. I didn't want a big proliferation of weird addresses on the bus so that if you access them with such and such hooked up it would do something funny.

BYTE: *The story of the IBM PC.*

RASKIN: The story of the Apple II.

BYTE: *One thing that surprised people, I think, when Mac was first introduced, was that it only had one disk drive.*

RASKIN: I know why there was [only] one originally. When I was there, the software was designed to work with one. But after you have the typical Lisa kind of software on it, it definitely needs more than one. Having first made the choice of putting that software in, certainly I would have put in two disk drives. It's not very convenient to use with just one.

BYTE: *Who came up with the idea of a detachable keyboard?*

RASKIN: I think Jobs.

BYTE: *What are your feelings about that?*

RASKIN: Once Macintosh grew to its present size, the separate keyboard was the only way to go.

BYTE: *Did it start out physically significantly smaller?*

TRIBBLE: Not very much smaller. The screen was a little bit smaller, but the whole box was a much lower profile.

RASKIN: But it was not like a Tandy Model 100. It did have a CRT [cathode-ray tube]. It was slightly smaller. It grew a great deal.

BYTE: *Have you seen any of the third-party software that's just beginning to emerge for Macintosh? We've seen some where we think the third-party developers have missed the point of the Mac.*

TRIBBLE: I think that's bound to happen, especially where you have so many people—a hundred companies are out there—writing software. It's a tremendous problem in communication. You have to reeducate all the people who write for CP/M, UNIX, and whatnot to write for a system that is completely different from anything they're used to.

HOWARD: It certainly takes a lot of

(continued)

When you visit your dealer and compare the Princeton IBM-compatible HX-12 side-by-side with the IBM color monitor, your eyes will see the difference.

The HX-12 gives you higher resolution and finer dot pitch (.31mm) than the IBM 5153's medium resolution (.43mm) for a cleaner, sharper image.

Compare our full range of colors and our crisp whites without red bleed. You'll also see a difference in our non-glare screen—a feature your eyes will really appreciate in a long work session.

The Princeton HX-12 comes with a cable that plugs directly into the IBM PC, ready to burst forth into 16 superb colors. All at a suggested retail price (\$695) that's a pleasure for sore eyes and overworked budgets.

Apple IIe users: call us to learn how you, too, can now enjoy the visible superiority of the Princeton HX-12.

Ask your local dealer for a demonstration and let your eyes decide. Or call us at 800-221-1490 for more information and the name of your nearest dealer.

If you're ready to move up to color, graduate to the Princeton HX-12. It's right at the head of its class.

Now available at Computerland, Entré and local independent computer dealers.

Nationwide service provided by Bell and Howell Service Company and MAI/Sorbus Service Company.



1101 I State Road Princeton New Jersey 08540
1609 683-1660 TLX 6857009 PGS Prin
800-221-1490

DON'T COMPROMISE: Circle 253 on inquiry card.



OURS: .31mm dot pitch, 80 column text.

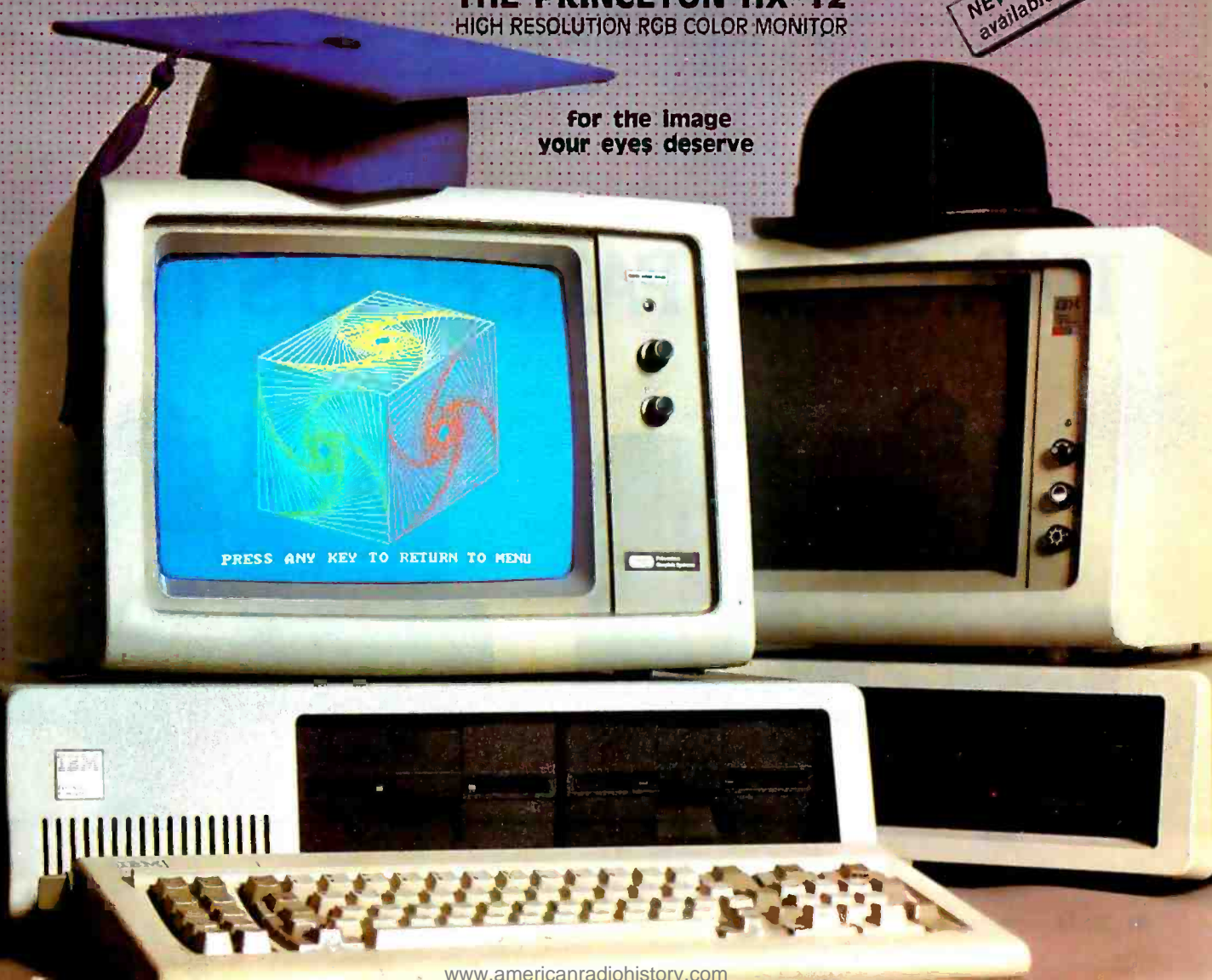


THEIRS: .43mm dot pitch, 80 column text.

THE PRINCETON HX-12 HIGH RESOLUTION RGB COLOR MONITOR

NEW: adapter available for PCjr.

for the image
your eyes deserve



rethinking about how you want to be doing what you're doing.

TRIBBLE: Early on, designing the operating system, I decided to incorporate most of the user-interface routines and procedures almost into the operating system. It was partitioned off as something called the user-interface toolbox—a set of tools that you could use to conform to the Macintosh user interface.

RASKIN: The original design documents also said that the user interface is pretty much the operating system.

TRIBBLE: But further than that, we have a problem because it is harder to conform to that user-interface standard than it is to just treat the thing as a TTY [teletypewriter]. How were we going to get all these third-party software vendors to go along with us? The strategy was not to legislate by saying, "You must do this," but to legislate de facto by putting all those toolbox routines in ROM. Then anybody who doesn't use those routines is penalized because the 64K-

byte ROM is sitting there with all these nice routines, and they're chewing up RAM with their own routines for their user interface. So it's a way of legislating a consistent user interface.

BYTE: *You started with 64K bytes and it was released with 128K bytes, and there is constant talk of a half-megabyte Mac. When did a half megabyte creep into the design philosophy?*

RASKIN: Very early on Burrell pointed out that it's very easy to make a design, once you had the 68000 in place, where you could just take out 64K-bit chips and put in 256K-bit chips. I've always believed that you just simply take the largest chip that is economically feasible to use in terms of the memory, and if they're bit-wide chips and you use 8 or 16 of them, then that should be the size of your memory. The size of memory, to be economical, should be the word length times the number of bits you have in a chip.

So it's clear that if you have 64K-bit RAMs and a 16-bit bus you get a 128K-

byte machine that's really fast. Burrell loves designing for it, software people had no trouble handling that, and it's very clean. When the 256K-bit chips come you just plug in all those and everything runs just about the same.

BYTE: *What brought Jobs to the Macintosh project? Why did he get interested in it?*

HOWARD: One reason was that Apple had no new projects in that sort of low price range, and I think it was becoming obvious that at some point people were probably going to quit buying the Apple II and Apple better have some other, at least that low if not lower-priced, project in the works. And part of it is that I think he was being sort of edged out of the Lisa project. Or that he could see that it was going off in a direction, perhaps even with his blessing, that he wasn't happy being a part of and therefore it was time for him to move on to something else.

By then it was becoming clear that Mac was the most exciting thing going

TWA. OUR 3 PAIR BEATS THEIR



on at Apple. Jobs definitely loves to be in on new projects as they get going, and he's not very able to just sit back and watch that happen. [He's] a very forceful person [who] has to get in and exert his influence.

BYTE: *What happened between Raskin and Jobs as Jobs moved into the Macintosh project?*

TRIBBLE: When I went to work for Apple, I went specifically to work for Jef. And there is an incredible difference in philosophy between Jef and Steve. In my own mind I was initially more aligned with Jef's philosophy than Steve's. I have to admit that I became somewhat influenced by Steve as time went on. I also have a somewhat Machiavellian view toward the Macintosh project. By that time I was in love with it and wanted to see it happen, and here were these bad, political things happening, kind of above my head. What I saw as inevitable was that essentially the company had turned against Jef. Things were not getting done and

were blocked here and there. It was upsetting. I almost decided to go back to Seattle right when Steve was taking over. But I made a decision that if Steve takes over the Macintosh project, then we'll have resources of the company available to us, and we won't be blocked here and there. At least we'll be able to get something done. That turned out to be partly true. But the flip side of that was that Steve is good at lots of things but not at being a boss on a one-to-one level.

BYTE: (to Raskin) *When did you leave the Mac project?*

RASKIN: I was sort of forced out. Like someone squeezing on a toothpaste tube. I resigned in February of 1982. It was gratifying that Markkula and Jobs did not accept my letter of resignation. While I disagree with Jobs in lots of ways, the *Rolling Stone* article [S. Levy, "The Whiz Kids Meet Darth Vader," March 1, 1984, page 36] made it appear as though he summarily fired me, which

is not at all true. He has not been in general a person who does that. He and Markkula asked me if I would please stay another month even if I didn't come in to work; they knew I was very unhappy there. At the end of that time they would make me an offer that I couldn't refuse.

They went back to the way it had started. They were going to set me up with a research division. This was the third or fourth or maybe the ninth or tenth—I don't remember how many—times I had been offered that and every time I had done it, something came up. And they would say, "Oh, you've got to turn this into a product; you've got to come over and put out this fire or something."

They made me the same offer over again, and I think I had finally learned that there was little likelihood of it actually happening. So I left. . . .

BYTE: *Were any of you surprised at all by the* (continued)

FULL HOUSE.



**ONLY TWA'S BUSINESS CLASS
GUARANTEES 6 SEATS ACROSS TO BOTH
EUROPE AND THE MIDDLE EAST.**



MOST AIRLINES HAVE 8.

For space and comfort across the Atlantic, the smart money's on TWA. Because TWA has 6-across seating on every nonstop from the U.S. to Europe and the Middle East. Most airlines have eight. And every seat is either an aisle seat or window seat, so you'll have more room to work, and more room to relax.

And now you get comfortable 6-across seating on every widebody TWA flies overseas—our L-1011's as well as our 747's. That's because we've folded down the two middle seats and added more legroom in our L-1011's. So now, they're more comfortable than ever.

TWA's Ambassador Class.* Just six seats across on every flight to Europe and the Middle East—not eight like most airlines.

Who's your money on?

You're going to like us



extent of the Mac hype? The scale?

HOWARD: That's something of Apple's. I guess you would call it extreme right from the start. I guess that is what has differentiated Apple from a lot of unsuccessful computer companies that have had products that were more or less comparable to Apple's—its marketing ability, its ability to really blow things up.

TRIBBLE: Apple was good at hype, for one thing. For another thing, we, the people involved in Macintosh, believed that there was something worth hyping.

HOWARD: It is a computer that you can get affectionate feelings about in a way.

RASKIN: I still think it has a lot of qualities that I wanted in it originally. Not exactly the same, many things have changed. But a lot of the feel has somehow managed to come through. I think the Mac is certainly the best of the personal computers of today.

TRIBBLE: The people who worked on Macintosh, especially that initial core group, were all emotionally involved in the machine. That is a lot of what made it turn out well.

The idea came up again and again from the early days, though, that the major problem of the Macintosh was going to be one of educating people about the machine. It's a new concept and you have to spend effort to teach people about it.

A person should be able to watch for five minutes and then sit down and do something useful. You shouldn't have to read a big manual:

Jef may not agree, but I feel that it's the mouse that allows you to do this. Because it's difficult to see what someone's fingers are doing on the keyboard

when you're watching them manipulate a program, and it's very easy to see what they're doing with the mouse.

RASKIN: I don't disagree. Except I have my strong belief that that's not a convenient thing to do for very long. It's certainly great to play with MacPaint.

BYTE: *Where did the concept of the Mac division as pirates come from?*

HOWARD: It came because of an internal public relations effort to show people who were afraid that Macintosh was turning into this giant organization, like the Navy, with lots of forms, rules, regulations, guidelines, and procedures, that this was not the case—we invented the slogan of "pirates."

TRIBBLE: Well, there is the idea of Macintosh stealing from Lisa.

HOWARD: I don't think that was intentional—I think that was the way they took it. It certainly did not improve Macintosh's relations with the rest of the company—since that made the rest of the company the Navy by implication.

BYTE: *In the very first days, was it more or less unofficial? Was it all backdoor?*

TRIBBLE: It was not a product.

HOWARD: We were calling it research partly so that nobody would be upset that we were working on these ideas.

TRIBBLE: If it's not a product we can do whatever we want.

BYTE: *There were some resources committed toward your "blue-sky" research?*

HOWARD: It wasn't that many resources were being committed. There were some bodies. Four or five of us were in a room that Apple was renting. But that was about it.

BYTE: *Did you feel like you were a secret society, in a sense?*

HOWARD: Kind of.

TRIBBLE: We made no attempt to keep ourselves secret, though.

HOWARD: We did feel that we were going off in a different direction from the rest of Apple.

RASKIN: And nobody, especially Steve Jobs, believed that we could do anything useful. Maybe a few clever ideas may come out of this group but certainly not a product. They were not going to get a product out of Raskin, Tribble and Howard. . . people who play music.

BYTE: *Is Mac a product that can evolve well?*

HOWARD: In a sense that any computer can because you can write an infinite number of programs on it.

RASKIN: The Mac in particular is easier to write infinite numbers of programs on than most computers.

TRIBBLE: It's a generalist's computer. It's a bit-mapped screen with some memory and a processor.

HOWARD: With some limitations, you can hook almost any piece of hardware to it through high-speed serial ports. And people will go on plugging all kinds of weird things in it.

BYTE: *Could Mac be done again in 1984?*

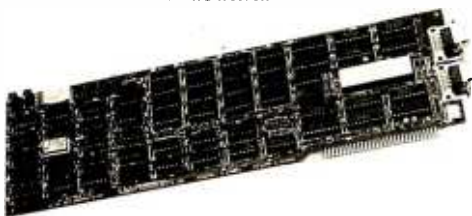
HOWARD: I think it could, but only by a similar process, a little group splintering off, working separate from the big group. I don't think it could be done on purpose, as Macintosh was not done on purpose.

RASKIN: From my point of view it was done on purpose, but from Apple's point of view it was an accident.

HOWARD: Actually Steve Jobs would support that kind of thing. That is the kind of thing that Jobs will go out on a limb for. ■

ULTRA-RES™ GRAPHICS

Available from stock



WHEN RESOLUTION COUNTS

Advanced feature display controllers for IBM-PC / XT and compatible systems. Features include NEC7220, programmable resolution to 1024X1024, slave controllers, transparent mode allows monochrome adapter and ULTRA-RES on same monitor. DMA compatible, light pen, externally powerable. Monitor protection circuits. Video outputs are TTL, direct drive or analog. Software drivers.

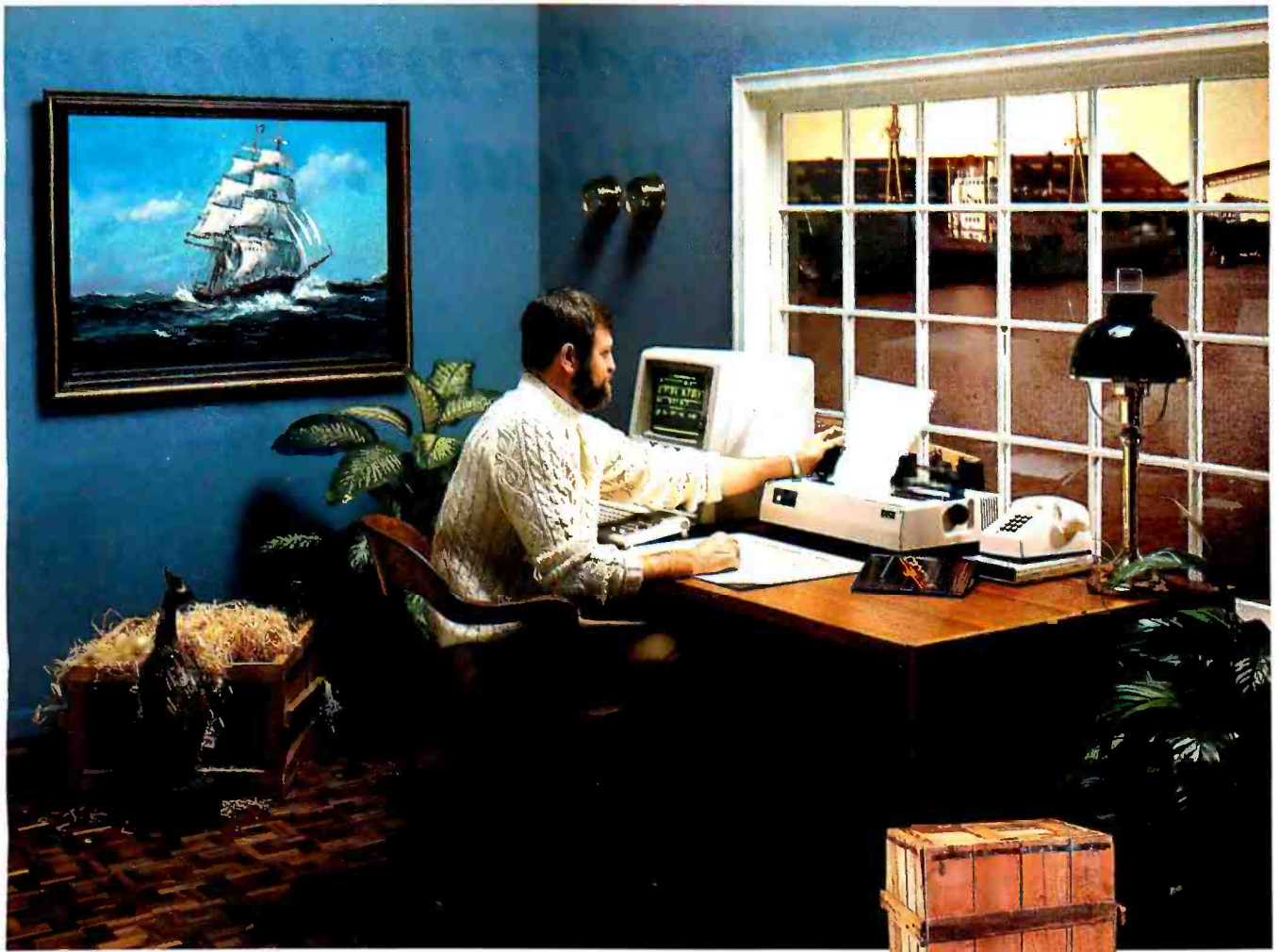
C.S.D. Incorporated
P.O. Box 253 SUDBURY, MA 01776

(617) 443-2750

ULTRA-RES Trademark CSD Inc
IBM-PC Trademark IBM

Prices from \$995

ULTRA-RES.
a family of graphic controllers for IBM-PC / XT and S-100 systems



International Connections

With the industry's most popular data communications program, the world is at your command.

An import/export office in New Jersey can instantly check the London market for current dollar exchange rates ... send Hong Kong an updated production schedule ... print-out the week's sales results from the Dallas branch.

There's virtually no limit to how far you can reach with your microcomputer, ordinary telephone lines, and CROSSTALK.

Even if your own business and personal needs are closer to home, you'll appreciate CROSSTALK's compatibility with a wide user base ... smart terminal characteristics ... total modem control ... and the ability to capture data at a high speed for later off-line editing. CROSSTALK has extras you may not find in other programs. Data capture to memory buffer (and on-line display). Protocol error-checking file transfer. Modem/telephone hangup, and display of elapsed time of call. Command file power and flexibility. Remote takeover and operation. And much more.

There is a CROSSTALK version for almost every CP/M, CP/M-86, or IBM DOS based microcomputer system. See your dealer, or write for a brochure.



CROSSTALK™

MICROSTUF®

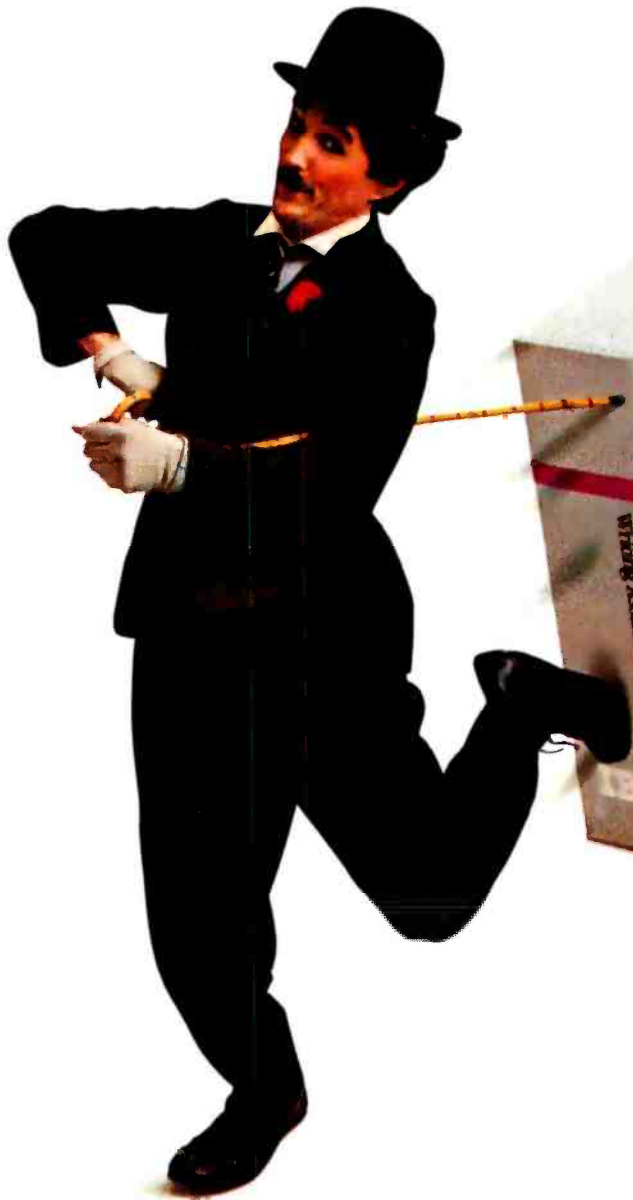
1845 The Exchange / Atlanta, Georgia 30339 / (404) 952-0267

CROSSTALK is a trademark of Microstuf, Inc. CP/M and CP/M-86 are trademarks of Digital Research, Inc. IBM is a trademark of International Business Machines, Inc.

Circle 213 on inquiry card.

AUGUST 1984 • B Y T E 357

Introducing the new United they stand.



Programs in IBM's Assistant Series are like actors in a play. Alone, each gives an outstanding performance. Together, they've been directed to act well as a troupe. (In the software world, this interaction is called "integration.")

Just as actors can easily perform on different stages, these programs can easily work on different IBM personal computers—from PCjr to larger systems like PC/XT.

How integrated software works.

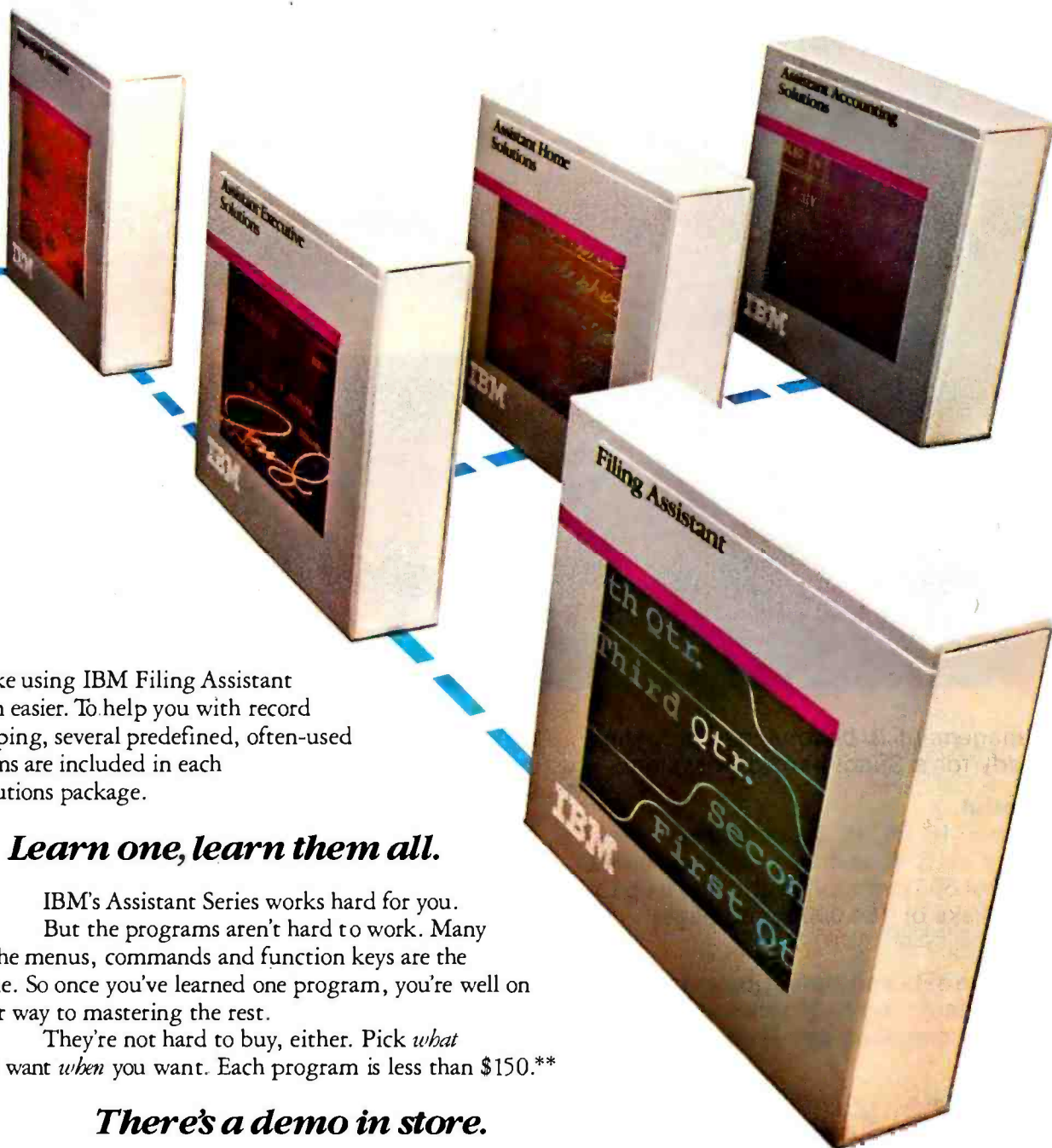
Want to get your facts and figures in order? Start with IBM Filing Assistant. Then, to print the facts in tabular form, add IBM Reporting Assistant. To write about what you've been working on (and make sure the spelling's accurate), use IBM Writing Assistant—the word processing program. Want to put a chart in the middle of your text? Use IBM Graphing Assistant. It takes data directly from IBM Filing Assistant to turn numbers into pictures. When it's time to think ahead with schedules and forecasts—get IBM Planning Assistant,* the spreadsheet program. The finishing touch? IBM Assistant Solutions. They

Little Tramp character licensed by Bubbles Inc., s.a.

* Available early next year.

** Prices apply at IBM Product Centers

IBM Assistant Series. Divided they stand.



make using IBM Filing Assistant even easier. To help you with record keeping, several predefined, often-used forms are included in each Solutions package.

Learn one, learn them all.

IBM's Assistant Series works hard for you.

But the programs aren't hard to work. Many of the menus, commands and function keys are the same. So once you've learned one program, you're well on your way to mastering the rest.

They're not hard to buy, either. Pick *what* you want *when* you want. Each program is less than \$150.**

There's a demo in store.

We've shown you how affordable the new IBM Assistant Series is. But we can't show you how easy. Your dealer can. Simply ask for a demonstration. For the authorized IBM Personal Computer dealer or IBM Product Center near you, call 800-447-4700. In Alaska or Hawaii, 800-447-0890.

Personal Computer Software

IT ALWAYS STACKS UP IN FAVOUR OF SUNOL



Sunol Winchester disk drive
replaces up to 2570 floppy disks,
increases your speed up to 1000%
and costs surprisingly little.



If data management is becoming a problem, you are ready for a Sunol hard-disk system.

We're Powerful

Choose from 8, 16, 25, 40, 65, or 92 megabytes per drive and up to four drives per controller. That's a total of 368 megabytes and that's up to 2570 floppy disks or 184,000 typed pages.

We're Fast

You've got more data and almost instantaneous access to that data ... up to 10 times faster than a floppy - 7.5 megabits per second transfer rate.

We're Compatible

You can connect your Sunol to the IBM PC and compatibles, Apple II and III, TI, Victor 9000, DEC, Epson QX-10, Zenith and more.



We're Connected

Use your Sunol to network with SUN*NET. SUN*NET can handle up to 64 users at a time and with seven different operating systems all on the same Sunol disk. Sunol's disk is also compatible with Omnet, PC Net, or Ethernet.

We Have Back-Up

Our optional 23 megabyte random access type cartridge gives you the back-up you need. And you can access it as a 23 megabyte floppy of on-line disk storage.

We're Clear

Our dynamic display lets you know exactly what the drive is doing at every moment.

We're Reliable

Sunol's Error Correction Code and off-line diagnostics give you the reliability you expect.

COMPARE SUNOL FEATURE FOR FEATURE

Then compare price. There is no better value. There is no better Winchester disk drive.

IBM P.C. is a registered trademark of International Business Machines Corporation.
P.C. Net is a trademark of Orchid Technology.
Apple is a registered trademark of Apple Computer Inc.
Omnet is a trademark of Corvus Systems Inc.

1072 Serpentine Lane, Pleasanton, California 94566 • (415) 484-3322 Telex: 703175

Circle 291 on inquiry card.

www.americanradiohistory.com

Microprocessor Design

The
Transputer
and its
special
language,
Occam

BY DICK POUNTAIN

BYTE readers probably are not used to thinking of Britain as a source of major innovation in computer design. The cost-cutting miracles wrought by Sir Clive Sinclair are perhaps the only examples that have crossed the Atlantic, and even those computers had limited commercial success.

Nevertheless, there is a lot of innovative work going on in these depressed isles, and some of it is at the advanced end of processor design.

The most exciting work of this sort is taking place at INMOS, the transnational semiconductor enterprise set up in 1978 with part funding from the British government. INMOS has manufacturing facilities in Colorado Springs in the United States and at Newport in the United Kingdom. So far its product range has been confined to high-speed static and dynamic RAMs (random-access read/write memories) aimed at high-performance mainframe and minicomputer markets. However, at the U.K. design center in Bristol, a research program is about to bear fruit in the shape of a revolutionary VLSI (very-large-scale integration) microprocessor chip called the Transputer.

The Transputer is INMOS's contender in the struggle over the next generation of microprocessors. It is pitted against the likes of the NS 16032 and the Intel 80286. But the design philosophy that underlies it is very different from that of its competitors. It is intended to be a "programmable component," hence the name, which is an amalgam of transistor and computer. The Transputer is designed to communicate with other Transputers in parallel-processing networks so that as many of them as desired can be applied to a particular task with minimal overheads in processor time and physical interconnections. Even more important, the same program can be run on a single Transputer or a network of communicating devices.

This sort of system design, using many processors working simultaneously on the same data, is widely recognized as an essential step in building the so-called "fifth generation" of computers. Fifth-generation systems will have to search huge databases if they are to per-

form natural-language processing and other "intelligent" activities. VLSI guru Carver Mead has suggested that "an additional four orders of magnitude of computational capability are available through concurrent processing." Connecting conventional microprocessors together to perform parallel processing is a tedious chore, complicated by the need for (ever wider) parallel buses to be securely shared and by terrifying problems of synchronization.

The Transputer avoids these problems by communicating over high-speed serial links (running at 1.5 megabytes per second, full duplex), and by having the necessary synchronization built into its instruction set.

Engineering samples of a 32-bit Transputer (designated the IMS T424) are expected in the last quarter of 1984. This chip will have four high-speed serial links, 4K bytes of ultrahigh-speed RAM, an external memory interface, and a peripheral interface on the silicon slice. Other processors planned for this family may have fewer serial links and varying amounts of on-chip RAM.

The T424 is a reduced-instruction-set computer (RISC). It has only 64 instructions, and they are designed to render the processing of concurrent tasks as efficient as possible. INMOS achieves this by using a stack-based architecture in which the 4K bytes of on-chip RAM serve in place of the registers of a conventional microprocessor. Different concurrent tasks have their own workspace among these registers, and switching tasks is merely a matter of switching a pointer to the workspace. The processor contains its own logic to schedule these tasks. A clever choice of instruction format, whereby instructions can be built up in 4-bit chunks, allows 16- or even 64-bit designs to be added to the range and to have compatible code. Virtual memory operation has been rejected in favor of a uniform address space—a T424 can directly address up to 4 gigabytes of external RAM.

(continued)

.....
Dick Pountain is a technical author and software consultant living in London, England. He can be contacted at BYTE, POB 372, Hancock, NH 03449.

The Transputer's various hardware modules run concurrently. The fact that the serial links, memory interface, and processor can all operate simultaneously makes communication inexpensive. Off-chip communication between Transputers is asynchronous so they don't have to share a common clock signal, and delays in the point-to-point connecting lines can be tolerated within broad limits.

INMOS is confident that the Transputer will be capable of running at 10 MIPS (million instructions per second) with a modest 5-MHz clock—two orders of magnitude faster than current microcomputers. This will be accomplished by using 2-micron CMOS (complementary metal-oxide semiconductor) technology with silicide interconnect and a reduced instruction set with I-byte instructions, and by having the various components of the chip all working in parallel.

OCCAM'S RAZOR

Full exploitation of the Transputer's potential for concurrency requires a new programming language. Some existing languages such as Concurrent Pascal, Ada, Modula-2, FORTH, and Simula can be used to write parallel programs, but in all of these a programmer has to arrange for synchronization of parallel processes that want to "talk" to each other (usually by setting special flags called semaphores to signal that a result is ready). This makes great demands on a programmer's mental picture of the program's execution in real time.

INMOS designed a new language called Occam to program the Transputer. In fact, the Transputer and Occam were designed concurrently, so the Transputer will directly execute Occam programs. Occam is the Transputer's assembly language. It's also a general-purpose programming language that can be run on conventional processors by time-shared simulated concurrency.

Occam was developed by David May of INMOS and Professor C. A. Hoare (perhaps Britain's leading computer scientist) of Oxford. The name of the language comes from William of Occam, the 14th-century Oxford philosopher whose principle: "Entia non sunt multiplicanda praeter necessitatem" ("Keep it simple, dummy!"), is better

known as Occam's razor.

With only 22 reserved words, Occam is a small and elegant language. It combines the best of contemporary thought about control structures and variable scoping with some radical new structures to handle concurrency. It can be used as a general calculus to describe concurrent activities in any field, much as pseudo-Pascal is often used to describe sequential algorithms.

Occam is based on a model of computation that is different from conventional languages in that it includes the notions of communication, parallel execution, and synchronization in its very structure. I/O (input/output) and interrupts are handled at high level and are transparent to the programmer. Occam is designed for system programming. It has only integer arithmetic and no built-in support for file and string handling or graphics, although floating-point and multiple-precision arithmetic are planned as future enhancements.

The basic unit of Occam programming is a "process" that performs a sequence of actions and then terminates. This is similar to ordinary programming languages, but in Occam there may be more than one process executing at any given moment. There are three primitive processes: input, output, and assignment. All other processes are constructed from these building blocks. The input and output processes transfer a word (32-bit in the latest version) from a "channel" to or from a variable. For example,

```
tube ! x
```

outputs the value of variable *x* to a channel called "tube," while

```
tube ? y
```

inputs the value into variable *y*. Channels, like variables, must be declared at the beginning of the process in which they are used. Physically they might be implemented as serial communications links between different Transputers or as memory locations that let independent processes inside the same Transputer exchange data—to Occam it doesn't matter. Channels are one-way (you can't input and output from one within the same process) and self-synchronizing, so that communication only occurs when both the input and output processes are ready. Some channels,

such as "keyboard" and "screen," may be predeclared by the system.

The Assignment process merely changes the value of a variable as in Pascal or BASIC:

```
x := y + 10
```

The simplest type of compound process is the kind called SEQ (for sequential). In the following program fragment:

```
VAR x:
SEQ
  keyboard ? x
  screen ! x
```

the input and output processes are executed one after the other as in any ordinary programming language. The indentation is not optional; it marks the extent of a subprocess. A two-character indent is required for each level of nesting (equivalent to begin...end). The only separator required (other than indentation) is a colon that indicates the end of a declaration. Incidentally, the preceding program merely allows you to type a single character on the screen. Processes can be given names (like procedures) so you could say

```
PROC echo =
VAR x:
SEQ
  keyboard ? x
  screen ! x:
  (- rest of program)
```

Note the colon at the end as we are declaring a process.

Two novel kinds of compound processes are PAR (parallel) and ALT (alternative). PAR indicates that the subprocesses that follow it (on paper) will be executed concurrently. If these processes have to communicate with each other via a channel, then whichever is ready first will automatically wait for the other to become ready. Synchronization is built into Occam and programmers need not worry about it. For example,

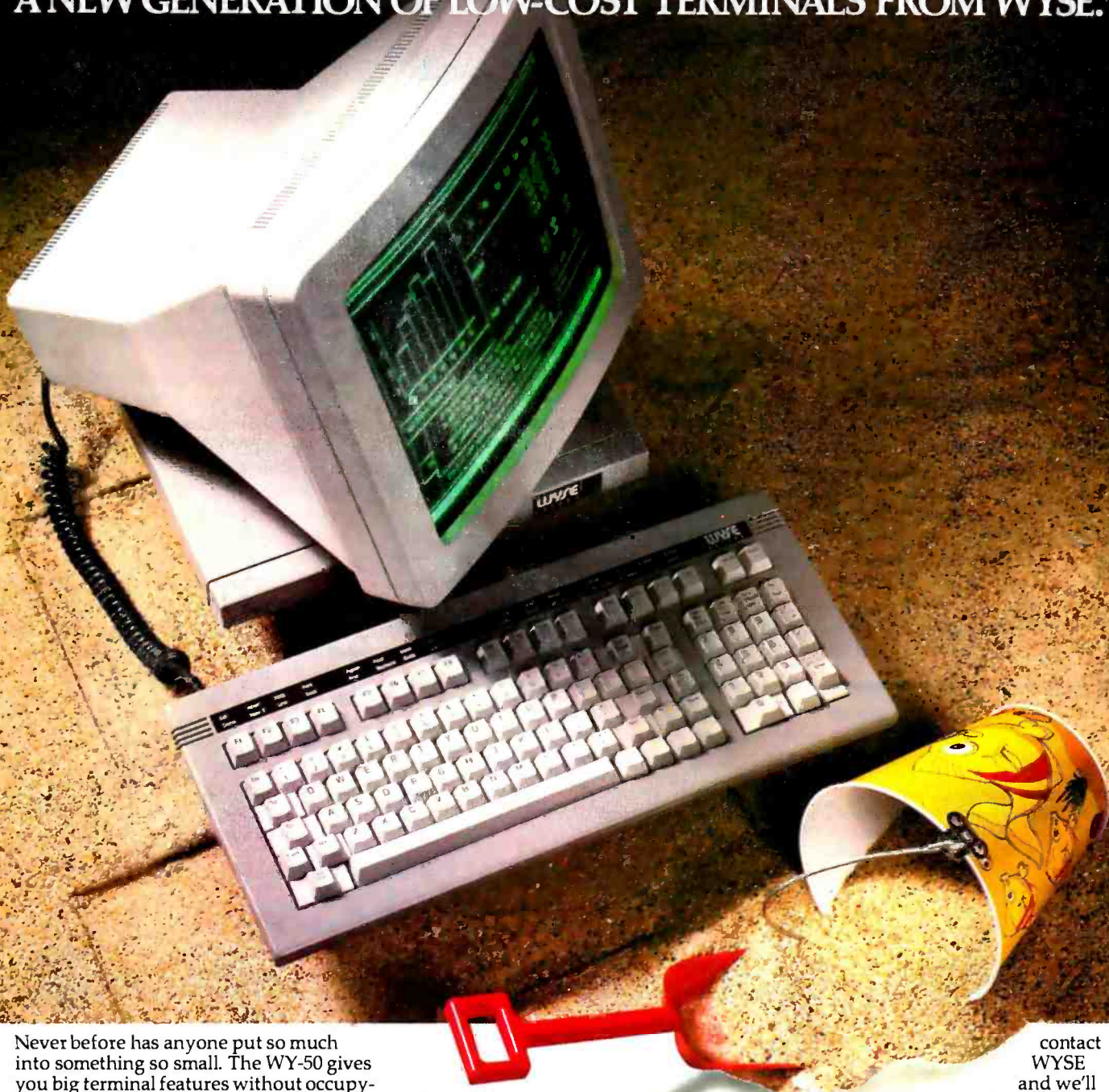
```
CHAN signal:
PAR
  VAR x:
  SEQ
    keyboard ? x
    signal ! x
  VAR y:
  SEQ
    signal ? y
    screen ! y
```

[continued]

THE WY-50.

PRETTY SMALL

A NEW GENERATION OF LOW-COST TERMINALS FROM WYSE.



Never before has anyone put so much into something so small. The WY-50 gives you big terminal features without occupying your entire work-space. This took revolutionary design. Design a lot of people couldn't accomplish for the price. But we did.

In fact, the WY-50 introduces a new standard for low-cost terminals. You get a compact, full-featured design that meets the most advanced European ergonomic standards. 30% more viewing area than standard screens. And a price tag as small as they come.

The WY-50 sells for only \$695.00.

FEATURES:

- 14" screen.
- 80/132 column format.
- Soft-set up mode.
- High resolution characters.
- Low-profile keyboard.
- Industry compatible.
- Only \$695.00.

For more information on the revolutionary design, outstanding features and unique good looks of the new WY-50,

contact WYSE and we'll send you a brochure filled with everything you need to know. The WY-50. The full-featured terminal with the small price.

WYSE

Circle 334 on inquiry card.

Make the Wyse Decision.

WYSE TECHNOLOGY 3040 N. First St., San Jose, CA 95134, 408/946-3075, TLX 910-338-2251, Outside CA call toll-free, 800/421-1058, in So. CA 213/340-2013.

The two sequential subprocesses run at the same time. The first waits for an input from the keyboard, the second waits for a "signal" message on the channel. When a key is pressed, the first process can terminate, allowing the second one to do so. The net result is the same as in our first example but the character has been passed between two processes on its way to the screen. Note that all variables are local to a single process (so I could, unwisely, have declared *x* for both) and they are deallocated (cease to exist) when it terminates. The order in which the processes are written on paper is irrelevant in a PAR construct: each waits until its input or output is ready.

The ALT construct provides a novel and elegant way of choosing between parallel processes in the time dimension. It sits and watches a group of input channels and then executes the process attached to whichever one delivers an input first. If two or more inputs occur simultaneously, then ALT chooses in a way that will be implementation dependent but which avoids any channel becoming permanently locked out. There is a provision called PRI ALT for

allocating priorities to the processes. Here's a typical ALT:

```
CHAN signal:
VAR Y:
ALT
  keyboard ? y
  SEQ
  screen ! y
  signal ? ANY
  SEQ
  (-do something interesting)
```

As part of a larger program this will either type a character on the screen or "do something interesting," depending on whether "signal" becomes ready before you press a key. The key word ANY throws away the input value instead of storing it—the input is then merely a signal to do what comes next. Each input process in an ALT construct can also have a logical condition (called a guard) in front of it. The process can then execute only if it's the first to receive input and the guard is true.

More conventional selection is done with IF, although it requires NO THEN or ELSE. Instead, IF is followed by a series of one or more conditions and it executes the process associated with the

first one that is true (on paper this time), so it also functions as a CASE statement:

```
IF
  x = 1
  output1 ! x
x = 2
  output2 ! x
```

Loops can be programmed using WHILE <condition> ... but a far more powerful kind of repetition using the less-conventional "replicator" is available, which allows any of the previously mentioned compound processes to be cloned a stated number of times. For instance, PAR *i* = [0 FOR *n*] creates an array of *n* parallel processes whose components can be accessed by the value of the index *i*. When used with SEQ, the replicator produces an iteration equivalent to a FOR ... NEXT loop, while ALT *i* = [0 FOR *n*] chooses from an array of *n* channels.

Occam's other features include the provision of arrays of variables or channels that can be passed as parameters (of unspecified size) to processes. Named constants and tables of constants (including string literals) can be defined, and string handling is done with byte arrays, as in C or FORTH.

TIME, a special input channel, caters to 'real-time programming': it is always ready and returns the current time from the system clock. When used with AFTER, it causes a process to wait until a given absolute time:

```
TIME ? AFTER t
```

This use of absolute times rather than relative delays simplifies the programming of device controllers because a programmer doesn't need to worry about how much time the actual control actions take. Many of the operations that are the stock-in-trade of communications engineers can be expressed in a single Occam process. For instance, a set of channels can be multiplexed with a replicated ALT, or a pipeline of filters could be set up using a replicated PAR. A sample Occam program is shown in listing 1.

Occam has an advantage over conventional languages for concurrent programming in that a program can be developed on a single processor and then run unaltered on any number of Trans-

(continues)

Listing 1: This short program illustrates many of Occam's features. It's a simple editor that allows text to typed on the screen. However, in the background is a "time-bomb" that inserts the word "WHAM!" into the text at regular real-time intervals.

```
PROC bang (CHAN send) = - PRINT STRING
  DEF bang word = "WHAM!"; - set up string as a byte vector
  SEQ i = 0 FOR bang word [BYTE 0] - first byte contains count
  send ! bang word [i]; - output string to channel

PROC bomb (CHAN ready) = - BACKGROUND PROCESS
  DEF time fuse = 1000; - a constant
  VAR count;
  WHILE TRUE - an endless loop
  SEQ
  count := 0
  WHILE count < time fuse - a delay loop
  SEQ
  count := count + 1
  ready ! 'a'; - send an 'a' as ready signal;
  - lany value would do)

CHAN scare: - MIN PROGRAM BODY
PAR
  bomb (scare) - runs continually in background
  VAR char;
  WHILE TRUE
  ALT
  keyboard ? char - receive char from keyboard
  SEQ
  SCREEN ! char - echo to screen
  scare ? ANY - throw away the 'a'
  SEQ
  bang (screen) - put WHAM! on screen
```


THE SAKATA CONNECTION

Your personal computer deserves the unequalled monitor quality of Sakata

Your computer deserves the most monitor quality value possible...and so do you. SAKATA CRT DISPLAY MONITORS give you more monitor quality than the most expensive monitors available. Each SAKATA MONITOR provides unequalled color reproduction; sharpest and most vivid graphics; text that you read more easily than you ever expected; and technical characteristics and capabilities that will amaze you.

Protect your personal computer's

performance by utilizing SAKATA CRT MONITORS which provide the utmost in monitor value. Choose from an entire line of Composite Color; RGB High Resolution Color; RGB Super High Resolution Color and two monochromes (green and amber) that have more quality than other monochrome monitors. **"We promise performance".**

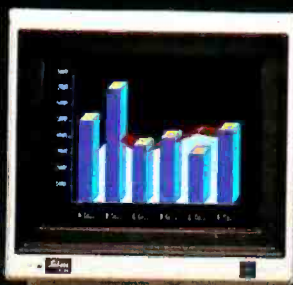
SAKATA CRT MONITORS are available wherever personal computers are sold or write for technical and illustrated literature and prices.

SAKATA U.S.A. CORPORATION
651 Bonnie Lane, Elk Grove Village, IL 60007
(312) 593-3211 800-323-6647 (outside Illinois)

Sakata

"Serving industry worldwide since 1896"

SC-100
COLOR COMPOSITE



SC-300
RGB SUPER HIGH
RESOLUTION COLOR



SC-200
RGB HIGH
RESOLUTION COLOR



SA-1000
MONOCHROME AMBER



SG-1000
MONOCHROME GREEN



The integrated "smart" editor understands the syntax of Occam.

puters sharing parallel processes for faster execution. This requires use of a construct called the PLACED PAR, which specifies a destination processor. The decision about how many processors to use can be left until the last minute and made on cost/efficiency grounds without affecting the program design.

Because the Transputer is not yet available, INMOS decided to produce a demonstration Occam compiler so programmers could get some experience with it now. The Occam Evaluation Kit has been on sale for about a year now and it runs under the UCSD p-System on various personal computers including the Apple II, IBM PC, and the Victor 9000. This kit implements all the major aspects of the language except for PLACED PARS, but it has only two channels to the outside world—the pre-defined "keyboard" and "screen." It is highly suitable for learning the language, but rather slow in compiling and execution because concurrency is only simulated on the single processor by time-slicing (p-code is not fast anyway).

INMOS currently is putting the final touches on the production compiler, which is written in Occam and will run first on the DEC (Digital Equipment Corporation) VAX, compiling to native code. It should be available to developers by the time you read this. To write the compiler in Occam, a "tiny" Occam that left out ALT and some other constructs was written; it is used to bootstrap the full compiler. The compiler is written in modular fashion, so that code generators for the Motorola 68000, Intel iAPX series, and the Transputer itself can be bolted on later. (INMOS has a Transputer emulator running on the VAXes at Bristol.) The compiler also uses concurrency with the lexer, parser, scoper, and generator passes running in pipelined fashion and communicating via channels. When Transputers are available, INMOS will use several in a development workstation to achieve compile times at least five times better than possible on an equivalent sequential machine.

The compiler has an integrated "smart" editor that understands the syntax of Occam. For example, it handles all the indentation automatically. Rather than taking the fashionable mouse-and-icon route, the design team chose to follow a less popular path: it used a "folding" editor similar to that developed in Cornell University's Program Synthesizer. The folding editor is a full-screen text editor with the facility for any process body to be folded out of sight (like an accordion) at a single key-stroke, so all that appears on the screen is a dotted line bearing the name of the process. Another keystroke unfolds the procedure and reveals its code.

Folds can be nested to any depth so an entire program (with all its sub-processes neatly folded away) can be displayed on a single screen. While not as pretty as overlapping windows, this technique has the advantage of being able to work on the humblest of text-only serial terminals—it doesn't require an ultrahigh-resolution bit-mapped screen. In the final product these folds will work under a FORTH-like virtual-memory system so that when you unfold a process, its source code will be automatically retrieved from disk if it isn't already in memory.

A CHECK command performs a syntax check on the current fold using the cursor to pinpoint the site of the error, so a program should be completely free of syntax errors by the time it's really compiled. The aim is to create a programming environment that is almost as interactive as a good BASIC interpreter.

On a multi-Transputer system, recompilation should be so fast that library routines can be kept in source form and combined in the editor. For other host systems, it's likely that separate compilation (as in C or Modula-2) will be included, with the fold as the compilation unit. However, linking machine-code modules is possible through the host machine's operating system so that users who are programming processors other than the Transputer can write drivers for the serial ports that implement Occam's external channels.

Though the language itself is small, the requirements of compiling parallel processes make the compiler fairly greedy; it occupies around 78K bytes of RAM and around 90,000 words of workspace on a VAX. Ongoing optimiza-

tion work is aimed at reducing these requirements, and, by the time the compiler is released (late summer target date), 68000-based systems like the Sage IV with 256K bytes of RAM should support it comfortably.

CRAY ON A DESK?

If all goes as planned, the Transputer and Occam promise to have dramatic effects on computer design. Initial interest is coming, predictably, from designers with a vested interest in communications. The first commercial applications probably will be in the areas of digital-signal processing, process control, and telecommunications. At London's Imperial College, a team working on a parallel supercomputer to run fifth-generation functional languages has chosen Transputers as the processing elements, largely because of their fast I/O.


A network of Transputers could be indispensable in a wire-guided aircraft-control system in which each airframe subsystem could possess its own intelligence and the whole system could reconfigure itself under software control in the event of failure.

Performance projections of a two-dimensional array of Transputers in computing discrete Fourier transforms were published by INMOS at Westcon 83; these projections promise supercomputer power without custom-hardware expense. Similar arrays (or trees) of Transputers can be used for ultrafast database searches.

The Transputer also promises great things for personal computer design. The family of Transputer chips will include an intelligent disk controller (IMS M212) and a graphics controller (IMS G213) that will draw at 4 megabits per second. Both chips can act as parallel processors in addition to their specialized functions. A workstation containing these two controllers and one or more 32-bit Transputers would make a formidable CAD/CAM (computer-aided design/computer-aided manufacturing) system in a single box. The sort of advanced user interfaces presaged by Xerox's Alto and Apple's Lisa and Macintosh would barely tax the capabilities of such a machine, to which more processing power could be added as necessary in the form of multi-Transputer boards. ■

Telecommunications Engineers

The Engineering Muscle And The Technical Talent To Lead A Telecommunications Revolution... Right Here With Hayes In Atlanta.



We've built a powerful engineering and technical team here at Hayes. It's been our strength and the reason for our success from the very beginning. Our focus has been on recruiting and developing the talent it takes to do more than merely compete, but to lead. The result has been a success story few in the industry can equal.

For those of you who have searched far and wide for just such an environment, where talent is provided the freedom and encouragement to grow, then perhaps it's time to take a good, hard look at Hayes in Atlanta. There's a future in it.

- PROJECT MANAGERS
- RESEARCH ENGINEERS
- RELIABILITY/
TESTABILITY
ENGINEERS
- PRODUCT ENGINEERS
- SENIOR SOFTWARE
ENGINEERS
- SOFTWARE
DEVELOPMENT
PROGRAMMERS/
ANALYSTS

Interested, qualified candidates should forward a confidential resume to: **Hayes Microcomputer Products, Inc., Dept. TJC-84, 5923 Peachtree Industrial Blvd., Norcross, GA 30092.** An Equal Opportunity Employer, M/F.

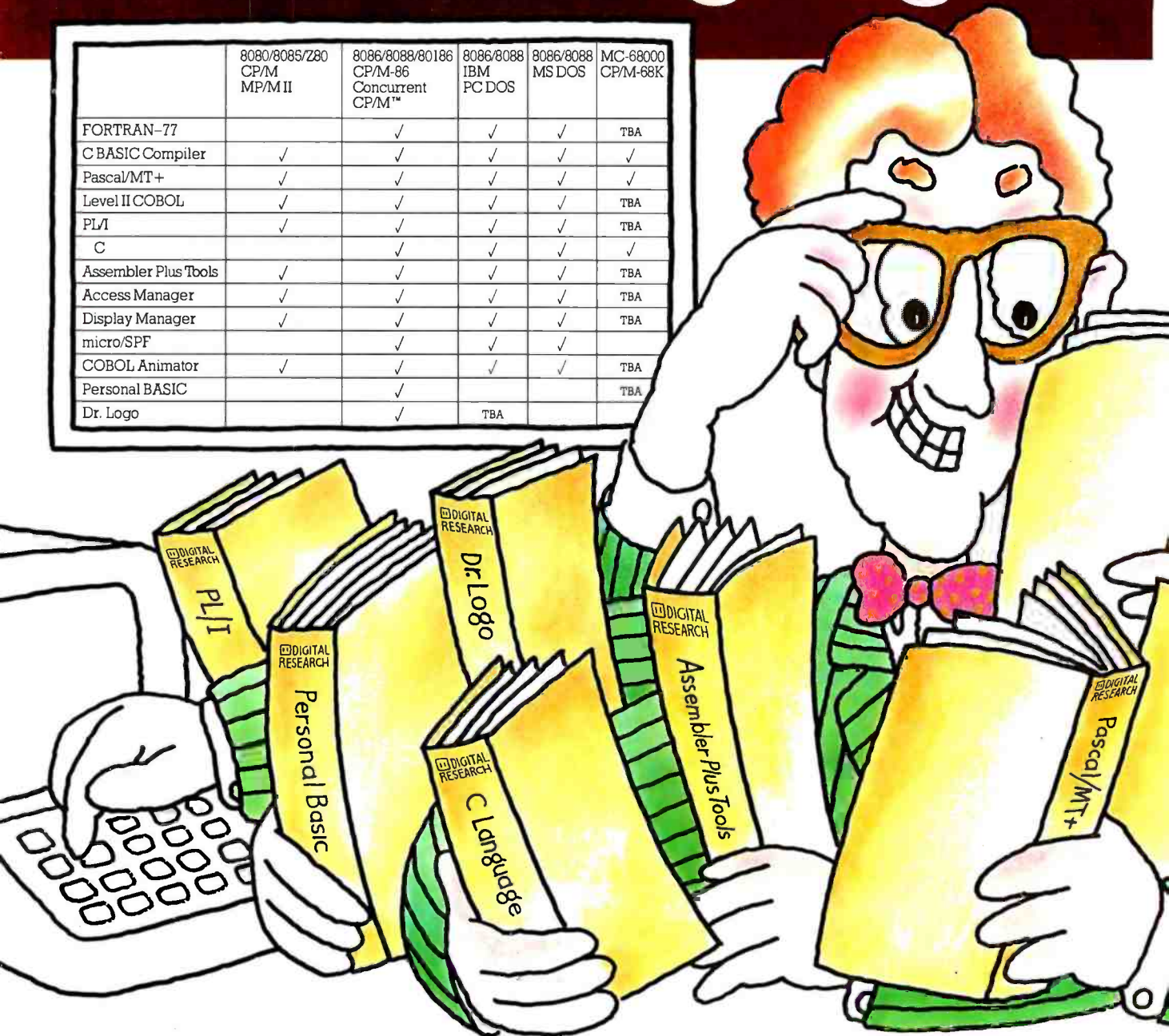
Opportunity for
the here and now.

 **Hayes**

Hayes Microcomputer Products, Inc.

We wrote the book on portability. In nine different languages.

	8080/8085/Z80 CP/M MP/MII	8086/8088/80186 CP/M-86 Concurrent CP/M™	8086/8088 IBM PCDOS	8086/8088 MS DOS	MC-68000 CP/M-68K
FORTAN-77		✓	✓	✓	TBA
C BASIC Compiler	✓	✓	✓	✓	✓
Pascal/MT+	✓	✓	✓	✓	✓
Level II COBOL	✓	✓	✓	✓	TBA
PL/I	✓	✓	✓	✓	TBA
C		✓	✓	✓	✓
Assembler Plus Tools	✓	✓	✓	✓	TBA
Access Manager	✓	✓	✓	✓	TBA
Display Manager	✓	✓	✓	✓	TBA
micro/SPF		✓	✓	✓	
COBOL Animator	✓	✓	✓	✓	TBA
Personal BASIC		✓			TBA
Dr. Logo		✓	TBA		



To every software developer who'd written off portability as an impossible dream, Digital Research humbly announces a few monumental breakthroughs.

We not only offer languages that are portable from 8 to 16 to the 32-bit chips of the future, they're portable across all popular operating systems, too. What's more, we supply the broadest range of quality languages and development tools available today. And will tomorrow.

So rest assured. Whether you design applications at a major corporation, plan to become a major corporation or just qualify as a hobbyist, you only have to write it once.

Simply pick the Digital Research language that's right for you. From Personal BASIC™ to Digital Research FORTRAN-77.™ The newest member of our remarkable family.

To complement languages, we offer a complete workshop of development tools. Our Display Manager™ and Access Manager™ simplify the design of screen displays and data bases. So you spend less time and effort.

If you write in COBOL, our Animator™ source level debugger will get your software running in record time.

And for programmers skilled with IBM mainframe SPF, we offer micro/SPF.™ An editor that helps turn your invaluable experience into valuable new software applications.

At Digital Research, we work as hard for you after the sale as we do to get the sale. With backup like quality documentation, software updates and a phone line to our technical support team.

With so much productivity and service to draw on, it's small wonder IBM chose our languages for its IBM®PC, XT and the new IBM 3270/PC.

For more information, or the name of the Digital Research retailer nearest you, call 800-227-1617, ext. 400. In California, 800-772-3545, ext. 400. Or call your IBM representative directly.

micro/SPF is a trademark of Phaser Systems, Inc. Animator and Level II Cobol are trademarks of Micro Focus, Ltd. IBM is a registered trademark of International Business Machines Corporation. The Digital Research logo and products are either trademarks or registered trademarks of Digital Research Inc. ©1984 Digital Research Inc. All rights reserved.



LOOK NO FURTHER!
we'll get you low
prices and fast
service, or else!



ALPHA OMEGA

COMPUTER PRODUCTS

COMPUTERS

TAVA PC IBM Compatible, 128K,
 3-320K Drives, Parallel Port,
 Monitor \$1989
 SANYO MBC 555 w/software 1049
 SANYO MBC 555-2 w/software 1420
 IBM PC 64K, 2-320K Drives,
 Color Graphics Board,
 DOS 2.1, Amdek 300G 2669

DISKETTES

SCOTCH 3M SSDD \$23
 MAXELL MD2 DSDD 39

PRINTERS

C. ITOH 8510 P. 120 cps SAVE
 EPSON FX80 160 cps \$495
 EPSON FX100 160 cps 695
 OKIDATA Microline 92 160 cps 425
 OKIDATA Microline 93 160 cps 699
 BMC BX-80 Printer 259
 GEMINI 10X 120 cps 275
 GEMINI 15X 120 cps 409
 NEC 3550 35 cps L/Q SAVE
 JUKI 6100 L/Q 18 cps 445
 C. ITOH F-10 40 cps 1075

MODEMS

HAYES Smartmodem 1200 482
 HAYES Smartmodem 1200B 425
 HAYES Micromodem IIe 249
 ANCHOR A. Mark I 300 Baud 81
 ANCHOR A. Mark XI 300/1200 269

MONITORS

TAXAN 12" Amber \$115
 GORILLA 12" Green 85
 AMDEK 310A for IBM PC 169
 AMDEK 300G 12" Green 135
 AMDEK 300A 12" Amber 145
 AMDEK Color I 13" 305
 PRINCETON HX-12 RGB 495
 BMC 13" Color 219

APPLE PERIPHERALS & SOFTWARE

VIDEX Videoterm 80C
 w/softswitch \$209
 VIDEX Ultraterm 279
 MICROSOFT 16K RAMcard 69
 MICROSOFT 280 Softcard 245
 MICROSOFT Premium Pack 479
 MICROSOFT Premium Softcard
 IIE 345

KRAFT & TG Joystick 45
 HAYES Mach II Joystick 99
 PROMETHIUS 1/2 Height Drives 195
 WIZARD IPI Parallel Interface 75
 PROMETHIUS Versacard 149
 EPS Keyboard 289
 KENSINGTON Systemsaver 68
 COOL & TIME (fan, surge, clock) 75
 KOALA Pad 93
 PFS Filing System 81
 PFS Report 81
 DBase II 389
 Wordstar 249
 Home Accountant SAVE
 Multiplan 165
 DB Master Version 4 249
 DB Utility 1 or 2 95
 Magic Window II 109
 Zaxxon 29
 Choplifter 25
 Zork I/II/III 28
 Wizardry 39
 Sublogic Pinball 27

IBM PERIPHERALS & SOFTWARE

TANDON TM100-2 360K \$219
 PANASONIC 1/2 Height 360K
 Drives 179
 MICROSOFT Mouse 139
 QUADRAM Quadboard w/64K 269
 QUADRAM Quadlink SAVE
 QUADRAM Quadcolor I 209
 64K RAM Kit 200 ns 55
 AST 6-pack plus 279
 STB w/64K clock, par, serial,
 game 295
 HAYES Mach II Joystick 35
 MAYNARD Int. 10MB Hard Disk 999
 rBASE 289
 Home Accountant + SAVE
 Multimate 329
 PFS Filing System 89
 PFS Report 81
 Lotus 1,2,3 319
 DBase II 389
 Friday 189
 Wordstar 259
 Wordstar Propack w/Mailmgr,
 Spellstar 349
 Multiplan 165
 Flight Simulator 33
 Deadline 38
 Zork I/II/III 28

Hundreds of available items. Call for complete pricing information.

We do not charge for VISA or MASTERCARD.

(213)
 (818) **345-4422**



4847 La Montana Circle, Tarzana, CA 91356

All products are in factory sealed packages. We guarantee all items for 30 days. Within this period, defective merchandise returns must be accompanied by RMA number. All other returns will be subject to a 10% restocking fee. For prepaid orders there will be a 3% shipping charge. 5% for UPS Blue Label. \$5.00 minimum. all orders outside U.S. at 15% shipping. There will be an additional \$4.00 surcharge on C.O.D. orders. Cash or Cashiers Check is required on C.O.D. orders. Calif. residents add 6.5% sales tax. Prices subject to change without notice. Circle 266 on inquiry card.

PREVIEW: FRAMEWORK

(continued from page 123)

an outline; an outline need not be used for frame organization. When an outline is a structural device, symbols that represent one of the various sorts of data frames appear alongside each item.

BUILDING RELATIONSHIPS

Fred, a macro programming language that takes as its starting point the formula macros found in many spreadsheets, is close to the heart of Framework. Though the drop-down menus control major operations and the outline generator oversees structure, it is Fred that provides the tools for sophisticated maneuvers with frames and the data they contain.

At its simplest level, Fred provides a wide-ranging assortment of commands for manipulating data within spreadsheet and database cells; Fred is used to build computation formulas. Fred also contains a large selection of commands for formatting and displaying data and chaining frames for output.

At a more sophisticated level, Fred is capable of interpreting variables whose names are created from the names and titles of units of data within the overall structure. This facility enables you to link things: one spreadsheet to another spreadsheet, a spreadsheet cell to a selection of database cells, or a database to a graphics chart.

Just as frames can be inserted almost anywhere in the structure, so too can Fred macros be attached to individual chunks of data, frames, frame labels, and the master outline. Everything in Framework revolves around the frame concept; a formula for a single spreadsheet cell can be blown out to a full frame of Fred programming.

Finally, Fred can be used to create extensions of itself that can be stored as frames. Frequently repeated operations or complicated procedures can be reduced to one-word Fred macros.

WORD PROCESSING

The Framework word processor is used in much the same fashion as its database, spreadsheet, and graphics programs. You enter a Framework editing frame either directly from the desktop by creating an empty word frame from the Create menu at the top of the display, or in a more structured manner by building from an element in an outline frame.

Word-processing style in Framework is tied closely to outline frames. While it is possible to work with documents as long as 32,000 characters, Framework encourages a writing practice that involves beginning a proposal, report, or article by creating a preliminary list of frame titles in an empty outline frame. In practice, this means that full-length documents are composed of shorter blocks of text linked together and displayed as a seamless whole on output. This may necessitate a period of adjustment for people who don't write from a working outline. Obviously, outline-based writing requires a more organized approach, a process that some are more comfortable with than others.

The editor itself is relatively simple to master. Once inside a particular frame, the cursor appears as a bright rectangle overlaid by a flashing inverse-video cursor. To move the cur-

(continued)

This October, 1983 ad



pulled 2,391
sales leads.
On page 489.

This is not an exception. In the same issue on page 409, WYSE Technology's ad generated 1,792 inquiries and the Prometheus ad—way back on page 495—garnered 1,588.

Advertisers in BYTE receive an average of over 1,000 inquiries per page of advertising, an average of 1,300 for full-page or larger ads. And not just in special, front-of-the-book positions, but all through the pages of BYTE.

Why? Because more than 430,000 high-tech computer sophisticates pay to read BYTE—cover to cover every month—for the microcomputer information they want and need. They'll send advertisers over 6 million ad inquiries this year, and over a half a million BYTE readers will buy products from ads they've seen in BYTE.

Including yours.

Talk to us—we're the people who wrote the book on microcomputer marketing. Just call Pete Huestis, Advertising Sales Manager, at (603) 924-9281.

BYTE

THE INTERNATIONAL STANDARD



BYTE is published monthly by McGraw-Hill, Inc., with offices at 70 Main St., Peterborough, N.H. 03458

UTAH PASCAL™

FOR MS-DOS™

Order Now!

All the elegant simplicity of Pascal is now affordable.

Diskette & Manual **\$39⁹⁵**

Requires 128K RAM IBM-compatible 8088 or 8086 system. You get 5 1/4" IBM-PC diskette and 134-page manual.



SINCE 1977

Ellis Computing, Inc.
3917 Noriega Street
San Francisco, CA 94122

Advanced Features:

- 14-digit precision.
- BCD Math, no round-off errors.
- Floating point + 63 - 64
- TRACE style debugging.
- Arrays up to 8 dimensions.
- 64K strings.
- External procedures.
- Dynamic module auto-loading.

We Welcome C.O.D.'s



(415) 753-0186

MS-DOS is a trademark of Microsoft Corp. IBM is a registered trademark of International Business Machines Corp. Utah Pascal is a trademark of Ellis Computing, Inc.

Quelo™ 68000 Assembler

New 5.0 Release

First Commercial Release
January, 1983

The Quelo™ portable 68000 assembler conforms to the Motorola resident assembler, publication M68KMASM[D4].

Quelo™ 68000 Assembler Package Features:

Input file concatenation, include function, macros, global parameter substitution from command line, listing date-time stamp, up to 31 character symbols, conditional assembly, structured programming directives, instruction optimization, 68010 instructions, relocation and linking, complex expression linking (all operators), DB-DW-DL directives for Z80 byte order data generation, object library utility, software configuration tracking, conditional linking, options for assembler and linker to write complete symbol table to a file, detailed symbol table listings, assembler symbol cross-reference, linker global symbol cross-reference, object library symbol cross-reference, superb linker load map, various HEX load formats produced by linker, error messages in English, extensive typeset manual with index, readily transported to any system with a C compiler and "UNIX like" system interface.

Ready to run in various disk formats for CP/M-80, -86, -68K, MS-DOS and PC-DOS | \$595

Portable source version with detailed installation and testing instructions. | \$750 and license agreement.

For more information or to order write or call Patrick Adams

Quelo™
2464 33rd Ave. W., Suite #173
Seattle, WA 98199
(206) 285-2528

COD, Visa, MasterCard.

CP/M-80, CP/M-86, CP/M-68K TM DRL UNIX TM Bell Labs. MS-DOS TM Microsoft. PC-DOS TM IBM.

PREVIEW: FRAMEWORK

sor, you use the cursor keypad in conjunction with the control key. The cursor-pad arrows by themselves move the cursor a character or a line at a time in any direction. With the control key depressed, they move either a word left or right or a sentence backward or forward. The popular WordStar control-key sequences are not supported by Framework; however, the capability of the Fred language to make keyboard macros should simplify redefining the command set.

Cursor control also offers the capability to move a full screen either forward or backward within a frame and to move instantly to the beginning or the end of a document. Because Framework keeps all the information you are working with in RAM (limited, of course, by the available memory of your system), text-editing operations take place very quickly; moving from the beginning to the end of a large document occurs virtually immediately.

Framework uses three of the function keys on the left side of the keyboard to move and copy text either within or between frames (it also is possible to move or copy entire frames from within an outline frame). Pressing the F6 function key marks a text selection. F7 moves the block, and F8 copies it to a new location as indicated by current cursor position.

The outline frame acts as an on-line table of contents, enabling you to scan quickly your "chapters" (smaller text fragments) while working within a document. It also lets you print a finished table-of-contents page with chapter numbers and corresponding page numbers for each separate frame.

On a monochrome monitor, Framework's word processor does not produce true what-you-see-is-what-you-get output. However, given the restrictions of a character-based display, the program goes a long way toward permitting control over the appearance of text. On-screen formatting functions are accessed through a menu item at the top of the desktop called Words. You can select this menu at any time either by holding down a control key and the W key or, on the IBM PC keyboard, by using the Insert key in conjunction with the cursor keys. The Words menu lets you set a text block as normal, boldface, underlined, or italicized. Because the character-mapped display does not accurately display all of these fonts, Framework shows boldface text as highlighted on the screen. Both underlined and italicized text are shown as underlined. On a color monitor, boldface, italicized, and underlined text are all visible.

To change the display of any block of text, you first select it by using the function keys to the left of the keyboard. Then you choose a new option from the Words menu. The Words menu also contains four text-alignment commands and separate commands for setting margins, paragraph indentation, and tab spacing. You can align text as flush left, flush right, justified, and centered.

In order to reformat all the paragraphs in a word frame, you first must move out of the individual frame to the frame-label level by pressing the gray + or - keys on the right-hand side of the PC's numeric keypad and then issue the command to change the format parameters.

You can implement fancier printed output by using a special set of verbs from the Fred programming language. Language elements are put together in a formula, or program, for a

(continued)

Houston Instrument's new PC Pad - the compact digitizer with "mouse-ability"

Houston Instrument has molded superior electronics into a handy 8" x 7" wedge-shaped tablet to give you a high-precision digitizer that also can be used as a mouse for cursor control.

By simply touching stylus to pad, you can drive the cursor to any point on your computer screen. So, with the PC Pad and appropriate software, you get the

capabilities of a mouse and a digitizer in one small product...for one low price—\$395.*

Features for Professionals

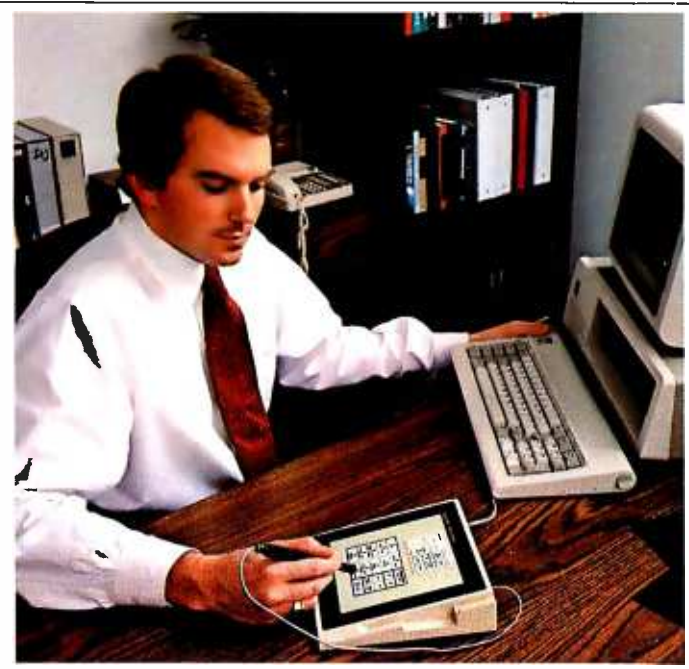
For systems builders, or for software authors who want to create a graphics package for an innovative product, the PC Pad is a perfect mix of convenient size and advanced capability.

With a PC Pad, you can convert minute details into data a computer can store. A PC Pad will address over one million individual points, allowing you to utilize sophisticated graphics monitors. No other digitizer its size has comparable resolution.

Easy to Interface

The PC Pad is compatible with the same serial formats used with Houston Instrument's popular HIPAD™ digitizers, and can be used with any computer which has an RS-232-C interface.

For more information about the compact, versatile PC Pad, contact Houston Instrument, P.O. Box 15720, Austin, Texas 78761 or call (512)835-0900. Outside Texas call 800-531-5205 for the name and location of your nearest representative. In Europe contact Houston Instrument, Belgium NV., Rochesterlaan 6, 8240 Gistel, Belgium. Tel. 059-27-74-45, TLX. 846-81399.



**houston
instrument**



Circle 207 on inquiry card.

4P015

THE

third

BYTE



COMPUTER SHOW

San Francisco
Convention Center/Brooks Hall
September 6-8

If you missed the *second* BYTE Computer Show which was held in June at the Los Angeles Convention Center, you can catch us at the *third* BYTE Computer Show in San Francisco this September! This is the reason we have regional shows—so you don't have to travel 'cross country to participate.

And, participate you will, because BYTE Shows are "selling" shows—where you can buy, not just look! BYTE subscribers enjoy special reduced admission prices to all BYTE Shows, their conferences and seminars. Each seminar is targeted to the interests of our subscribers, led by such BYTE favorites as Jerry Pournelle.

The BYTE Shows are professionally produced by The Interface Group—the same pros who bring you the Comdex Shows. Their show "know-how", combined with BYTE's editorial expertise, make the BYTE Shows ideal *information centers* and *shopping marts* for our subscribers.

Further information on our subscribers' exclusive benefits will be coming to you by mail.

So plan to be in San Francisco's Convention Center/Brooks Hall on September 6-9, or, at the BYTE Show nearest you!

Mc
Graw
Hill

BYTE

WANTED

"Buyers," & We'll pay the shippin'

• CALL FREE (800) 654.4058 •

"Call For Reduced Prices At Various Quantities"

Verbatim	Dysan CORPORATION	3M Scotch
5 1/4" sin-side dbl-den. 2 40	5 1/4" sin-side dbl-den. 3 20	5 1/4" sin-side dbl-den. 2 20
5 1/4" dbl-side dbl-den. 3 45	5 1/4" dbl-side dbl-den. 4 20	5 1/4" dbl-side dbl-den. 3 20
5 1/4" sin-side quad. 3 20	5 1/4" sin-side quad. 4 45	8" sin-side sin-den. 2 35
5 1/4" dbl-side quad. 4 40	5 1/4" dbl-side quad. 4 95	8" sin-side dbl-den. 2 95
8" sin-side sin-den. 2 75	8" sin-side sin-den. 3 45	8" dbl-side dbl-den. 3 90
8" sin-side dbl-den. 3 05	8" sin-side dbl-den. 4 45	
8" dbl-side dbl-den. 3 40	8" dbl-side dbl-den. 4 95	
Head Cleaning Kits... 5 20 Refills... 9 55	We Stock "Bulk-Packed" Diskettes	Disk Minder - Smoked Plastic - Holds 75 Disks 16 75 ea

Prices per ea. 10 per box

the **Diskette Connection™**

P.O. Box 1674 Bethany, OK, 73006

Dealer Inquiries Welcomed

Prices Reduced

Prices Called

Master Charge

VISA

(Continental U.S. only. Add 3% on orders under 40*)

frame. As the language is generalized throughout Framework, you can apply it to a frame whether it is a database, spreadsheet, or word frame, and frames of different types can be output as a continuous report.

The Fred printing verbs control the formatting of the final document and enable you to set margins, line spacing, headers, footers, and so on. They are essential text-oriented formula functions that are established while at the level of the frame label. These verbs affect only the printing of frame information; they do not affect the way a document appears on the screen. To insert a printing formula, you press the F2 Edit Formula key and enter the printing verbs you need to produce the desired effect. Like other verbs in the Fred language, each printing verb begins with the @ symbol and is separated from others by commas. Because frames can be nested, formatting verbs attached to the highest level of a document affect the printing of every frame the document contains. Verbs in an individual frame border supersede those at the document level, but only for the specific frame with which they're associated.

The Framework editor or independent utility programs can read WordStar or ASCII (American National Standard Code for Information Interchange) files prepared with other word-processing programs into Framework frames. Documents longer than the 32,000-character frame limit are split into succeeding frames: the initial frame is titled with the original filename, and subsequent frames are untitled.

DATABASE MANAGEMENT

The Framework database manager is based on a relational database model. It is not designed as a "heavy-duty" database, in the sense of Ashton-Tate's dBASE II or III, to handle files of unlimited scope. In fact, designers at Forefront are careful to stress that the database is not meant to replace the dBASE series, both to avoid conflicts within the Ashton-Tate product line and because Framework databases are limited by RAM availability. Framework will be sold with special utilities that permit users to load in and filter either dBASE or ASCII data files; you can use Framework as a tool to view sections of large databases prepared with other programs and to incorporate that data into Framework reports.

The developers have made an effort to retain a common user interface throughout the various Framework applications, and the database manager is no exception. For example, you create a new database in Framework by opening an empty frame—the same way word-processing and spreadsheet frames are created. You select the Create menu and choose the number of columns (fields) and rows (records) your database will have. You then move to the Database menu to open a new database frame. The default number for records and fields is 14 each, but this can be changed from the Create menu at any time; however, because each Framework database file must reside entirely in memory, Forefront encourages users to start with database specifications that are limited to the current number of records. The number of records in the database can then be increased during later data-entry sessions.

What is the maximum number of records you can have in a given database? This depends largely on the total number

(continued)

Technologically Superior
S-100 (IEEE 696) BOARDS
WITH A PAST AND A FUTURE
From Syntech Data Systems
(SDSYTEMS)

- DUAL PROCESSOR CPU BOARDS • STATIC RAM
- DYNAMIC RAM • MASTER OR SLAVE Z80 BOARD
- FLOPPY/WINCHSTER CONTROLLERS
- MULTI I/O BOARDS • AND MANY MORE

Supporting Concurrent CP/M*, UNIX*, PC-DOS/MS-DOS*, TURBODOS*, and CP/86*

Compatible with most popular S-100 systems and boards including:

COMPUPRO* CROMEMCO*
ZENITH* NORTHSTAR*

MCC also provides S-100 systems including:

- MULTI-USER
- MULTI-TASKING

- LABORATORY CONTROL
- MULTI-I/O/S

For more information call **301-942-5442**
MCC MICRO COMPUTER COMPANY INC.
101 Woodmont Pike North Wales, Maryland 20902
SALES • SERVICE • SUPPORT

* Manufacturers Trademarks

Introducing the software that makes communications a piece of cake.

EasyLink™ Instant Mail™ Manager software is probably the only communications package you'll ever need. Designed to blend in perfectly with Western Union's EasyLink service, it makes the total communication process easy, instant, and automatic too.

All the right ingredients.

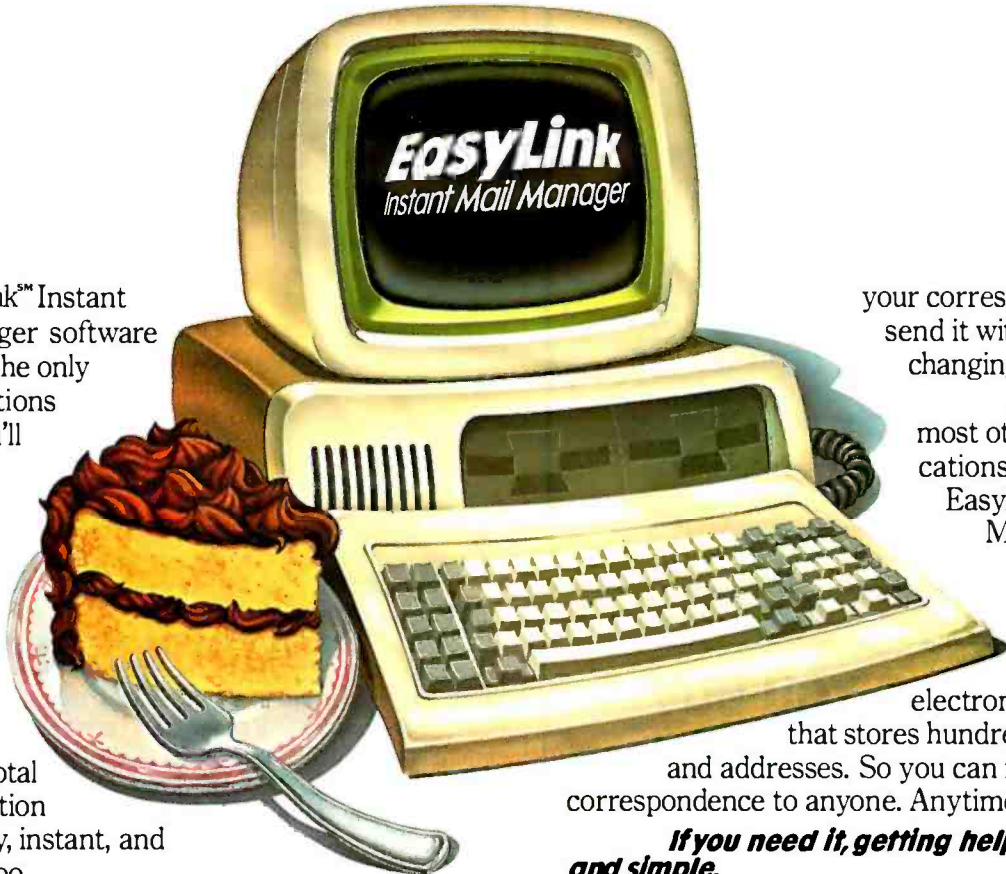
EasyLink Instant Mail Manager works with EasyLink service to provide automatic access and transmission of almost any type or length correspondence over the EasyLink network. So sending mail instantly to virtually any other phone-equipped PC or word processor is a snap.

You can even reach people without equipment. Thanks to EasyLink's instant access to Western Union's Worldwide communications services.

EasyLink Instant Mail Manager also lets you access your company's computer or connect instantly to other business and information services.

The frosting on the cake.

EasyLink Instant Mail Manager is more than simple "send and receive" software. With it, you also have complete word processing capabilities. So you can easily create, edit and change the format of



your correspondence, then send it without ever changing software.

And, unlike most other communications software,

EasyLink Instant Mail Manager allows you to create and manage a permanent

electronic address file

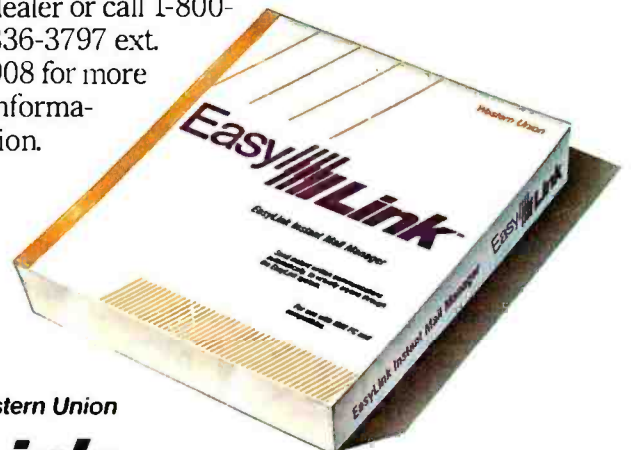
that stores hundreds of names and addresses. So you can instantly speed correspondence to anyone. Anytime.

If you need it, getting help is sweet and simple.

EasyLink Instant Mail Manager is set up to guide you step by step. From how to format messages to how you go about sending them.

EasyLink Instant Mail Manager software and EasyLink service. The perfect mix.

Available now at your computer software dealer or call 1-800-336-3797 ext. 908 for more information.



Western Union
EasyLink™

- COMPETITIVE EDGE -
 P.O. Box 556 • Plymouth, MI 48170 • (313) 451-0665
COMPLETE SYSTEMS AND COMPONENTS WITH

**CompuPro® — LOMAS DATA PRODUCTS
 AND TELETEK COMPONENTS**

40 MEGABYTE HARD DISK SUBSYSTEM WITH DISK 3 1/4" FOR ALL COMPUPRO® SYSTEMS	52595
HARD DISK SUB SYSTEMS FOR 286, 5-100 CP/M® 2.2 COMPUTERS WITH TELETEK HD/CTC HARD DISK AND TAPE CONTROLLER	1495
10 & 32 MB DRIVES 90ms access	1895
32 & 42 MB DRIVES 55ms access	2295
65, 105, 140, & 280 DRIVES 30ms access	2695
	3195
	3995
	4895
	8895
FOR TURBODOS TELETEK SYSTEM	
10 MEGABYTE HARD DISK SUBSYSTEM FOR LOMAS WITH 5 1/4" FLOPPY	1595
20 MEGABYTE HARD DISK SUBSYSTEM FOR LOMAS WITH 5 1/4" FLOPPY	2095
40 MEGABYTE HARD DISK SUBSYSTEM FOR LOMAS WITH 5 1/4" FLOPPY	2595
SYSTEMS WITH COMPUPRO® COMPONENTS YOU INTEGRATE: (UN-SYSTEMS) OR WE INTEGRATE	
85/86™ DISK 1™, INTERFACER™, RAM 1™, ENCLOS 2™, P.D. DR CAB. 2-8" UN SYS	3276
AS ABOVE ONLY WE INTEGRATE	3395
10MHz 8086, DISK 1, RAM 21™, I/O-4, ENCLOS 2, P.D. DR CAB. 2-8" UN SYS	3843
WE INTEGRATE IALL SYSTEMS INCLUDE CABLES AND OPERATING SYSTEM	3995
SINGLE 8" DRIVE AND 20 OR 40 MEGABYTE HARD DISK SYSTEMS AVAILABLE	
S-100 BC 286/5™ FLOPPYS 256K LOMAS COMPONENTS SINGLE USER CCP/M-86™	3495
S-100 BC 8086 THUNDER 186 SYSTEM WITH 5" FLOPPYS 256K LOMAS COMPONENTS	3995
S-100 SC 286/287 5" FLOPPYS 256K STATIC CCP/M-86™	4795
S-100 SC 86/87 5" FLOPPYS 256K STATIC CCP/M-86™	3895
ABOVE SYSTEMS AVAILABLE WITH 8" & 5" FLOPPYS, 10, 20, OR 40 MEGABYTE HARD DISK SYSTEM WITH TELETEK SYSTEMASTER™, 2-8" 5500 FLOPPYS 10 MB HARD DISK SYSTEM WITH SYSTEMASTER™, 2-8" DSDO FLOPPYS 1 SBC-2 (2 USER) TURBODOS SYSTEM WITH SYSTEMASTER™, 2-8" DSDO DISK 26MHz 128K SBC-1'S TURBODOS 16 USER SYSTEM WITH SBC-2'S 42MB HARD DISK 10 SLOT BUDGET BOX 1-8" 16 USER SYSTEM WITH 6MHz 128K SBC-1'S (FAST) 42MB HARD DISK 20 SLOT ABOVE 16 USER SYSTEM WITH 140 MEGABYTE 30MS ACCESS HARD DISK	2995 3695 4095 2995 17295 19395
COMPONENTS FROM COMPUPRO®, LOMAS, TELETEK	
THUNDER 186™ 256K SINGLE BOARD	51195
LIGHTNING 1™ 86	420
8 PORT SERIAL	316
DISK 1™	459
RAM 21™ 256K	1155
10MHz 8086 CSC	561
TELETEK SBC-1	525
TELETEK HD/CTC	499
QUME 102 TERM	539
WE CARRY EPSON, C. ITOH, AND DATAPRODUCTS PRINTERS MOST SOFTWARE FOR CP/M & MSDOS 8" & 5" ANCHOR AUTOMATION SIGNALMAN MARK XII I280 MODEM	220 725 327 657 459 995 135 549 549
	259
	1116
	636
	396
	327
	359
	297
	733
	557
	665

All prices subject to change and stock on hand. Manufacturer's warrant as apply. CompuPro® never sell and use to buy. Please call both our CompuPro®
 Dist. 1A, Dist. 1 CPU 286, CPU 586, RAM 22, RAM 21, RAM 17, RAM 18, Dist. 3, NO 3 System Support. Interface & are trademarks of CompuPro®
 CompuPro® is a General Company CPU, CCP/M-86 are registered trademarks of D-Data Research. Systemaster™ is a registered trademark of T-Data
 Enclosure 186/286 is a trademark of Microsoft. Turbodos & other elements of Software 2000 Inc. Lightning 1, Lightning 286, Interall 1, LDP
 72, RA M 87, are trademarks of Lomas Data Products Inc

PREVIEW: FRAMEWORK

of database fields you're using and the amount of memory available in your computer. Let's assume you have a database composed of 10 records of 10 characters each. According to Forefront, its tests indicate it will be possible to create a 2,000-record database (it is possible to get at least partially around this limit by writing macros using the Fred language). The benefits of keeping an entire database file in memory are obvious—Forefront claims that its database manager is capable of sorting 200 records per second.

An empty database frame is divided into two horizontal windows. The bottom window is the table area, in which you can enter data, and the top window is a row in which you enter field labels (and define formulas). When creating a new Framework database, your first step is to declare field names and adjust field widths. You create fields by typing in the labels that name them and then pressing the Tab or Return key. You adjust fields by selecting a field, pressing the F4 Size key, and resizing the field with the left or right arrow key on the keypad. If you need to add new fields after the database has been created, it is only necessary for you to highlight the field you want the new one to follow, select the Column Add key from the Create menu, and press the Insert key. Modifications to the structure of a database do not destroy data.

You navigate through a Framework database by using the cursor keys in conjunction with the control key. You can move to a field or record in any direction or jump to the first or last record of the database. Moving or copying information is possible either within a single database or between databases, word-processing frames, and spreadsheets. This procedure is exactly the same as it would be for copying or moving blocks of information elsewhere in Framework.

Although the default mode of the Framework database manager is a "table" view, you also can select a "forms" view by pressing the F10 View key. This lets you display each field in your database as a separate frame within the larger database frame. You also can set up customized display forms using the F3 Drag key to relocate individual fields.

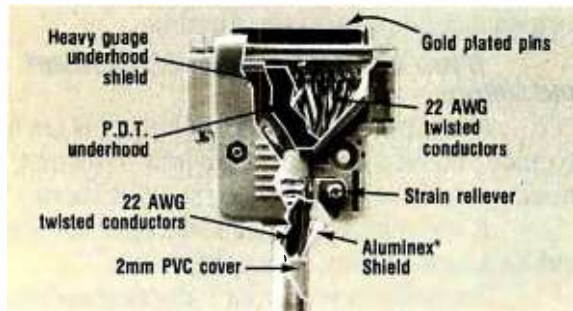
To pull a particular record out of a Framework database, you use the Locate menu at the top of the screen. This menu enables you to search for a particular word, phrase, or value, as well as to perform sorts of a database. Sorts put records in ascending or descending alphabetical and numerical order. Multiple sorts require repeated sorts of individual fields.

Possibly the most intriguing feature of the Framework database manager is the capability of defining database macros using the Fred language. You also can use formulas within individual databases, as well as for automatic calculation of fields and the identification of records that meet particular criteria. Formulas can be entered in a field, at the label of a field, or at the top label of a database. At the field level, a formula is referred to as a local formula, and the formula is calculated only for that field in a particular record. At the field-label level, a formula operates on an entire column in a database. For example, to automatically calculate a 12 percent commission for each record, you could enter the following formula in the label window of a database frame:

@SET(COMMISSION.SALES*.12)

(continued)

**BEFORE YOU BUY
 CABLE ASSEMBLIES,**



CHECK UNDER THE HOOD!

DATA SPEC™ cable assemblies are the very best. Each cable is fully shielded to exceed FCC EMI/RFI emission requirements. Furthermore, the unique P.D.T. technique is employed beneath the hood shield for maximum integrity under the most adverse conditions. DATA SPEC™ was the first to use the P.D.T. process, and cable assemblies constructed with P.D.T. carry a lifetime warranty. DATA SPEC™ has interface cables for all your requirements: Modems, Monitors, Disk Drives, and much more. Insist on DATA SPEC™ cables in the bright orange package. Available at better computer dealers everywhere. For more information, call or write:

DATA SPEC™

A Division of Alliance Research Corporation

18215 Parthenia Street, Northridge, CA 91325 (818) 701-5853



adds VISION to your PC

20/20 Vision for \$495.

Quick and versatile, PC-EYE converts your IBM PC or PC/XT into a high-performance image processing system. It improves productivity through better communications. \$495 for PC-EYE will allow you to capture any object that can be viewed with a standard EIA RS-170 compatible video camera. The image can then be displayed, stored, processed, printed, or remotely transmitted. High resolution and real-time display interaction allow simple adjustment of light, focus, or object position for superb quality pictures.

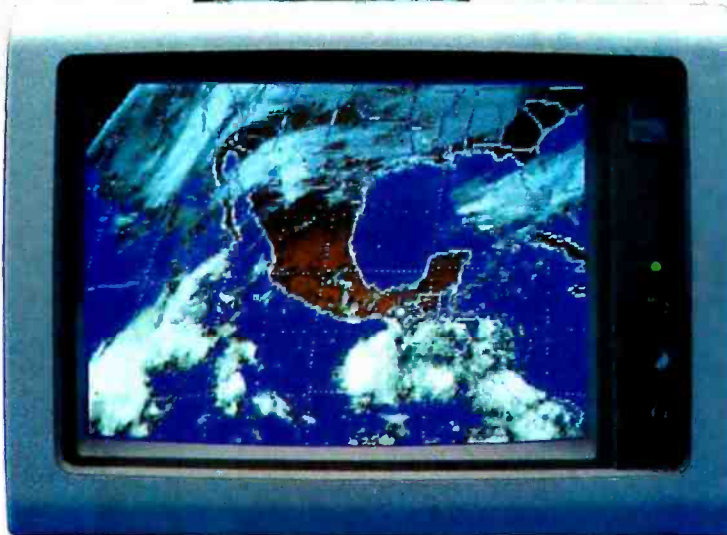
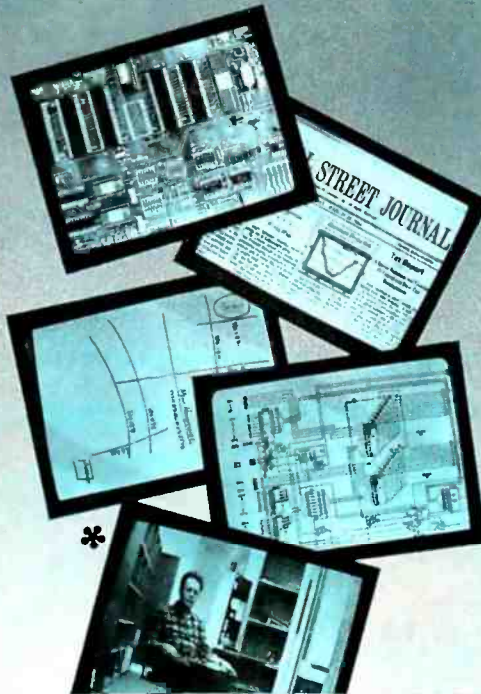
Adds computer picture power for . . .

- Graphic Presentations
- Personal Teleconferencing
- Document/Report Generation
- Surveillance/Security
- Measurement and Inspection
- Thermography

Uses are so varied that Chorus offers software developers the chance to promote their products in our PC-EYE Catalog. Special awards will be given periodically for the software judged most unique or of greatest interest.

Software makes it happen

Utility software is included with menu driven support for various graphics adaptors and printers. This support includes interactive control of image borders, white and black level, and image location within the borders. The user can direct input to



main memory or the graphics adaptor memory; compare images; and store images or set-up parameters on disc.

Software application packages soon to include PC-EYE support are: digital paint and drawing, slide generation, word processing, communications, and data base management.

Compare our specifications:

Input: Any EIA RS-170 (Monochrome or RGB) video source

Spatial Resolution: Up to 640 x 512 pixels

Intensity Range: 2, 4, and 16 levels (or pseudo-colors) standard; 64 levels optional

Capture Speed:

.33 seconds for a 640 x 400 x 16 level image

.1 second for a 320 x 200 x 4 level image

.6 seconds for a 640 x 400 x 64 level image

Input Channels: Four video plus external trigger

I/O Slots: 1 IBM PC or PC/XT compatible

Get started with the CHORUS family of products

We offer a selection of cameras, accessory kits, and compatible graphic adaptors. For our price/catalog and further details, write,

or call 1-800 OCHORUS
or 1-(603) 424-2900

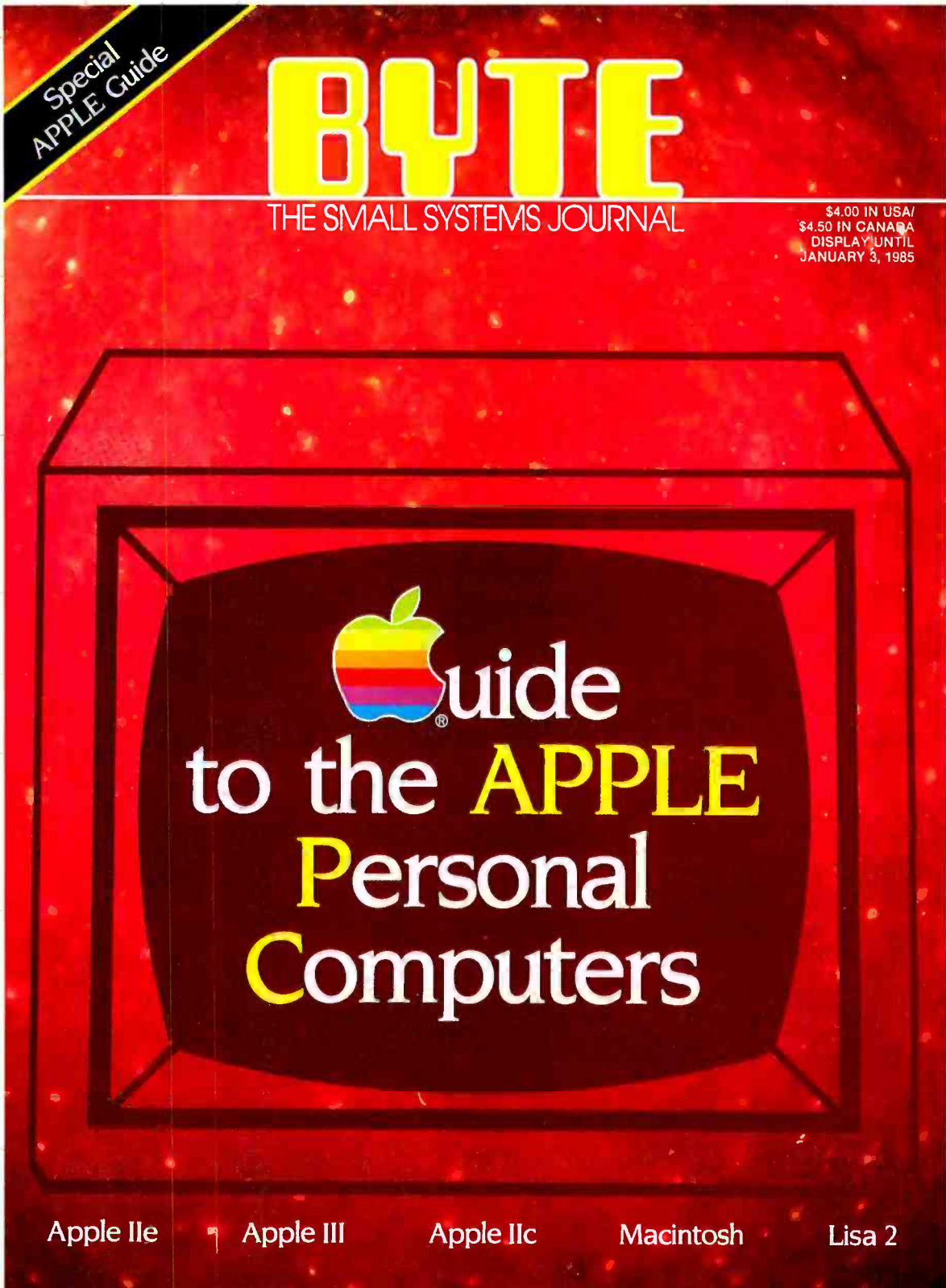
*The B&W pictures are taken with a 35mm SLR camera. The pictures were captured with an RCA TC 1005 video camera on an IBM XT and sent to the monitor with a Tecmar Graphics Master** graphics adapter in the 640 x 400 x 16 level mode via its composite output.

**Trademark for CHORUS DATA SYSTEMS' family of video capture products.

CHORUS

Chorus Data Systems, Inc., 6 Continental Blvd., P.O. Box 370, Merrimack, New Hampshire 03054

The second in the series of new **BYTE** GUIDES.



Apple IIe

Apple III

Apple IIc

Macintosh

Lisa 2

APPLE and APPLE Logo are registered trademarks of APPLE Computers, Inc.

www.americanradiohistory.com



BYTE on the APPLE!

This is not a regular edition of BYTE. The BYTE GUIDE to the Apple Personal Computers is your opportunity for exposure to *the most select* micro audience.

Apple owners and users read BYTE more than *any other* micro publication. They rely on BYTE for *objective* reporting and state-of-the-art analysis of the entire family of Apple micros and compatibles.

438,000 paid BYTE readers influence purchasing decisions for *hundreds of millions of dollars* in micro products. And they are buying Apple:

- 36% of our subscribers who own micros own Apple PCs for business and personal use.
- 28% of our subscribers who plan to buy personal computers plan to buy Apple for business and personal use.

Every month BYTE draws over 500,000 inquiries to advertised products. The only way to reach this responsive, influential and well-salaried audience is to showcase your product in the BYTE GUIDE to the Apple Personal Computers.

To reserve your advertising space, call your local BYTE advertising salesperson or Pete Huestis, Adv. Sales Mgr., at (603) 924-9281.

Closing date
for space reservations: 8/21/84.

On-sale date: 10/24/84.

BYTE GUIDES. The One Source.

64K S100 STATIC RAM

\$199⁰⁰
KIT

NEW!

LOW POWER!
RAM OR EPROM!



BLANK PC BOARD
WITH DOCUMENTATION
\$55

SUPPORT ICs + CAPS
\$17.50

FULL SOCKET SET
\$14.50

FULLY SUPPORTS THE
NEW IEEE 696 S100
STANDARD
(AS PROPOSED)
FOR 56K KIT **\$185**

ASSEMBLED AND
TESTED ADD **\$50**

FEATURES:

- * Uses new 2K x 8 (TMM 2016 or HM 6116) RAMs.
- * Fully supports IEEE 696 24 BIT Extended Addressing.
- * 64K draws only approximately 500 MA.
- * 200 NS RAMs are standard. (TOSHIBA makes TMM 2016 as fast as 100 NS. FOR YOUR HIGH SPEED APPLICATIONS.)
- * SUPPORTS PHANTOM (BOTH LOWER 32K AND ENTIRE BOARD).
- * 2716 EPROMs may be installed in any of top 48K.
- * Any of the top 8K (E000 H AND ABOVE) may be disabled to provide windows to eliminate any possible conflicts with your system monitor, disk controller, etc.
- * Perfect for small systems since BOTH RAM and EPROM may co-exist on the same board.
- * BOARD may be partially populated as 56K.

PREVIEW: FRAMEWORK

Assuming that both Commission and Sales columns exist, this formula causes the appropriate commission amount to be automatically entered in every record. If this seems to be quite similar to the way in which formulas are used in spreadsheet operations, the coincidence is intentional.

Formulas entered at the level of the frame border of a particular database are called filter formulas. They cause the frame to hide all records that fail to meet a particular criterion; it is later possible to restore hidden records. You also can employ filter formulas to delete or move specific datasets from a database.

THE SPREADSHEET ENVIRONMENT

Within Framework, a full-featured spreadsheet environment is two keystrokes away. That's all it takes to create a spreadsheet frame that also can share data with database and graph frames and be positioned within an outline.

As with database frames, you initially determine the size of each spreadsheet by specifying the number of rows and columns desired. You can add or delete rows and columns freely as the model develops. Because spreadsheet size is dependent on available memory, this feature enables you to minimize the memory used by each spreadsheet.

Like other frames created within Framework, a spreadsheet frame can be labeled, stretched, moved, copied, saved, put away, included in an outline, zoomed to a full view, and otherwise manipulated on the desktop. You do this with the same function keys, special keys, and menus common to all frames on the desktop.

Once inside the spreadsheet frame, the same keys are again used to manipulate spreadsheet cells and data. For example, the Size function key used to stretch frames and database fields is used to dynamically stretch column widths to suit your needs. The Select function key used to highlight words and paragraphs for moving and copying in the word-processing environment is used to highlight ranges of spreadsheet cells for manipulation. The same menu items used to format text in the word processor can be used to create underlining, italics, and boldface within a spreadsheet. You can print spreadsheets using the common print option within the master set of menus. The sorting of whole or partial columns of data, and even the word-processing search-and-replace functions, operate within the spreadsheet environment. Search-and-replace also can be used to edit formulas.

You letter columns and number rows as in conventional spreadsheets. Formulas can be developed using these standard alphanumeric cell references or by using row and column labels. For example, say you were to place column headings in the topmost row of a spreadsheet as January through December and row headings in the leftmost column as Revenue, Expense, and Net. After entering revenue and expense figures for the various months, you could then reference January revenue in a formula as +January.Revenue. You even can use cursor pointing to construct formulas and have the row/column name references appear as you point to various cells.

You can tie spreadsheets to other spreadsheets or databases quite freely, eliminating the need to construct massive grids merely in order to link variables. The

(continued)

ALL SALES SUBJECT TO THE TERMS OF OUR 90 DAY LIMITED WARRANTY. FREE COPY UPON REQUEST.

256K S-100 SOLID STATE DISK SIMULATOR!
WE CALL THIS BOARD THE "LIGHT-SPEED-100" BECAUSE IT OFFERS AN ASTOUNDING INCREASE IN YOUR COMPUTER'S PERFORMANCE WHEN COMPARED TO A MECHANICAL FLOPPY DISK DRIVE.

FEATURES:

- * 256K on board, using + 5V 64K DRAMS.
- * Uses new Intel 8203-1 LSI Memory Controller.
- * Requires only 4 Dip Switch Selectable I/O Ports.
- * Runs on 8080 or Z80 S100 machines.
- * Up to 8 LS-100 boards can be run together for 2 Meg. of On Line Solid State Disk Storage.
- * Provisions for Battery back-up.
- * Software to mate the LS-100 to your CP/M* 2.2 DOS is supplied.
- * The LS-100 provides an increase in speed of up to 7 to 10 times on Disk Intensive Software.
- * Compare our price! You could pay up to 3 times as much for similar boards.



BLANK PCB
(WITH CP/M* 2.2
PATCHES AND INSTALL
PROGRAM ON DISKETTE)

\$69⁹⁵

\$349⁰⁰

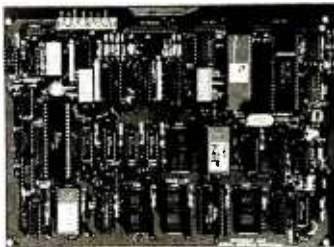
#LS-100 (FULL 256K KIT)

THE NEW ZRT-80 CRT TERMINAL BOARD!

A LOW COST Z-80 BASED SINGLE BOARD THAT ONLY NEEDS AN ASCII KEYBOARD, POWER SUPPLY, AND VIDEO MONITOR TO MAKE A COMPLETE CRT TERMINAL. USE AS A COMPUTER CONSOLE, OR WITH A MODEM FOR USE WITH ANY OF THE PHONE-LINE COMPUTER SERVICES.

FEATURES:

- * Uses a Z80A and 6845 CRT Controller for powerful video capabilities.
- * RS232 at 16 BAUD Rates from 75 to 19,200.
- * 24 x 80 standard format (60 Hz).
- * Optional formats from 24 x 80 (50 Hz) to 64 lines x 96 characters (60 Hz).
- * Higher density formats require up to 3 additional 2K x 8 6116 RAMS.
- * Uses N.S. INS 8250 BAUD Rate Gen. and USART combo IC.
- * 3 Terminal Emulation Modes which are Dip Switch selectable. These include the LSI-ADM3A, the Heath H-19, and the Beehive.
- * Composite or Spill Video.
- * Any polarity of video or sync.
- * Inverse Video Capability.
- * Small Size: 6.5 x 9 inches.
- * Upper & lower case with descenders.
- * 7 x 9 Character Matrix.
- * Requires Par. ASCII keyboard.



BLANK PCB WITH 2716
CHAR. ROM, 2732 MON. ROM

\$59⁹⁵

SOURCE DISKETTE - ADD \$10
SET OF 2 CRYSTALS - ADD \$7.50

WITH 8 IN.
SOURCE DISK
(CP/M COMPATIBLE)

\$129⁹⁵

(COMPLETE KIT,
ZRT-80
2K VIDEO RAM)

Digital Research Computers

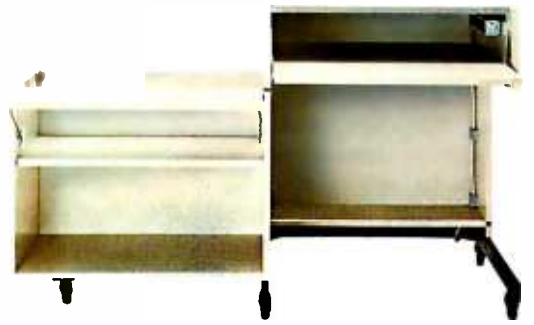
P. O. BOX 461565 • GARLAND, TEXAS 75046 • (214) 271-3538

TERMS: Add \$3.00 postage. We pay balance. Orders under \$15 add 75¢ handling. No C.O.D. We accept Visa and MasterCard. Texas Res. add 5% Tax. Foreign orders (except Canada) add 20% P & H. Orders over \$50 add 85¢ for insurance.

One good idea



deserves another



and another



and

another.



At IBM, we've been working to help your business keep up with its computer needs.

That's why we developed our innovative line of IBM Personal Computer Furniture. You'll find work stations, tables and chairs that are custom-designed to accommodate Personal Computers, as well as the people who use them.

And best of all, you'll find IBM's PC Furniture available in a variety of prices designed to accommodate your budget.

The IBM Synergetix® PC Work Station (pictured in pearl white) provides a convenient and compact workspace for the Personal Computer. In addition, it's completely mobile, so you can move it from office to office. But most important, the entire unit closes and locks, so you can secure and protect your system.

The IBM PC Table (pictured in walnut) is a stationary unit that's economically priced. It has the same durable construction as our PC Work Station, along with some basic security features. What's more, it's also perfect for the IBM PCjr.

The IBM PC Chair boasts a price tag you don't have to sit down for. This ergonomically engineered seating comes equipped with fingertip adjustments and features a contoured backrest for greater comfort and support.

You'll find our IBM PC Furniture in a variety of attractive colors at your IBM Product Center. The IBM PC Work Station is also available at participating retailers. To find out the location nearest you or to order by phone, call *IBM Direct* toll free at 1 800 IBM-2468, ext. 104.

IBM Personal Computer Furniture. It's designed with you and your PC in mind.

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

Framework philosophy holds that giant spreadsheets are rarely used; most outputs fit onto 11- by 17-inch sheets of paper and, by extension, can be held in a single frame.

Let's say you labeled the spreadsheet frame in the preceding example Income. The label you give to a spreadsheet frame serves as a pathway into that frame; if you were in another spreadsheet on the desktop and wanted to bring in the January revenue figure described above, you would simply enter the formula =Income\JanuaryRevenue. By being in the total of a column of figures in the Amount field of a database frame labeled Clients, you would enter the formula @Income\Clients.Amount. It's that easy. You can even jump in and out of different frames while pointing to variables to construct your formula.

In the process of developing formulas, you can zoom the formula to full-screen size for a clear view. Comments can be placed in formulas using semicolons; if you were to begin a long formula and start to get confused, pressing the Zoom function key would give you a full-screen view of your formula, whereupon you could place comments within the formula and further develop it over several lines. A single formula, therefore, can be a rather sophisticated data-manipulation program—a very powerful feature.

Absolute and relative references are considered when formulas are copied. You denote an absolute reference by prefixing either the row number or column letter or both with a \$. Using the # places the results of the computation of the formula into the cell and then renames the formula.

Framework spreadsheets are certainly not lacking in built-in functions. All of the standard (30) functions available in the best spreadsheets on the market are present in Framework. Not only is there an internal rate of return (IRR) function, but a modified internal rate of return (MIRR) as well. @MIRR uses a combination of safe and/or risk interest rates to more realistically calculate return when negative cash flows are involved.

Date and time functions include @TODAY and @GETDATE functions and a variety of date formats. Financial functions include future, present, and net present value in addition to return and/or an amortization function. All the logical Boolean operators are available, including error-checking functions. The full complement of standard arithmetic and trigonometric functions includes ceiling, floor, and random-number generation. Standard statistical functions are also included.

Strings can be freely used in formulas as long as you enclose them in double quotes. For example, you might want to try

```
@JanuaryIncome > $10000
"Thank you very much." * Nine (please)
```

You are not restricted to a specific, small number of characters, and you can use spaces in the text string. A variety of built-in string functions also are provided for converting text to values and vice versa. You can concatenate values to other labels. Best of all, you can develop your own @ functions, which you can then freely use in formula development.

Once your own functions and templates have been implemented, you can serialize them with a special utility; this means that only the copy of Framework you used to produce them can be employed to name or edit the formula

in them. Cells can be protected as with conventional spreadsheets. After protection, you can use a Blank command to remove all data from a template so you can store it empty for later use.

Macro-command files can be developed within the spreadsheet environment to control complex procedures, and they can be loaded each time you wish to use them. These command files can be associated with single-letter mnemonics preceded by the Alt key. Alt+mnemonic then execute a whole series of commands, relieving you of having to enter them one at a time from the keyboard.

BUSINESS GRAPHICS

Graphing data from a spreadsheet or database can take less time than rebooting your computer. The easiest way is to use the Select function key to highlight the range of data you want to graph. Then simply choose the Graph menu option and tell Framework to draw by pressing the return key a couple of times. A graph frame is created automatically with your graph displayed inside. Scaling is calculated, and the column headings placed in Row 1 of your source are used as period labels. Of course you can polish up the graph, but a quit-and-dirty preview is close at hand.

Once a graph has been derived from a particular spreadsheet or database and you want the graph to be recalculated as you edit your source data, simply enter the name of the graph frame in the lower right-hand corner of the source frame.

On the IBM PCs color monitor, Framework displays the desktop in black-and-white, high-resolution mode; when graphics frames appear scaled down on the desktop, they also appear in those two colors. If you zoom in to a full-screen display however, you can view your graph in four colors. On monochrome monitors, the different colors are indicated with different textures and shading.

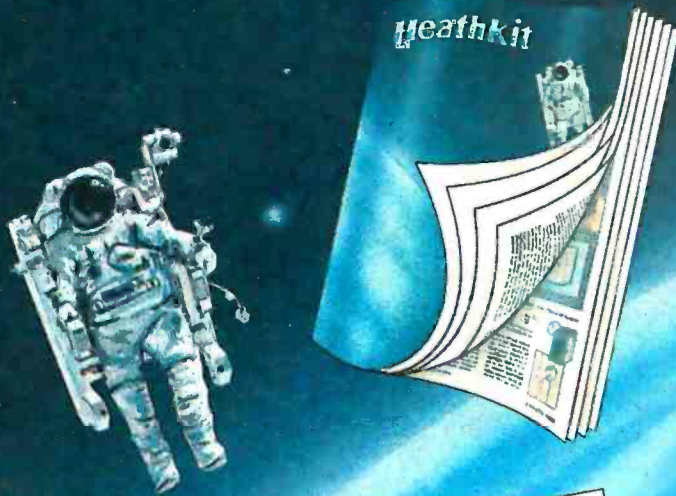
PUTTING IT ALL TOGETHER

There's a lot to Framework, and the diversity of its capacity might make learning to operate it seem like a major undertaking. However, the common command structure and the similarity of procedures from one application to another should cut down on the learning curve significantly.

This is the first time that outline processing has been brought into integrated business software as a major organizing feature. It is not similar and not necessarily suited to the working style that the software marketplace has caused many users to adopt. In that sense, it marks a radical break with the past. Rather than letting you continue with old habits, outline processing may force you to think about your work in an entirely new way. This may mark a change as striking as the one brought about by the introduction of the first computerized spreadsheets.

Framework offers an important pathway into outline processing that may make the transition easier. The outline structure need not be called into play until its required Framework's application elements are strong enough standing alone to be used independently. You don't have to use the outlines to accomplish real work—you can sneak up on them bit by bit as you go about your tasks. When you're ready for the full power of outline processing, it's waiting for you. ■

The Heathkit Catalog & American Technology... Inseparable!



Ever since radio grew into electronics, the illustrated Heathkit Catalog has been a guide to new and exciting electronic kit products for people like you to build. Enjoy. Learn from. And save money.

The Heathkit Catalog is now even better. The ALL NEW full-color catalog features more than 450 different products in electronics, computers and other state-of-art technology. Page after page is devoted to new and exciting products for your home, hobby and business.

If you don't have the latest Heathkit Catalog, you're missing something great! Now's your chance to get involved in American Technology first hand. Your free ALL NEW Heathkit Catalog is waiting for you.

Fill out and return the attached Catalog request card today! Or use reader service number below.

Circle 150 on inquiry card

Discover the Challenge



Great innovations in electronics are at your fingertips in each quarterly issue of the Heathkit Catalog. From computers to test instruments to the latest in personal robotics. Act now and send this card for the ALL NEW Heathkit Catalog.

CATALOG OFFER
Heath Company
Dept. 001-209
Benton Harbor, MI 49022

Yes I want to see the latest in electronics from Heathkit. Please send my free copy of the ALL NEW Heathkit Catalog to:

Name _____
Address _____
City _____
State _____ Zip _____
PC-148

Discover the Pride



With Heathkit, you'll discover the pride of accomplishment only a hand-built quality product can provide. From Stereos and TVs to Ham Gear and the latest in education. Act now and send this card for the ALL NEW Heathkit Catalog.

CATALOG OFFER
Heath Company
Dept. 001-209
Benton Harbor, MI 49022

Yes I want to see the latest in electronics from Heathkit. Please send my free copy of the ALL NEW Heathkit Catalog to:

Name _____
Address _____
City _____
State _____ Zip _____
PC-148

Post Office
will not
deliver mail
without stamp.

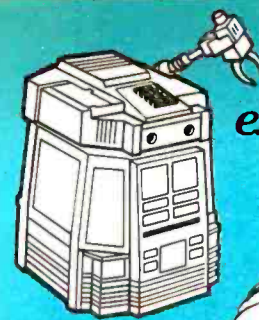
Post Office
will not
deliver mail
without stamp.

CATALOG OFFER

Heath Company
Dept. 001-209
Benton Harbor, MI 49022

CATALOG OFFER

Heath Company
Dept. 001-209
Benton Harbor, MI 49022



Kitbuilding is an exciting hobby and unique learning experience for the whole family.

Be a part of today's exciting world of high technology.

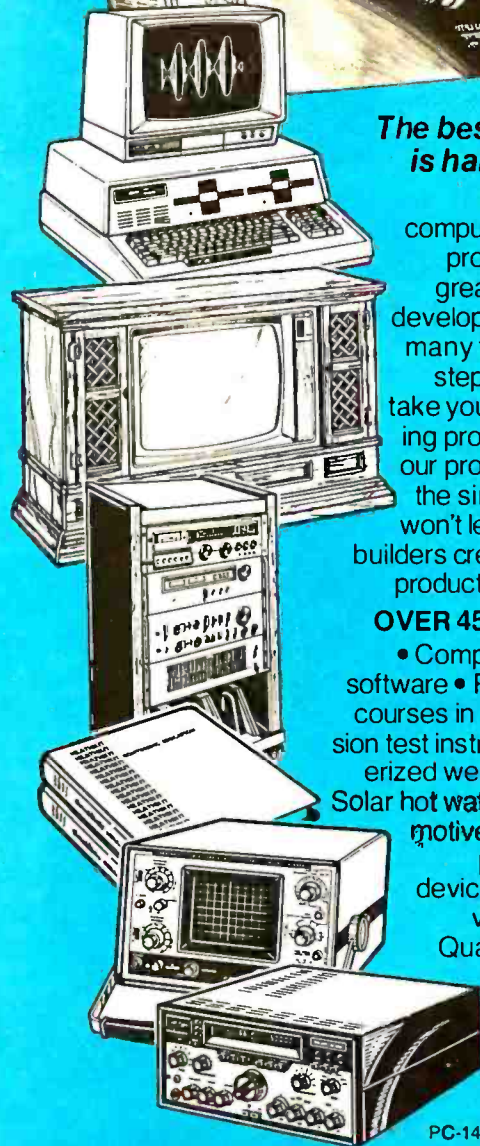


The best in electronics is hand-built by you.

Building advanced computers and electronic products from kits is a great hands-on way to develop skills and ability in many technologies. Easy step-by-step directions take you through the building process. And we back our products and you with the simple promise: "We won't let you fail." Heathkit builders create more than fine products. They build pride.

OVER 450 KITS TO BUILD

- Computer hardware and software
- Robots
- Self-study courses in electronics
- Precision test instruments
- Computerized weather instruments
- Solar hot water systems
- Automotive and home energy products
- Security devices
- Color TVs and video accessories
- Quality Stereo components
- Amateur radio gear



PC-148

Start by ordering your **FREE** Heathkit Catalog today. Or use Reader Service Number

Circle 750 on inquiry card.



software interrupt (DI)

is low "1". On the 6302 card and on the 6310 in its 6302 emulation, it indicates a *stop, break* instruction. A software interrupt transfers control to the *DI* = 0 mode as does the hardware interrupt (DI=masked by flag "1"), when not emulating a 6302, the 6310 adds a separate vector (see figure 2) that defines the software interrupt routine's location. The vector interrupts routine from having to determine which type of interrupt invoked it.

The new "R" flag, as well as X, is used when the 6310 is not emulating a 6302. They both determine whether operations treat the accumulator and index registers as 8- or 16-bit entities. The R flag, when set to "1" indicates that the accumulator is to be treated as an 8-bit register; when set to 0, the accumulator is 16 bits long. The X flag has the same effect on the index (IX and IY) registers.

The added "E" flag determines whether the 6310 emulates a 6302 or acts as a 16-bit processor. Since the status register is defined as having only 8 bits, the E flag is conceptually an extension of the C flag, while E cannot be directly treated set, or cleared. ACE exchange C and E flags permits swapping with the C flag, which can.

The additional 16-bit register, called the "direct register" determines placement of the "direct page" in bank zero. As on the 6302, one special page in memory is designated for the most frequently used or most time-critical portions of a program, because the address within this page can be completely specified in a single byte instructions can be shorter. This arrangement results in smaller programs, and since the processor fetches one less byte per instruction, execution is faster. On the 6302 the direct page (also called "zero page") resides permanently at the beginning of memory; that is, the high-order byte of the address is 0. On the 6310, the direct page can appear anywhere in bank zero, even across normal page boundaries. This feature permits more flexibility in context switching and sharing of data between subroutines or routines. Also notable, if the low-order byte of the direct register (DL) is nonzero, the 6310 needs an extra cycle for every instruction that has any form of direct page addressing. The additional

cycle is used to add DL to an offset, if DL is zero, the 6310 has special circuitry to skip the cycle. Except in special cases, therefore, the direct page should begin on a page boundary. The direct register can be accessed by transferring data to or from either the C accumulator or the stack.

The two new 8-bit bank registers give the 6310 its ability to access a full 16 megabytes of memory. As shown in figure 1, the program bank register (PBR) is an extension of the program counter. A program can read the register's contents only after pushing them onto the stack, and then loading them into another processor register. PBR is modified by "long" forms of the jump and jump-to-subroutine instructions. Although its contents can be pushed onto the stack, PBR cannot be loaded except when it is also loading the program counter. If PBR were ever loaded independently the next instruction after the one that loaded it would be fetched from the "following" location—but in a different bank. The unusual instruction, in fact, would most likely lead the processor off into never-never land.

In some addressing modes, such as direct page (*LDI*), the data bank registers explicitly specify the bank number in any *LDI*, where the bank number is not laid down precisely; the data bank registers assign one. Strictly speaking, they are not extensions of the index registers, except in the sense that they help determine addresses that use the indirect addressing modes. The data bank registers are accessed through the stack and *LDI* is modified by the bank move instructions described next.

NEW INSTRUCTIONS

In "The OS/6 6302" (December 1981) BYTE, page 164), I pointed out that the newer version added a number of instructions to those of the two 6302 negative-channel metal-core semiconductor 6302. Those instructions filled gaps in the instruction set: *LDI*, rounded it out for the 6302.

The 6310 goes a step further by adding some new 16-bit instructions plus some others *LDI* for the change to 16 bits and the addition of new registers. The op operations codes corresponding to hexadecimal codes T3 and F3 ("T" and "F" individual bits in page

zero" and "branch if bit set or reset in page zero") are present only on the flopped version of the 6302, Western Design Center, the designer of both the 6302 and the 6310, does not specify them. On the 6310, Western reserves the *LDI* and *F* instructions for "long" addressing modes of existing instructions. A description of the long addressing modes follows.

Figure 1 shows the complete instruction set of the 6310. The hexadecimal code for each op code is given by the digit at the left end of the row (most significant digit) and the digit at the top of the column (least significant digit). The op-code mnemonic is three capital letters, followed by the addressing mode in lowercase. The number at the lower left of each box gives the number of bytes for the op code (plus its operand's address or data). In the case of the immediate addressing mode with 16-bit data, one additional byte is required. The number in the lower right of each box gives the basic number of clock cycles required for the instruction.

Additional cycles are required for a variety of cases, since this figure is *LDI*, the number of cycles for executing that instruction in the fastest case. For example, add one cycle for instructions using the direct register for part of an address if DL is not zero; add a cycle for read or write operations using 16-bit data; add two cycles for read-modify-write instructions, such as *LDI*, using 16-bit data; add one cycle for branch instructions (including BRAs) when the branch is taken, and another if the *LDI* crosses page 1; *LDI* in the 6310 emulation mode; add one cycle for indirect addressing *LDI*, where the indexing causes a page boundary crossing; and add one cycle for *LDI* or *LDI* that set status register flag instructions using the immediate addressing mode.

The two 6302 6302 allows several types of conditional program branches but does not include an unconditional form. Since this is the only type of position-independent program transfer on the 6302, some programs use a *LDI* or *LDI* with a *LDI*, *LDI* set the carry flag, branch if carry set, respectively to achieve an unconditional branch. The 6310 instruction BRA branch relative always fills this gap in the instruction

continued

Table 4. W65SC816 Microprocessor Op Code Matrix

		LSD																
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
MSD	0	BRK s 2 8	DRA(d,x) 2 6	COP s 2*8	DRA sr 2*4	TSB d 2*5	DRA d 2 3	ASL d 2 5	DRA(d) 2*6	PHP s 1 3	DRA imm 2 2	ASL acc 1 2	PHD s 1*4	TSB a 3*6	DRA a 3 4	ASL a 3 6	DRA al 4*5	0
	1	BPL r 2 2	DRA(d,y) 2 5	DRA(d) 2*5	DRA(sr,y) 2*7	TRB d 2*5	DRA d,x 2 4	ASL d,x 2 6	DRA(d),y 2*6	CLC imp 1 2	DRA a,y 3 4	INC acc 1*2	TCS imp 1*2	TRB a 3*6	DRA a,x 3 4	ASL a,x 3 7	DRA al,x 4*5	1
	2	JSR a 3 6	AND(d,x) 2 6	JSL al 4*8	AND sr 2*4	BIT d 2 3	AND d 2 3	RDL d 2 5	AND(d) 2*6	PLP s 1 4	AND imm 2 2	RDL acc 1 2	PLD s 1*5	BIT a 3 4	AND a 3 4	RDL a 3 6	AND al 4*5	2
	3	BMI r 2 2	AND(d,y) 2 5	AND(d) 2*5	AND(sr,y) 2*7	BIT d,x 2*4	AND d,x 2 4	RDL d,x 2 6	AND(d),y 2*6	SEC imp 1 2	AND a,y 3 4	DEC acc 1*2	TSC imp 1*2	BIT a,x 3*4	AND a,x 3 4	RDL a,x 3 7	AND al,x 4*5	3
	4	RTI s 1 7	EDR(d,x) 2 6	WDM RESERVED	EDR sr 2*4	MVP xyc 3*7	EDR d 2 3	LSR d 2 5	EDR(d) 2*6	PHA s 1 3	EDR imm 2 2	LSR acc 1 2	PHX s 1*3	JMP a 3 3	EDR a 3 4	LSR a 3 6	EDR al 4*5	4
	5	BVC r 2 2	EDR(d,y) 2 5	EDR(d) 2*5	EDR(sr,y) 2*7	MVN xyc 3*7	EDR d,x 2 4	LSR d,x 2 6	EDR(d),y 2*6	CLI imp 1 2	EDR a,y 3 4	PHY s 1*3	TCD imp 1*2	JMP al 3*4	EDR a,x 3 4	LSR a,x 3 7	EDR al,x 4*5	5
	6	RTS s 1 6	ADC(d,x) 2 6	PER s 3*6	ADC sr 2*4	STZ d 2*3	ADC d 2 3	RDR d 2 5	ADC(d) 2*6	PLA s 1 4	ADC imm 2 2	RDR acc 1 2	RTL s 1*6	JMP (a) 3 5	ADC a 3 4	RDR a 3 6	ADC al 4*5	6
	7	BVS r 2 2	ADC(d,y) 2 5	ADC(d) 2*5	ADC(sr,y) 2*7	STZ d,x 2*4	ADC d,x 2 4	RDR d,x 2 6	ADC(d),y 2*6	SEI imp 1 2	ADC a,y 3 4	PLY s 1*4	TDC imp 1*2	JMP(a,x) 3*6	ADC a,x 3 4	RDR a,x 3 7	ADC al,x 4*5	7
	8	BRA r 2*2	STA(d,x) 2 6	BRL rl 3*3	STA sr 2*4	STY d 2 3	STA d 2 3	STX d 2 3	STA(d) 2*6	DEY imp 1 2	BIT imm 2*2	TXA imm 1 2	PHB s 1*3	STY a 3 4	STA a 3 4	STX a 3 6	STA al 4*5	8
	9	BCC r 2 2	STA(d,y) 2 6	STA(d) 2*5	STA(sr,y) 2*7	STY d,x 2 4	STA d,x 2 4	STX d,y 2 4	STA(d),y 2*6	TYA imp 1 2	STA a,y 3 5	TXS imp 1 2	TXY imp 1*2	STZ a 3*4	STA a,x 3 5	STZ a,x 3*5	STA al,x 4*5	9
	A	LDY imm 2 2	LDA(d,x) 2 6	LDX imm 2 2	LDA sr 2*4	LDY d 2 3	LDA d 2 3	LDX d 2 3	LDA(d) 2*6	TAY imp 1 2	LDA imm 2 2	TAX imp 1 2	PLB s 1*4	LDY a 3 4	LDA a 3 4	LDX a 3 4	LDA al 4*5	A
	B	BCS r 2 2	LDA(d,y) 2 5	LDA(d) 2*5	LDA(sr,y) 2*7	LDY d,x 2 4	LDA d,x 2 4	LDX d,y 2 4	LDA(d),y 2*6	CLV imp 1 2	LDA a,y 3 4	TSX imp 1 2	TYX imp 1*2	LDY a,x 3 4	LDA a,x 3 4	LDX a,y 3 4	LDA al,x 4*5	B
	C	CPY imm 2 2	CMP(d,x) 2 6	REP imm 2*3	CMP sr 2*4	CPY d 2 3	CMP d 2 3	DEC d 2 5	CMP(d) 2*6	INY imp 1 2	CMP imm 2 2	DEX imm 1 2	WAI imp 1*3	CPY a 3 4	CMP a 3 4	DEC a 3 6	CMP al 4*5	C
	D	BNE r 2 2	CMP(d,y) 2 5	CMP(d) 2*5	CMP(sr,y) 2*7	PEI s 2*6	CMP d,x 2 4	DEC d,x 2 6	CMP(d),y 2*6	CLO imp 1 2	CMP a,y 3 4	PHX s 1*3	STP imp 1*3	JML (a) 3*6	CMP a,x 3 4	DEC a,x 3 7	CMP al,x 4*5	D
	E	CPX imm 2 2	SBC(d,x) 2 6	SEP imm 2*3	SBC sr 2*4	LPX d 2 3	SBC d 2 3	INC d 2 5	SBC(d) 2 6	INX imp 1 2	SBC imm 2 2	NOP imp 1 2	XBA imp 1*3	CPX a 3 4	SBC a 3 4	INC a 3 6	SBC al 4*5	E
	F	BEQ r 2 2	SBC(d,y) 2 5	SBC(d) 2*5	SBC(sr,y) 2*7	PEA s 3*5	SBC d,x 2 4	INC d,x 2 6	SBC(d),y 2*6	SED imp 1 2	SBC a,y 3 4	PLX s 1*4	XCE imp 1*2	JSR(a,x) 3*6	SBC a,x 3 4	INC a,x 3 7	SBC al,x 4*5	F

* New W65SC816 Op Codes
 • W65SC02 Op Codes

Figure 3: The 65816's instruction set with hexadecimal equivalents, mnemonics, addressing-mode number of bytes for the op code and operand, and the basic number of clock cycles required for the instruction.

set. Not only is BRA position independent, it requires 1 less byte than the alternative JMP (unconditional jump) instruction. It is limited to destinations within 126 bytes before and 129 bytes after the branch instruction, but this range is frequently wide enough for loops within a program.

Because the 6502 has a limited number of registers, the index registers are frequently turned to general-purpose uses. Since there are no instructions to directly transfer data between index registers and the stack or between each other, the accumulator sometimes is used to mediate transfers. The se-

quence PHA (push the A register on the stack), TXA (transfer the contents of the X register to A), PHA, TYA (transfer the contents of Y to A), PHA is common in subroutines that must preserve all processor registers for the calling routine. The sequence for restoring the registers is equally clumsy. Also, the data in the A register is destroyed, and it is tricky for the subroutine to recover this data from the stack without destroying data for the index registers. The 65816 adds the instructions PHX, PHY (push index registers to stack), PLX, PLY (pull index registers from stack), TXY, and TYX (transfer X to Y and Y to X, respective-

ly). This sequence lets a subroutine save just those registers it needs to use and restore, or save them in a different sequence on the stack so that the data is available later in the correct sequence.

The 6502 has found applications both in general-purpose systems and in special applications, such as printer controllers. Most general-purpose applications don't often need the ability to set or reset specific bits of memory or input/output ports. Such dedicated applications as printer or appliance controllers, on the other hand, frequently rely heavily on this ability.

Multiple-processor systems need the

ability to set and clear semaphores to arbitrate the use of resources such as memory and peripherals. Furthermore, they must be able to do it in such a way as to change a bit and then have access to its previous state. The requirement is made even more demanding by the stipulation that no other processor can also get to the semaphore during such access. The TRB (test and reset bits) and TSB (test and set bits) instructions provide this capability. Bit 7 of the addressed memory location is copied to the C flag, and bit 6 is transferred to the V flag. TRB then computes the logical AND of the memory data and the inverse of the accumulator data, while TSB computes the logical OR of the memory data and the accumulator. Either instruction then stores the result back in the memory location and sets the Z flag to indicate whether or not the result was 0. The effect is to set or clear the bits corresponding to "1" bits in the accumulator, while loading the N and

V flags with the previous state of bits 6 and 7 of memory. Two similar instructions, REP and SEP, use a byte of immediate data to determine which status register bits to change. Using immediate data is more economical than adding distinct instructions for controlling each such bit. There is still no instruction for complementing any of the flags.

Eight new instructions permit new types of stack accesses. Five of the eight transfer registers to and from the stack: PHB and PLB for the data bank register, PHD and PLD for the direct register, and PHK for the program bank register. Again, there is no instruction to pull just the program bank register from the stack.

The three other new stack instructions permit pushing computed data onto the stack and then later pulling it back into one of the processor registers or accessing it through new stack-relative addressing modes. The simplest of the three is PEA (push effective absolute

address). This instruction pushes the third byte and second byte of the instruction, in that order, onto the stack. The name implies that the instruction is meant to be used to pass a data block's address to a subroutine. However, it might also be used to pass any fixed 16-bit data. The effect is the same as loading the accumulator with 16-bit data and then pushing the accumulator to the stack, except that data in the accumulator is left intact and PEA executes faster.

The PEI (push effective indirect address) instruction is only slightly more complex than the PEA instruction. The second byte of the instruction is used as an offset into the direct page (pointed to by the direct register), and the two bytes of data at that and the next-higher memory location are pushed onto the stack. The effect is to save the contents of two memory locations in the direct page, just as if they

(continued)

**U S C Proudly introduces Our New
"PROFESSIONAL COMPUTER CHASSIS/
POWER SUPPLY" for IBM PC/XT
& Compatibles**

Designed to enable easy, straight-forward conversion of IBM PC/XT & compatibles board-level products into complete microcomputer-based systems meeting specific performance and installation requirements.



Features:

- More than just another pretty face
- Sturdy to withstand the vigors of use in the intended environment.
- Good RF attenuation to eliminate interference with adjacent electronic equipment.
- High efficient switching power supply, with all DC cables-plug right in.
- Built in fan, 2 additional AC sockets plus card racks with plastic guides.
- Assembled & Tested

\$199

- Professional PC-Chassis (65W)..... \$199.00
- Professional XT-Chassis (130W)..... \$259.00

Dealers & OEM inquiries invited.

U S Components
1055 Sunnyvale - Saratoga Rd.
Sunnyvale, CA 94086
TEL (408) 730-1399

Midwest Distributor:
Macrotron Systems Inc.
8147 Delmar Blvd.
St. Louis, MO 63130
(314) 721-3356

Terms: Prepaid check or money order. Mastercard or Visa.
Shipping Charges: U.S. FREE, Canada \$2.00, COD \$5.00 (No COD's to Canada)

**MORE POWER...
MORE SPEED...**



C86, the leading C compiler for PC-DOS and MS-DOS is better than ever. **50% faster execution, highest portability, floating point math, strong support, and much more. Still only \$395.**

FOR MORE INFORMATION OR TO ORDER CALL:

800-922-0169

Technical Support: (201) 542-5920



COMPUTER INNOVATIONS

980 Shrewsbury Avenue, Suite B
Tinton Falls, NJ 07724

C86 is a trademark of Computer Innovations, Inc. MS-DOS is a trademark of Microsoft. PC-DOS is a trademark of International Business Machines.

made up a 16-bit processor register.

PER (push effective program-counter-relative address) passes the address of a data block to a subroutine. The data is then stored within the calling routine, and the address is given as an offset from the PER instruction's location. The calling routine treats the second and third bytes of the instruction as a 16-bit quantity and adds them to the program counter. The 16-bit result is the data to be pushed on the stack. PEA and PER both pass data stored in the calling routine's code. While PEA can be used to pass a single 16-bit quantity to a subroutine, PER passes the address of a whole block of data.

Since the 65816 has several more internal registers than the 6502, it needs some new instructions for transferring data inside itself. Transfers between the X and Y index registers were covered above. The TCD (transfer accumulator C to the direct register) and TDC (transfer D to C) instructions provide the only way to set or read the direct register without using the stack. The 65816's TCS (transfer accumulator C to stack pointer) and TSC (transfer S to C) instructions ease the 6502's bottleneck of being able to access the stack pointer only through the X register. XBA (exchange B and A) lets you flip-flop the upper and lower 8-bit halves of the accumulator to help it handle mixed 8- and 16-bit data. The Z and N flags are set during the exchange to indicate the new status of the accumulator. The XCE (exchange carry flag with emulation flag) is needed because the emulation (E) flag does not actually belong to the status register proper.

The RTL (return from subroutine—long) instruction is needed because a new absolute long addressing mode has been applied to the JSR (jump to subroutine) instruction. In addition to restoring the program counter, RTL also restores the program bank register from the stack. In keeping with the convention that higher-order bytes appear higher in memory, RTL pushes the program bank register before and pulls it after the normal program counter. RTI (return from interrupt) is always treated by the program as a long return, since interrupts, by their very nature, must specify the full address of the interrupt routine, possibly changing the program bank register in the process.

Several new instructions deal with control of the system bus and clocks. The COP (coprocessor) instruction supports coprocessors and acts like a software interrupt, except with its own vector. The STP (stop the clock) instruction stops the system clock with the phase two clock high. This state can be released only by a reset, which then functions as a high-priority interrupt, with the stack set up correctly for the RTI instruction to resume processing with the instruction following the STP instruction. The WAI (wait for interrupt) instruction stops execution and waits for either the maskable or nonmaskable interrupt (IRQ or NMI). One additional code (WDM) is defined as a no-operation instruction, but it is reserved for future use. The mnemonic comes from the design engineer's initials.

The new block-move instructions, MVP and MVN, are reminiscent of the block moves of the Z80 processor, except that they can be used to move a block of memory anywhere within the full 16-megabyte address space. MVP (move preceding) is meant to move data higher in memory. The move starts at the top end of the block and proceeds downward. This procedure avoids overwriting data that has yet to be moved in cases where the old and new block locations overlap.

MVN (move next) is similarly intended for moving data. In this case, however, data is moved to a position that is lower in memory, starting at the low end of the block and working upward through it. The second byte of the instruction gives the bank address of the destination memory area and the third byte gives the bank address of the old location in memory. The X register contains the low-order 16 bits of the first byte's current address. The Y register contains the low-order 16 bits of the new address. The C accumulator contains the number of to-be-moved bytes minus one. Each byte moved requires seven clock cycles, and the move can be interrupted and resumed through the normal interrupt mechanisms. After completion, the data bank register contains the destination memory area's bank address. This is an important consideration since the program will normally need to operate on the data after moving it. The X and Y registers are incremented or decremented as the move

proceeds. As a result, the Y register will hold the 16 low-order address bits of the next byte beyond (above or below) the new area. The A register contains hexadecimal FFFF. The 65816 boasts versions suitable for clock rates from 1 to 10 MHz. This capacity allows a system using the slowest clock to move a complete 64K-byte data block (characters to a very high resolution memory-mapped video display, for example) in just under half a second. With a 10-MHz clock, the same transfer would take somewhat less time than a complete screen refresh (standard monitor with interlaced scanning).

ADDRESSING MODES

The 65816 includes all the addressing modes of the standard 6502 plus a number of new ones. The existing addressing modes were extended to allow for 24-bit addresses and 16-bit data where appropriate. Internal operations employing implied addresses take the data width corresponding to the specific registers being used. Most of the 6502 addressing modes now have separate long addressing modes, allowing them to use either a 16-bit address within the bank specified by the data bank pointer or a 24-bit address within the full 16-megabyte address space.

The immediate mode of the 6502 assumes that one of the operands is an 8-bit quantity stored immediately after the op code. For operations on 16-bit registers, the 65816 lets you store 16-bit data in the two bytes following the operation.

The addressing modes—absolute, indirect indexed, and absolute indexed with X (but not Y)—have new long forms as well as standard forms. Their standard addressing modes specify the low-order 16 bits of the address; the high-order 8 bits come from the data bank register. The zero page designation on certain modes has been replaced by direct page. The change is consistent with this special page's new mobility as granted by the direct register but leads to such double-talk as "direct indirect indexed" for an addressing mode description. To translate, keep in mind that "direct" always refers to the direct register or page, "indirect" refers to the memory location(s) holding a further address rather than data, and "indexed" means adding an index register to the

address formed up to that point. Also, the name of the addressing mode describes, from left to right, the order in which the operations are performed. Thus, the example "direct indirect indexed" means that the instruction's operand specifies a direct-page location (direct), which contains only an address (indirect), and to which the Y register is added (indexed). Adding the Y register forms the data's final address for that particular instruction. Other addressing modes use these terms in different sequences and in combination with other, more self-explanatory terms. For all cases, the same general idea holds.

The branch, jump, and jump-to-subroutine instructions each retain their old 6502 addressing modes. The jump and jump-to-subroutine instructions also have new long addressing modes that load both the program counter and the program bank register with new values. In addition, both jump and jump-to-subroutine have new indexed addressing

modes that use the X register as the index of a subroutine address table. The unconditional branch instruction's long addressing mode specifies a 16-bit displacement from the current location. This displacement can be positive or negative and wraps around within the current program bank. Conditional branches have no analogous long addressing mode.

Expanded stack addressing modes complement the new stack manipulation instructions. With parameters passed to it on the stack, a subroutine can read or modify them as easily as it can access those parameters stored in a fixed block of memory. It can pop or push parameters as before and can also access them without moving the stack pointer. All it has to do is specify a displacement ranging from 0 to 255 bytes above the stack pointer. Using the "stack relative indexed" addressing mode, a subroutine can use a stack parameter as the table address to be in-

dexed by the Y index register. Since the stack pointer can now be transferred directly to or from the accumulator, a simple arithmetic operation can allocate or delete large stack areas. Combined with the long relative branch, the new stack-addressing modes herald the 6502 family's move toward position-independent, reentrant, and even recursive routines.

With its enhanced instruction set, new addressing modes, expanded interrupt handling, and 24-megabyte address space, the 65816 enters the 16-bit arena on equal footing with the 8086 and 68000. Its one handicap is its lateness, but that might be offset by the familiar, compact, and powerful 6502 instruction set that it brings along. Next month I will show you some hardware enhancements that ease the system designer's burden when using this 6502 cousin in boxes ranging from dedicated controllers to multiuser, multiprocessor systems. ■

DECADES OF SERVICE
FROM THE NATION'S LARGEST NEC DEALER

NEC THE PERFECT SOLUTION

NEW!



- Complete System Prices from \$1795
- IBM Compatible
- High Resolution (640 x 400)
- Fast (8MHz 8086)
- Runs MS-DOS, UNIX

FOR A LIMITED TIME
COMPLETE SYSTEM

ONLY \$1395⁰⁰! **PC-8800**

BEST BUY

INCLUDES:

- MONITOR
- Dual 5 1/4" DSDD floppy drives
- Powerful 64K memory
- Wordstar, Mailmerge
- Multiplan
- CP/M 2.2
- N-88 Basic

IBM compatible
16 bit option available

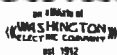


PC-8200 portable computer

GSA Contracts • Support • Service • Competitive Prices
Corporate Purchasing Plans • Leasing • Exporting

Washington Computer Services

97 Spring Street (212) 226-2121
N.Y., N.Y. 10012

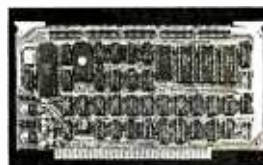


HOURS: 9 AM - 5 PM / Monday - Friday TELE: 12-5606 CABLE: WASHCOMP NYK

PLEASE! Do not confuse us with mail order dealers. We are a full service distributor serving the data processing & installation needs of business and industry from micros to mainframes. System houses, educational institutions & governmental agencies given special consideration. Dealer and international inquiries welcome.

Extended Processing S100 Boards

POWER I/O



High performance S100/IEEE-696 smart slave computer with 64K RAM, 3 serial ports, 1 centronic port, comprehensive 4K operating system in EPROM and 1 timer. Host access is through a high speed parallel I/O port. Accepts 256K RAMS when available. Optional ADD-ON board doubles I/O and RAM. Standard software and hardware supports 6 serial ports, 2 parallel ports and 512K of RAM. Entire board is software programmable including all I/O buffer sizes.

POWER I/O w/64K and 3S+P:	\$375.00
64K RAM ADD-ON board:	\$175.00
3S+P ADD-ON board:	\$195.00
64K and 3S+P ADD-ON board:	\$295.00

BURNER I/O II



Multifunction S100/IEEE-696 board. Complete EPROM programmer handles 5 volt EPROMS: 2508, 2758, 2516, 2716, 2532, 2732, 2732A, 2564, 2764, 27128, 27256. Fully I/O mapped. EPROM selected totally with software. No switches or program modules. Menu driven software supplied in 4K EPROM. 2 independent serial ports with baud rate to 19,200. 1 centronic type parallel port. Memory management for address lines A16-A23.

Option A: Full board	\$355.00
Option B: Programmer	\$220.00
Option C: I/O (2S+P)	\$220.00
Option D: Programmer+I/O	\$330.00
Option E: Memory management	\$110.00
Memory management for B or C:	\$ 25.00

All E.P. boards are built with quality components and are fully assembled and tested. Full documentation including schematics and source code listings.

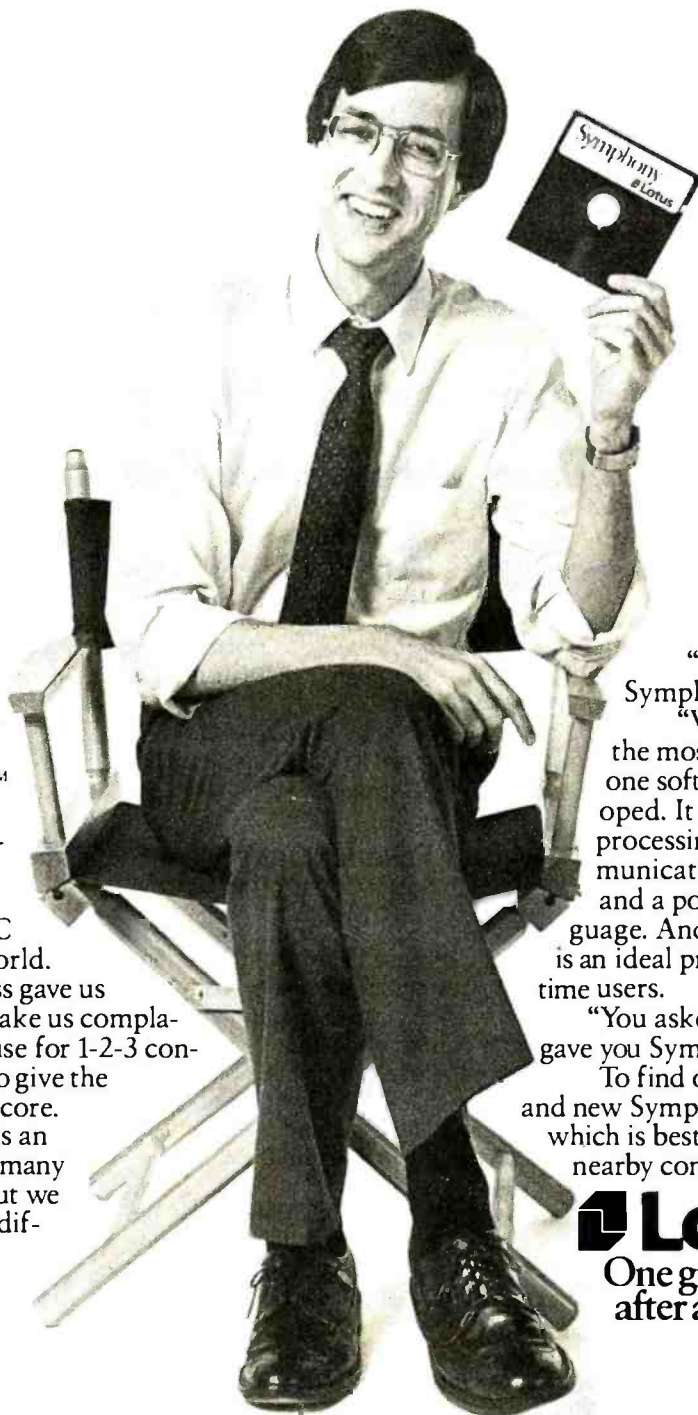
ep Extended Processing 3861 Woodcreek Lane,
San Jose, Ca, 95117 (408) 249-8248

“You asked for an encore.”



Brian Stains is the Symphony Program Manager at Lotus Development Corporation. He was previously involved with the creation of 1-2-3 software and is one of the original members of the company.

We gave you a Symphony.”



“It took a dedicated team to create what the business community termed ‘an overnight success.’ But that’s just what 1-2-3™ software became.

“When people discovered the incredible speed and power of 1-2-3, they made it the number one PC business software in the world.

“Naturally this success gave us confidence, but it didn’t make us complacent. So even as the applause for 1-2-3 continued, we were working to give the business community an encore.

“We realized 1-2-3 was an analytical tool that solved many people’s business needs. But we also talked to people with different requirements.

“We listened and we learned.

“The result is new Symphony™ software.

“We believe Symphony is the most comprehensive, all-in-one software system ever developed. It combines word processing, spreadsheet, communications, database, graphics, and a powerful command language. And like 1-2-3, Symphony is an ideal program even for first time users.

“You asked for an encore, we gave you Symphony.”

To find out more about 1-2-3 and new Symphony software—and which is best for you—visit your nearby computer dealer.

 **Lotus**

One great idea after another.”

(continued from page 130)

Is there a simple way to test the assembled system to verify that the components were not defective or damaged during system assembly?

By the way, Radio Shack (Canada) informs me that the 273-100 has been discontinued and will not be available after current inventories have been exhausted. Can you suggest an alternate unit?

Thanks very much. Your articles are one of the main reasons I don't like to miss an issue of BYTE.

TERRY J. DEVEAU

Armdale, Nova Scotia, Canada

Three MOVs are required to protect against common-mode transients as well as differential-mode transients. Common-mode transients occur from either side of the line to ground; differential-mode transients occur across the line. MOVs are cheap—use three!

A line filter, like other filters, has a characteristic impedance. Placing two in parallel will half the input and output impedances and reduce the effectiveness of the filter. It would be better to split the outlets into two groups and feed each half with a 5-A filter.

There is no simple way to test the MOVs after assembly. They fail in a short-circuit mode, so an ohmmeter check might turn up a defective unit. Visual checks in service (similar to a fuse) will reveal a unit that has absorbed too much energy.

Several companies manufacture power-line filters that are suitable for your applications. They include type 5VK1 or 5VK3 from Corcom Inc., 1600 Winchester Rd., Libertyville, IL 60048, (312) 680-7400; type APF511L from Cornell-Dubilier Electronics, 150 Avenue L, Newark, NJ 07105, (201) 589-7500; type 05DBAG5 from Delta Electronic Industry USA, 1355 Yosemite Way, Hayward, CA 94545, (415) 785-5231; and type 600A5 from Potter Company, POB 337, Wesson, MS 39191, (601) 643-2215. These filters are equivalent to the Radio Shack 273-100.—Steve

I NEED AN MOV

Dear Steve,

Help! I've gone to five Radio Shack stores to try to buy a V130LA10A MOV

to build your power strip. I couldn't find this part. All they had was the V8AZ1 MOV.

What should I do? Can something else be substituted? Thank you for any information.

GERALD CARON

Berkley, MA

Radio Shack still sells the V130LA10A MOV transient protectors (part number 276-570) but could not anticipate the demand caused by my article. In fact, I was surprised by the number of letters I received on this subject. It's nice to know so many are interested in power-line protection.

I chose the Radio Shack MOVs because they were easily obtainable, but there are several other sources. The V130LA10A is manufactured by General Electric and should be available from a local GE distributor or electronics-parts supply house. In addition, Panasonic and General Instrument manufacture similar units. The equivalent Panasonic part, number ERZ-C14DK201, is available as part number P7063 from Dig-Key Corporation, Highway 32 South, POB 677, Thief River Falls, MN 56701, (800) 346-5144. The General Instrument equivalent, part number S14K130, is available from Active Electronics, POB 8000, Westborough, MA 01581, (800) 343-0874.

The V8AZ1 MOV is designed for 5-V DC circuits; the V130LA10A is designed for 130-V AC circuits.—Steve

WRONG FREQUENCIES

Dear Steve,

I just purchased the ECM-103 modem kit. Following an expensive confrontation with the customs department, I set about putting it together. Then, to my surprise, a local guru on computing advised me that Australian frequencies for modem channels 1 and 2 are 980 to 1180 Hz and 1650 to 1850 Hz, respectively.

Is there any way the ECM-103 can be modified to operate at these frequencies? Is it possible to change the crystal? I'm hopeful that you will be able to help me.

GEORGE HENDERSON

Turramurra, New South Wales,
Australia

Texas Instruments, the supplier of the IC that forms the heart of the ECM-103, produces another chip that should solve your problem. I believe that the frequencies you describe are the European standard versions for data transmission. TI produces a chip that is pin compatible with the device used in the ECM-103, and it covers the European standard. The part number you want is TMS99534. Be sure to get an application note, as this will let you know if different passive component values are required.—Steve

CP/M IN ROM

Dear Steve,

I hope to put together a Z80-based system and intend to use the interface found in "Build a Super Simple Floppy-Disk Interface" (May and June 1981). I want the system to run under CP/M 2.2, but I do not have another system with which to generate the CBIOS (custom basic input/output system). I do have an EPROM programmer that runs on a ZX81. In "Build the Circuit Cellar MPX-16 Computer System, Part 1" (November 1982, page 78), I saw an ad for CP/M-86 BIOS in ROM. Could I program the CP/M 2.2 CBIOS into an EPROM? And if I do, what is to be done to interface with the remainder of CP/M?

The system will also use your E-Z Color Graphics Interface ("High-Resolution Sprite-Oriented Color Graphics," August 1982, page 57). I would like to use its external video input to display text from a 6845 CRT controller, giving a backdrop plane of 80-column text. Do you have any advice that would help interface the two? I am concerned with the need for synchronization and an appropriate video output from the 6845 circuitry to the 9918A.

Thanks for your time.

R. A. PEDERSON

Orleans, Ontario, Canada

The CP/M BIOS-support ROMs for the MPX-16 provide only boot and device support for CP/M. The BIOS actually comes in off the disk itself. This is a change from the original implementation, made to enhance the flexibility of the system. Now, PC-DOS and 514- and 8-inch CP/M all run off the same ROM set.

It is certainly possible to code a BIOS in ROM, but I understand that the newest version of CP/M requires that device drivers be loaded externally from the disk at initialization. It may be possible to do this in ROM, too, but I am not enough of a CP/M user to say for sure.

As far as actually setting up a machine, I have found that it is virtually impossible to set up a new BIOS if you don't already have a running system to create it on. I suggest getting in touch with your local CP/M users group for technical assistance in this area.

The question you raised about the TMS9918A is a good one. While TI claims that it can be set up to accept an external video source, we have had a lot of trouble setting up synchronization circuits that work reliably.—Steve

GIVE THE RTC-4 A DATE

Dear Steve,

I am a research assistant at the University of Petroleum and Minerals. I read your article "Build the RTC-4 Real-Time Controller" on page 26 in the July 1983 BYTE. I am interested in the fixed-time programs capability of the RTC-4. Is there any way to add the date to the fix program if I wish to program the RTC-4 to do a function after one month or more?

I understand that I can change the day or time by the keyboard. Is there any mechanism to connect a receiver to this circuit so that I can change this data by wireless? If so, would you please provide me with the necessary information?

Thank you.

WASIM RA'AD
Dhahran, Saudi Arabia

The TMS1121 chip used in the RTC-4 real-time controller is a preprogrammed version of the Texas Instruments TMS1000 4-bit single-chip microcomputer. It is therefore not possible to change the internal program, and no additional features or functions can be added. The chip was designed as a universal timer controller but could not anticipate every possible requirement.

It is relatively easy to control the RTC-4 by wireless. My article in the February 1981 BYTE ("A Computer-Controlled Bank," page 44) describes a

method to control a Texas Instruments TMS1000-series microcomputer with a citizens band walkie-talkie. Other transmitting frequencies can easily be adapted as necessary.—Steve

LIKES THE MPX-16

Dear Steve,

I built the blank MPX-16 board and am pleased with its performance. I used sockets for ICs of ≥ 20 pins and for RAM. This was successful except for one bad IC.

I reduced R21 to 1.8k ohms because the 4.9-MHz crystal tended to go into the third overtone with R21 = 33k ohms. I designed my own 8-MHz oscillator using the same design you chose for the 4.9-MHz crystal.

I intend to design a keyboard interface and a video adapter using an Intel 82720.

I'm delighted with the educational value of this project.

I speak highly of your product where I work (I'm an IBM hardware/software engineer).

Since I will be making some changes to the BIOS, I was wondering if I could have an assembly-language listing?

R. A. FAUST
Tucson, AZ

The original BIOS for the MPX-16 was written in PLM-86. It has since been expanded from 4K to 8K bytes and rewritten in 8088 assembly code. The source listings are available on two disks for \$20 from The Micromint (25 Terrace Dr., Vernon, CT 06066).

The new BIOS allows the MPX-16 to operate either as a terminal-based machine or PC clone with a color graphics/monochrome board and keyboard. PC-DOS can be booted and executed in either configuration (the terminal configuration can't duplicate graphics functions, of course).—Steve

SWEET TALKER CONVERSION

Dear Steve,

I am having trouble interfacing the IO bus on my TRS-80 Model III. I am trying to convert or redesign the Sweet Talker speech box ("Build an Unlimited-Vocabulary Speech Synthesizer," Sep-

tember 1981, page 38). I built the parallel port and it works great, but I would like to change it to the IO bus port, if possible. Can you tell me where to find a schematic of the interface? Thank you.

BILLY BISHOP
Sachse, TX

Use of the IO bus port on the Model III requires that you enable the external device-driver chips by writing to a latch inside the TRS-80. Also, external logic must drive the direction line of the bidirectional buffers. Other than this, there are no special tricks to using the interface.

William Barden has written several articles for BYTE on how to construct and drive devices attached to the TRS-80 Model I, Model III, and Color Computer. You can find back issues of BYTE at a local library or order them from BYTE. (See the December 1982 cumulative index update for a listing of Barden's articles.)

Be sure to remember to include the 100-ms pulse extender and to have your software check the A/R line of the Sweet Talker, or the device will not function correctly.

The Model III Technical Manual contains the schematics of the IO bus interface as well as functional descriptions of how it works. It might be a good idea to secure a copy of this from your local Radio Shack store.—Steve

ADAPTING MICROVOX SOFTWARE

Dear Steve,

For several months now I have been using my VIC-20 with a Sweet Talker speech synthesizer. While I have enjoyed the many applications I have found for this versatile circuit, I now see the need for a more general-purpose stand-alone unit such as the Microvox text-to-speech synthesizer presented in the September and October 1982 issues. However, being a basically lazy guy, I would like to avoid a major construction project, if possible.

Would it be possible (and not too difficult) to adapt the Microvox text-to-speech algorithm to run on a SYM-I microcomputer, and, if so, is the Micro-

(continued)

vox software available either as a listing or in EPROM?

I realize that this would involve some timing and other modifications to the SYM, but if it's easier than building the Microvox from scratch, I would like to give it a try. Any suggestions you might be able to provide would be greatly appreciated.

RON HACKETT
Port Jefferson, NY

It is possible to adapt the Microvox text-to-speech algorithm to any 6502-based computer, provided that memory space at C000-C1FF and E000-EFFF hexadecimal is available for the two 2732 EPROMs containing the algorithm. In addition, RAM is required at 0000-0FFF hexadecimal, and the SC-01A interface hardware must be duplicated.

The Sweet Talker I presented in September 1981 also has a text-to-speech algorithm for the Apple II. The interface hardware and algorithm are much simpler than the Microvox's and therefore possibly easier for you to convert to the SYM-I. I refer you to that article.—Steve

MICRO D-CAM SECURITY SYSTEM

Dear Steve,

The first part of your article, "Build the Micro D-Cam Solid-State Video Camera," on page 20 in the September 1983 BYTE was very interesting. I would like to use the IS32 optic RAM, which you described in the article, in an alarm system. Specifically, I want to monitor an area with the IC so that whenever the scene changes, an alarm sounds and the image of the area is displayed.

How can I overcome the problem of changes in ambient light? Could I build such a system at a reasonable price? Thanks for any help you can give.

O. N. G. FERRAO
Doonside, Republic of South Africa

Using the Micro D-Cam as the sensor in an alarm system sounds like an interesting experiment. I assume you are talking about intrusion alarms, where the basic requirements for a successful system are that the system must detect intruders and that it must not give false alarms. The first condition could be

easily met with the Micro D-Cam by storing a reference picture in memory and comparing subsequent pictures with it. Any change would signal a possible intruder. Saving a reference picture can be accomplished by copying the contents of screen memory to another block of memory or by modifying the Micro D-Cam software to put the picture at any convenient location. It isn't really necessary to ever see the picture.

Avoiding false alarms is another problem, however. If you simply make a pixel-by-pixel comparison, changes in ambient light will be bothersome, as you suspected. In addition, you will get spurious responses scattered randomly over the picture area due to electrical noise and temperature changes. This happens because some cells in the detector will normally receive almost, but not quite, enough light to turn on. These cells will occasionally give a signal that will be interpreted as an intrusion. Your software must be designed to ignore these isolated signals as well as compensate for ambient light variations.

More sophisticated software might eliminate these problems. Some methods include periodically changing the reference picture to compensate for ambient light variations, ignoring any changes involving single or very small groups of pixels, and, hardest of all, distinguishing real movement from apparent changes in the appearance of stationary objects.

It is possible to design an alarm system such as you envision, and much of the needed software is included with the unit. Good luck.—Steve

Z8-CONTROLLED LAB SCALE

Dear Steve,

I am in the laboratory balance business and am working on a micro-balance of my own. Presently, most lab balances measure from 0.1 microgram to several kilograms and use a digital display. I have designed a weighing mechanism accurate to a microgram at 20 grams; this range is good for most lab use.

I would like to have a balance with an on-board computer, capable of options not found on other balances. I thought of your Z8 BASIC system controller.

The servo amp of my system has an

analog output of 0-2 V DC or whatever I need.

Could you tell me how I could interface your system and also how to use a small monitor as a readout? I would like the system to be complete.

Thanks.

PAUL BIANCHETTI
McCall, ID

A Z8 BASIC system controller could be used for your application. Since the original article, the system has been expanded to include a variety of Z8 cross-assemblers and extra memory, I/O, EPROM programmer, and serial boards. There is also a 10V 8-channel 8-bit A/D board.

While a 0-2V servo-amp output could be resolved with the present 10V range of the A/D, it might be better to amplify the signal (by 5) or reduce the span of the A/D from 10 V to 2 V.

Regarding the display, my January and February articles described a single-board intelligent terminal, Term-Mite ST-1000, which can be configured with a keyboard to function as a terminal or simply to drive a monitor to report computed results. While Term-Mite is a stand-alone system, it is coincidentally Z8 BASIC system-compatible and can be plugged into the same backplane with the system controller and A/D to drive a monitor.

Finally, projects such as the Z8 BASIC board are frequently just the beginning of my interest in a subject. Often, many enhancements are made after the original article. The latest addition is a 4K-byte FORTH chip that is interchangeable with the Z8671 BASIC chip. This modification should allow the board to be used in more sophisticated applications.—Steve

AND A Z8-CONTROLLED SOLAR COLLECTOR

Dear Steve,

Boy, am I ever in trouble. I'm a senior in high school in the middle of a science project for a science fair. My physics teacher and I are building a hot-air solar collector, which will have fairly high efficiency, contain some solar-heat storage, and be controlled by a small dedicated processor.

We have purchased a Micromint Z8

controller, have on order the basic analog-to-digital converter, and are presently assembling eight operational amplifier circuits on a vector card. These circuits are those you used in controlling your wood stove (February 1980, page 32). We are presently communicating with the Z8 by way of the serial port using a modem program and a Heathkit H-89. The modem software allows transmission of programs to and from disk files and the Z8. I've also ordered the new Term-Mite card to hopefully replace the H-89.

I have two problems. We have a fairly good idea on how to use the tiny BASIC in the Z8. What we can't seem to figure out is how to write the subroutines to read the temperature probes. Somehow, the A/D converter has to be addressed, a port opened, and data read and stored somewhere. This data would then be compared to cause something to happen or not happen. We've gotten quite a few booklets from Zilog concerning the Z8 and we still can't seem to get the picture.

I'm hoping that you might share some code with us. I feel that if we can at least get some idea of what the code should look like, we should be able to make some adjustments.

The second problem has to do with controlling a few fans. What can I buy or make to interface with the Z8 that would enable me to turn these items on/off?

KENNY LANGO
Amenia, NY

The routines needed to get at temperature probes are really not hard things to write. The A/D board looks like a memory location and requires no special configuration to get at. Using the @ or ^ functions of the Z8 BASIC, you can directly access the board from within a BASIC program. You can evaluate the value in the A/D converter and use BASIC to make decisions on what to do inside the system.

To control fans and the like, use the port-2 output lines to drive a solid-state relay. You can get them from Radio Shack.

The hardest part will be calibrating the A/D output with real temperatures. The standard sensor described in the example that comes with the A/D board uses Kelvin temperature, which is the Centi-

grade temperature offset 273 degrees. The program listing does show an example of Kelvin to Fahrenheit conversion, and I'm sure your physics professor can modify anything necessary.
—Steve

TO BUILD AN MPX-16

Dear Steve,

I thought you might like to hear from someone who had constructed an MPX-16 from a bare board. I have done so and survived to tell the tale.

I ordered the bare board and the manuals for the MPX-16. The manuals are legible, well organized, and written for the most part in English.

Let me skip ahead a bit and give you an overview of how I spent my time on the MPX-16 project: 50 percent chasing down parts, 5 percent loading and soldering the board itself, 10 percent in mechanical assembly (drilling square holes in chassis, etc.), 10 percent doing electrical (versus electronic) chores (harness, cables, fuses, etc.), and 25 percent making it work after it was together.

The system includes Chassis 1: MPX-10 Switching Power Supply, MPX-16 Main Circuit Board, fully loaded except for no 8087, muffin fan, and miscellaneous harness, fuses, switches, and sockets; Chassis 2: two Tandon TM-100-2 (powered off the MPX-10); a Heath H-19 terminal; and a pti Industries Data Shield Line Filter (which has four out of six sockets wired with hot and neutral reversed!).

Even though I live close to Silicon Valley and did my buying before the current economic recovery caused eager OEMs to buy up all the chips in sight, I still spent most of my time chasing down parts. ICs were not generally a problem, though 8288s were scarce when I needed one and it took a while to find anyone who realized that a 629 was a TTL part and not a commuter train. The real headache was some of the linear parts. Nobody stocked all the precision resistor values I needed in the tiny physical sizes intended to be used on the board. Nobody stocked the Erie trimmer capacitor. Nobody stocked the right SIP (single-inline package) resistors. Nobody had any 62-pin card-edge connectors. And so on. I fixed these problems by an assortment of kludges, lead-

bending, and ingratiating smiles. (Speaking of kludges, did you know that you can trim extra resistors off an SIP with a hacksaw? All you do is notch the case a bit, snap off what you don't need with pliers, and daub some epoxy over the broken end. Steve, is something the matter?)

I decided to use high-quality sockets: Augat 5XX-AG19Ds throughout. With more than 2000 IC pins on the board, the prospect of having some of them in intermittent contact was terrifying.

I also bought a good soldering iron, an Ungar 9100 with adjustable temperature. It spoiled me very quickly; my previous iron has been demoted to wood-burner.

With everything in hand, the board loaded very quickly—a few evenings of manic soldering, followed by an hour or two stuffing in ICs. I made one modification as I worked (besides the jumpers Micromint said to put in): I anticipated that the kind of programming I like to do would crash the system frequently, and I am skeptical of the practice of cycling the power too often, so I installed a Reset button. There's a cap on the RESET pin of the 8284. I came off it with a 4.7k-ohm resistor, through a big red normally open push button, to ground. That works just fine. I brought the leads from the resistor and from ground to a two-pin header in the breadboard area at one edge of the board, so that I could get to the push button by a detachable plug.

So far, so good. I decided I wanted a compact power supply, and I was too scared to try building a switcher, so I ordered an MPX-10 from Micromint. It came, and I tried to make it work. I knew you had to load a switcher properly, but I did not realize that you have to load all three positive supplies on the MPX-10 before any of them will regulate correctly. I am sufficiently an ignoramus that I will forgive myself that error, but I was amused to find that the Micromint engineer I talked to didn't know it either. Between my ignorance and his, a perfectly good switcher made an extra round trip to the East Coast before I stumbled across the solution. Live and learn.

I bought the biggest LMB Unipac chassis I could find—7 by 12 by 17 inches—and mounted board, power

(continued)

supply, and a 4.75-inch muffin fan inside. The big fan works beautifully at keeping the temperature down (even the bipolar 8288 is no more than luke-warm when it is stabilized at operating temperature), but the chassis holes for air inlet and exhaust make so much noise that I wear a hearing protector when I use the system.

I bought a little bag of cable ties and used them freely. It is amazing how professional a kludge can look when everything is routed neatly.

I bought two Tandon TM-100-2s from Jaded at a computer fair and found an appropriate chassis for them at a swap meet. One drive refused to read, but Jaded fixed it promptly.

I cut, stripped, crimped, soldered, and cursed up the necessary cables, then came to the astonishing realization that it was all done. I spent several days finding excuses not to turn it on, then fired up the H-19, closed my eyes, and flipped the switch. Nothing happened.

I found three elementary assembly errors by looking for pulse activity with a logic probe. I had made one cold-solder joint that was interfering with the buffering of SYSCLOCK (if a bad connection at pin 1 of U1 isn't an ill omen, I don't know what is), one solder bridge that had tied an address line high (I replaced the drivers for that part of the bus as a precaution), and had incompletely crimped one of the ribbon-cable connectors in the disk-drive harness.

By this time, the system booted CP/M-86, and the real work began. I tried to back up the system disk, and although the format program ran to conclusion, the disk-copy utility crashed with a track-read error as soon as it tried to write onto the newly formatted disk. I fussed with the logic probe and traced signals with a borrowed oscilloscope. I disassembled the format routine with DDT86 and stared at it. I assembled little BDOS and BIOS calls, again with DDT86, and ran them. Not a clue. Micro-

mint's imposingly thick BIOS listing got thinner and thinner and simpler and simpler as I studied it. I nosed about in the BIOS with the debugger and set breakpoints at judicious locations, ignoring the looming specter of nonreentrant code.

The disk controller thought it was doing a fine job of formatting the disk: it reported all zeros in its status registers after each track-format command. But when the same chip tried to read the same disk later on, it claimed that it couldn't find any sector identification.

I bought another \$40 disk controller and plugged it in. That bug expired, but others sprang valiantly forth to take its place.

But let me get back to the hardware. My system now appears to run fine, and so far I have nothing but praise for its design. As you correctly pointed out, bringing a system of this complexity up from a bare board is not a simple task.

(continued)

Before this happens, call SAFEWARE

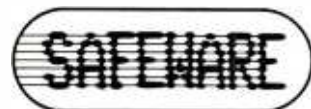
800/848-3469

(In Ohio, call 614/262-0559)

Protects your computer against theft, fire, power surges and other accidental losses. Insures your entire system for as little as \$35 a year — depending on the value of your hardware, software, and media. Full replacement after a low \$50 deductible.

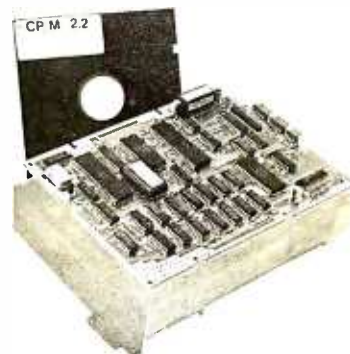
We're SAFEWARESM the first name in computer insurance. Tens of thousands of satisfied customers. Call toll-free for rates or immediate coverage.

SAFEWARE, The Insurance Agency Inc.
P. O. Box 02211
2929 N. High Street
Columbus, Ohio 43202



The Little Board™ ...\$199*

The world's simplest and least expensive CP/M computer



- 4 MHz Z80A CPU, 64K RAM, Z80A CTC, 2732 Boot ROM
- Mini/Micro Floppy controller (1-4 Drives, Single/Double Density, 1-2 sided, 40/80 track)
- Only 5.75 x 7.75 inches, mounts directly to a 5 1/4" floppy drive
- 2 RS232C Serial Ports (75-9600 baud & 75-38,400 baud), 1 Centronics Printer Port
- Power Requirement: +5VDC at .75A; +12VDC at .05A/On-board -12V converter
- CP/M 2.2 BDOS • ZOPR3 CCP • Enhanced AMPRO BIOS
- AMPRO Utilities Included:
 - read/write to more than 2 dozen other formats (Kaypro, Teletype, IBM CP/M86, ...)
 - format disks for more than a dozen other computers
 - format/copy/verify all in one
 - menu-based system customization
- SCSI OPTION • BIOS and Utilities Source Code Available
- Custom Versions: Contact Factory • OEM enclosure available

* In OEM Quantities.

Distributor/Dealer/Reseller Inquire in need

AMPRO
COMPUTERS, INCORPORATED

Z80A is a registered trademark of Zilog, Inc.
CP/M is a registered trademark of Digital Research
In Europe, Africa and the Middle East
contact Techexport (Telex: 95-1969)

67 East Evelyn Ave. • Mountain View, CA 94041 • (415) 962-0230 • TELEX 4940302

CALL 1-800-222-2602



YOU CAN BANK ON IT!
Our Rock Bottom prices will make a believer out of you!
CHECK US OUT!
Apple Country Ltd. is the leader in Rock Bottom computer prices. We intend to keep it that way!
We will try to meet or beat any advertised price!



CALL TODAY... WE CAN HELP!

CREDIT CARD ORDERS 1-800-262-2602

For order status, technical assistance and California calls (619) 765-0239 Apple Country, Ltd., P.O. Box 1099, 2602 Washington St., Julian, Calif. 92036 We accept AmEx. Prices reflect 2% discount for VISA/MC cash & check (2 weeks to clear). S&H in continental US 5% (\$5 min) Monitors \$10 min. APO/FPO & others call. Calif add 6% tax. P.O. must include check. No COD. All orders prepaid. All items are new with Mfg's warranty. Prices, products & terms subject to change without notice. All sales final. Returns require RMA#. No returns on software. Volume discounts available.

Apple Country, Ltd. is a DISCOUNT MAIL ORDER HOUSE for the micro computer industry and is a California corporation not affiliated with Apple Computer Inc. Apple is a trademark of Apple Computer Inc.

MONITORS

AMDEK COLOR I PLUS	309.95
AMDEK COLOR II PLUS	459.95
AMDEK COLOR IV	694.95
AMDEK VIDEO 300 (GREEN)	139.95
AMDEK VIDEO 300 (AMBER)	154.95
AMDEK VIDEO 310 (AMBER)	169.95
BMC 12" GREEN	189.95
BMC 13" COLOR	239.95
BMC 13" RGB	259.95
COMREX 13" COLOR W/SOUND	289.95
COMREX 12" HI-RES AMBER	119.95
COMREX 12" HI-RES GREEN	124.95
COMREX 13" RGB CR-6600	274.95
COMREX 13" RGB CR-6800	489.95
GORILLA 12" AMBER	99.95
GORILLA 12" GREEN	89.95
NEC 12" HI-RES GREEN	154.95
NEC 12" ECONO GREEN	109.95
NEC 12" LO-RES COLOR	294.95
NEC 12" AMBER SCREEN	159.95
NEC 12" COLOR - IBM	434.95
PRINCETON GRAPHICS HX-12	509.95
PRINCETON GR. 12" AMBER	189.95
SAKATA 13" COLOR	294.95
SAKATA 13" RGB COLOR	549.95
SAKATA SUPER RGB	749.95
SAKATA 12" GREEN	119.95
SANYO CTR-36 GREEN	169.95
TAXAN 12" GREEN	124.95
TAXAN 12" AMBER	134.95
TAXAN RGB 212 MED RES	309.95
TAXAN RGB 415 HI RES	439.95
TAXAN RGB 420 IBM	519.95
ZENITH 12" AMBER	109.95
ZENITH 12" GREEN	99.95
ZENITH RGB 274-135 COLOR	524.95
USI 9" AMBER PI-4	129.95
USI 9" GREEN PI-1	119.95
USI 12" AMBER PI-3	144.95
USI 12" GREEN PI-2	124.95
USI 13" LO-RES COLOR	309.95

MODEMS

ANCHOR MARK I (RS-232)	84.95
ANCHOR MARK VII (RS-232)	119.95
ANCHOR MARK X (RS-232)	124.95
ANCHOR MARK XII (RS-232)	289.95
KENSINGTON MODEM 1200	429.95
NOVATION J-CAT	119.95
NOVATION 212 AUTO CAT.	724.95
RIXON R212A 1200 BAUD	409.95
SMARTCAT 103/212	429.95
SMARTCAT 103	199.95
SMARTMODEM 300 BAUD	219.95
SMARTMODEM 4800 BAUD	489.95
SMARTMODEM 1200B - IBM	419.95
US ROBOTICS AUTODIAL 212	499.95
US ROBOTICS PASSWORD	379.95

DISKETTES

SS/SD ELEPHANT 16.95 OPUS	17.95
SS/DD ELEPHANT 19.95 OPUS	20.95
SD/DD ELEPHANT 25.95 OPUS	26.95

PRINTERS

AMDEK 5040 40CPS DAISY	1439.95
AMDEK DP-9501B	1099.95
AMDEK DP-9625B	1299.95
AMDEK DP-9628B	1179.95
AMDEK NP-6000	2299.95
AMDEK DP-6500TR 500CPS	2529.95
AMDEK 9725B COLOR	1394.95
C. ITOH A10 DAISY WHEEL	509.95
C. ITOH 8510P	489.95
C. ITOH 8600BP	489.95
C. ITOH 8510 SCP COLOR	569.95
COMREX CR-II DAISY WHEEL	499.95
COMREX CR-III DAISY	819.95
DAISYWRITER 2000 48K	1129.95
DELTA-10	424.95
DELTA-15	624.95
EPSON FX-80 W/TRACTOR	519.95
EPSON FX-100 F/T	719.95
EPSON MX-100 F/T	449.95
EPSON RX-80	284.95
EPSON RX-80 F/T	339.95
EPSON RX-100	579.95
EPSON LQ-1500P COMPLETE	1189.95
GEMINI 10X	284.95
GEMINI 15X	409.95
GORILLA BANANNA	189.95
IDS MICROPRISM 480	529.95
IDS PRISM 132	1659.95
JUKEI 6100 PRINTER (P)	449.95
MANNESMANN TALLY MT160L	639.95
MANNESMANN TALLY MT180L	879.95
MANNESMANN TALLY SPIRIT	319.95
NEC 3550 SPINWRITER-IBM	1769.95
OKIDATA PACEMARK 2350P	2279.95
OKIDATA PACEMARK 2410P	2569.95
OKIDATA PACEMARK 2410S	2639.95
OKIDATA 82A	354.95
OKIDATA 83A	629.95
OKIDATA 84P	409.95
OKIDATA 84S	1199.95
OKIDATA 92P	474.95
OKIDATA 93P	789.95
OKIDATA 93S	879.95
PANASONIC P1090	264.95
PANASONIC P1091	344.95
PRINTMASTER (DAISY)	1319.95
PRINTMASTER I (8510P)	344.95
PROWRITER II (1550P)	564.95
QUME SPRINT 11/40+	439.95
SANYO PR5000 DAISY WHEEL	499.95
STAR POWER-TYPE DAISY	409.95
STARWRITER DAISY WHEEL	1039.95
TOSHIBA P-1351 LP	1479.95
TRANSTAR 315 COLOR	409.95
TRANSTAR 120P 14CPS	439.95
TRANSTAR 130P 18CPS	599.95
MICROBUFFER (EPSON RS232)	124.95
GRAFFETTI CARD (APPLE)	89.95
GRAFFETTI (APPLE)	114.95
PRINTERFACE CARD (APPLE)	59.95
PK80 PRINTER I/F (APPLE)	139.95
WIZARD BPO 16K (APPLE)	139.95
WIZARD SOB 16K (APPLE)	199.95

OTHER PRINTERS AVAILABLE

APPLE

4TH DIMENSION DRIVE-ONLY	199.95
4TH DIMENSION DRIVE+CTRL	279.95
ALS CP/M CARD	299.95
APPLE-CAT II MODEM	284.95
BUFFERED GRAPPLER+	169.95
C-BASE II (REG Z-80)	356.95
COLLARS & SENSE (MAC)	109.95
GIBSON LIGHT PEN	179.95
GRAPHICS MAGICIAN (MAC)	39.95
HAYES MICROMODEM IIe	234.95
HOME ACCORDANT (MAC)	74.95
MACH II JOYSTICK IIe	39.95
MACH III JOYSTICK IIe	41.95
MANAGEMENT EDGE (MAC)	179.95
MICROBUFFER II+ 16K (P)	199.95
MICRO-SCI A2 DRIVE-ONLY	194.95
MICROSOFT BASIC (MAC)	119.95
MICROSOFT CHART (MAC)	99.95
MICROSOFT WORD (MAC)	149.95
MILLIONAIRE (MAC)	49.95
MULTIPLAN (MAC)	149.95
MULTIPLAN II	89.95
PFS:FILE & REPORT (MAC)	149.95
PREMIUM SOFTCARD IIe	299.95
QUADRAM 64KB/COL CRD IIe	124.95
SMARTMODEM 300 for //c	274.95
SOFTCARD II	354.95
VIDEX VIDEOTERM W/SETSW	239.95
VIDEX ULTRATERM	274.95
WS/MM/SS/SI w/STARCARD	459.95
ZORK I (MAC)	29.95

IBM

IBM PC 256k 2-DS/DD	2149.95
DBASE III	499.95
ACCESS 1,2,3	469.95
DR DRAW PC DOS	199.95
DOW JONES MARKET ANALYZE	249.95
HERCULES GRAPHICS CARD	389.95
KOBALA PAD TOUCH TABLET	119.95
KRAFT JOYSTICK	39.95
KGRAPH	164.95
KPAINT	79.95
MEGA PAK 256k	399.95
MICROPRO PRO PACK	419.95
MICROSOFT SYSTEMCRD 256k	479.95
MICROSOFT MOUSE	139.95
MOUSE SYSTEMS PC MOUSE	219.95
MULTIPLAN	139.95
PFS:WRITE	99.95
PLANTRONICS COLORPLUS	439.95
QUADCHROME MONITOR	589.95
QUADLINK APPLE EMULATOR	519.95
QUADRAM QUADBOARD I 64K	299.95
QUADRAM QUADCOLOR I	329.95
R-BASE 4000	359.95
RANA DS/DD DISK DRIVE	274.95
SIX PAK PLUS 64k	309.95
STB SUPER I/O MULTIFUNCT	184.95
TG JOYSTICK W/TOGGLE	44.95
TRANSENO P.C. MODEM 1200	439.95
VERSAWRITER GRAPH TABLET	249.95
VISI-ON MOUSE	194.95
WIZARD SPOOLER P/S 16K	249.95

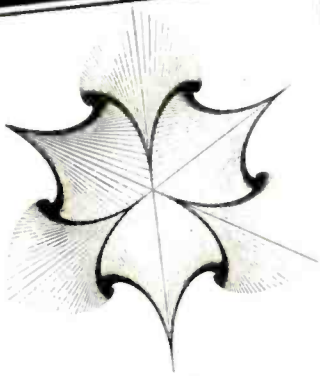
COMPUTERS

ALTOS 586-40 16-BIT	8229.95
ALTOS 986-40 16-BIT	9899.95
APPLE IIC	10W1
APPLE IIE	10W1
ATARI 800X COMPUTER	309.95
ATARI 850 INTERFACE	199.95
BMC 800-GREEN COMPUTER	
Z80A 64K PRINTER, MONITOR, RS-232, WORDSTAR, CALCMSTAR, MAILMERGE, SPELLSTAR, C/P 2.25	1424.95
COMMODORE 64 COMPUTER	LOW1
COMMODORE 1541 DISK DRIVE	LOW1
EAGLE PC PLUS-2 SYSTEM	3399.95
128K, 2-DS/DD DRIVES, MONITOR, EAGLEWRITER, MS-DOS, ENGLECALC, & CP/M-86	
EAGLE SPIRIT-II	2264.95
EAGLE SPIRIT-XL	3354.95
PORTABLE 128K EXPANDABLE TO 640K ON BOARD, 1 320K FLOPPY, 10 MEGABYTE HARD DISK, IBM COMPATIBLE KEYBOARD, 2 SERIAL 1 PARALLEL PORT, MS-DOS 2.0, MONOCHROME MONITOR, CP/M 86	
NEC APC-H01	2239.95
NEC APC-H02	2799.95
NEC APC-H03	3524.95
NEC APC-H04	2939.95
NEC 8201 COMPUTER	449.95
SANYO 550-1 1SS/DD DRIVE	769.95
SANYO 555-1 2SS/DD DRIVE	1079.95
SANYO 550-2 1DS/DD DRIVE	839.95
SANYO 555-2 2DS/DD DRIVE	1259.95
ZENITH IBM COMPATIBLE	2649.95
ZENITH W/10 MEG DSK	3999.95
TAVA PC - IBM COMPATIBLE 1999.95	
128K-RAM, 2 SERIAL PORTS, 1 PARALLEL PORT, 2 DS/DD DRIVES, COLOR GRAPHICS CARD, & MORE.	
WALNUT PC - IBM PC COMPATIBLE SPECIAL \$1799.95	
128K RAM, 2 DS/DD DRIVES, SERIAL, PARALLEL, COLOR CARD & SOFTWARE.	

IQ TECHNOLOGIES, INC.

SMART CABLES	
INSTANT RS-232 CONNECTIONS	
#817 (WORKHORSE)	79.95
#821 DIAGNOSTIC FEATURES	164.95

* ONE CABLE FITS ALL *



**V-GRAPH
TEKTRONIX 4010
GRAPHIC EMULATOR
FOR YOUR
PERSONAL
COMPUTER**

V-GRAPH is your link into the world of powerful, high-resolution graphics. Now your personal computer can act as a Tektronix 4010 terminal. Not just an emulator, V-GRAPH can even save graphics and text on disk and replay or print it later without reconnecting to the host computer.

V-GRAPH provides an equivalent for every function found on the Tektronix, including the cross-hair cursor used for graphic input. Plus, control and function keys may be programmed to emit commonly used character strings.

V-GRAPH supports the highest resolution possible, and is currently available for the IBM PC, Zenith Z-100 and Victor 9000. Requires MS-DOS & 64K. \$120

CompuView
PRODUCTS, INC.

1955 Pauline, Ann Arbor, MI 48103 • (313) 996-1299

CIARCIA'S CIRCUIT CELLAR

My present plans for the MPX-16 are varied. The real reason I wanted a home computer was that I have become interested in the creation of programming languages. In spare time at work, I have kludged up a threaded interpreter (not FORTH, but an emulation of the keyboard language of my old HP-65 programmable calculator—in a FORTRAN shell, yet!); brought up a RATFOR translator to the point where it would boot-strap; and even written a teeny compiler (for "WHATDUZITDO," which you will find in your back files of BYTE). I am presently trying to write a decent 8086 macro assembler, using the MPX-16. The only good one that exists seems to be Intel's ASM86, which I use daily at work, but that costs a jillion trillion dollars and runs only on Intel equipment, under ISIS. Odds are less than even that I can do such a thing, I suspect, but it will be fun to try.

Is there an MPX-16 users group?

JAY REYNOLDS FREEMAN
Belmont, CA

Yes, there is a users group. The newsletter can be obtained for \$5 a year. Contact Michael Bamberg, 1059 NW Danielle St., Hillsboro, OR 97124.

Readers should know that the MPX-16 can also now emulate the IBM PC directly using the IBM color graphics/monochrome board and keyboard rather than a monitor as originally described.—Steve

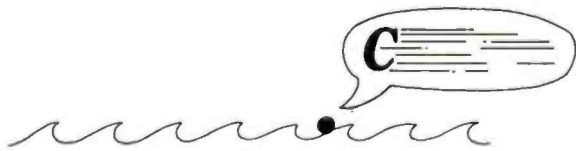
NEXT MONTH

Have you ever wondered how much power your appliances really use? The AC Power Monitor will tell you. ■

Ciarcia's Circuit Cellar, Volume I covers articles that appeared in BYTE from September 1977 through November 1978. Ciarcia's Circuit Cellar, Volume II covers December 1978 through June 1980. Ciarcia's Circuit Cellar, Volume III covers July 1980 through December 1981. Ciarcia's Circuit Cellar, Volume IV covers January 1982 through June 1983.

To receive a complete list of Ciarcia's Circuit Cellar project kits available, circle 100 on the reader-service inquiry card at the back of the magazine.

Editor's Note: Steve often refers to previous Circuit Cellar articles. Most of these are available in reprint books from BYTE Books, McGraw-Hill Book Company, POB 400, Hightstown, NJ 08250.



New Release

One user told us that, compared to other 8-bit C Compilers, Eco-C's "floating point screams". True. But, Release 3.0 has a number of improvements in other areas, too:

New optimizers with speed improvements of up to 50 percent over earlier releases!

New Compiler-time switches for greater flexibility.

A standard library with 120 pre-written functions.

Expanded error checking with over 100 possible error messages in English including multiple, non-fatal errors.

Improved, easy-to-read user's manual.

The Eco-C Compiler supports all data types (except bit-fields) and comes with MACRO 80 and the **C Programming Guide** for \$250.00. An optional, high-speed assembler and linker is available for an additional \$75.00. Eco-C requires a Z80 CPU, CP/M, and 56K of free memory. To order, call



6413 N. College Ave. • Indianapolis, IN 46220
(317) 255-6476



Eco-C (Ecosoft), CP/M (Digital Research), Z80 (Zilog), MACRO 80 (Microsoft)

More Computer for Your Calculating Dollar

Try the New

XPC-XT by **XOR**

Introductory Offer

\$1995.00
SYS-8100-00

"Need a 16-bit IBM-PC™ to process your data?"

The first IBM™ compatible that IS compatible! A complete system including the PC-DOS™ operating system from IBM™. Two thinline double-sided 5 1/4" Disk Drives hold 360K of formatted storage each, the other drive opening is fitted with a close-out plate. Removal of the plate will allow room for a Winchester Hard Disk. The Power Supply is like that of an IBM-PC XT™. Hard Disk ready! How compatible is the **XPC-XT**? It will run 1-2-3™, Flight Simulator™, dBASE II™, WordStar™, SuperCalc™, VisiCalc™ and hundreds of others. The system will also support MS-DOS™ 1.1 and 2.1, PC-DOS™ 2.2, CP/M-86™ and Unix Operating Systems. Add-on an additional 192K of RAM for a full 256K of on-board Memory for only \$195.00. This computer comes standard with 2 Serial and 1 parallel ports (IBM™ COM1 and COM2). No need to purchase Add-On cards.



Standard Features:

- PC-DOS™ Operating System Vers. 2.1
- 64K of parity checked RAM, expandable on-board to 256K
- 8088 16-bit CPU
- 5 IBM compatible expansion slots
- 4 DMA and 3 Timer channels
- Up to 32K of EPROM (supplied with full 8K)
- DOS BIOS on EPROM
- Full size capacitance touch keyboard with 10 function keys and calculator type numeric keypad
- 8087 Math Co-Processor ready
- 110-220 VAC, 50-60 Hz
- High resolution, 12" Monitor with Green Screen and 18MHz bandwidth.
- Two Slimline 5 1/4" DS/DD 48 TPI Floppys @ 360K storage each.
- Floppy Disk Controller expansion card, runs up to four SS or DD Floppys
- ALSO supports MS-DOS™ and CP/M-86™ Operating Systems.
- Power Supply is Hard Disk ready, no need to add-on additional power
- Full One Year Parts and Labor Warranty on all XDS Manufacturing products!

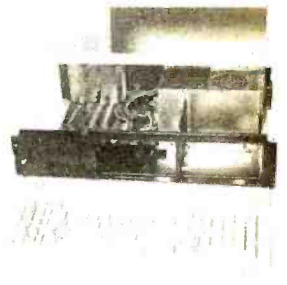
BASIC XPC SYSTEM

If that incredibly LOW Total System price doesn't suit you, try this "Do it Yourself System" and take your pick of the wide range of options listed below.

The Features: •64K RAM •Expandable to 256K

- 4 DMA channels
- 5 Expansion Slots
- Runs MS/DOS™ and CP/M-86™ (not included)
- Multi-function Keyboard and Cable
- Hard Disk Ready Power Supply
- 2 Serial and one Parallel Port
- and MORE!

Only \$895



The following are registered Trademarks and their Companies: 1-2-3-Lotus Development Company; MS-DOS, PC-DOS, Flight Simulator-MicroSoft; dBase II-Ashton-Tate; WordStar-MicroPro International Corp.; SuperCalc-Sorcim, Inc.; VisiCalc-VisiCorp, Inc.; CP/M-86-Digital Research Inc.; IBM, IBM-PC, IBM-PC XT-International Business Machines.

Call or Write for Nearest Dealer and Full Catalog

IBM-TYPE KEYBOARD

IBM-type keyboard. Super touch! (Even nicer than IBM!) L.E.D. indicator for CAPS and NUM LOCK. Also different layout available to conform with Selectric.

- KEY-1000-00 \$139.00
- KEY-1024-00 (SEL) \$195.00

POWER SUPPLY

Linear Power Supply with fan and power filter. Fits in case above. Uses 140 watts and runs Hard Disk. Mounting hardware and power cord included.

- POW-1030-00 \$175.00
- Also IBM replacement type for Hard Disk.
- POW-1040-00 \$175.00

MOTHERBOARD

Two IBM-style mother boards, 5-slot and 8-slot. Five-slot has two serial slots and one parallel. Both 256K expandable.

- BOA-6000-00 5-slot \$450.00
- BOA-6050-00 8-slot \$485.00

FLOPPY DRIVES

Your choice: Panasonic or Hitachi. 48-TPI double-sided. Perfect for your IBM-type systems. 90 day warranty! Shipped same day as ordered! Cables too!

- (PAN) DRI-6600-00 \$175.00
- (HIT) DRI-6650-00 \$170.00



XOR DATA SCIENCE

HARD DISK ADD-ON Complete Packages

Includes BIOS Software, 5 1/4" Winchester Hard Disk, mounting hardware, Interface P.C.B. for expansion slot, and all the necessary power and data cables (the Power Supply in the XPC-XT is Hard Disk ready).

- 10 Megabyte \$995
- 20 Megabyte \$1295
- 40 Megabyte \$1795
- 65 Megabyte \$2495
- 105 Megabyte \$3295
- 140 Megabyte \$4195

10-MEG TAPE BACKUP

★★★\$395.00★★★

1/2" high cassette type tape backup can be added to any HD system by removing one floppy. File managed software included!

IBM-TYPE CASE

Two styles to choose from, 5-slot and 8-slot. Includes hardware to mount drives and IBM-type circuit board, but no Power Supply.

- CAB-3050-00 5-slot \$110.00
- CAB-3060-00 8-slot \$110.00

COLOR

MON-1500-00 \$345.00



Three models of Color to choose from, each with higher and higher resolution. Price from \$345.00 to \$750.00. Monochrome Unit is outstandingly clear and easy on the eyes. In Green or Amber screens.

MONOCHROME

MON-1000-00 \$ 99.00



BOARDS

FLOP/SCSI/RTC

- BOA-8648-00 \$149

MODEM

- BOA-8725-00 \$295

HARD DISK

- BOA-8050-00 \$325
- MEMORY 512KW/64K

- BOA-8650-00 \$195

COLOR/MONO

- BOA-8410-00 \$289

PROM BURNER

- BOA-8640-00 \$129

MULTIFUNCTION

- BOA-8680-00 \$225

CALENDAR CLOCK

- BOA-8700-00 \$ 99

XDS Manufacturing ■ 5791 Machine Drive ■ Huntington Beach, CA 92649 ■ 714/898-0336

(continued from page 135)

features can make slow hardware seem fast. If implemented poorly, they can make even the most elegant hardware seem archaic. UNIX benchmarks should concentrate on some critical areas.

UNIX was developed on a small machine with limited memory and is disk intensive by its very nature. Therefore, we should test features of UNIX that use the disk.

The user interface to the UNIX system is called the shell (several common varieties exist). Since all requests made by the user are processed by the shell, it should be tested extensively.

The UNIX pipe qualifies on all the above criteria. A pipe is an I/O channel that is written into by one program and read by another. Pipes are used by a number of UNIX utilities, the shell in particular. Pipes are also often buffered on disk. A UNIX benchmark using a pipe is given in listing 1. The program creates a child process to read the pipe using the `fork()` system call and then crams 0.5 megabyte through the pipe. What do the results tell us? The two times of interest are the system and elapsed times. The system time, for all practical purposes, is a measurement of how long it took to set up and perform the piping. It thus is a direct measurement of pipe efficiency. The elapsed time is of interest because it helps give a good measurement of how slow the disk is. Elapsed time minus system time minus user time is essentially the disk-overhead time. Since microcomputers usually don't have the fastest disks, this is an important measurement for them. User time by itself is of little importance.

So you can get some idea of the time required to execute this and other benchmarks discussed in this article, table 1 shows the timings for some common minicomputers and microcomputers running UNIX. These times are average times on an otherwise idle system, as per the guidelines established above.

In the pipe benchmark, we measured the time it took to perform certain system calls (`fork()`, `read()`, `write()`, etc.) that were related to pipe implementation. The time to perform just one system call can be divided into several components:

1. The time required for the user-

program system-call library interface to set up and execute a trap (an SVC to IBM 370 users) to the kernel so that privileged instructions can be executed. When this happens, the registers needed by the processor (stack pointers, program counter, etc.) to run the user program are saved so that they can be restored after the system call is complete.

2. The time the processor is performing the desired function.

3. The time required for the user-program registers to be restored and control transferred so that the user program can resume computation with the result from the system call in hand.

4. The time used when a context switch between processes is required.

It would be nice to measure 1, 3, and 4, since they can be considered the majority of the overhead in making a system call. The program in listing 2 does just that. It does nothing but repeatedly (25,000 times) query the operating system concerning its process identity with the `getpid()` system call. This information is kept in an in-core process table, so access is extremely fast and actual computation very small, as long as no other processes are competing for the processor. (See the need for an idle system?) Since we're interested in measuring overhead, and the program doesn't do much other than system calls, the elapsed time is important here. System time should be close to the elapsed time, and user time should be very small. Both are insignificant. Again, the results of this benchmark are shown in table 1.

Now that we've benchmarked system-call overhead, the overhead involved in an ordinary user function call and return naturally follows. This benchmark may initially seem superficial but consider that it is compiler implementation that to a large degree determines object-code efficiency, and the same compiler (C in our case) is probably used to compile the operating-system kernel. If so, it *should* be considered when evaluating the operating system. It should also be noted that an inefficient compiler can nullify any speed gained by structured-programming techniques. Benchmarking compilers is a topic by itself and will

be left alone here. Let's just measure function-call overhead and consider it representative of compiler efficiency.

It is possible to determine the overhead involved in a function call in a number of ways. The method used here is believed to be more accurate than others. Since our comparison is two-way, two programs should be written: one that uses a function to achieve a goal and one that does not. The two programs, however, should perform the same task. After these programs are run, the user-execution time from the program not using the function is subtracted from the user-execution time of the program that does. This difference is the function-call overhead involved. This number can be divided by the number of times the call was made to arrive at a seconds-per-call overhead value, which can be enlightening when compared from system to system. An example of how this is done is shown in listing 3. Even though the program could have been made simpler by not passing a value to the function `empty()`, in real life all functions return at least one value, whether examined or not, and most functions pass at least one value (which is overhead, really). Using the C preprocessor, it is possible to write two distinct programs in one text file, depending on how the text file is compiled. The program in listing 3 is either compiled with `-EMPTY` to generate the empty function program or with `-DASSIGN` to generate the program that doesn't use a function but achieves the same goal.

As mentioned above, the user time, not the real time, is used in the calculation. This is because the real time is accurate only to the second, whereas the user time is accurate to the tenth. And, since we're generating a nonrelative numerical result, where virtually no system time is used, the measurement with the greater precision is needed.

Let's turn our attention to the C compiler. When most people think of compiler benchmarks, they think of the Sieve of Eratosthenes, which tests compiler efficiency and processor throughput quite well. It's an excellent test for looping, testing, and incrementing. The program in listing 4 is a slightly modified copy of the Sieve presented in the January 1983 BYTE (page 283). Since we're not using a stopwatch, all unnec-

BENCHMARKING

essary I/O has been removed. Also, by the guidelines established above, register declarations have been added. The time to be interested in here is the elapsed time. The user time should be about the same as the elapsed time, while the system time should be quite small.

We briefly touched on disk performance with the pipes test, but disk performance deserves a more in-depth evaluation. UNIX provides methods for both sequential and random-access files, and both should be tested. Listings 5a and 5b are benchmarks that test random-access disk implementation. The program in listing 5a creates, opens, and writes a 256- by 512-byte file. The number of blocks manipulated is specified by a #define statement and can easily be changed if it is too large for a small microcomputer implementation. The program in listing 5b randomly reads the file created in listing 5a and

removes it afterward.

While sequential access should be tested, it is not presented here since disk access is by and large random access. It should be easy to derive a sequential-access test from the random-access program given in listings 5a and 5b. Since the file created by benchmark 5a is relatively large, it's doubtful that it could be stored on one large, contiguous chunk of disk. More than likely, it will be segmented into several pieces, depending upon how full the filesystem is. Most efficient UNIX (and UNIX-like) implementations segment a physical disk into more than one logical disk partition. Each partition is called a filesystem. When the filesystem is created, all disk blocks are contiguous. As the filesystem is used more and more, it becomes more splintered with many small chunks of contiguous space.

Since we would like to run the bench-

(continued)

Listing 2: *The system-call benchmark.*

```

/*
 *      UNIX Operating System Implementation Test #2
 *
 * This program compounds the kernel overhead involved in executing
 * a system call. Making a system call involves a 'trap' to kernel
 * or supervisor mode, performing the desired function, and returning.
 * Context switching is, when it occurs, also overhead. The getpid()
 * system call is used because all it does is look in an in-core table
 * for the numeric process id.
 *
 * Instructions:
 *   Compile by:          cc -O -s -o scall scall.c
 *
 *   The -O option says to use the optimizer.
 *   The -s option says to strip the namelist from the
 *   object file after linking.
 *   The -o option says to place the object file in the file
 *   specified by the next argument.
 *
 * Time by:              /bin/time scall
 *
 * Results:
 *   Since we're testing system overhead, the elapsed time is of
 *   interest here.
 */

#define TIMES 25000

main()
{
    /* take advantage of the hardware */
    register int i;
    for (i = 0; i < TIMES; i++)
        getpid();
}

```

GIVE YOUR COMPUTER THE ABILITY TO INTERACT WITH THE REAL WORLD



**MONITOR AND CONTROL
TEMPERATURES**

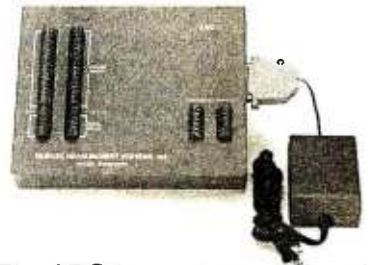
**MANAGE INDUSTRIAL
PROCESSES**

**MEASURE ENERGY
CONSUMPTION**

**CONTROL LAMPS AND
APPLIANCES**

**PROVIDE SECURITY
PROTECTION**

**PERFORM SCIENTIFIC DATA
COLLECTION**



The ADC-1 serves as a real world interface for any computer or modem with a RS-232 serial port.

This sophisticated yet easy-to-operate data acquisition and control system includes:

- 16 Analog to Digital Inputs - 12 bits provide 0.1mV resolution over $\pm 0.4V$.
- 4 Digital Inputs for security and rotary encoder sensors.
- 6 Switched Outputs for relays and low voltage device control.
- AC Line Carrier Transmitter - controls 32 BSR X-10 type remote modules.
- Owner's Manual with detailed programming examples.

Sensors available from Remote Measurement Systems include: light, temperature, humidity, wind, sound, soil moisture, ultrasonic ranging, energy consumption and security.

**The ADC-1 – an exceptional
purchase at \$369.**

**REMOTE MEASUREMENT
SYSTEMS, INC.**

P.O. Box 15544 • Seattle, Washington 98115
Tel. 206-525-3369

Send for complete specifications
Telephone, Visa and Mastercard
orders welcome.

marks under normal operating conditions, benchmark 5 should be executed in a filesystem that is used regularly. Several UNIX implementations place the directory /tmp in a filesystem of its own, since /tmp is used frequently under normal conditions. In any case, this benchmark should be run in an ac-

tive filesystem in order to give a more realistic result as to what the response time under a real user load would be. This benchmark, of course, is extremely disk dependent, but that's what we're testing. As implied, the elapsed time is important here because the time spent waiting for I/O completion is not

charged to either user or system time.

One of the things programmers do best is compile programs, and the compiler is a good operating-system exerciser because of it. The command to compile a C program under UNIX is cc. This command is actually a small C program that invokes the C preprocessor, the compiler proper, the assembler, and the linker in succession. To time the compilation process, just place /bin/time in front of the cc command line. Naturally, the C compiler is disk intensive, and with today's fast microprocessors, the disk is often the bottleneck in compilation throughput.

Something needs to be said about the size of the object files that the compiler leaves us with. It can be found by direct examination that the size of the object files compiled on comparable microcomputers can vary by an order of magnitude. In early UNIX days, when memory address space was limited, the loader didn't include a lot of unused code in the object file when it resolved all function references. With today's microcomputers having more memory than minicomputers of a few years ago, some implementations include unnecessary system-call hooks that are never referenced in the program. A good way to test this is to compile the following program:

```
main ()
{
}
```

which is the shortest C program possible. To tell how much memory the object file will use when loaded into memory, look at the size of the object file with the UNIX size command. Size reports the size of the text, data, and bss segments. The text segment is composed of program instructions. The data segment contains initialized program data. The bss segment contains uninitialized program data. The total size is usually given in both decimal and/or octal or hexadecimal. Another command of interest is nm, which will list the symbol table (NaMelist) of an object file. Some of the library modules loaded will be present in any program, and with good reason (__exit, __environ, __cleanup, __main, and crt0.o, for example). Some are pure excess (malloc.o, isatty.o, write.o, and stty.o, for example) and usually result from one library func-

Listing 3: *The user function-call benchmark.*

```
/*
 *      UNIX Operating System Implementation Test #3
 *
 * This program enables precise arithmetic calculations of user function
 * overhead by subtracting the execution user time when compiled without
 * using a function from execution user time using a function.
 *
 * Instructions:
 *   Compile by:      cc -O -DEMPTY -s -o fcalle fcalle.c
 *   and
 *                   cc -O -DASSIGN -s -o fcalla fcalle.c
 *
 *   The -O option says to use the optimizer.
 *   The -D option specifies C preprocessor action.
 *   The -s option says to strip the namelist from the
 *   object file after linking.
 *   The -o option says to place the object file in the file
 *   specified by the next argument.
 *
 * Time by:          /bin/time fcalle
 *   and
 *                   /bin/time fcalla
 *
 * Results:
 *   Since the user time is more accurate than the real time,
 *   and since system time effectively does not contribute to
 *   the real time number, we can use the difference between
 *   the user times in seconds as an accurate numerical account
 *   of function call overhead.
 */

#define TIMES 50000

main()
/* The first way of doing things — use a function call */
#ifdef EMPTY
{
    register unsigned int i;
    for (i=0; i < TIMES; i++)
        j = empty();
}

/* the empty function */
empty()
register unsigned int k;
{
    return(k);
}
#endif
#ifdef ASSIGN
/* The second way of doing things — without a function call */
{
    register unsigned int i, j;
    for (i = 0; i < TIMES; i++)
        j = i;
}
#endif
```


tion referencing another in a larger module, creating a cascade effect. The compactness of the code generated says something about the efficiency and implementation of the compiler and loader.

We've covered most of the more frequently used aspects of UNIX individually up to now. Let's develop some tests for the UNIX system interface, the shell. The best way to test this is by having a shell program do what users normally do when they sit down at the keyboard.

A good general UNIX benchmark is the shell script, or program, in listing 6a. This program, named `tst.sh`, invokes several commonly used UNIX commands and exercises disk access with them. This program was originally written for use in evaluating UNIX microcomputers at the '83 USENIX (an association of UNIX users) conference. In retrospect, it should have contained some commands to run concurrently in the background, such as the compilation of one of the C benchmarks described above. This benchmark makes use of the shell's I/O redirection and indirection (indirection being the ability to take input from the current input stream instead of a file) to sort, save on disk, manipulate, and ultimately remove from disk a list of English words. The utilities used (`sort`, which sorts; `od`, which gives an octal listing; `grep`, which does pattern matching; `tee`, which makes a disk copy of the input given it; `wc`, which counts words, lines, and characters; and `rm`, which removes disk files) are all standard UNIX tools. The shell variable `$$` is the current numerical process ID and is used to make unique filenames. The shell benchmark is run with the command `/bin/time /bin/sh tst.sh`. Execution times for even this simple benchmark varied widely, as shown in table 1.

A few words should be said about determining how many users a small multiuser system can support. With small multiuser systems, accurately simulating real user load is more important than with large multiuser systems because of the limited amount of memory, disk, and processor resources. You can simulate a real user load in several ways, but the only true way is to have someone at another terminal executing the same program you are at the same

time. Why can't a process running in the background simulate a real user load? Because background processes usually run with a lower priority. Additionally, some multiuser microcomputer implementations limit the amount of memory an individual user can use at one time, even if no other user is on the system! What's more, some implementations impose an incredibly small limit on the number of files you can have

open or the number of processes you can have running at any one time, again regardless of the number of other users or processes on the system. Watch out for these systems.

Since we're mainly concerned with microcomputer implementations, where there may or may not be additional terminals, and since we want portable benchmarks that can be run on any

(continued)

Listing 4: *The Sieve of Eratosthenes benchmark.*

```

/*
 *                               UNIX Operating System Implementation Test #4
 *
 * No benchmark suite would be complete without the ever-popular
 * sieve benchmark. It is a good test of compiler efficiency and
 * CPU throughput. Below is a sieve benchmark as presented in the
 * January 1983 issue of BYTE, with some minor changes: Register
 * declarations have been added, and some unnecessary (from our
 * standpoint) printf() statements removed.
 *
 * Instructions:
 *   Compile by:                cc -O -s -o sieve sieve.c
 *
 *                               The -O option says to use the optimizer.
 *                               The -s option says to strip the namelist from the
 *                               object file after linking.
 *                               The -o option says to place the object file in the file
 *                               specified by the next argument.
 *
 * Time by:                      /bin/time sieve
 *
 * Results:
 *   In the past, the elapsed time has been used, since most
 *   operating systems can measure real time. Actually, user
 *   time is a better value.
 */

/* Eratosthenes Sieve Prime Number program in C */
#define TRUE 1
#define FALSE 0
#define SIZE 8190

char flags[SIZE + 1];

main() {
    register int i, prime, k, count, iter;
    /* printf("10 iterations\n"); */           /* We don't need this */
    for (iter = 1; iter <= 10; iter++) {      /* do program 10 times */
        count = 0;                             /* prime counter */
        for (i = 0; i <= SIZE; i++)           /* set all flags TRUE */
            flags[i] = TRUE;
        for (i = 0; i <= SIZE; i++) {
            if (flags[i]) {                   /* found a prime */
                prime = i + i + 3;           /* twice index + 3 */
                /* printf("\n%d: prime: ", prime); */           /* Nor this */
                for (k = i + prime; k <= SIZE; k += prime)
                    flags[k] = FALSE;       /* kill all multiples */
                count++;                       /* primes found */
            }
        }
    }
    /* printf("\n%d primes.", count); */       /* primes found on 10th pass */
}

```

UNIX system no matter how small, our only recourse is to benchmark a varying number of background processes (i.e., a multitasking benchmark) and assume that the results can be extrapolated to a multiuser environment. Even if the benchmark is used to help decide which single-user system to buy, evaluating background-process performance is beneficial since the ability to have many background processes is a strong point of UNIX.

Using the shell benchmark in listing 6a as a starting point, we can invoke that script in the background a number of times to see how long it takes to execute one, two, three, four, five, and even six of these identical background processes. The shell script in listing 6b does just that. Contained in a file called multi.sh, it executes the shell test found in listing 6a in the background a number of times. The number of background processes created is determined by the number of command-line parameters given the shell script. The actual values of the command-line parameters are not important, it's the quantity of positional parameters that the shell script uses. Although any character would do as a positional parameter, for readability it is convenient to use the characters "1," "2," "3," etc. as those parameters. The benchmark is run as shown in table 2.

The shell statement wait causes the shell script to pause until all background processes have terminated. Invoking tst.sh more than six times may not be possible (depending upon your operating system) if a "per-user process limit" is defined.

Table 3 shows the results from the multitasking shell benchmark given in listing 6b for a variety of UNIX-based systems. The table is sorted on the fastest elapsed time for six background processes. Remember, this benchmark does not measure how many users the system will support but is rather a measure of how many processes the system will support comfortably.

By plotting the number of invocations versus execution time, you can graph how a multitasking load varies with response time. See figure 1 for a plot of the results of table 3 in this manner. With fast disks the graph should be linear, with a change in slope when there are more processes than can remain concurrently in memory.

Listing 5a: A benchmark to create and write a disk file.

```

/*
 *          UNIX Operating System Implementation Test #5a
 *
 * This portion of the disk throughput benchmark creates and writes
 * a 512x256 byte file. Since UNIX is so disk intensive, it is important
 * to have some general idea of how fast (or slow) disk operations are.
 *
 * Instructions:
 *   Compile by:          cc -O -s -o dwrite dwrite.c
 *
 *   The -O option says to use the optimizer.
 *   The -s option says to strip the namelist from the
 *   object file after linking.
 *   The -o option says to place the object file in the file
 *   specified by the next argument.
 *
 * Time By:              /bin/time dwrite
 *
 * Results:
 *   The time to observe is the elapsed time, as we are trying to
 *   gauge disk throughput.
 */

#include <stdio.h>

#define BLOCKS 256

main()
{
    /* the buffer for writing */
    char buffer[512];
    /* the filename */
    char *filename = "a_large_file";
    /* a counter to keep up with the blocks written */
    register int i;
    /* file descriptor for the disk file */
    int fildes;
    /* create the file */
    if ((fildes = creat(filename, 0640)) < 0) {
        printf("Cannot create file\n");
        exit(1);
    } else {
        close(fildes);
        /* open the file for writing */
        if ((fildes = open(filename, 1)) < 0) {
            printf("Cannot open file\n");
            exit(1);
        }
    }
    for (i = 0; i < BLOCKS; i++)
        /* write the file, one block at a time */
        if (write(fildes, buffer, 512) < 0) {
            printf("Error writing block %d\n", i);
            exit(1);
        }
    /* close the file now that we're done */
    close(fildes);
}

```

Listing 5b: A benchmark to randomly read the disk file created by listing 5a.

```

/*
 *          UNIX Operating System Implementation Test #5b
 *
 * This portion of the benchmark opens and reads a 256x512 byte
 * file. This benchmark uses a random instead of sequential access
 * read, since the majority of disk access is random. Due to differences

```

(continued)

- in the rand() routine between UNIX versions, you need to determine if
- the rand() on the machine to be tested generates numbers in the range
- $0 - 2^{15}$ or in the range $0 - 2^{31}$, and compile the benchmark accordingly.

• Instructions:

• Compile By: cc -DSIXTEEN -O -s -o dread dread.c
 • for machines with rand() in the range $0 - 2^{15}$
 •
 • cc -DTHIRTYTWO -O -s -o dread dread.c
 • for machines with rand() in the range $0 - 2^{31}$
 •

• The -O option says to use the optimizer.
 • The -s option says to strip the namelist from the
 • object file after linking.
 • The -o option says to place the object file in the file
 • specified by the next argument.

• Time By: /bin/time dread

• Results:

• The time to observe is the elapsed time, as we are trying to
 • gauge disk throughput.

•/

```
#include <stdio.h>

#define BLOCKS 256

long lseek();

main()
{
    /* the buffer for writing */
    char buffer[512];
    /* the filename */
    char *filename = "a_large_file";
    /* a counter counting blocks read */
    register int i;
    /* the file descriptor */
    int fildes;
    /* offset to seek into file */
    long int offset;

    /* open the file */
    if ((fildes = open(filename, 0)) < 0) {
        printf("Cannot find '%s'. Run 'dwrite' first.\n", filename);
        exit();
    }

    for (i = 0; i < BLOCKS; i++) {
        /* pick a byte, any byte */
#ifdef SIXTEEN
        offset = (long)rand() * 4L;
#endif
#ifdef THIRTYTWO
        offset = (long)rand() / 16384L;
#endif

        /* seek to it */
        if (lseek(fildes, offset, 0) < 0L) {
            printf("Lseek to %ld failed i=%d\n", offset, i);
            exit();
        }
        /* read a block, starting with the current byte */
        if (read(fildes, buffer, 512) < 0) {
            printf("Error reading block at byte %ld\n", offset);
            exit();
        }
    }

    /* get rid of the file */
    unlink(filename);
}
```

A short benchmark that tests incrementing and looping is shown in listing 7. It originally appeared on UNIX USENET news (article megatest.186) in February 1983. This little benchmark tests long integer arithmetic (increment and test) and is totally processor bound. It is a lot like the functional benchmarks shown earlier: it tests long integer arithmetic but does little else. It could be improved by multiplying by 2, dividing by 2, adding 2, and then subtracting 1 to better test long integer arithmetic functions. The benchmark is presented here in its original form because I had already tested a number of machines with that particular version. See the results in table 1.

RESULTS

A lot has happened in the last nine months during which this article was written. Several UNIX implementations now exist for the IBM PC. Microcomputer UNIX systems continue to infiltrate the business environment, and the UNIX application-software market seems to be developing at a good pace. Both DEC and IBM have embraced UNIX as an alternative to their own proprietary operating systems, which lends legitimacy to the claim that UNIX is an industry-standard operating system. There does not yet seem to be a clear winner in the UNIX microcomputer marketplace though several vendors are in the forefront of the cost/performance ratio contest.

Judging from the systems I've seen, the best performance comes from the Altos 586. It has less memory and fewer I/O ports than the Altos 986 but is otherwise identical. For about \$10,000, you get an excellent multiuser UNIX system (512K-byte RAM, 40-megabyte [formatted] Winchester, and six serial ports) that under moderate load approaches DEC VAX performance for most tasks that a user would normally invoke. Some may argue that if the operating system isn't spelled U-N-I-X, it isn't real UNIX. That's just not the case. Altos XENIX is Version 7 UNIX with some useful extensions, including a screen-oriented editor, record and file locking, and semaphores. Although AT&T no longer markets Version 7 UNIX, it is well established in the marketplace and will be around for quite a while.

(continued)

Modula-2

Apple II \$295 Apple III \$395 IBM PC and XT \$395 Sage II and IV \$495

Volition Systems

PO BOX 1236
Del Mar, CA 92014
(619) 481-2286

Sage™ Sage Computer Technology Apple™ Apple Computer Inc IBM™ IBM Corp
Circle 324 on inquiry card.

TAKE \$50 OFF
THESE PRICES
August only

BENCHMARKING

The Sun-2/120 and Masscomp computers are VAX-class machines, but their cost is beyond the reach of most prospective microcomputer owners. They both offer superb graphics and excellent response time under loading.

The TRS-80 16B is a usable multiuser microcomputer system, but its response time is hindered by the relatively slow internal 15-megabyte Winchester. Thus, depending upon the applications run, it may not be desirable for more than a two-user load.

The SCI-1000 system benchmarked is still under development, and the times reported here should not be taken as gospel. This system, with an 80186 chip, has the potential for better performance than the Altos 586 at less cost and offers System III UNIX.

IBM's UNIX, PC/IX, was not developed in house. It is a System III port with added features (a vi-like full-screen editor) done by Interactive Systems Cor-

poration. It is a complete, usable single-user implementation that does what can be done with the 8088. It's interesting to note that both IBM PC (16-/8-bit 8088) implementations performed better than did the old reliable 16-bit F-11 chip used in the PDP-11/23 and DEC Professional.

The Omnibyte OB68K with Idris was one of the first UNIX work-alike systems around. As such, the implementation is not the de facto Version 7 standard. I understand that a new version of Idris is coming out (to borrow a phrase from Jerry Pournelle) Real Soon Now for the Omnibyte that increases performance substantially.

The VENIX implementations on the DEC Professional and IBM PC perform adequately but seem to have a problem with multiple background processes. Although it makes sense to limit the number of processes a user may have on a multiuser minicomputer, it doesn't make much sense to impose those

Listing 6a: A general-purpose shell benchmark. The shell script shown is contained in a file called tst.sh and is invoked by /bin/time /bin/sh tst.sh.

```
sort > sort.$S << /*EOF
Now
is
the
time
for
all
good
men
to
come
to
the
aid
of
their
country
/*EOF
od sort.$S | sort -n +1 > od.$S
grep the sort.$S | tee grep.$S | wc > wc.$S
rm sort.$S grep.$S od.$S wc.$S
```

Listing 6b: A multitasking benchmark with a variable number of background processes. This shell script is contained in a file called multi.sh. The number of concurrent processes created is determined by the number of command-line parameters, such as /bin/time /bin/sh multi.sh 1 2 3.

```
for i
do
    echo $i
    /bin/sh tst.sh &
done
wait
```


BENCHMARKING

limits on a microcomputer that will probably never be used by more than one person. What's more, no message is given the user when the number of processes reaches the per-user process limit. Instead, quite literally, nothing happens. Granted that the multitasking benchmark is a little esoteric, it is the only way to simulate a multiuser/multi-tasking load short of having multiple users and is a good measure of how efficiently or inefficiently competing background processes are handled.

And then there's Apple's Lisa. Due to disk I/O limitations, Lisa's in a class by herself when it comes to disk-intensive tasks, as can be easily seen from figure 1. This exemplifies my claim that disk I/O is the single most limiting factor in over-

all response time and system throughput. If Apple could improve the disk throughput for Lisa to the same as an Altos, Lisa would rival the Altos in the best-value category, not to mention the possibility of excellent graphics.

It should be noted that some of the systems above that were implied to be single-user are really multiuser, but the response time is such that they would not be usable in a multiuser environment. This is the case with such computers as the IBM PC, DEC Professional, and Apple Lisa.

CONCLUSIONS

Some words of caution: a few micro-computer systems that claim to be

(continued)

Table 2: The shell benchmark run sequence.

```
/bin/time /bin/sh multi.sh 1
/bin/time /bin/sh multi.sh 1 2
/bin/time /bin/sh multi.sh 1 2 3
/bin/time /bin/sh multi.sh 1 2 3 4
/bin/time /bin/sh multi.sh 1 2 3 4 5
/bin/time /bin/sh multi.sh 1 2 3 4 5 6
```

Table 3: Results for the multitasking UNIX benchmark in listing 6b with a variable number of background processes. The data are the elapsed (real) times for the benchmark to complete. The table is sorted on the fastest execution times with six background processes (the last column) where possible.

No.	Machine	System UNIX Version	Elapsed (Real) Time in Seconds					
			Number of Concurrent Processes					
			1	2	3	4	5	6
1	VAX-11/780	4.1 BSD	4.3	5.5	7.8	9.0	11.0	13.8
2	VAX-11/750	4.1 BSD	4.3	5.5	8.8	10.3	13.3	15.0
3	PDP-11/70	2.8 BSD	5.0	7.8	9.3	11.8	14.3	16.7
4	Masscomp	Sys III+	4.2	5.5	9.1	11.8	14.5	17.8
5	Sun-2/1120	4.2 BSD	3.6	6.2	8.7	11.8	14.4	18.0
6	Altos 986	XENIX	6.3	7.3	9.3	19.3	27.2	36.0
7	TRS-80 16B	XENIX	20.0	24.5	33.0	56.5	1:10.5	1:39.3
8	SCI-1000	Sys III+	15.1	28.6	51.8	1:17.4	1:34.8	1:57.2
9	PDP-11/23	V7	22.3	37.3	52.3	1:14.8	1:31.0	2:05.0
10	IBM PC XT	PC/IX	10.6	23.4	42.8	1:14.1	1:24.2	2:10.7
11	Apple Lisa	Sys III+	38.1	1:14.8	1:54.5	2:34.2	3:14.6	3:48.6
12	PDP-11/23	VENIX	14.0	32.8	—	—	—	—
13	IBM PC XT	VENIX/86	15.0	23.5	39.0	—	—	—
14	DEC Prof/350	VENIX	26.0	41.0	1:22.3	—	—	—
15	Omnibyte	Idris 1.21*	—	—	—	—	—	—

+ Indicates UNIX System III plus some Berkeley enhancements.

- Indicates a benchmark that would not complete.

* The Idris-shell command wait did not appear to function properly, and thus the benchmark could not be run.

Modula-2

The Volition system recommends itself based on its superior development environment... its compiling speed, and its relative polish.

—Joel Pitt, PC Magazine

If you do not have access to a VAX, the next most powerful development system is a Sage with Volition's compiler; it is very fast compiling and reasonably fast running.

—Terry Anderson, Journal of Pascal, Ada & Modula-2

It is a tribute to the compactness of this programming language that it can be used on a 64K byte personal computer.

—Allen Munro, Apple Softalk

The documents that come with Volition Systems Modula-2 are about the best introduction to the language that I know of.

—Jerry Pournelle, BYTE

Volition Systems

PO BOX 1236
Del Mar, CA 92014
(619) 481-2286

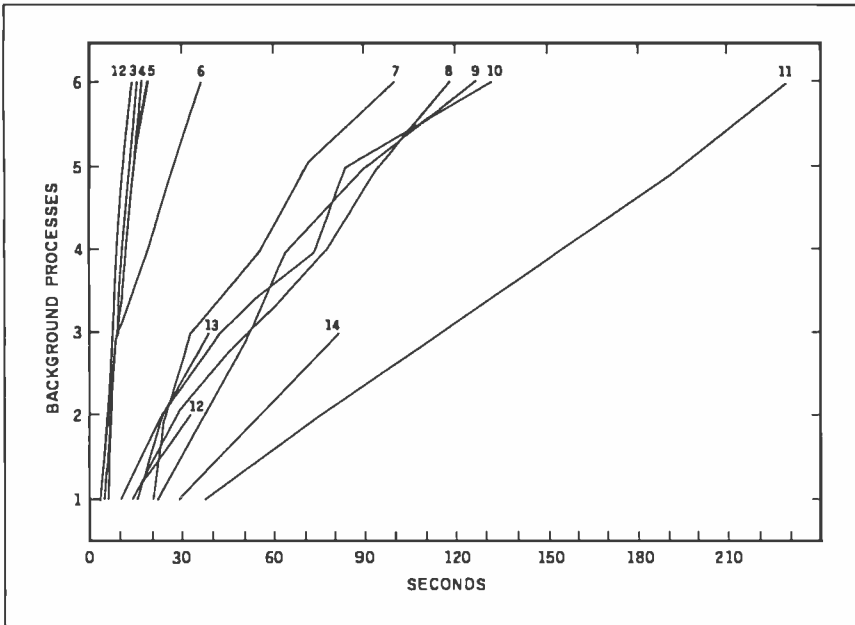


Figure 1: A graph of the multitasking benchmark data in table 2 with the number of background processes versus elapsed time for each computer. The numbers at the top of each line correspond to the computers as listed in table 3. It is interesting to note the cluster of high-performance systems on the left-hand side and the cluster of other systems on the right.

Listing 7: A simple benchmark to test incrementing and looping.

```

/*
 *      UNIX Operating System Implementation Test #7
 *
 * This program tests long integer incrementation. It is
 * taken from USENET news article "megatest.186".
 *
 * Instructions:
 *   Compile by:          cc -O -s -o loop loop.c
 *
 *       The -O option says to use the optimizer.
 *       The -s option says to strip the namelist from the
 *       object file after linking.
 *       The -o option says to place the object file in the file
 *       specified by the next argument.
 *
 * Time by:              /bin/time loop
 *
 * Results:
 *   Although not very significant, it does say something about the
 *   speed of the processor, since the compiler would hopefully
 *   compile the "i++" as an INCR instruction and not an ADD
 *   instruction. The benchmark is presented here for historical
 *   reasons.
 */

main()
{
    long i;
    for (i = 0; i < 1000000; i++)
        ;
    printf("Done\n");
}

```

multiuser and UNIX-like do not swap. That is, they cannot swap a process out to disk and bring in another user's process. A system that cannot swap is neither truly multiuser nor UNIX-like. When a process runs out of primary memory in these systems, it dies. These implementations are substantially cheaper than most others, so be suspicious of low-cost UNIX-like systems.

As mentioned earlier, some systems implement a relatively low predefined limit on the amount of memory or number of processes one user can have, regardless of other system activity (or inactivity). Once this limit is exceeded, activity grinds to a halt, as a deadlock has been reached. Each blocked process (blocked in the sense that it is waiting for resources before it can continue) is waiting for the other to terminate before it can continue. If you plan to be an active user on a small multiuser system in a single-user environment, look out for this. The multitasking benchmark in listing 6b will usually bring any problems to light.

Knowledgeable 4.1 BSD and 4.2 BSD users should beware of systems that claim to have Berkeley enhancements. This means that the Berkeley version of some UNIX commands have been added. For example, most so-called Berkeley-enhanced systems include the termcap (terminal capability) database, more (a utility that prints files one screen at a time), and a version of ls (a utility to list the files in a directory) that lists files across, rather than down the screen. Don't expect to find the newtty driver and the job-control facilities of real Berkeley UNIX systems.

If you're considering a UNIX micro-computer, remember that response doesn't always vary linearly with load (even on large UNIX systems). This is due to several factors, most notably available real memory and disk-access speed. If you plan to add a user or two later, test the prospective system now. Find out if the hardware can support additional memory and/or faster disks.

The benchmarks presented here try not to be blind to what users do at the keyboard (not all users execute programs similar to the Sieve of Eratosthenes), but they do try to evaluate operating-system features that are routinely used. By explaining how benchmarks should be developed, this article

Benchmark the specific kinds of things you will be doing as well as overall performance.

has tried to dispel the myth that all benchmarks do is see how fast a machine can crunch numbers (e.g., the Whetstone benchmark has not been mentioned).

Of course, benchmark results are not the only means to judge microcomputers. Clear and sufficient documentation, a solid customer base, and good product-support history are also important. If you do perform benchmarks on systems you are considering purchasing, try to benchmark the specific kinds of things you will be doing as well as overall performance in case your needs change. This sounds incredibly obvious, but many people have been disappointed by systems purchased yesterday that don't meet their needs today. ■

REFERENCES

1. Gilbreath, Jim, and Gary Gilbreath. "Eratosthenes Revisited: Once More through the Sieve." *BYTE*, January 1983, page 283.
2. Lions, J. "A Commentary on the UNIX Operating System." 1977.
3. Peterson, L., and A. Silberschatz. *Operating System Concepts*. Reading, MA: Addison-Wesley, 1983.
4. UNIX *Programmer's Manual*, 7th ed., Virtual VAX-11 Version, volumes 1 and 2c. Berkeley, CA: University of California, Department of Electrical Engineering and Computer Science, June 1981.
5. UNIX *Programmer's Manual*, 7th ed., volumes 1, 2a, and 2b. Murray Hill, NJ: Bell Telephone Laboratories, January 1979.

ACKNOWLEDGMENTS

Thanks to Ellen Mendelson and Walt Kennedy of the Durham and Raleigh Radio Shacks for access to the TRS-80 Model 16. Thanks to David Holloman of Keystone Systems Inc. of Raleigh for access to the Altos 586. Thanks to Michael Smith of East Carolina University for running the Idris benchmarks. Special thanks to the North Carolina Educational Computing Service for allowing me access to most of the remaining machines listed in table 1.

a message to our subscribers

From time to time we make the BYTE subscriber list available to other companies who wish to send our subscribers material about their products. We take great care to screen these companies, choosing only those who are reputable, and whose products, services, or information we feel would be of interest to you. Direct mail is an efficient medium for presenting the latest personal computer goods and services to our subscribers.

Many BYTE subscribers appreciate this controlled use of our mailing list, and look forward to finding information of interest to them in the mail. Used are our subscribers' names and addresses only (no other information we may have is ever given).

While we believe the distribution of this information is of benefit to our subscribers, we firmly respect the wishes of any subscriber who does not want to receive such promotional literature. Should you wish to restrict the use of your name, simply send your request to the following address.

BYTE Publications Inc
Attn: Circulation Department
70 Main St
Peterborough NH
03458

Inmac makes it easy to make your computer work harder.

- Choose from over 2000 products, all especially selected to help you get more out of your computer.
- **Guaranteed quality.** Most guaranteed for one year, some guaranteed for life.
- **45-day risk-free trial.** Full refund if not completely satisfied.
- **One-stop shopping.** Paper, connectors, cables, more. Many exclusive Inmac products, too.
- **Easy ordering.** Mail, phone or TWX. Verbal PO's welcome.
- **Lower shipping costs.** All 9 Inmac distribution centers are fully stocked, so your order can be shipped from the nearest center.

1-800-547-5444.*

inmac

Please send me a free copy of Inmac's Personal Computer support Catalog.

Inmac Catalog Dept.
2465 Augustine Drive
Santa Clara, CA 95051

NAME _____

COMPANY _____

ADDRESS _____

CITY _____

STATE _____ ZIP _____ PHONE _____

*In California, call 1-800-547-5447 for your free catalog.

107138



CRAFTSMEN OF THE NEW TECHNOLOGY.
BEST PRICES WITH QUALITY SUPPORT* ON SOFTWARE AND HARDWARE.

ORYX SYSTEMS

QUALITY DISCOUNTS

APPLE/ FRANKLIN

ADVANCED ANALYTICS TECHNOLOGY
the "bonner" \$ 22

ASHTON-TATE
d-Base II \$ Coll

BEAGLE BROS.
Apple Mechanic \$ 22
DOS Boss 17
Utility City 22

BRODERBUND
Bank Street Writer ... \$ 45

CDEX
All Training Prog \$ 49

CENTRAL POINT
Copy II + \$ 34

d-BASE II CORNER

Anderson-Bell
Abstot \$ 329

Ashton-Tate
d-Base II \$ Coll
d-Base III \$ Coll
FPL \$ 410
Friday 179

Better Business Solutions, Inc.
d-Base II (writes checks) \$ 75

Data Based Solutions
dNAMES \$ 95

Fox & Geller
dGraph \$ 215
Quick Code 175
D Util 62

Global Technologies
dbLINK \$ 69

Human Soft
d-Base Plus \$ 90

Sensible Designs
D-Programmer \$ 199

Software Banc
d-Base II
User's Guide \$ 20
Advanced d-Base II
User's Guide \$ 27
Report Writing w/ purchase of d-Base II! \$ 10

Tylog Systems
d-Base Window ... \$ 179

*All above available on PC-DOS

CONTINENTAL SOFTWARE
Home Accountant \$ 49

DIGITAL RESEARCH
Excellent selection on current and the exciting new products \$ Coll

DOW JONES
Market Analyzer \$ 245
Market Manager 219
Microscope 525
Spreadsheet Link 199

KRELL
Logo \$ 75

LIVING VIDEOTEXT
Think Tank \$ 99

MACINTOSH CORNER

Ashton-Tate
d-Base II \$ 479
Friday 199

Continental Software
Home Accountant ... \$ 75
Main Street Software
Main Street Filer ... \$ 225

Microsoft
Microsoft Basic \$ 99
Multiplon 159

Software Publishing
PFS: File-Report . eo \$ 95
Davang Disk Drives . \$ Coll

Kensington Microware
Swivel \$ 29
Surge Suppressor ... 45
Modem 399
Maxell 3 1/2" diskettes \$ Coll
Memorex diskettes . \$ 49

MICROPRO
Wardstar w/Stor CP/M \$ 295
Infostar+ w/Storbust . \$ 299

MICROSOFT
Cobol-80 \$ 499
Fortran-80 145
TASC Compiler 119
Multiplon (DOS) 149

OMEGA
Locksmith \$ 79

PEACHTREE \$ Coll

PENGUIN SOFTWARE
Complete Graphics ... \$ 50
Graphics Magician ... 45
Complete Graphics/
Apple Tablet \$ 86

PROMETHEUS
Applesurance \$ 99

SIERRA ON-LINE
Homeward \$ 48

SOFTWARE PUBLISHING
PFS: File, Gr, Rep . eo \$ 79

SYSTEMS PLUS
Landlord \$ 375

VISICORP
Visicalc (II or IIE) ... \$ 165
Visischedule 195
VisiOn Series \$ Coll

XEROX EDUCATION
Sticky Bear ABC \$ 35
Sticky Bear BOP 35
Sticky Bear Numbers . 35

CP/M SOFTWARE

FORMATS AVAILABLE

All prices below are for 8" standard. Other formats are available. Some formats subject to "Download" fee and require minimum 2 weeks for delivery. Please inquire.

ATI
*All Training Prog . eo. \$ 60

COMPUVIEW
*V-Edit 8080 Z80, IBM/PC \$ 130
*V-Edit CP/M 86 \$ 130
Systron 99

DIGITAL RESEARCH
*Pascal MT + w/SPP \$ 389
DR Assembler & Tools . 149
CP/M 2.2 125
C Basic 95
PL/1-80 375
Personal Basic 120
CP/M Gold Card \$ Coll
Access or Display Mgr. \$ 299
C Language/compiler . 260
Concurrent CP/M \$ Coll
All 8" - 86 Version of Above \$ Coll

INFOCOM
*Deadline \$ 49
*Starcross 39
*Suspended 39
*Zork, I, II, III eo. 39



PEACHTREE CORNER

Back to Basics
Acct'g System \$ Coll

Home Software Library \$ Coll

PeachPak 4 (GL, AP, AR) \$ 249

Series 8 (GL, AP, AR, Sales Inv., Inv. Control, Job Cost, Client Post, & Acct. ... each mod. \$ 389

MARK OF THE UNICORN
*Final Word \$ 199

MICROPRO
*WardStar \$ Coll
*InfoStar \$ Coll
*Pro-Pack (WS/MW/SL/CS) \$ Coll
All others \$ Coll

MICROSOFT
Basic 80 \$ 239
Basic Compiler 249
Fortran 80 330
Cobol 80 449
Macro 80 130
MuMoth/MuSimp 179
*Multiplon 149

MICROSTUF
*Crosstalk \$ 109

NORTHWEST ANALYTICAL
*Statpak \$ 365

OASIS
The Word Plus \$ 120
Punctuation and Style \$ 99

SORCIM
*Supercalc II \$ 179
Superwriter (w/Speller & Mailer) . \$ 149

SUPERSOFT
*Diagnostic II \$ 89
Disk Doctor 74
*Scratchpad Plus 129
T MAKER III \$ 195

IBM/PC

Please see CP/M listing. All products with an * in front are also made for PC/DOS and are priced the same unless otherwise specified.

ALPHA SOFTWARE
Data Base Mgr. II \$ 179
Apple-IBM Connection . 169

AMERICAN INT'L COMMUNICATIONS
Tlx-A-Syst \$ 199
Grom-A-Syst 199

AUTODESK
Autocad \$ Coll

B&L
Multi-Job (runs nine programs at once) ... \$ 145

CENTRAL POINT
Copy II PC \$ 34

CONTINENTAL
Home Accountant \$ 89

Ctek
PC Calculator \$ 29
Prog. PC Calculator ... 49
Prog. PC Calculator w/ Fin. Mod. \$ 55

DIGITAL RESEARCH
Concurrent CP/M 86 ... \$ 225
Pascal MT + 86
CP/M 86 w/SPP \$ 375
Pascal MT+ (PC/DOS) 385
DR Logo 99

DOW JONES
Market Analyzer \$ 245
Market Manager 219
Spreadsheet Link 199

ECO-SOFT
Microstat \$ 259

ENERTRONICS
Energraphics \$ 265

Please call us regarding products for Macintosh and IBM PC's.

FASTWARE
Thor (the thought organizer) ... \$ 245

FINANCIER
Tax Series \$ 105
Financier II 119

FOX & GELLER
Grafox \$ 199
OZ \$ Coll
RGraph (for R-base 4000) \$ 215

FYI
Superfile \$ 149
FYI 3000 287

GRAPHIC/MOSAIC SOFTWARE
Super Chartman II \$ 299
Chartman IV 199
Combo II & IV 350
Integrated 6 369

LIFETREE
Volkswriter Deluxe ... \$ 199

LIGHTHOUSE SOFTWARE
Key II (Data Mgmt for 1-2-3) \$ Coll

LIVING VIDEOTEXT
Think Tank (256K) ... \$ 139

MICROPRO
Storbust \$ 149

MICRORIM
R-base \$ 299
R-base Clout \$ Coll

MORGAN COMPUTING
Professional Basic ... \$ 299
Troce 86 99

PEACHTREE
See CP/M listing.
Peachtext 5000 \$ 225

SATELLITE SOFTWARE
Word Perfect w/ Sp ... \$ 299

SORCIM
Supercalc III \$ 249

SPI
Open Access \$ 399

STAR SOFTWARE SYSTEMS
Legal Time, Billing ... \$ 787
Property Mgmt. 787
Acct'g Partner 289

SUPERSOFT
C Compiler - 8086 ... \$ 350
Basic Compiler 225
8087 Support 40

SYSTEMS PLUS
Landlord (prop mgmt) \$ 375

VISICORP
VisiOn Line \$ Coll

WANG SOFTWARE
Grammatik \$ 59
Proofreader 42
... and many more!

SDI, Inc.
STOPLOCK
Completely STOPS computer in boot mode — LOCKS IT UP INTERN. ALLY. OPENS only to valid user with I.D. code. (Check money-back guarantee by SDI, Inc.) \$ Coll

APPLE/ FRANKLIN BOARDS

ALS

CP/M Card	\$ 279
Smarter II	135
Z-Card II	120

CCS 7710 Asynch Serial S	119
East Side	
Wild Card II	\$ 117
Microsoft 16K Romcard	69
Microsoft Softcard	219
Microsoft Softcard +	449
Microsoft Premium	
Softcard (IE)	\$ 335
Microtek P-inter. I/F	75
Microtek Dumping-16K	169
Microtek Dumping-GX	89
Mountain A-C/D-A	\$ Coll
Mountain	
Music System	\$ 299
PCP 4 MHz	
Appli-Card + 88 Card	\$ Coll
PCP 88 Card	
16 Bit + 64K	\$ 425
Prometheus Versacord	159
SSM ASIO Serial I/F	
w/cable	\$ 129
SSM AIO-2 Serial/	
Parallel	\$ 179
Tymac Parallel I/F	
w/cable	\$ 79
Videx	
Videoterm VT-600	\$ 179
Videoterm VT-602	249
Ulraterm	249

IBM/PC BOARDS

AST RESEARCH	
Six Pak Plus 64K (exp 384K - Ser, Par, Clk)	\$ 269
MegaPlus 64K. (Cl/Col, Ser Part, 512K capacity w/ Megapok)	\$ 269
MonographPlus	\$ 499
PC Net Starter Kit	\$ 899
Extra parts available for Megapok and I/O Plus II (Game, P/S)	\$ 40
AST-5251 (PC to System/34, 36, 38 connection)	\$ Coll
Megapok 256K upgrade for Megapok	\$ Coll
I/O Plus II Cl/Col and Ser Part	\$ 115
MA SYSTEMS	
PC Peacock Clr Bd	\$ 325

MAYNARD ELECTRONICS	
Flappy Drive Cntrlr	\$ 169
w/ Par Part	219
w/ Ser Part	229
Sandstar Flappy Drive Cntrlr	\$ 199
Sandstar Mem Card - 3 modules cap.	\$ 145
Sandstar Multifunction Card-6 modules cap.	\$ 79
Sandstar Modules	\$ Coll

DISPLAY CARDS CORNER

Amdelc MAI Card	\$ 420
Fredericks/Plantronics Colorplus	\$ Coll
Hercules Graphics Board	\$ 359
Quadram	
Quadcolor I	\$ 199
Quadcolor II	389
Quadcolor II (upgrade)	\$ 210
Tecmar	
Graphic Master	\$ 499
USI Display Card (clr/monochrome)	\$ 399

QUADRAM

Quadboard 64K, (exp 384K Clk/Col, Ser & Par Parts, Software)	\$ 269
Quadboard 384 (OK)	239
Microfozer Stock Printer	
Par/Par BK (exp 512K)	\$ 139
Ser/Par BK (exp 64K)	149
Ser/Ser BK (exp 64K)	149
Quadlink 64K Mem (allows Apple SW to run on IBM/PC)	\$ 469
Other Quadram Prads	\$ Coll
TECMAR Products	\$ Coll
XEDEX/MICROLOG	
Baby Blue	\$ 325
Baby Blue II	525

MONITORS

Amdelc 300A Am	\$ 149
Amdelc Color II +	429
NEC J81201 - 12" Gr	\$ Coll
NEC J81260 - 12" Gr	\$ 119
NEC JC1216 RGB	429
Panasonic CT60	
10" comp	\$ Coll
PGS HX12 RGB Clr	\$ 499
PGS MAX 12	220
SR12 (690 x 480 Res)	639
Quadram	
Quadchrome	\$ 495
Sanya P12 12" HR Gr	\$ Coll

SONY Component TV System I

Profeel 19" Trinitron Color Monitor. (Analog digital RGB inputs for graphics and Teletext/Videotext applications. Built-in stereo amp. w/ 5 watt per channel output) \$ Coll

VTX-1000R -
Profeel Access Tuner (Cable ready express tuning, pay-TV ready, stereo-ready, 10-key express commander, multiple video & stereo inputs/outputs) \$ Coll

SS-X2A Component Speakers \$ Coll

Taxon

KG 12N-UY 12" HR Am	\$ 139
KG 12N 12" HR Gr	132
RGB Vision-1 12" LR Clr	\$ 323
RGB Vision-3 12" HR Clr	\$ 459
USI 1200A 12" HR Am	\$ 159

MODEMS

Hayes 300	\$ Coll
Hayes 1200	\$ Coll
Hayes 1200B (Int)	\$ 449
Hayes Chronograph	189
Novation	
Apple-Clk II	\$ 259
the Orchid "Blossom" (Up to 384K, Clk w/ alarm, S&P Parts, Rom-disks, disk cloning, upgradeable to PC-Net)	\$ Coll
Prometheus Pronodem	\$ 449
US Robotics	
Auto-Dial 300/1200	\$ 459
S-100 Modem	349
Password	325
Zoom Telephonics	
Networker	\$ 109

DISK DRIVES

CDC 1800	\$ 229
Corona	
5 MB Hard w/cntrlr	\$ 1,395
10 MB Hard w/cntrlr	1,795
Corvus	
Davong 10/15/20 MB	\$ Coll
Santa Clara	\$ Coll
Tandon TM-100-2	\$ 219
Vista	
Dynalume Systems w/ 5 to 40 MB Primary Disk Drive	\$ Coll

HALF HIGHS

Matsushita	\$ 199
Panasonic	199
Shugart	225
Super 5 (Apple)	\$ Coll
Teac w/brackets	\$ 210

PRINTERS

AUGUST SPECIALS!

Juki Industries of America, Inc.
6100 - Prints graphics. 2K buffer. (exp 10 BK), bidir., tractor feed option, proportional spacing. 11" print line, uses 100-char drop-in daisy wheel and IBM Selectric 18⁹ ribbon \$449.

Printek, Inc.

920 S/P - 340 cps multi-function, 80 cps letter quality, 260 lines/minute. 136 col., 1-4 copies w/ friction & pinfeed std., 144 x 144 dots/inch graphics, Bell & Howell 3rd party service \$2,099

Diablo 630 ECS	\$ Coll
Diablo 630 API	\$ Coll
Epson	\$ Coll
Mannesman Tally	
MT1801	\$ 810
MT1601	595
Spirit	330
NEC 3550	1,745
Okidata 82-93	\$ Coll
Quadram Quadjet	\$ Coll
Siemens	
Ink Jet Printer PT88	\$ 749
Silver-Reed	
Daisy Wheel	\$ Coll
Star Micronics	\$ Coll
Teletex T1014	\$ 499
Transtar	
T-130 P&S	\$ 665
T-315 P-Dot Matrix	489
T-120 P&S	475

.. and much more.

We offer the following complete systems. For assistance in determining your needs, please use our technical line. We will be happy to provide full support.

Franklin 1000 & 2000	NEC APC & 8800
Corona	Columbia
Televideo	Hyperion

DISKETTES

3M 5" DS, DD, Box	\$ 40
CDC	\$ 28
Maxell 5" DS, DD, MD2, Box	\$ 40
Verbatim 5" DS, DD, Box	\$ 35
Ultra Magnetics 5" DS, DD, Bonus Box (12 Diskettes)	\$ 35
(3 Boxes Diskettes Minimum)	

PLOTTERS

Enter P100 Sweet P Apple/Franklin, IBM/PC	\$ 545
Enter's 6-Shooter	\$ Coll
Strobe M100 Plotter w/ I/F Apple/Franklin	\$ 499
Strobe M100 Plotter (RS 232)	\$ 499
Panasonic	
VP680IP Plotter	\$ 1,375

MISC.

Alpha-Delta "MACC" Surge Protector	\$ 69
Hauppauge	
8087 Math Pkg	\$ 255
87 Chip	169
Others	\$ Coll
Keytronic	
Keyboard 5150	\$ 175
WP K85151	219
WP K85151 Dvorak	\$ Coll
Orange Micro	
Grappler Plus	\$ 117
Grappler Plus w/Buffer	175
Siemens	
Optech CRT filters	\$ Coll
Street Electronics	
Echo Speech Synth IBM S	179
Echo II Speech Synth	129
TG	
Joystick IBM/PC	\$ 49
Joystick Apple/FRK	46
Wico	
Analog Joystick	\$ 39
Versa Computing	
VersoWriter	\$ 239

Policy:

- ▶ Wisconsin residents add 5% for sales tax.
- ▶ Minimum \$4.00 for shipping, handling and insurance for orders to \$200.
- ▶ For orders over \$200, add 2½% for shipping, handling and insurance.
- ▶ 1% discount for cash payments.
- ▶ Foreign — add 15% handling & shipping for prepayment. (Int'l money order.)
- ▶ Prices are subject to change without notice.
- ▶ All items subject to availability.

ORYX SYSTEMS, INC.

CRAFTSMEN OF THE NEW TECHNOLOGY

425 First Street • P.O. Box 1961
Wausau, Wisconsin 54401

*For technical assistance, order status and in Wisconsin:
715-848-1374

Int'l Telex: 260181
ORYX SYS WAU

We Welcome:

- ▶ Visa, MasterCard and American Express. (No charge for credit cards.)
- ▶ Corporate, government and educational accounts. (For additional discounts, please ask for special accounts desk.)
- ▶ COD (Add \$2.00 per shipment. Cash or certified check required.)
- ▶ Checks. (Allow 1-2 weeks for clearing.)

Working Hours:

Monday-Friday 8:30-6:00
Saturday 10:00-2:00
Central Time

ORDER TOLL FREE OUTSIDE WISCONSIN 1-800-826-1589



Table 3: FORTH-83 modifications to the required word set. (For an explanation of the abbreviations used in the stack diagrams, see table 7.) The pronunciation is in parentheses next to the FORTH word. A star (☆) indicates a new FORTH word.

# ("sharp")	
Stack:	(+d1 - +d2)
Modifications:	stack diagram modified; usage outside of <# ... #> is unrestricted
#S ("sharp-s")	
Stack:	(+d - 00)
Modifications:	stack diagram modified; usage outside of <# ... #> is unrestricted
#TIB ("number-t+i-b")☆	
Stack:	(- addr)
New definition:	user variable, containing the byte length of the text input buffer
' ("tick")	
Stack:	(- addr)
Format:	' <name>
New definition:	leave the compilation address <i>addr</i> of <name>, which must be found within the current search order; note that ' is no longer an immediate word
(("paren")	
Stack:	(-) (-) (compiling)
Format:	(ccc)
New definition:	comment characters <i>ccc</i> , up to the ")" delimiter, are not processed; the zero or more comment characters must be entirely contained within the remaining input stream
÷I ("times-divide")	
Stack:	| n1 n2 n3 - n4 |
New definition:	multiply <i>n1</i> by <i>n2</i> to form an intermediate 32-bit value, then divide by <i>n3</i> ; result <i>n4</i> is the floored quotient, rounded toward negative infinity; forces an error for <i>n3</i> equal to 0 or <i>n4</i> out of range
÷/MOD ("times-divide-mod")	
Stack:	| n1 n2 n3 - n4 n5 |
New definition:	multiply <i>n1</i> by <i>n2</i> to form an intermediate 32-bit value, then divide by <i>n3</i> ; result <i>n4</i> is the remainder, with the same sign as <i>n3</i> if nonzero; result <i>n5</i> is the floored quotient rounded toward negative infinity; forces an error for <i>n3</i> equal to 0 or <i>n5</i> out of range
+LOOP ("plus-loop")	
Stack:	(n -) (sys -) (compiling)
Format:	: ... DO ... +LOOP ... ;
New definition:	immediate word to add <i>n</i> to the loop index; terminate the loop if the index was incremented over the (limit-1) to limit boundary (otherwise, repeat the loop); the error-check value <i>sys</i> is left by DO during compilation
, ("comma")	
Stack:	(16b -)
Modifications:	stack diagram modified; definition clarified to indicate that <i>16b</i> is compiled at the top of the dictionary
." ("dot-quote")	
Stack:	| - ) ( - ) (compiling)
Format:	: <name>" ccc" ... ;
New definition:	immediate word to output the character string <i>ccc</i> , up to the delimiting "quote" character, during execution of <name>
.I ("dot-parens")☆	
Stack:	(-) (-) (compiling)
Format:	.I ccc
New definition:	immediate word to output the character string <i>ccc</i> , up to the delimiting ")" character

(continued from page 138)

resulting in 65,536 passes before detection of the necessary transition.

Execution of LEAVE in FORTH-79 sets the loop index to the limit value, causing termination at the next LOOP or +LOOP. FORTH-83's LEAVE jumps control to the first word beyond the next LOOP or +LOOP, without executing any words between LEAVE and LOOP or +LOOP during the final pass.

Relationals in the new standard use true arithmetic comparisons. Some older FORTH implementations (but not FORTH-79) use a 64K-byte number circle for comparisons as well, so that a relational test such as

```
-30000 30000 <
```

returns an incorrect result. FORTH-83's arithmetic comparisons instead must use a "number line" from the lowest to the highest permissible operand values, providing proper results in all cases.

FORTH-83 comparisons that result in a Boolean true flag leave a value of -1 (FFF hexadecimal in 2's complement rotation) rather than FORTH-79's value of 1 (01 hexadecimal). Although these definitions are shown as changed in the standard, it is the definition of "true flag" that has been revised. Many FORTH-79 applications use comparison flags arithmetically and may not operate properly with the new "true" value. Any nonzero value is still accepted as a true flag when used as an operand, though. NOT now leaves the 1's complement of a numeric operand and is no longer equivalent to 0=.

BUFFER RESTRICTIONS

Mass-storage buffer areas, frequently used as scratch pads between FORTH-79 disk accesses, are restricted in FORTH-83. The definition of BLOCK now specifies that buffer contents may not be changed unless that change can be transferred to mass storage. FORTH-79's EMPTY-BUFFERS has been relegated to the reference word set because FORTH-83 buffers by definition contain only data to be saved by SAVE-BUFFERS, UPDATE, or FLUSH. FLUSH, new to FORTH-83, saves all buffer contents before unassigning all buffers; this permits disks to be changed during processing without the chance of data or source code being placed on

(continued)

FORTH-83

/ ("divide")

Stack: (n1 n2 - n3)

New definition: divide n1 by n2, leaving the floored quotient n3 rounded toward negative infinity; forces an error if n2 equals 0 or n3 is out of range

/MOD ("divide-mod")

Stack: (n1 n2 - n3 n4)

New definition: divide n1 by n2, leaving the floored quotient n4 rounded toward negative infinity; remainder n3 has the same sign as n2 if nonzero; forces an error if n2 equals 0 or n4 is out of range

0< ("zero-less")

Stack: (n - flag)

New definition: leave a true flag (-1) if n is less than 0

0= ("zero-equals")

Stack: (w - flag)

New definition: leave a true flag (-1) if w equals 0

0> ("zero-greater")

Stack: (n - flag)

New definition: leave a true flag (-1) if n is greater than 0

2/ ("two-divide")★

Stack: (n1 - n2)

New definition: the operand is shifted 1 bit right arithmetically, including the sign bit

: ("colon")

Stack: (- sys)

Format: : . . . ;

Modifications: stack diagram modified; vocabulary references changed to comply with FORTH-83 search order

< ("less-than")

Stack: (n1 n2 - flag)

New definition: leave a true flag (-1) if n1 is less than n2

= ("equals")

Stack: (w1 w2 - flag)

New definition: leave a true flag (-1) if w1 equals w2

> ("greater-than")

Stack: (n1 n2 - flag)

New definition: leave a true flag (-1) if n1 is greater than n2

>BODY ("to-body")★

Stack: (addr1 - addr2)

New definition: leave the parameter field address addr2 of the word whose compilation address is addr1

?DUP ("question-dupe")

Stack: (16b - 16b 16b) or (0 - 0)

Modifications: stack diagram modified and pronunciation changed

ABORT ("abort-quote")★

Stack: (flag -)

(-) (compiling)

Format: : <name> . . . ABORT "ccc" . . . ;

New definition: immediate word to output the character string ccc (up to the delimiting "quote") and initiate a system-dependent abort if flag is true when <name> is executed; the abort routine must at least include all functions of ABORT

BASE

Stack: (- addr)

New definition: user variable containing the current I/O radix, in the range of 2 to 72

(continued)

A User-Friendly Catalog

...and it's FREE!



WP/DP/PC SUPPLIES & ACCESSORIES, COPIER PRODUCTS & MORE!

Modern office supply is never a problem—until you run out. When that happens, you'll want fast service and a large selection of products.

We're Nashua-Plus™ one of the world's leading independent suppliers of information-processing products and accessories. Word processing, data processing, personal computing, copier supplies—our catalog makes everything easy to find, easy to order, and available at a moment's notice.

Send for the new Nashua-Plus™ Catalog—a \$2.00 value, yours free.

Supplies & Service to Keep Your Office Working

- WE PAY THE FREIGHT
- ORDER BY PHONE OR MAIL
- RAPID DELIVERY
- HELP WHEN YOU NEED IT

ACT NOW! CALL TOLL FREE OR USE THE COUPON!

1-800-331-3400

In New Hampshire call 603-880-2178

Nashua-Plus™
70 Franklin Street, CS 2038, Dept. A-6
Nashua, NH 03061

Yes! Send my FREE Nashua-Plus™ Catalog (worth \$2.00)!

NAME _____
COMPANY _____
TITLE _____
ADDRESS _____
CITY _____ STATE _____ ZIP _____
TELEPHONE _____



wabash

Flexible Diskettes

6 Year Warranty - 100% Certified

*FREE DELIVERY

5 1/4" \$135 BULK SSSD each 48 TPI W/WRAP RING Packed 10 per Soft Pack QTY 20	BULK SSSD \$119 each 48 TPI W/WRAP RING Packed 10 per Soft Pack
5 1/4" \$155 BULK SSD each 48 TPI W/WRAP RING Packed 10 per Soft Pack QTY 20	BULK SSD \$138 each 48 TPI W/WRAP RING Packed 10 per Soft Pack
5 1/4" \$189 BULK DSD each 48 TPI W/WRAP RING Packed 10 per Soft Pack QTY 20	BULK DSD \$169 each 48 TPI W/WRAP RING Packed 10 per Soft Pack

24 Hour Order Desk



TOLL FREE NAT'L. **1-800-634-2248**

Visa, MasterCard, Cert. chk., M/O, C.O.D. cash.
Get immediate shipment. Schools & govt. on P.O. #.
Personal or company checks held 14 days.
APO, FPO, Can. and other non-UPS delivered, add \$5.
*Free delivery on minimum orders of \$50 or more. Others add \$12 for SA H.

Software Services™

1326 25th St. S., Suite H, Fargo, ND 58103 1-701-280-0121

Circle 282 on inquiry card.

CONVERSE WITH YOUR COMPUTER

AT LAST! A FULL IMPLEMENTATION of the original ELIZA program is now available to run on your microcomputer!

Created at MIT in 1966, ELIZA has become the world's most celebrated artificial intelligence demonstration program. ELIZA is a non-derivative psychotherapist who analyzes each statement as you type it in and then responds with her own comment or question—and her remarks are often amazingly appropriate!

Designed to run on a large mainframe, ELIZA has never before been available to personal computer users except in greatly stripped down versions lacking the sophistication which made the original program so fascinating.

Now our new microcomputer version possessing the FULL power and range of expression of the original is being offered at the introductory price of only \$25. And if you want to find out how she does it for teach her to do more, we will include the complete SOURCE PROGRAM for only \$20 additional.

Order your copy of ELIZA today and you'll never again wonder how to respond when you hear someone say, "Okay, let's see what this computer of yours can actually do!"

ELIZA IS AVAILABLE IN THE FOLLOWING FORMATS:

- 5 1/4 inch disk for the 48K Apple II, II Plus, IIe or IIx \$25 for Protected Version—\$45 for AppleSoft Source Version
- 5 1/4 inch disk for the 64K IBM Personal Computer, \$25 for Protected Version—\$45 for IBM Disk BASIC Source Version
- 5 1/4 inch disk or tape cassette for the Commodore 64 (specify which) \$25 for Protected Version—\$45 for C-64 BASIC Source Version
- Standard 8 inch single density disk for all CP/M based computers \$25 for ELIZA.COM—\$45 with Microsoft BASIC-80 Source
- 5 1/4 inch disk for most CP/M based computers (specify computer) \$25 for ELIZA.COM—\$45 with Microsoft BASIC-80 Source

Please add \$2.00 shipping and handling to all orders (California residents please add 6% sales tax)

ARTIFICIAL INTELLIGENCE RESEARCH GROUP

921 North La Jolla Avenue, Dept. B
Los Angeles, CA 90046
(213) 656-7380 (213) 656-2214
MC, VISA and checks accepted



Circle 26 on inquiry card.



EDGE-PC: An Affordable IBM PC-Compatible System for \$1361

- PC-88 CPU card \$349
- Color/Graphic card \$189
- Disk adapter with cable \$120
- Monochrome card \$189
- Keyboard \$149
- System Enclosure \$119
- 100W Power Supply & fan \$139

EDGE MICRO SYSTEMS, INC.
2350 WALSH AVE., SANTA CLARA, CA 95051
(408) 980-8866 TLX 3719075 EDGE LB

Circle 118 on inquiry card.

BLOCK

Stack: (u - addr)
New definition: assign the buffer whose first data byte is at *addr* to block *u* and transfer the data if the block is not already in a buffer; prior contents of the buffer are saved to disk if the update bit is set; if block *u* is already in a buffer, *addr* points to it and no data is transferred; buffer contents must be storable (only the data within the last buffer referenced by BLOCK or BUFFER is valid)

BUFFER

Stack: (u - addr)
New definition: similar to BLOCK except that block *u* might not be transferred to the buffer if not already in memory; the contents of the buffer after execution are unspecified

CMOVE> ("c-move-up")*

Stack: (addr1 addr2 u -)
New definition: move *u* bytes, starting with the byte at (*addr1* + *u* - 1) to (*addr2* + *u* - 1) and proceeding toward low memory; no bytes are moved if *u* is 0

COMPILE

Stack: (-)
Format: : <name1> ... COMPILE <name2> ... ;
New definition: during execution of <name1> , compile the compilation address of the nonimmediate word <name2> into the top of the dictionary

CONSTANT

Stack: (16b -)
Format: CONSTANT <name>
New definition: compile the definition of <name> such that later execution of <name> leaves 16b on the stack

D< ("d-less-than")

Stack: (d1 d2 - flag)
New definition: leave a true flag (-1) if *d1* is less than *d2*

DEFINITIONS

Stack: (-)
New definition: make the compilation vocabulary the same as the vocabulary now first in the search order

DO

Stack: (w1 w2 -)
(- sys) (compiling)
Formats: : ... DO ... LOOP ... ;
: ... DO ... +LOOP ... ;
New definition: immediate word to begin an indexed loop, with initial value *w2* and limit value *w1*; all DO loops are performed at least once; *sys* is balanced during compilation by LOOP or +LOOP ; force an error if space is not available for at least three levels of nesting

DOES>

Stack: (- addr)
(-) (compiling)
Format: : <name1> ... <create> ... DOES> ... ;
New definition: immediate word to define the execution behavior of any later word <name2> defined using <name1> ; the <create> may be CREATE or any user-defined word that executes CREATE ; later execution of <name2> places <name2>'s parameter field address on the stack before executing the sequence of words between DOES> and ; in <name1>'s definition

EMIT

Stack: (16b -)
New definition: display the ASCII character defined by the lowest 7 bits of 16b on the current output device; if additional bits are available for display in an environmentally-dependent manner, all must be displayed

EXPECT

Stack: (*addr + n -*)
 New definition: store characters beginning at *addr* until a "return" is encountered or *n* characters have been stored; the "return" is not stored but is displayed (along with all received characters) as a blank

FIND

Stack: (*addr - addr2 n*)
 New definition: for a string with a count byte at *addr1*, search for a matching word name using the current search order; if found, *addr2* is the matching word's compilation address; *n* is 1 if the word is immediate (or -1 otherwise); if no match is found, *addr2* is the same as *addr1* and *n* equals 0

FLUSH ☆

Stack: (-)
 New definition: unassign all block buffers after executing a sequence equivalent to the **SAVE-BUFFERS** operation

FORGET

Stack: (-)
 Format: **FORGET** < *name* >
 New definition: delete < *name* > and all later-defined words; force an error if < *name* > is not within the current search order or if the compilation vocabulary is removed

FORTH

Stack: (-)
 New definition: make **FORTH** the first vocabulary in the search order; not immediate

FORTH-83 ☆

Stack: (-)
 New definition: force an error condition if the operating environment is not a **FORTH-83** standard system

HOLD

Stack: (*char -*)
 Modification: usage outside of < # ... # > is unrestricted

KEY

Stack: (- *16b*)
 New definition: receive the ASCII character defined by the lowest 7 bits of *16b* on the current input device; all ASCII codes are permitted; characters are not displayed, nor are control characters processed

LEAVE

Stack: (-)
 (-) (compiling)
 Formats: : < *name* > ... DO ... LEAVE ... LOOP ... ;
 : < *name* > ... DO ... LEAVE ... +LOOP ... ;
 New definition: immediate word, to transfer execution of < *name* > to the first word beyond **LOOP** or **+LOOP**; **LEAVE** may appear multiple times or within other control structures

LITERAL


Stack: (- *16b*)
 (*16b -*) (compiling)
 Format: : < *name* > ... LITERAL ... ;
 New definition: immediate word to compile a system-dependent operation; later execution of < *name* > leaves *16b* on the stack

LOOP ("loop")

Stack: (-)
 (*sys -*) (compiling)
 Format: : ... DO ... LOOP ... ;
 New definition: immediate word to increment the current loop index by 1; terminate the loop if the index was incremented over the (limit-1) to limit boundary (otherwise, repeat the loop); the error check value *sys* is left by **DO** during compilation

(continued)


ZENITH/Heath Users



Double Your
5 1/4" disk storage
capacity without adding a drive.

Get twice as much from your H88 or H89 microcomputer. Our FDC-880H floppy disk controller, in conjunction with your 5 1/4" drives, for example, expands memory capacity from 256 bytes to 512 bytes per sector.

And it handles single and double-sided, single and double-density, 8" and 5 1/4" drives — simultaneously.



C.D.R. Systems Inc.
 Controlled Data Recording Systems Inc.
 7210 Clairmont Mesa Blvd., San Diego, CA 92111
 (619) 560-1272

Circle 51 on inquiry card.

MEMOREX FLEXIBLE DISCS

WE WILL NOT BE UNDER-SOLD! Call Free (800)235-4137 for prices and information. Dealer inquiries invited and C.O.D.'s accepted.




PACIFIC EXCHANGES
 100 Foothill Blvd.
 San Luis Obispo, CA
 93401. In Cal. call
 (800)592-5935 or
 (805)543-1037

Circle 243 on inquiry card.

Serial ← ||| ||| ||| → Parallel

NEW!



Convert What You Have To What You Want!

- * RS232 Serial
- * 8 Baud Rates
- * Latched Outputs
- * Centronics Parallel
- * Handshake Signals
- * Compact 3 1/2", 4 1/2", 5 1/4"

No longer will your peripheral choices be limited by the type of port you have available! Our new High Performance 700 Series Converters provide the missing link. Based on the latest in CMOS technology, these units feature full baud rate selection to 19.2K, with handshake signals to maximize transfer efficiency. Detailed documentation allows simplified installation. Order the Model 770 (Ser/Par) or Model 775 (Par/Ser) Today!

Butler Products Coming Soon! **Tigertronics** only \$89.95
 Connector Option \$10.00
 CA Residents \$16 tax
 UPS Shipping \$3.00

1501 8 Pine Street
 P.O. Box 2723
 Orem, UT 84054-2723

CALL (805) 487-1665 or 487-1666
 For FAST Delivery

Circle 123 on inquiry card.

COMPUTER RUNS MOTORS

\$225⁰⁰



- ROBOTS
- PROCESS CONTROL
- CONVEYORS
- ONE PORT RUNS UP TO FOUR MOTORS

Use your computer with the CDFR controller to command speed and direction of two independent motors from a single output port. For robot drive motors or any two functions requiring proportional bipolar control of 15Vdc up to 12 Amps each. Normally the controller installs between the computer, a 12Vdc battery, and two DC-PM motors mounted right and left on a robot. Simple software commands set speed and direction latches in the CDFR thus freeing your computer for other tasks. Two CDFR's control four motors with a single port. The CDFR speed control uses CMOS, optoisolators & relayless PWM power circuitry. One year limited warranty. Buy now with parallel interface for \$225.00, or serial for \$315.00. Other robotics components available. MC, VISA, MO, or check.

VANTEC

15445 VENTURA BLVD, SUITE 10-281
SHERMAN OAKS, CA 91413
(213) 993-1073



Circle 315 on inquiry card.

ORDER NOW!

FREE SHIPPING
WHOLESALE PRICE

BEST BUY!

LOCK!

Keeps up to 100 5 1/4" Diskettes in a Protective, sleek, smoke acrylic cover, ABS beige plastic bottom and 9 plastic dividers. Don't lose this chance to get a convenient, elegant, top quality organizer, fast delivery and lower price on your LOCKING Diskette File. LA-90



No: LA-90

5 7/8" x 7 1/2" W x 1 1/2" H

WT 2.8 lbs

— WAREHOUSE DIRECT SALE —

UPS shipping charge is prepaid (continental U.S. only). Cashier check, money order or cash will ship within 24 hours. Personal / company check allow 10 days to clear.

YOUR NET PRICE	
QTY	1 2-5 6-10
	\$ 19.90 18.90 17.90

JUST MAIL YOUR ORDER WITH CHECK, TODAY!
DEALER / DEM WELCOME — DISCOUNT WITH QUANTITY ORDER
(714) 892-8229 • (714) 895-8188
LONG-LIFE ACCESSORIES CO.
P.O. BOX 2925 • SEAL BEACH, CA 90740

Circle 183 on inquiry card.

BASF
DISKETTES

BASF Diskettes at competitive price. Call TOLL FREE (800) 235-4137 for prices and information. Visa and Master Card accepted.



PACIFIC EXCHANGES
100 Foothill Blvd
San Luis Obispo, CA
93401 (In Cal call
(805) 543-1037)

Circle 243 on inquiry card.

FORTH-83

MOD

Stack: (*n1 n2 - n3*)

New definition: divide *n1* by *n2*; the remainder of *n3* has the same sign as *n2* if nonzero; force an error if *n2* equals 0 or *n3* is out of range

NOT

Stack: (*16b1 - 16b2*)

New definition: leave the one's complement of *16b1*

PAD

Stack: (- *addr*)

New definition: leave a pointer to the first byte of a floating scratch-pad area; the area must contain at least 84 bytes

PICK

Stack: (+ *n - 16b*)

New definition: leave a copy of the *n*th stack location, not counting the location containing the +*n* operand; the operand is zero-based, so that DUP is equivalent to 0 PICK, and OVER is equivalent to 1 PICK

ROLL

Stack: (+ *n -*)

New definition: roll the *n*th (not counting the position occupied by +*n*) stack location's contents to the top of the stack, moving all intervening values down one location; the +*n* operand is zero-based, thus ROT is equivalent to 2 ROLL and 0 ROLL is a null operation

SIGN

Stack: (*n -*)

Modification: usage outside of < > and colon definitions is unrestricted

SPAN ☆

Stack: (- *addr*)

New definition: user variable containing the number of characters received and stored by the last execution of EXPECT.

STATE

Stack: (- *addr*)

Modification: contents may not be modified by a program

TIB ("t-i-b") ☆

Stack: (- *addr*)

New definition: leave a pointer to the first byte of the terminal input buffer; length of the buffer must be at least 80 characters

U < ("u-less-than")

Stack: (*u1 u2 - flag*)

New definition: leave a true flag (-1) if *u1* is less than *u2*

UM* ("u-m-times") ☆

Stack: (*u1 u2 - ud*)

New definition: leave the unsigned double-precision product of *u1* and *u2*

UM/MOD ("u-m-divide-mod") ☆

Stack: (*ud u1 - u2 u3*)

New definition: leave the remainder *u2* and floored quotient *u3* of *ud* divided by *u1*; force an error if *u1* equals 0 or *u3* is out of range

VOCABULARY

Stack: (-)

Format: VOCABULARY < *name* >

New definition: compile a definition for < *name* > to initiate a new vocabulary; later execution of < *name* > makes it the first vocabulary in the search order; the sequence < *name* > DEFINITIONS makes < *name* > the compilation vocabulary, to which new definitions are linked; < *name* > is not immediate

changed from 1-origin to 0-origin form. In other words, the FORTH-83 sequence 2 ROLL 4 PICK is equivalent to FORTH-79's 3 ROLL 5 PICK. Definitions for all required words with stack operands or results have been more closely defined, using the value types listed in table 7. FORTH-79 and FIG-FORTH both suffer from poorly specified stack operands: for example, earlier definitions of DROP specify a signed single-precision operand, yet they also work perfectly well for unsigned numerics or ASCII (American National Standard Code for Information Interchange) values. The FORTH-83 version indicates that any arbitrary 16-bit value (one stack position) can be properly used. Similar revisions throughout FORTH-83's required and extension word sets remove many ambiguities and greatly enhance the internal consistency of the language (see table 2).

I/O words have been redefined to permit coding for I/O-device selection, input-line editing, output control codes, and other "environmentally dependent" operations. To be labeled compatible with the FORTH-83 standard, however, programs must keep all environmentally dependent word definitions in an isolated set, with full documentation.

The input stream from the terminal is now directly accessible, using the buffer whose address is given by TIB and whose length (80 characters or more) is specified by the user variable #TIB. Unlike FORTH-79, FORTH-83 does not add ASCII nulls to delimit the end of an input stream. Instead, the new user-variable SPAN holds the count of the characters actually received and stored by the last execution of EXPECT.

Numeric I/O may be received and transmitted in any radix up to 72; FORTH-79 has a limit of 70. Pictured numeric output words, #, #S, HOLD, and SIGN are no longer restricted to use between <# and #>, and SIGN may also appear outside of colon definitions if desired. The floating scratch-pad area designated by PAD is now at least 84 characters rather than 64.

FORTH-79 has several immediate "state smart" words: their execution differs depending upon whether the system is compiling or executing (specified by the value of user-variable STATE). Some words have been made "state

(continued)

WORD	
Stack:	(char — addr)
New definition:	parses the next word delimited by char (ignoring any leading instances) or the end of the input stream and stores it with its count bytes at addr; a blank is appended to the character string but is not included in the count; the count equals 0 if the input stream is already exhausted; the pointer in >IN is updated to indicate the character after the final delimiter
<hr/>	
[] ("bracket-tick")☆	
Stack:	(— addr)
	(—) (compiling)
Format:	: <name1> ... [] <name2> ... ;
New definition:	immediate word to compile the compilation address addr of <name2> as a literal in the definition of <name1> ; later execution of <name1> leaves addr on the stack

Table 4: FORTH-83 modifications to the double-number (32-bit) word set. (For an explanation of the abbreviations used in the stack diagrams, see table 7.) The pronunciation is in parentheses next to the FORTH word. A star (☆) indicates a new FORTH word.

2CONSTANT ("two-constant")	
Stack:	(32b —)
Format:	2CONSTANT <name>
New definition:	create a dictionary definition for <name>, which executes by leaving 32b on the stack
<hr/>	
D.R ("d-dot-r")	
Stack:	(d + n —)
New definition:	output d in the current radix, right justified in a field of +n characters; force an error condition if the field width is insufficient
<hr/>	
D0 = ("d-zero-equals")	
Stack:	(wd — flag)
New definition:	leave a true flag (-1) if wd is 0
<hr/>	
D2/ ("d-two-divide")☆	
Stack:	(d1 — d2)
New definition:	the operand d1 is shifted one bit right arithmetically, including the sign bit
<hr/>	
D< ("d-less-than")	
Stack:	(d1 d2 — flag)
New definition:	leave a true flag (-1) if wd1 is less than wd2
<hr/>	
D= ("d-equals")	
Stack:	(wd1 wd2 — flag)
New definition:	leave a true flag (-1) if d1 is less than d2
<hr/>	
DABS ("d-absolute")	
Stack:	(d — ud)
Modifications:	stack diagram modified; pronunciation changed
<hr/>	
DU< ("d-u-less")	
Stack:	(ud1 ud2 — flag)
New definition:	leave a true flag (-1) if ud1 is less than ud2

the new disk by mistake.

All mass-storage buffer assignments are in an installation-dependent sequence rather than the rotation specified by FORTH-79 to assign a block to the buffer accessed least recently. In FORTH-79, BUFFER can be used to assign a buffer to a specific disk block without actually transferring the block

from disk. The FORTH-83 version of BUFFER may (but needn't, depending on the installation) actually transfer the specified block from disk to buffer. As a result, buffer contents after execution of BUFFER are unspecified in FORTH-83.

The data (parameter) stack-manipulating words PICK and ROLL have been

Table 5: FORTH-83 system-extension word set. (For an explanation of the abbreviations used in the stack diagrams, see table 7.) The pronunciation is in parentheses next to the FORTH word.

<MARK ("backward-mark")
Stack: (- addr)
Format: : <name> ... <MARK ... ;
Definition: leave the pointer <i>addr</i> to the destination of a backward branch; the pointer is primarily for later use by <RESOLVE
<RESOLVE ("backward-resolve")
Stack: (addr -)
Format: : <name> ... <RESOLVE ... ;
Definition: used after ?BRANCH or BRANCH at the source of a backward branch to compile a branch address using the destination pointer <i>addr</i>
>MARK ("forward-mark")
Stack: (- addr)
Format: : <name> ... >MARK ... ;
Definition: used after ?BRANCH or BRANCH at the source of a forward branch at <i>addr</i> to compile space for a pointer to the destination; the pointer is primarily for later use by >RESOLVE
>RESOLVE ("forward-resolve")
Stack: (- addr)
Format: : <name> ... >RESOLVE ... ;
Definition: used at the destination of a forward branch to compile a branch offset in the space left by >MARK, using the source pointer <i>addr</i>
?BRANCH ("question-branch")
Stack: (flag -)
Format: : <name> ... COMPILE ?BRANCH ... ;
Definition: in the specified format, compile a conditional branch operation; a branch address must immediately follow; it is usually compiled by <RESOLVE (backwards branch) or >MARK (forward branch); later execution of <name> ignores the branch if flag is true or executes the branch if flag is false
BRANCH
Stack: (-)
Format: : <name> ... COMPILE BRANCH ... ;
Definition: in the specified format, compile an unconditional branch operation; a branch address must immediately follow; it is usually compiled by <RESOLVE (backward branch) or >MARK (forward branch)
CONTEXT
Stack: (- addr)
Definition: user variable specifying the dictionary search order
CURRENT
Stack: (- addr)
Definition: user variable specifying the vocabulary to receive new word definitions

dumb" in FORTH-83, and programs are also prohibited from changing the value of STATE. Both ." and LITERAL may now appear only within colon definitions. FORTH-83's ' ("tick") is no longer immediate; it's supplemented by the immediate word ['] to compile a compilation address within a colon definition. The new immediate word .| displays the characters that follow up to the delimiting right parenthesis, during compilation or execution. Both compilation and run-time stack diagrams are

now specified for FORTH-83's immediate words, and all references to separate run-time code have been removed.

FORTH-83 defining words have not escaped change. The definition of DOES> has been expanded to permit use not only with CREATE but also with any user-defined word that executes CREATE.

Vocabulary creation, searching, and deletion have always been problem areas for FORTH, and that tradition, un-

fortunately, continues in FORTH-83. FORTH-79's CONTEXT and CURRENT user variables have been moved to the new system-extension word set, along with words to mark and resolve branch operations within colon definitions. The word-name that serves as an operand following FORGET must now be found in the compilation vocabulary (called the "current" vocabulary in FORTH-79) that receives new definitions; FORTH-79 permits the specified word to be in either the current or the FORTH vocabulary.

The default search order still begins with the last executed ("context") vocabulary and ends with FORTH, but now it may be changed in a system-dependent manner. All further references to chaining have been removed from VOCABULARY and search-related words.

The vocabulary search words FIND and WORD have been significantly changed in FORTH-83. FIND now requires an address operand pointing to the first (count) byte of a dimensioned string. If a matching word is found within the currently active search order, its compilation address is left on the stack; an additional value of -1 is left on top of the stack if the matching word is nonimmediate, or 1 if immediate. If no match is found, the result matches the address operand, and the value on top of the stack is a false flag (0). FORTH-83's version of WORD parses the next delimited word from the input stream, along with a preceding count byte, but the delimiter operand may now be specified as any ASCII character, including a null. The resulting string ends with a blank (not included in the count) rather than the actual delimiter found (as in FORTH-79).

Both FORTH-79 and FORTH-83 strongly restrict the user's direct access to many areas of memory. Programs are absolutely prohibited from addressing into the data or return stacks or any definition fields other than parameter fields stored by the application. One improvement of FORTH-83 is the addition of >BODY, which converts a word's compilation (code field) address to its parameter field address.

CONCLUSIONS

Due to the numerous variations, only relatively few FORTH-79 programs will

Table 6: FORTH-83 modifications to the assembly-language extension word set. (For an explanation of the abbreviations used in the stack diagrams, see table 7.) The pronunciation is in parentheses next to the FORTH word.

;CODE ("semicolon-code")	
Stack:	(-)
	(sys1 - sys2) (compiling)
Format:	: <name!> ... <create> ... ;CODE ... END-CODE
Modifications:	format modified to permit use with any user-defined word executing CREATE : stack diagram added
<hr/>	
ASSEMBLER	
Stack:	(-)
New definition:	make ASSEMBLER the first vocabulary in the search order; not immediate
<hr/>	
CODE	
Stack:	(- sys)
Format:	CODE <name> ... END-CODE
New definition:	compile a code definition for <name> using ASSEMBLER, which is made the first vocabulary in the search order; the definition of <name> cannot be found by a dictionary search before execution of END-CODE, which uses the sys parameter
<hr/>	
END-CODE	
Stack:	(sys -)
Format:	;CODE ... END-CODE CODE ... END-CODE
Modifications:	stack diagram changed: usage formats specified

Table 7: Stack parameter types, ranges, and abbreviations for FORTH-83.

Parameter Type	Width (bits)	Decimal Range	Abbreviation
Address	16	0 ... 65,535	<i>addr</i>
Arbitrary			
bit	1	0 ... 1	<i>b</i>
Boolean flag	16	0 (false), nonzero (true)	<i>flag</i>
byte	8	n.a.	<i>8b</i>
2 bytes	16	n.a.	<i>16b</i>
4 bytes	32	n.a.	<i>32b</i>
Boolean			
false	16	0	<i>false</i>
true	16	-1 (result), nonzero (operand)	<i>true</i>
Character	7	0 ... 127	<i>char</i>
Double-precision			
signed	32	-2,147,483,648 ... 2,147,483,647	<i>d</i>
positive	32	0 ... 2,147,483,647	<i>+d</i>
unsigned	32	0 ... 4,294,967,295	<i>ud</i>
arbitrary	32	-2,147,483,647 ... 4,294,967,295	<i>wd</i>
Single-precision			
signed	16	-32,768 ... 32,767	<i>n</i>
positive	16	0 ... 32,767	<i>+n</i>
unsigned	16	0 ... 65,535	<i>u</i>
arbitrary	16	-32,768 ... 65,535	<i>w</i>
System compilation			<i>sys</i>
(generated by system: normally used for error checking; width and range constraints do not apply)			

execute properly in a FORTH-83 environment without conversion: considering FORTH's often cryptic source code, conversion of application programs may require substantial effort. Of

course, existing software can still be used under a FORTH-79 system.

Compliance with the FORTH-83 standard is necessary only to indicate if a system includes the required (or op-

tional) word set(s) in source or object form: FORTH-83 applications are to execute equivalently on each standard system. The FORTH Standards Team has explicitly acknowledged that non-compliance is sometimes both beneficial and necessary and is entirely within the user's choice: publication of the standard was not intended to prevent the implementation, marketing, purchase, or use of noncomplying systems or programs.

In a language praised for its transportability, the abundance of competing—and generally incompatible—dialects may continue to be detrimental. Is FORTH-83 the final word? That would seem about as likely as Apple Computer building abacuses, or universal acceptance of COBOL as the ultimate programming language. There is no question that FORTH-83 is several steps ahead of earlier versions, but the scope of the revisions indicates a language still very much in flux. FORTH-85, -86, or -87 may be inevitable. ■

FOR MORE ON FORTH

Copies of the FORTH-79 and FORTH-83 standards are available from the FORTH Interest Group (FIG), POB 1105, San Carlos, CA 94070. (415) 962-8653. FIG also offers back issues of its journal, *FORTH Dimensions*.

The Orange County (CA) FIG offers a public-domain version of FORTH-83 on 8-inch CP/M, Apple, or IBM PC disks for \$25. Contact Wil Baden, 325 Princeton, Costa Mesa, CA 92626.)

BIBLIOGRAPHY

McCabe, C. Kevin. *FORTH Fundamentals*, volumes 1 and 2. Beaverton, OR: dilitium Press, 1983. Ragsdale, William F. *FIG-FORTH Installation Manual, Glossary, and Model*.

Smith, Robert. "Compilation Addresses and Parameter Fields." *FORTH Dimensions*, March/April 1983, page 12.

Smith, Robert. "FORTH-83 DO-LOOP." *FORTH Dimensions*, September/October 1983, page 25.

Smith, Robert. "FORTH-83 Standard." *FORTH Dimensions*, September/October 1983, page 26.

Smith, Robert. "Representation for Logical True." *FORTH Dimensions*, November/December 1982, page 23.

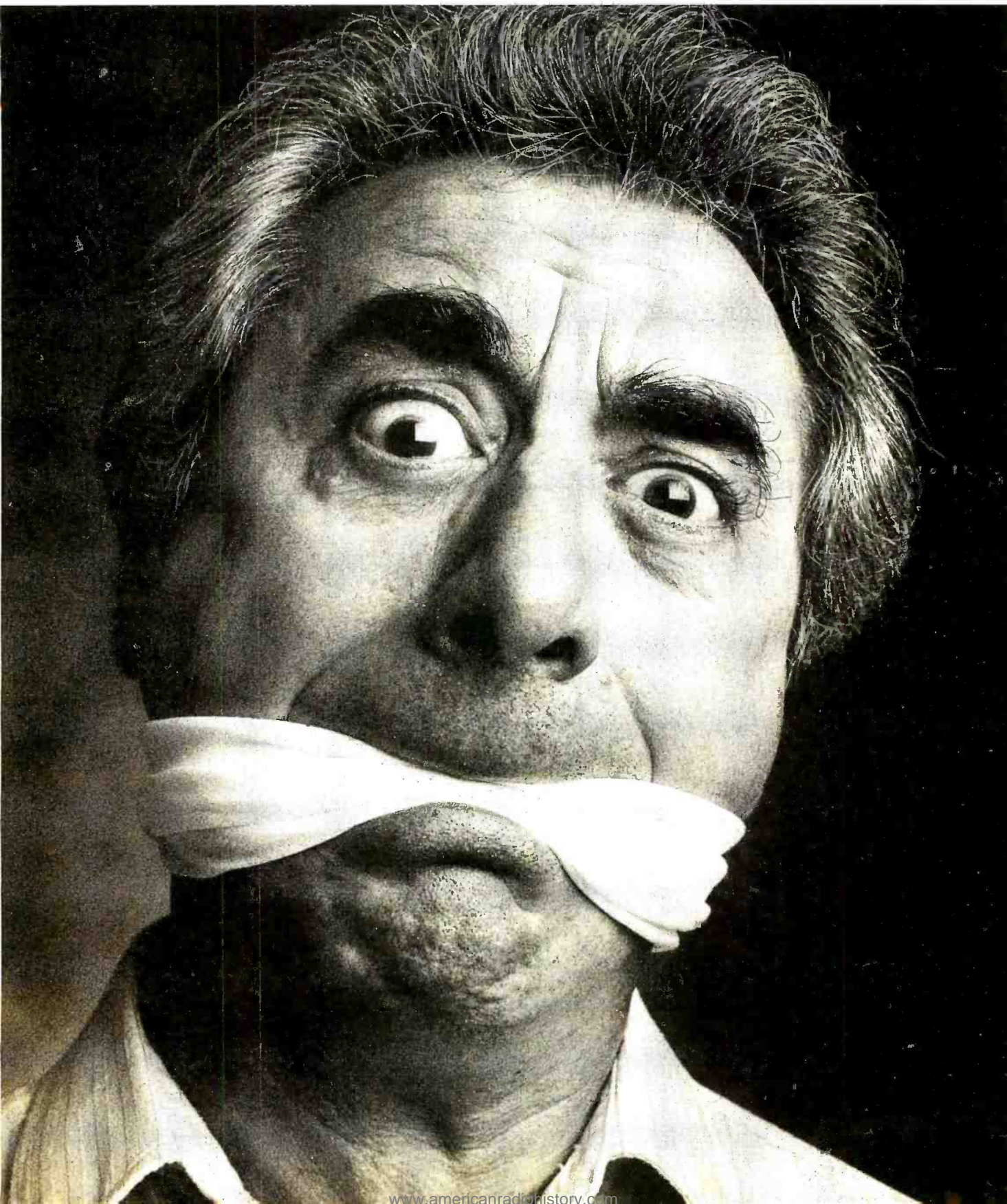
Smith, Robert. "Summary of Changes in Proposed FORTH-83." *FORTH Dimensions*, January/February 1983, page 29.

Smith, Robert. "Towards a New Standard." *FORTH Dimensions*, July/August 1982, page 19.

Suralis, Klaxon. "FORTH-79 Compatible LEAVE for FORTH-83." *FORTH Dimensions*, September/October 1982, page 25.

Tenny, Glenn. "FORTH-83: A Minority View." *FORTH Dimensions*, September/October 1983, page 27.

**To communicate voice
the ordinary modem**



and data simultaneously, leaves a lot to be desired.

Introducing the Tel-A-Modem.

Now you and your personal computer can talk on the same phone at the same time.

Let's say, for example, certain data you were transmitting via your personal computer to a remote computer user needed some verbal explanation to go along with it. With the ordinary modem it couldn't be done. Not simultaneously.

You'd have to first call the user to inform them that data was coming. Hang up. Redial in order to connect modems. Transmit the data. Hang up. And then call back with your explanation. If you had additional input to transmit and discuss, you'd have to begin the whole process again. Talk about frustration.

Code-A-Phone's solution to this problem is the Tel-A-Modem. An innovative two-line desk telephone integrated with an intelligent modem capable of transmitting voice and data simultaneously.

Of course, the genius of Tel-A-Modem doesn't end with its unique communication capabilities and state-of-the-art convenience.

Specially designed for use with RS-232C compatible computers and terminals, it offers a full spectrum of both telephone and modem cost effective features, including: single button selector for voice or data on either line; full-duplex mode; automatic answer/origi-

nate modes; 300 and 1200 baud data transmission rates; automatic selection of baud rates; switch dialing for tone-dial or pulse-dial systems; memory autodial; and modem status LEDs.

So much for words.

For more information and the name of your nearest Tel-A-Modem dealer, call 1-800-547-4683. That is, just as soon as your computer gets off the phone.

In Oregon, Alaska and Hawaii, call 1-503-655-8940.

Code-A-Phone[®]
A SUBSIDIARY OF CONRAC CORPORATION



Circle 53 on inquiry card.

B·O·O·K·S R·E·C·E·I·V·E·D

- ATE: AUTOMATIC TEST EQUIPMENT. Allan C. Stover. New York: McGraw-Hill. 1984: 256 pages. 16 by 23.5 cm. hardcover. ISBN 0-07-061792-9. \$32.50.
- AN INTRODUCTION TO PROGRAMMING THE DRAGON 32. R. A. and J. W. Penfold. London, England: Bernard Babani Ltd.. 1983: 96 pages. 11.3 by 17.8 cm. softcover. ISBN 0-85934-108-9. £1.95.
- THE APPLE ALMANAC. Eric E. Goetz and William B. Sanders. Chatsworth, CA: Datamost. 1983: 240 pages. 20.5 by 27.3 cm. softcover. ISBN 0-88190-109-1. \$19.95.
- APPLE BASIC MADE EASY. David A. Gardner and Marianne L. Gardner. Englewood Cliffs, NJ: Prentice-Hall. 1984: 256 pages. 18.3 by 24 cm. hardcover. ISBN 0-13-038928-5. \$19.95.
- APPLE IIe USER'S HANDBOOK. WSI staff. Chesterland, OH: Weber Systems Inc.. 1983: 318 pages. 13.5 by 21.5 cm. softcover. ISBN 0-938862-46-4. \$14.95
- APPLESOFT BASIC: FROM THE GROUND UP. Henry Mullish and Dov Kruger. New York: McGraw-Hill. 1984: 240 pages. 13.5 by 20.3 cm. spiral-bound. ISBN 0-07-044034-3. \$10.95.
- THE ART OF COMPUTER GAME DESIGN. Chris Crawford. Berkeley, CA: Osborne/McGraw-Hill. 1984: 128 pages. 18.3 by 23.3 cm. softcover. ISBN 0-88134-117-7. \$14.95.
- BASIC & FORTRAN IN PARALLEL. S. J. Wainwright and A. Grant. London, England: Bernard Babani Ltd.. 1984: 96 pages. 11 by 17.8 cm. softcover. ISBN 0-85934-112-7. £1.95.
- BASIC COMPUTER SIMULATION. Lawrence L. McNitt. Blue Ridge Summit, PA: Tab Books. 1983: 352 pages. 18.8 by 23.5 cm. softcover. ISBN 0-8306-0585-1. \$15.50.
- THE BYTE GUIDE TO CP/M-86. Mark Dahmke. New York: McGraw-Hill. 1984: 272 pages. 14.8 by 22.8 cm. softcover. ISBN 0-07-015072-9. \$16.95.
- THE COMMODORE 64 EXPERIENCE. Mike Dean Klein. Chatsworth, CA: Datamost. 1983: 207 pages. 13.3 by 20.9 cm. softcover. ISBN 0-88190-230-6. \$14.95.
- COMMODORE 64 GRAPHICS & SOUND PROGRAMMING. Stan Krute. Blue Ridge Summit, PA: Tab Books. 1983: 256 pages. 18.8 by 23.5 cm. softcover. ISBN 0-8306-0640-8. \$15.50.
- THE COMPLETE FORTH. Alan Winfield. New York: John Wiley & Sons. 1983: 144 pages. 15 by 20.8 cm. softcover. ISBN 0-471-88235-6. \$15.95.
- COMPUMATH MAGIC. M. J. Winter. Chatsworth, CA: Datamost. 1983: 96 pages. 21 by 27.3 cm. softcover. ISBN 0-88190-217-9. \$7.95.
- COMPUTABILITY WITH PASCAL. John S. Mallozzi and Nicholas J. De Lillo. Englewood Cliffs, NJ: Prentice-Hall. 1984: 208 pages. 15.5 by 23.5 cm. hardcover. ISBN 0-13-164443-2. \$26.95.
- COMPUTER IN YOUR POCKET. Ed Faulk. Chatsworth, CA: Datamost. 1983: 160 pages. 13.3 by 20.9 cm. softcover. ISBN 0-88190-070-2. \$14.95.
- COMPUTER PLAYGROUND. M. J. Winter. Chatsworth, CA: Datamost. 1983: 128 pages. 27.5 by 20.3 cm. softcover. ISBN 0-88190-108-3. \$9.95.
- COMPUTERS AND DATA PROCESSING. 2nd Ed.. H. L. Capron and Brian K. Williams. Menlo Park, CA: Benjamin/Cummings Publishing. 1984: 490 pages. 20.5 by 26 cm. hardcover. ISBN 0-8053-2214-0. \$26.95.
- COMPUTERS FOR PROFESSIONAL PRACTICE. E. J. Neiburger. Waukegan, IL: Andent. 1984: 282 pages. 20.3 by 26.5 cm. softcover. ISBN 0-014555-00-6. \$14.95.
- EASY-TO-UNDERSTAND GUIDE TO HOME COMPUTERS. the editors of *Consumer Guide*. New York: Beekman House. 1984: 96 pages. 20.5 by 27.5 cm. spiral-bound. ISBN 0-517-42584-X. \$3.98.
- EASY-TO-UNDERSTAND GUIDE TO WORD PROCESSING. the editors of *Consumer Guide*. New York: Beekman House. 1984: 96 pages. 20.5 by 27.5 cm. spiral-bound. ISBN 0-517-39869-9. \$3.98.
- EVERYONE'S GUIDE TO BASIC. the editors of *Consumer Guide*. New York: Beekman House. 1984: 80 pages. 21 by 27.5 cm. spiral-bound. ISBN 0-517-41594-1. \$4.98.
- GAMES ATARIS PLAY. Hal Glicksman and Kent Simon. Chatsworth, CA: Datamost. 1983: 224 pages. 22.3 by 27.8 cm. spiral-bound. 0-88190-118-0. \$14.95.
- GRAPHICS PROGRAMMING ON THE IBM PERSONAL COMPUTER. J. Edward Volkstorf Jr. Englewood Cliffs, NJ: Prentice-Hall. 1984: 304 pages. 17.3 by 23.3 cm. softcover. ISBN 0-13-363219-9. \$39.95.
- HIVELY'S CHOICE. Wells Hively. St. Louis, MO: Hively's Choice Publications. 1984: 244 pages. 21.5 by 27.8 cm. softcover. ISBN 0-8454-8100-2. \$19.95.
- THE IBM COBOL ENVIRONMENT. Robert T. Grauer. Englewood Cliffs, NJ: Prentice-Hall. 1984: 400 pages. 18.3 by 24.3 cm. hardcover. ISBN 0-13-448654-4. \$21.95.
- IBM PC BASIC PROGRAMMING. Richard Haskell and Glenn A. Jackson. Englewood Cliffs, NJ: Prentice-Hall. 1984: 192 pages. 21.5 by 27.8 cm. softcover. ISBN 0-13-448424-X. \$13.95.
- IBM PCir FAVORITE PROGRAMS EXPLAINED. Donald C. Kreutner. Indianapolis, IN: Que Corp.. 1984: 208 pages. 18.5 by 23.5 cm. softcover. ISBN 0-88022-102-X. \$12.95.
- INVESTING WITH A COMPUTER. Herb Brooks. Princeton, NJ: Petrocelli Books. 1984: 148 pages. 14.4 by 21.3 cm. hardcover. ISBN 0-89433-194-9. \$19.95.
- KIDS AND THE IBM-PC / PCir. Edward H. Carlson. Chatsworth, CA: Datamost. 1983: 240 pages. 22.3 by 27.3 cm. spiral-bound. ISBN 0-88190-265-9. \$19.95.
- KIDS TO KIDS ON THE COMMODORE 64. Sam Edge. Billy Sanders. and Kris Houser. Chatsworth, CA: Datamost. 1983: 160 pages. 27.3 by 20.8 cm. softcover. ISBN 0-88190-320-5. \$9.95.
- KIP'S ARMOR. Jay Danler. Twin Cities, MN: Treasure Hunters International. 1983: 108 pages. 13.8 by 21.5 cm. softcover. ISBN 0-916167-00-3. \$11.95.
- A LIBRARY OF SUBROUTINES. David S. Walonick. Glenview, IL: Scott, Foresman and Co.. 1984: 128 pages. 18.5 by 23.5 cm. softcover. ISBN 0-673-15965-5. \$19.95.
- MICOS: A MICROPROGRAMMABLE COMPUTER SIMULATOR. Lubomir Bic. Rockville, MD: Computer Science Press. 1984: 128 pages. 15.3 by 22.5 cm. softcover. ISBN 0-914894-76-5. \$15.95.
- MS-DOS USER'S GUIDE. Chris DeVoney. Indianapolis, IN: Que Corp.. 1984: 350 pages. 18.8 by 23.5 cm. softcover. ISBN 0-88022-061-9. \$12.95.
- MAKING THE MOST OF YOUR TRS-80 COLOR COMPUTER. Peter Vernon. Englewood Cliffs, NJ: Prentice-Hall. 1983: 200 pages. 15 by 23 cm. softcover. ISBN 0-13-547647-X. \$19.95.

.....
THIS IS A LIST of books recently received at BYTE Publications. The list is not meant to be exhaustive, its purpose is to acquaint BYTE readers with recently published titles in computer science and related fields. We regret that we cannot review or comment on all the books we receive; instead, this list is meant to be a monthly acknowledgment of these books and the publishers who sent them.

MASTERING dBASE II THE EASY WAY. Paul W. Heiser. Englewood Cliffs, NJ: Prentice-Hall, 1984; 240 pages. 21.3 by 28 cm. spiral-bound. ISBN 0-13-559626-2. \$14.95.

MATHEMATICS FOR COMPUTER PROGRAMMERS. Christine Benedyk Kay. Englewood Cliffs, NJ: Prentice-Hall, 1984; 416 pages. 18.3 by 24.3 cm. hardcover. ISBN 0-13-562140-2. \$24.95.

MICROCOMPUTER TOOLS FOR COMMUNICATIONS ENGINEERING. Shing Ted Li, John W. Rockway, James C. Logan, and Daniel W. S. Tam. Dedham, MA: Artech House, 1983; 278 pages. 21.3 by 28 cm. spiral-bound. ISBN 0-89006-132-7. \$50.

THE MICROCOMPUTER USERS HANDBOOK 84. Dennis Longley and Michael Shain. New York: John Wiley & Sons, 1983; 336 pages. 20.8 by 29.5 cm. softcover. ISBN 0-471-80436-3. \$39.95.

MICROCOMPUTERS FOR LAWYERS. J. Stewart Schneider and Charles E. Bowen. Blue Ridge Summit, PA: Tab Books, 1983; 128 pages. 18.8 by 23.5 cm. softcover. ISBN 0-8306-0614-9. \$14.50.

MICROPROCESSOR OPERATING SYSTEMS. VOL. III. John Zarrella, ed. Fairfield, CA: Microcom-

puter Applications, 1984; 160 pages. 15.3 by 22.8 cm. softcover. ISBN 0-935230-10-6. \$12.95.

MICROPROCESSORS: HARDWARE, SOFTWARE, AND DESIGN APPLICATIONS. Wunnara V. Subbarao, Ph.D. Reston, VA: Reston Publishing Co., 1984; 365 pages. 18 by 24.5 cm. hardcover. ISBN 0-8359-4394-1. \$27.95.

THE MODEL 100 BOOK. Jonathan Erickson and Robert J. Sayre. Berkeley, CA: Osborne/McGraw-Hill, 1984; 336 pages. 16.3 by 23.3 cm. softcover. ISBN 0-88134-124-X. \$17.95

THE MODEL 100 COMPANION, the editors of Osborne/McGraw-Hill. Berkeley, CA: Osborne/McGraw-Hill, 1984; 150 pages. 20.5 by 27.5 cm. softcover. ISBN 0-88134-122-3. \$15.95.

MUSIC AND SOUND FOR THE COMMODORE 64. Bill L. Behrendt. Englewood Cliffs, NJ: Prentice-Hall, 1984; 192 pages. 15 by 22.8 cm. softcover. ISBN 0-13-607094-9. \$14.95.

PARADIGMS AND PROGRAMMING WITH PASCAL. Derick Wood. Rockville, MD: Computer Science Press, 1984; 440 pages. 15.5 by 23.5 cm. hardcover. ISBN 0-914894-45-5. \$25.95.

PASCAL. Geneva G. Belford and C. L. Liu. New York: McGraw-

Hill, 1984; 352 pages. 18.5 by 23.5 cm. softcover. ISBN 0-07-038138-0. \$19.95.

PASCAL APPLICATIONS FOR THE SCIENCES. Richard E. Crandall. New York: John Wiley & Sons, 1984; 256 pages. 17.3 by 25.3 cm. softcover. ISBN 0-471-87242-3. \$14.95.

PASCAL FOR PROGRAMMERS. Olivier Lecarme and Jean-Louis Nebut. New York: McGraw-Hill, 1984; 288 pages. 16 by 23.5 cm. hardcover. 0-07-036958-5. \$22.95.

PRODUCING USEFUL KNOWLEDGE FOR ORGANIZATIONS. Ralph Kilman. New York: Praeger Publishers, 1983; 750 pages. 16 by 24 cm. hardcover. ISBN 0-03-063199-8. \$49.95.

PROFIT FROM THE IBM. Dan Post. Arcadia, CA: Edge Press, 1984; 192 pages. 16 by 23.8 cm. hardcover. ISBN 09-11160-89-2. \$17.95.

PROTECTING YOUR MICROCOMPUTER. Harold Joseph Highland. New York: John Wiley & Sons, 1984; 274 pages. 17 by 25 cm. softcover. ISBN 0-471-89216-5. \$14.95.

P-SOURCE: A GUIDE TO THE APPLE PASCAL SYSTEM. Randall Hyde. Chatsworth, CA: Datamost, 1983; 463 pages. 13.3

by 20.9 cm. softcover. ISBN 0-88190-004-4. \$24.95.

REINVENTING MAN. Igor Aleksander and Piers Burnett. New York: Holt, Rinehart & Winston, 1984; 304 pages. 15.8 by 23.5 cm. hardcover. ISBN 0-03-063857. \$17.95.

SCIENTIFIC PASCAL. Harley Flanders. Reston, VA: Reston Publishing, 1984; 580 pages. 17.3 by 23.5 cm. softcover. ISBN 0-8359-6931-2. \$21.95.

SOFTWARE AUTHOR'S GUIDE. Mildred A. Heiney. Chatsworth, CA: Datamost, 1983; 208 pages. 21 by 27.8 cm. softcover. ISBN 0-88190-235-7. \$19.95.

THE SOFTWARE GUIDE. IBM PERSONAL COMPUTER & XT. Gerald VanDiver. Prior Lake, MN: Micro Information, 1983; 1024 pages. 21 by 27.5 cm. softcover. ISBN 0-912603-00-3. \$49.95.

STRUCTURED PROGRAM DESIGN WITH TRS-80 BASIC. Thomas Dwyer and Margot Critchfield. New York: McGraw-Hill, 1984; 352 pages. 21.5 by 27.8 cm. softcover. ISBN 0-07-018493-3. \$17.95.

33 ADULT COMPUTER GAMES IN BASIC. David W. Chance. Blue Ridge Summit, PA: Tab Books, 1983; 504 pages. 13 by 21 cm. softcover. ISBN 0-8306-1627-6. \$13.50. ■

BYTE COVERS

The prints shown at left are beautiful Collector Edition Byte Covers, strictly limited to 750 prints each, and signed and numbered by the artist, Robert Tinney. Each print is 18 in. x 22 in., and is accompanied by its own Certificate of Authenticity. To order, use the coupon below. Visa and MasterCard orders may call 1-504-272-7266.



Through the Trap Door
March 1979—\$35



Breaking the Sound Barrier
September 1977—\$35

Please send _____ Through the Trap Door prints (\$35), _____ Breaking the Sound Barrier prints (\$35), or _____ sets of both prints (\$55). I have included \$3 per order shipping and handling (\$8 overseas).

I have enclosed check or money order.
 Please send me your color brochure.

Robert Tinney Graphics • 1864 N. Pamela Dr. • Baton Rouge, LA 70815

Visa MasterCard
 Card No. _____
 Expires: _____
 Name: _____
 Address: _____
 City: _____
 State: _____ Zip: _____



Herbie Briggs has just destroyed the myth that all floppy discs are created equal.

They seem equal. Until you look at the seams.

That's where equality ends.

Most companies seal their discs with a spot here, a spot there. Leaving most of each seam not sealed at all.

Sooner or later, the seams might do what comes naturally: they bulge. Warp. Pucker. Open up.

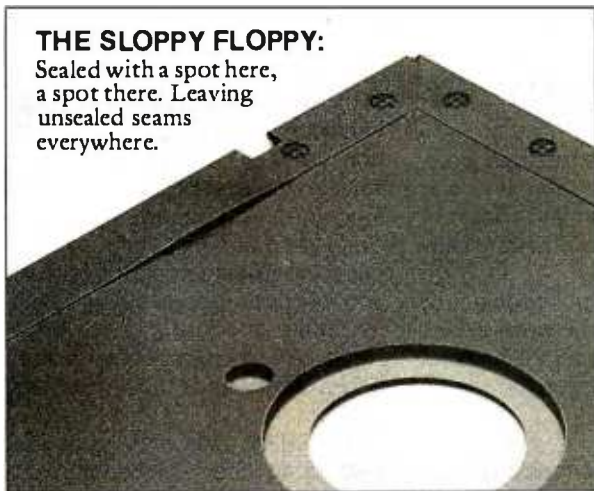
Pens, pencils, fingernails—even a four-year-old's, like Herbie—can catch and snag in those wide open spaces.

That's sloppy. And dangerous. Because if you put a sloppy floppy into your disc drive, it can jam your drive. Ruin your drive head. Lose your data.

So much for their seams. Ours are different.

THE SLOPPY FLOPPY:

Sealed with a spot here, a spot there. Leaving unsealed seams everywhere.



Memorex uses a process we developed, called Solid-Seam Bonding.

Solid-Seam Bonding seals shut every inch of every seam of every Memorex* floppy disc. Tight as a drum. That makes the Memorex

floppy stiffer. Stronger. And your data safer.

To resist bulging, warping, puckering, or opening up.

MEMOREX SOLID-SEAM BONDING:

Every inch of every seam is sealed shut. Tight as a drum.



To resist all the things that can jam your drive, ruin your drive head, or lose your data.

Which proves that a Memorex floppy disc isn't equal to all the others. It's better.

Solid-Seam Bonding is just one example of the extra care that goes into every Memorex floppy disc. Be it 8" 5¼" or the new 3½" Extra care that lets us guarantee every Memorex disc to be 100% error-free.

The next time you're buying a floppy disc—or a few hundred of them—just remember this:

It's always better to be safe than sloppy.

For more information on the full line of Memorex quality computer media products, including computer tape, call toll-free: 800-222-1150. In Alaska and Hawaii call collect: 408-987-2961.



Your Data. When it matters, make it Memorex.™

MEMOREX

Memorex is a registered trademark of Memorex Corporation.

©1984 Memorex Corporation
A Burroughs Company

Circle 195 on inquiry card.

AUGUST 1984 • BYTE 427

UCSD PASCAL VS. MODULA-2

A DISSENTING VIEW

BY DAVID V. MOFFAT

*A comparison between the old "extended"
and the new "standard"*

SEVERAL ARTICLES have shown how Modula-2 is an improvement over Standard Pascal (see references 2 and 4). Other articles describe some of Modula-2's imperfections and major trouble spots (see reference 3). In this article, I will endeavor to show how UCSD Pascal is superior to Modula-2 in many ways.

Like Modula-2, UCSD Pascal is a Pascal derivative designed for general-purpose and systems programming. The two languages are about the same size—that is, they have the same number of symbols, identifiers, and statements. Both support type-checked separate compilation, procedure libraries, concurrent programming, low-level I/O (input/output) handling, interrupt handling, and many other kinds of programming. But they have major differences as well.

SPELLING

One of the seemingly trivial, but irritating, facts about Modula-2 is that spellings are case sensitive. This means that "Number," "number," and "NUMBER" are all different words. Therefore, to read a program aloud verbatim is im-

possible, that is, to *talk* about a program accurately. Two examples follow:

```
WHILE SYM = while DO ...
IF N < N THEN ...
```

Note that WHILE is a reserved word, but While is not. Worse, there is no way to predict how the standard names or another programmer's names are capitalized.

UCSD Pascal solves this problem by making no distinctions between the uppercase and lowercase spellings of words, just like any dictionary.

TYPES

Modula-2 lacks several types that are used constantly in general-purpose programming.

First, this language has no varying-length string type as found in UCSD Pascal (and many other languages). While varying-length strings can be simulated and included in a library of routines for future use, this solution is only a half measure. The advantages of

David V. Moffat is an instructor of computer science at North Carolina State University in Raleigh, North Carolina 27650.

having them designed into the language are many; they are available by default, they are highly efficient, and the compiler allows them to have special behaviors. For example, the string functions in UCSD Pascal can return string values (unlike programmer-defined functions), and some string functions can accept varying numbers of parameters. Programmer-defined procedures and functions are not nearly as easy to use. Unlike Modula-2, UCSD Pascal accepts a single-character literal as either a character or as a single-character string.

The CHAR type in Modula-2 is restricted to the 128 standard ASCII (American National Standard Code for Information Interchange) values, thereby defining away almost all the special values used for graphics and special fonts. UCSD Pascal accepts all 256 character values.

UCSD Pascal also provides a long integer type, with up to 36-digit accuracy. Long integers are used in applications that require exact-precision arithmetic, such as financial calculations. This type, and operations upon it, can be simulated in Modula-2, but UCSD Pascal per-

mits the use of the simpler standard operations, DIV, +, -, and *, and defines conversions between long integers and other types.

Modula-2 sets are defined to be small, but their exact size is not defined. In programming, one of the most convenient sets is a set of character values, used quite often in any kind of text processing. However, Modula-2's sets are too small for this application. UCSD Pascal's sets can contain 4088 elements, enough for a wide variety of range-checking and value-testing applications.

UCSD Pascal lets you "pack" any structured variable into as little space as necessary to contain it. These compact data structures save disk space and are useful in systems programming. Packing is not available in Modula-2.

Taken together, these characteristics make it apparent that UCSD Pascal provides a richer selection of useful types for the demands of programming in a variety of real-world applications.

INPUT AND OUTPUT

Input and output in Modula-2 is the most tedious of any language, except perhaps assembly languages without macros. All of the convenient I/O procedures that you would normally use in almost all of your programs are missing. Whereas in UCSD Pascal the READ procedure can be used to read any number of values of any single-valued or string type, Modula-2 has the procedures Read (a character), ReadString, ReadInt, ReadReal, ReadCard, and so on. Each procedure can read only one value of the type implied by its name. Standard output (Write) is similar. In UCSD Pascal one could use

```
WRITELN('The ', N, ' cars average ',
        W:8:2, ' pounds.');
```

but Modula-2 would require

```
WriteString('The ');
WriteInt(N, 1);
WriteString(' cars average ');
WriteReal(W, 8, 2);
WriteString(' pounds.');
```

(and, of course, the procedures must be capitalized exactly as shown).

Most of the procedures used to do standard input and output in UCSD Pascal also apply to files of programmer-defined types (sometimes called

record files in other languages). These files can therefore be handled in a similar and familiar fashion. In Modula-2, I/O procedures for such files must be custom programmed.

Interestingly, UCSD Pascal also provides the low-level I/O operations that Modula-2 provides. In all, UCSD has 26 I/O procedures, functions, and so on, which do more for the programmer than Modula-2's 46 I/O operations. UCSD Pascal also provides more support for interactive I/O and graphics.

Overall, convenient I/O took a big step backward in Modula-2. UCSD Pascal's I/O routines, joined with its greater variety of types, make it a much better general-purpose language.

SEPARATE COMPILATION

Though both languages support separate compilation, UCSD Pascal does it in a simpler fashion than Modula-2. In both languages, groups of related declarations and procedures can be packaged into a module, compiled as a single unit, and saved on disk as part of a "library" of precompiled packages. Programs can then use these packages of declarations and procedures as if they were built into the language. These packages are called modules in Modula-2 and units in UCSD Pascal.

In both languages two parts compose each module or unit—an interface that shows how to use the procedures and the implementation. The major difference between the languages is in how these parts are stored. In Modula-2 the interface is stored in a source file, then compiled into an object file; the implementation is stored in another source file and compiled into another object file—a total of four files. In UCSD Pascal, the interface and implementation are in the same source file, which is compiled into a single object file. Half as many files are used. UCSD Pascal lets the operating system keep track of the various parts, the ordinary function of operating systems.

The UCSD Pascal units are also easier to understand and maintain because both parts can be edited at the same time.

DEVELOPMENT ENVIRONMENT

The languages differ in many other ways, but those discussed above are the most important ones. However, other

factors must be considered when comparing languages—factors that determine how the programmer gets his or her work done. One such consideration is the language's environment.

UCSD Pascal comes embedded in the UCSD p-System operating system, a complete development, production, and maintenance environment. The p-System includes compilers, an assembler, an editor, a linker, a file manager, an execution monitor, a print spooler, a large set of utilities and software tools, and a large library of precompiled units for screen handling, graphics, and other applications. The languages and system commands are integrated into a unified whole.

Modula-2 comes with a compiler, a linker, an execution monitor, and a set of standard modules (these modules support features that are built into UCSD Pascal). Modula-2 has few, if any, software tools and no utilities. Editing and file handling must be done catch-as-catch-can using the existing operating system. Therefore, the environment is not integrated at all.

The run-time environment provided by the UCSD p-System is available for many computers for as little as \$50. Because UCSD Pascal programs are entirely portable with respect to this environment, programs written on one system can be run on every major microcomputer. The portability of Modula-2 programs is still very limited; they have too few implementations.

Because the UCSD operating system is such a good development environment, one version of Modula-2 (by Volition Systems) has been embedded in a UCSD system, but it is an older version, not the portable p-System.

In any case, a language cannot stand on its own: its environment is an important factor in its usability.

DOCUMENTATION

Setting aside differences in language and development environments, to use a language successfully you have to learn it and understand what has already been done with it. These factors are yet two more ways in which UCSD Pascal is an "improvement" over Modula-2.

In the first place, UCSD Pascal is an extended Pascal; Modula-2 is not. If you

(continued)

HALF PRICE

Swivel Monitor Base

List \$49.⁰⁰ ~~Your Cost \$35.⁰⁰~~

NOW ONLY \$24.50

- Swivels 300 Degrees
- Fits up to 12.5" Diagonals
- Fits Down to 5" Diagonals
- Made of ABS Plastic, Firm & Durable
- Matches any Brand or Color Monitors
- Free Shipping and Handling in Continental U.S.

Order Toll Free 1-(800) 821-5339 or Call 1-(801) 298-0872
 or Rush Check or Money Order To: C. R. E. Wholesale
 P. O. Box 361 North Salt Lake, Utah 84054



1984

Circle 87 on inquiry card.

RIBBONS

Ribbon Type (Prices per ribbon)

Ribbon Type	6	12
C. Itoh Prowriters	5.30 ea.	4.46 ea.
Epson/IBM FX/RX/MX-80	5.14 ea.	4.10 ea.
Epson/IBM FX/RX/MX-100	6.74 ea.	5.45 ea.
Gemini 10/10X/15/15X	2.50 ea.	2.00 ea.
Okidata 80/82/83/92/93	2.50 ea.	2.00 ea.
Anadex Apple Centronics Dec Diablo IDS NEC Cume	2.50 ea.	2.00 ea.

Shipping & Handling in Continental U.S. Free for over 50.00 order

Order Toll Free 1-(800) 821-5339 or Call 1-(801) 298-0872

or Rush Check or Money Order To: C. R. E. Wholesale

P. O. Box 361 North Salt Lake, Utah 84054

1984

Circle 88 on inquiry card.

maxell

5 1/4" Soft Sector Diskettes

MD1 SS/DD... List 39.⁹⁵ ~~Your Cost 25.⁰⁰~~

NOW ONLY 19.⁹⁵ per box of 10

MD2 DS/DD... List 71.⁰⁰ ~~Your Cost 45.⁰⁰~~

NOW ONLY 35.⁵⁰ per box of 10

Call or Write for Excellent Quantity Discounts!

Free shipping in Cont. U.S. for orders over \$50.⁰⁰ or add \$3.⁰⁰

Order Toll Free 1-(800) 821-5339 or Call 1-(801) 298-0872

or Rush Check or Money Order To: C. R. E. Wholesale

P. O. Box 361 North Salt Lake, Utah 84054

Circle 89 on inquiry card.

TECHNICAL FORUM

A new language is not necessarily more advanced than its predecessors

already know Standard Pascal, you already know much of UCSD Pascal.

More to the point, many good texts, references, and tutorials are available for UCSD Pascal alone. In addition, more than 100 other Pascal texts and books have been written. These books exhibit algorithms and working programs for business, games, graphics, operating systems, software tools, database management, and so on. More than 90 percent of this material applies to UCSD Pascal. By contrast, there are very few books on Modula-2 and even fewer texts.

Even if all else were equal, getting down to serious work using UCSD Pascal is possible much sooner than with Modula-2.

SUMMARY

I have presented UCSD Pascal almost as if it were a "successor" to Modula-2. In fact, Modula-2 was designed chronologically later than UCSD Pascal. My point was to show that a new language is not necessarily more advanced than its predecessors. In fact, UCSD Pascal is a positive step in the evolution of "living" Pascal (as opposed to Standard Pascal which, like Latin, is unchanging and therefore dead). Modula-2, on the other hand, is another language altogether, even if Pascal-like. (Ada, Euclid, Mesa, Edison, and many other languages are also Pascal-like.)

Between the publications of the first Pascal report and the first Modula-2 report, hundreds of papers were written on Pascal, many of which pointed out its deficiencies and offered ways to improve it. When Wirth designed Modula-2, he ignored most of that advice, even though much of it came from experienced critics and users of programming languages. He was obviously not so interested in improving Pascal as in designing another language for an entirely different application area. That was his decision. But it is not intellectually honest for persons promoting Modula-2 to claim that it is "the" suc-

cessor to Pascal (it is not), or that it solves all of Pascal's problems (it does not).

At the same time, users of Modula-2 can either rejoice or be wary that Wirth and others are trying to avoid having Modula-2 suffer the same fate as Pascal—what the orthodox would call undisciplined changes and extensions to the language. In reality, such modifications are part of a process of evolution in response to real and perceived needs. To have anything in computing nailed down long enough to become comfortable with it is a luxury. But computing marches on: if we are not going forward, then we are standing still, and if we are standing still, then we are falling behind. Standard Pascal is nailed down; will Modula-2 be nailed down also?

Thus, when Modula-2 is looked at as a candidate for a long-term language commitment for systems programming on microcomputers, it is a big improvement (in many ways) over much older languages. It is not very remarkable in comparison to other modern languages. Although Modula-2 implementations and environments are likely to improve, even as the language remains unchanged, if commitment to a language is necessary, then UCSD Pascal, already a mature and well-supported product, is probably a better choice in terms of better business sense.

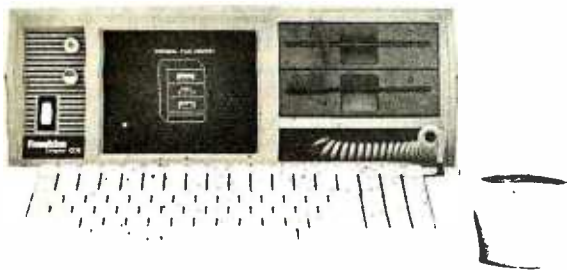
On the other hand, in the perspective of ongoing developments in computing, Modula-2 is just an interestingly different—and imperfect—stepping-stone along the way, frozen in time and space. We should pause to admire it, but it is not the end of the road. We must reconcile ourselves to the insecurity of constant change. That is what progress is about. ■

REFERENCES

1. Jensen, K., and N. Wirth. *Pascal-User Manual and Report*. 2nd ed. New York: Springer-Verlag, 1978.
2. Johnson, M. C., and A. Munro. "Pascal's Design Flaws: Modula-2 Solutions and Pascal Patches." *BYTE*, March 1984, page 371.
3. Spector, D. "Ambiguities and Insecurities in Modula-2." *SIGPLAN Notices*, volume 17, number 8, 1982, page 43.
4. Sumner, R. T., and R. E. Gleaves. "Modula-2—A Solution to Pascal's Problems." *SIGPLAN Notices*, volume 17, number 9, 1982, page 28.
5. Wirth, N. *Programming in Modula-2*. 2nd ed. New York: Springer-Verlag, 1983.

NEW SYSTEMS

Portable Computer Line from Franklin



Franklin Computer Corporation recently introduced a line of portable computers. The CX Series is made up of four models, each incorporating 64K bytes of RAM, the Franklin Office Manager integrated software package, and Franklin DOS. Advanced models are available with CP/M and MS-DOS.

Franklin DOS is an Apple-compatible operating system that uses a minimal amount of ROM memory and boots the operating system, language, or utility software into RAM on an as-needed basis under operator control. When not using BASIC, Franklin DOS

provides an additional 12K bytes of memory.

The Franklin Office Manager integrates word processing, spreadsheet, graphics design, and a spelling checker. It uses icon-type prompting aids and an 80-column display (70 columns for graphics).

The CX Series unit measures 15% by 16% by 6% inches and weighs approximately 25 pounds. It includes color capabilities and a high-resolution monitor. Its 86-key detachable keyboard has 10 programmable function keys, numeric keypad, WordStar-compatible control keys, uppercase/lowercase, and LED indicators for cap- and

numeric-lock keys.

Interface ports are supplied for Centronics-parallel or RS-232C serial printers. An RS-232C, external composite-video, and miscellaneous (DB9) port are standard equipment. The 7-inch green-phosphor monitor has brightness and contrast controls, blink and reverse video, and a 192- by 280-pixel resolution.

Options include a 110/300-bps modem, a carrying case, MS-DOS memory upgrades to 256K bytes, peripheral card brackets, keyboard templates, and a technical reference manual.

The CX-1 is a single-disk-drive computer that sells for \$1395. The dual-drive CX-2 is \$1695. Including CP/M, WordStar, and 64K bytes of additional RAM, the CX-2C is \$1995. The top-of-the-line CX-2M is \$2295, which includes 128K bytes of additional memory, WordStar, and MS-DOS. Contact Franklin Computer Corp., 1070 Busch Memorial Highway, Pennsauken, NJ 08110, (609) 488-0600. Circle 610 on inquiry card.

Computer Derived from Micro/PDP-11

The CI-Micro-11 from Chrislin Industries is derived from DEC's Micro/PDP-11 computer. It permits upward expandability and is available in a variety of configurations.

The CI-Micro-11 can use LSI-11/23+ or LSI-11/73 central processors. Winchester-disk storage capacities range from 10 to 40 megabytes, and emulation on the Winchesters is RL02, RL01, and RD51. Each CI-Micro-11 comes with dual floppy-disk backup. Floppy disks are available in RX50 (800K bytes) or RX02 (2 megabytes).

The CI-Micro-11 operates under existing software and diagnostics without modifications. Emulators permit software-transparent operation under RSTS-E, RSX11M, RSX11M+, RT11, and UNIX.

A rack-mounted CI-Micro-11 is \$6850. Vertical floor mount is available. For more information, contact Chrislin Industries Inc., 31352 Via Colinas #101, Westlake Village, CA 91362, (818) 991-2254. Circle 611 on inquiry card.

Apple- and CP/M-Compatible Portable

An Apple- and CP/M-compatible portable computer, the Alex 500A is available for \$2495. The Alex has dual Z80 and 6502 microprocessors, 64K bytes of RAM, four expansion slots, twin disk drives, and a speaker. It has built-in disk and printer interfaces and a single RS-232C serial, a parallel, external-monitor, and game ports. Alex's keyboard is detachable and equipped with a numeric keypad and uppercase/lowercase capabilities.

This computer weighs 18 pounds and measures 15 by 14 by 5 inches. Contact Comp-U-Save, Turtle Creek, POB 1300, Skyland Park, NC 28776, (704) 274-3003.

Circle 612 on inquiry card.

Slave Boards and Module Create Multiuser PC

Alloy Computer Products' PC-Plus family of hardware and software products lets you build a multiuser system with inexpensive terminals. Alloy says that the cost of the PC-Plus scheme approaches half that of competitive offerings.

Alloy's approach is based on the assumption that you have already made your investment in a microcomputer. By plugging one of Alloy's PC-Slave boards directly into a personal computer expansion slot and adding a terminal, you have created a two-user system, complete with shared disk drives and printer.

Up to 12 users can be accommodated with Alloy's PC-XBUS expansion module, which plugs directly into the host's expansion slot and houses a mix of

8- and 16-bit processors. With three PC-XBUS modules, as many as 30 processors can share data, software, and peripherals under the tutelage of the host computer.

The PC-Plus is faster than most computers and nearly twice as fast as an IBM PC, according to Alloy. The PC-Slave/16 board includes an 8-MHz 8088 processor, 256K bytes of RAM, and two serial ports. The PC-Slave/8 has a 6-MHz Z80B, 128K bytes of RAM, and two serial ports. High-speed band switching provides bus-speed host/slave transfers of 64K bytes. The serial ports, which serve as an interface to the user's terminal, have programmable rates up to 19,200 bps.

The PC-Plus operates under

Alloy's PC-RTNX executive, which deploys system resources and provides file/record locking with controls to manage file access. It emulates the functions of such black-and-white terminals as the DEC VT-100/200 series and Televideo 925. It supports PC-DOS, MS-DOS, and Concurrent CP/M for the PC-Slave/16 processors and CP/M for the PC-Slave/8. Software support includes Lotus 1-2-3, WordStar, and dBASE II.

Single-unit prices are \$1195 for the PC-Slave/16 and \$995 for the PC-Slave/8. The PC-XBUS is \$1495. For more information, contact Alloy Computer Products Inc., 100 Pennsylvania Ave., Framingham, MA 01701, (617) 875-6100.

Circle 613 on inquiry card.

(continued)

PERIPHERALS

Quadram's Quadmodem Line

Quadram has introduced a line of modems for Apple, IBM PC, and other popular microcomputers. Available in both stand-alone and integral models, the intelligent Quadmodem operates at either 300 or 1200 bps. Its diagnostic capabilities tell you whether a communications problem is occurring with the modem, the transmission over telephone lines, or the remote modem.

QuadTalk, a menu-driven communications software package, provides the Quadmodem with such features as auto or manual dial, auto or manual answer, AT&T 212A/103 compatibility, electronic call progress detection (i.e., dial, busy, ring back, data-carrier tone, and human voice), auto-speed selection, and auto parity. Tone or rotary-pulse dialing can be automatically selected or command specified.

The Quadmodem is compatible with most modems. The stand-alone version is \$695, and the integral card for the IBM PC is \$595. Contact Quadram Corp., 4355 International Blvd., Norcross, GA 30093, (404) 923-6666.

Circle 614 on inquiry card.

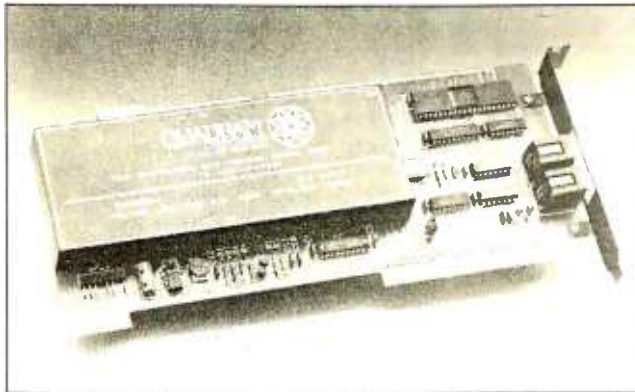
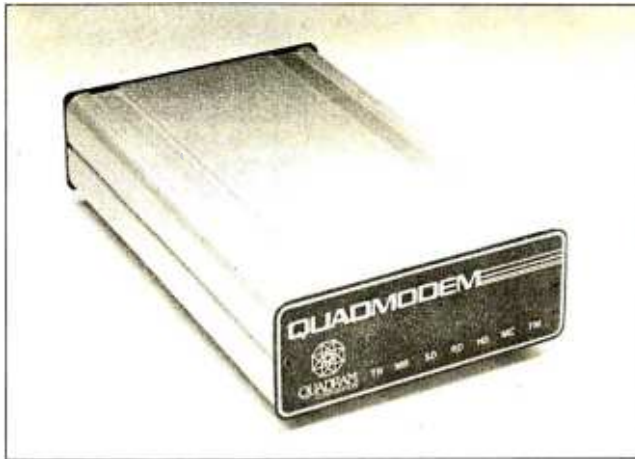


Image Processors for Personal Computers

The Computer Research Company's Oculus-100 and Oculus-200 are image-processor boards for the IBM PC or PC compatibles.

The Oculus-200 is a high-performance board incorporating such features as a real-time 30-frame-per-second video digitizer and 256K bytes of memory. With its on-board video output, you can display processed images on an auxiliary monitor and use graphic overlays and vectoring. It transforms images received from any standard video camera into a 512- by 512-pixel array with 128 shades of gray. The Oculus-200 lists for \$1995.

The Oculus-100, suitable for applications where a real-time binary system is required, digitizes a television image into a 512- by 512-pixel black-and-white array that can be processed by your personal computer and displayed in low resolution. The \$695 Oculus-100 has 32K bytes of memory.

Each board comes with menu-driven imaging software, cable, and manual. Dedicated software for a variety of applications is available. Contact The Computer Research Co., 547 St. Thomas, Longueuil, Quebec J4H 3A7, Canada, (800) 361-4997; in Canada, (514) 651-2919. Circle 616 on inquiry card.

Modem for Osborne

The CTS OE-1 for the Osborne Executive is a full-duplex, 300-bps AT&T 1031-compatible modem. It comes with Mycroft Labs' Myterm communications package.

The OE-1 lets the Osborne emulate an intelligent terminal with text- and binary-file transfer capabilities. It has auto answer, auto dial, asynchronous operation, and a direct-connect telephone link.

The price is \$129, plus \$6 shipping. Contact Modem Sales, CTS Datacomm Products, POB 320, Sandwich, IL 60548, (815) 786-8411.

Circle 617 on inquiry card.

Videodisc Interface

Orenda's LaserLynx 100 controls all your videodisc's functions, and it can switch the video source between your computer and videodisc player. It's compatible with Apple, Atari, and Commodore computers, and it interfaces with most videodisc players. Support software is available. The list price is \$99.95. Contact Orenda Inc., 3754 Overland Ave., Los Angeles, CA 90034, (213) 202-0770.

Circle 615 on inquiry card.

Hard Disk and Hard-Disk Boot Chip

Falcon Technology has added a 30-megabyte unit to its PC eXTender line of IBM PC hard-disk drives and a ROM chip that boots PC-DOS directly from hard disk.

The 30-megabyte eXTender features a clock/calendar, a serial port, and sockets on the hard-disk controller board for up to 192K bytes of RAM. A voice-coil positioner in the drive has decreased the data-access time to 45 milliseconds; the 30-megabyte PC eXTender can read 1 megabyte of data from the disk every 3 seconds. Complete with software backup utilities and an enclosure that complements the IBM PC, the 30-megabyte PC eXTender is \$3995.

The boot chip, designed for all PC eXTenders, eliminates the need to use floppy disks to load the disk operating system into the PC's main memory. It plugs into an empty socket on the IBM PC system board.

Present owners of the PC eXTender can upgrade their systems with the ROM chip for \$15. The chip is included with all eXTenders shipped after June 1. Contact Falcon Technology Inc., Suite T-101, 6644 South 196th St., Kent, WA 98032, (800) 722-2510; in Washington, (206) 251-8282.

Circle 618 on inquiry card.

ADD-INS

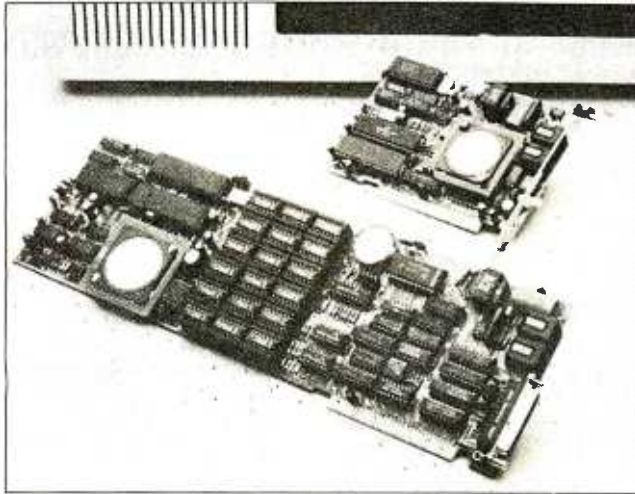
Auto-Dial Modems for IBM PC

The Personal Communicator line of integral modems from U.S. Robotics is designed for the IBM PC, PC XT, and IBM PC compatibles. Available in three configurations, each Personal Communicator modem provides data-transmission capabilities of 300 and 1200 bps. Two of the modems have usable RAM, a battery-backed real-time clock, and a parallel interface. The Personal Communicator, which is AT&T 103/212A-compatible, slides into any available PC expansion slot.

The basic Personal Communicator is an auto-dial, auto-answer asynchronous modem featuring automatic speed-detect, audio telephone-line monitor, volume control, programmable commands, two RJ11C telephone jacks, telephone cord, a manual, and the Telpac communications software package.

Telpac lets you use the Personal Communicator to automatically or manually call another computer, and it allows a remote computer to enter your system. It provides password protection and the ability to create graphics to be viewed by the receiver. An unlimited number of telephone numbers can be stored and automatically dialed. Each phone number can be assigned such options as data rate, parity, full- or half-duplex, a log-on sequence, and tone- or rotary-pulse dialing. Telpac also automatically redials busy numbers and has four types of protocols, including "MODEM" and user-defined protocols. Other features are automatic error detection and two types of block checks.

The enhanced Personal Communicators come with 64K or 256K bytes of RAM and a parallel port. They are priced at \$699 and \$999, respectively. The basic model is \$499. For more information, contact U.S. Robotics Inc., 1123 West Washington Blvd., Chicago, IL 60607, (312) 733-0497. Circle 619 on inquiry card.



Speech Synthesizers Use SC-02 Chip

The Voice Box 3 line of speech synthesizers from the Alien Group comes in versions for the Apple II and any computer with an RS-232C serial port. Each unit features an SC-02 (i.e., SSI 263) speech chip, software, and an external speaker. All have unlimited vocabularies and can speak with male or female voices with variable speed and loudness in response to commands added to the text.

The software produces speech directly from English text, adding inflection either automatically or under user direction. Voice Box 3 uses punctuation, word length, and other clues, such as word endings, to assign stress. In an alternate mode, you can control intonation by inserting numbers that represent pitch changes into the text. It is not necessary to mark syllable boundaries or resort to phoneme spelling when adding intonation.

The Voice Box 3m plugs into any Apple slot and works with BASIC or assembly-language programs. The speaking program, which occupies less than 5K bytes of memory, comes on

disk and is loaded into memory. It produces a high-resolution face, which moves its mouth in synchronization with the spoken word.

Voice Box 3i, also for the Apple, is configured as an intelligent peripheral. You can use the Voice Box 3i with word processors and report generators. The card contains the text-to-speech program in ROM, a 1.5K-byte buffer, and a micro-processor that allows it to speak while the Apple works on another task.

The Voice Box 3s connects to any computer through a standard RS-232C interface. It's configured as a bus, which lets it share a single port with other devices. The host computer sends English text to the 3s, which accumulates the text until it is instructed to speak.

The Voice Box 3m is \$129, and the 3i lists for \$219. Both prices include software and an external speaker. With an integral speaker, the 3s is \$269. For more information, contact The Alien Group, 27 West 23rd St., New York, NY 10010, (212) 741-1770.

Circle 620 on inquiry card.

Integrated Text/ Graphics System

The Concept 100 is a multi-purpose VDI (virtual device interface) graphics controller for the IBM PC and PC XT. It gives you the means to create high-resolution, interactive text and graphics that can be reproduced on a printer or other output device. It offers the ability to lay out pages in different formats and concurrent operation of the computer and output devices.

The Concept 100 is made up of an Intel 80186-based intelligent graphics subsystem, software incorporating a graphics editor and data-driven charting capabilities, a Wang look-alike word processor, a mouse, and documentation. The graphics subsystem replaces and emulates both IBM color and monochrome display adapters. The display resolution is 720 by 352, with two levels of intensity for alphanumerics and graphics. The display is 50 Hz, noninterlaced, and supports 25 rows by 80 columns of characters.

The Graphics Software Systems implementation of the proposed ANSI VDI standard is used. The graphics editor has many of the capabilities of a CAD package, and it lets you create charts, flow diagrams, lines, boxes, circles, maps, and text with diagrams.

A basic font set and sizes are provided. File translators for commonly used programs, dictionaries, and a spelling checker are standard. Epson FX-80/ MX-100, C. Itoh Prowriter, and Okidata printers are supported. Centronics-type parallel and RS-232C serial ports are offered.

Options are an extended font set, Tektronix 4010 terminal emulation, the ability to accept graphics formats from CAD/CAM systems, and equation setting. The list price is \$2195. For further details, contact Concept Technologies Inc., 6950 South-west Hampton, Tigard, OR 97208, (503) 684-3314. Circle 621 on inquiry card.

(continued)

SOFTWARE • CP/M / MS-DOS

New MS-DOS Versions of Pascal, FORTRAN, and C

Microsoft has released new versions of Pascal, FORTRAN, and C Compiler languages for use with its MS-DOS operating systems.

Two new mathematics libraries have been added to Pascal, supplementing the existing 8087 coprocessor and 8087 emulation support, and its name has been changed to Pascal 3.2. The first library offers high-speed performance without an 8087. It supports both single- and double-precision numbers, which makes it faster than emulation software but slightly less accurate. The second mathematics package offers BCD floating-point arithmetic for more accurate dollars-and-cents calculations.

Pascal 3.2's 14-digit decimal format eliminates many of the problems associated with rounding off binary mathematics. Other features include

MS-DOS 2.0 run-time support, the ability to access files by means of the path-name directory structure, linker extensions that support overlays so that program modules can be loaded when required, and the ability to call overlays from the root program or from another overlay.

FORTRAN 3.2 can now handle nearly unlimited data arrays. The 64K-byte segment restrictions for arrays and common blocks have been overcome, which allows manipulation of large matrices. In conjunction with module linking, a single program can use up to 1 megabyte of 8086 memory.

FORTRAN 3.2 supports complex number calculations in addition to specific and generic conversion intrinsics conforming to the ANSI 77 standard. Double-precision Complex data types have also been added.

Some of its other features are a Parameter statement, Block Data programs, an Inquire statement, and an I/OStat read/write clause for checking the status of I/O operations.

Microsoft's C Compiler 2.0 supports the use of path names to take advantage of the DOS directory structure as well as I/O redirection. It has expanded memory capabilities that let programs compiled with C employ the full memory capacity of their system. Small, medium, compact, and large memory models are programmer-selectable.

Pascal 3.2 is \$300, while FORTRAN 3.2 and C 2.0 are priced at \$350 and \$500, respectively. Previous owners can purchase updates at reduced rates. Contact Microsoft Corp., 10700 Northrup Way, Bellevue, WA 98004, (206) 828-8080. Circle 622 on inquiry card.

Telecommunications Program

ReachOut 2.001 is a telecommunications program for any 8-bit micro running CP/M and any 16-bit IBM PC or PC compatible using CP/M or MS-DOS. A key feature of ReachOut is its auto-answer facility, which permits unattended file transfers to or from another computer that has ReachOut. A reporting system informs operators of the unattended computer what activity occurred during their absence.

This menu-driven program offers a Help system, keyboard and directory dialing, automatic redialing, and the execution of scripts for the automatic control of log-on, data capture, and disconnect. Files can be transferred either with or without error checking. Pretyped electronic mail can be sent.

Transfers to another system include an estimate of the transfer time and file-by-file updates on both computers. Batches can be defined either ambiguously or by a list of file-names. When problems are encountered during batch transfers, the resultant files contain filenames that can be used to control later transfer attempts. The free space on the target disk is determined before each file is sent.

ReachOut automatically renames incoming files when they duplicate names of existing files. All operating system transients are contained within the program. A nonmodem installation option is provided for downloading applications. ReachOut uses a 16-bit CRC transfer protocol and is compatible with the file-transfer error correction/detection protocols of many public-domain programs, including Modem7. ReachOut comes with utilities and a menu-driven installation program. It costs \$199, which includes a pair of updates. Contact Applied Computer Techniques, 104 Knight Dr., San Rafael, CA 94901, (415) 459-3212. Circle 624 on inquiry card.

MegaBASIC Addresses Up to 1 Megabyte

MegaBASIC can directly address 1 megabyte of memory by accessing packages from memory in much the same way as FORTH provides its extensions. This procedure lets you load libraries of programs, subroutines, and functions into memory that can be executed from the running program with a single statement as if it were an integral part of MegaBASIC itself. The packages are user-written in MegaBASIC, which provides each user with the ability to tailor the language to individual needs.

With direct addressing of 1 megabyte of memory for program and data, MegaBASIC gives MS-DOS, MP/M-86, CP/M-86, and TurboDOS users flexible use of the 16-bit processing power of such machines as the IBM PC. All memory allocation is fully dynamic and transparent. Up to 64 separate programs can coexist in memory simultaneously. Its memory

management can support more than 6000 variables at the same time: each string variable contains up to 65,535 characters, and bit strings can be 524,288 characters long. Nesting of WHILE and FOR loops, functions, GOSUBS, and procedures is allowed to any depth.

MegaBASIC is said to execute programs faster than any existing BASIC by a factor of 2 to 15 times. Large-scale file applications under MegaBASIC reportedly run faster than under compiled software. Other features include execution control and debugging, structured programming, segmentation and overlays, unlimited numeric and string array dimensions, and a variety of data-manipulation functions.

The standard version of MegaBASIC contains 28 commands, 65 statements, 64 functions, 37 operators, and a variety of specialized control keys. Its editor has such capabilities as

global search, list, and edit, and the ability to rearrange, move, or copy all program lines, including a fully global, defined regional, or line-specific renumbering command. One feature provides a quick display of statistics about the program and its execution state, while a separate cross-reference generator defines all variables, functions, and so on.

MegaBASIC immediately executes programs written in North Star BASIC. A translator is available for converting Microsoft BASIC programs to MegaBASIC. This language will work with any machine based on the 8086 or 8088 microprocessor. The list price is \$400, including extensive documentation. For complete details, contact American Planning Corp., Suite 425, 4600 Duke St., Alexandria, VA 22304, (800) 368-2248; in Virginia, (703) 751-2574. Circle 623 on inquiry card.

SOFTWARE • IBM PC

Text Editing, Page Makeups with PagePlanner

PagePlanner from Westminster Software is a text editing/design tool that lets you enter, hyphenate, justify, and design text into full-page makeups with an IBM Personal Computer. When your page is complete, PagePlanner's drivers let you run the text through Mergenthaler 202, Compu-graphics, AM, Autologic, and Itek typesetting equipment.

For text entry and editing, PagePlanner lets you merge raw text with typesetting codes. Status fields can be filled with information both by the operator and the system. Editing functions include character, word, line, and block delete, block move, and copy. An intermediate save function lets you store chunks of text.

Hyphenation and justification

of text is performed at more than 1000 lines per minute. Hyphenation is determined by a user-selectable 5000-rule prefix/suffix logic table. Justification is done by accessing the correct character width and using a 500 typeface kerning table. A document can be hyphenated and justified up to 99 times. A logical hyphenation capability backs up the kerning tables.

PagePlanner lets you continually review and revise any part of your project. Major revisions to a job are merely a matter of changing the job specifications on screen.

Its page-makeup mode lets you display solid blocks of type, rule lines, and protected areas and modify them to meet your design criteria. Multicolumn designs and odd-size areas can

be laid out. All page designs remain "soft" until they're output to hard copy.

Minimum system requirements are 128K bytes of RAM, two 320K-byte floppy-disk drives, IBM Color Graphics card, color monitor, and a parallel printer port. Software requirements are CP/M-86 with GSX86 and MS- or PC-DOS 2.0 with the Graphics Program. It will also work with IBM or Hercules graphics card and monochrome monitors and the Compaq. (Other PC compatibles are being evaluated.) A custom cable for interfacing with the typesetting equipment is available.

PagePlanner costs \$1995. Contact Westminster Software Inc., Suite 2..660 Hansen Way, Palo Alto, CA 94304, (415) 424-8300. Circle 625 on inquiry card.

Multilingual Word Processor

The Multilingual Worldmaster word-processing program from Emcon Marketing lets you type two languages within the same document. Worldmaster, which runs on the IBM PC and PC compatibles, allows you to mix eight character sets in a single document. It has a menu-based structure, and the mixing of languages is performed using simple function keys. Keyboard templates and stickers are pro-

vided so that you can identify the characters for each key.

Worldmaster is available in four versions: English to Romance languages, to Arabic, to Hebrew, and to Russian. The Arabic and Hebrew versions let you type from right to left in both the insert and regular edit modes.

This program is configured to work with Epson's FX series printers and with such letter-

quality printers as the Diablo and Juki. (Foreign print wheels are required for the daisy-wheel printers.) A minimum of 128K bytes of memory and a color-graphics card for the Arabic, Hebrew, and Russian versions are required. The suggested retail price is \$495. Contact Emcon Marketing Group Inc., 366 Fifth Ave., New York, NY 10001, (212) 563-0443. Circle 626 on inquiry card.

Color Print Utility

ColorScreenPrint from Application Techniques is a software utility that lets you obtain full-color graphics from your IBM Personal Computer Color Printer. In addition, it can print any graph that can be displayed on the PC's color display at any size up to 13 inches anywhere on paper.

When used with Lotus 1-2-3, ColorScreenPrint eliminates the need to swap disks to print

graphs. By pressing the PrtSc key, you gain control over the graph's colors, size, and positioning.

Colors can be selected from a palette of 16 or from virtually unlimited user-defined colors. The width and height of the printout is set in tenths of inches, and auto centering is supported. A portion of the screen can be cut out for printing anywhere on the paper, and a quarter-turn rota-

tion is supported.

A program that generates samples of more than 50 color textures and shows you how to produce different colors comes with ColorScreenPrint. A demonstration program is supplied.

ColorScreenPrint is \$79.95. For more information, contact Application Techniques Inc., 80 Townsend St., Pepperell, MA 01463, (617) 433-5201. Circle 627 on inquiry card.

More Than 110 Scientific Subroutines

AFORTRAN 77 Scientific Subroutine Library for IBM PC-DOS users can be purchased from Peerless Engineering Service. Each of the more than 110 subroutines is written and tested in Microsoft FORTRAN 3.13 and is provided in disk form, both as a linkable library and in source format. Each subroutine has an accompanying test program on disk. The 450-page manual provides hard copy of each subroutine, its test program, the results of the test, and the mathematical method used in the subroutine.

This scientific library has subroutines for statistical and numeric analysis, solutions for third-order differential equations, solutions to M equations in N unknowns, and approximations by a variety of different methods. It is \$149.95, plus \$2.50 shipping. Contact Peerless Engineering Service, POB 71, Soquel, CA 95073, (800) 824-7888, operator 419; in California, (408) 462-0330. Circle 628 on inquiry card.

LISP Interpreter

Levien Instruments bills its BYSO LISP interpreter as a "very healthy" subset of McCarthy's LISP 1.5, which implements every feature described in Laurent Siklossy's *Let's Talk LISP*.

BYSO LISP includes integers, map functions, functional arguments, input/output functions, a variety of list operators, functions, lambda operators, an editor, and tracing functions. It comes with an error system that explains each error with a message and the context in which it appeared.

BYSO LISP is written in assembly language. It requires an IBM PC, PC XT, or PCjr and 128K bytes of RAM. The list price is \$195. Contact Levien Instrument Co., POB 31, McDowell, VA 24458, (703) 396-3345. Circle 629 on inquiry card.

(continued)

SOFTWARE • IBM PCjr

Business Productivity Tools



Rags to Riches is a financial-management series for the IBM PCjr, comprising ledger, receivables, sales, and payable modules. All the modules are one-disk programs requiring about 32K bytes of memory. They load into RAM, which makes response time fast. The modules are consistent in design, and they work with each other.

The modules come with software templates so that they can be customized for a variety of business, retail, or personal applications. The users manual provides workbook-style introductions and tutorials.

The receivables module shows the status of customer accounts,

audits accounts, produces reports, and automatically updates accounts. It has a wild-card provision. The payable module tracks payments required by vendors, including their terms, discounts, and outstanding balances. Miscellaneous payments or adjustments can be added at any time. Totals are accumulated as invoices or payments are recorded.

The sales module features automatic calculation of tax and change. You can preset the keyboard to record the sale of specific items or type of payments and use formulas for data-entry calculations, such as partial refunds. Its itemized jour-

nal provides an audit trail, and product classifications can be grouped for reporting.

The general-ledger program constantly displays income, expenses, assets, liabilities, estimated profits, and net worth. Updates are made with each entry. Transactions are documented by individual submenus. It provides such reports as audit trails and charts of accounts.

Individual Rags to Riches modules are \$99.95. Support booklets with tips on computerized accounting are \$9.95. Contact Chang Labs Inc., Suite 200, 5300 Stevens Creek Blvd., San Jose, CA 95129, (408) 246-8020. Circle 630 on inquiry card.

SOFTWARE • APPLE MACINTOSH

Program Locks Up Files

The Lock-It-Up copy-protection system for the Apple II series and the Macintosh lets you impose several levels of security that render disks uncopyable. This package includes a software-duplication system that enables you to duplicate the protected disk.

Lock-It-Up uses an encrypted signature track written to a random location on the disk. The code to verify the accuracy and existence of the signature track is automatically encrypted into the protected program. Protected files can be backed up by the user, although they will operate only if they reside on the original disk.

Protection is not based on a physical fingerprint. Lock-It-Up is said to make information completely write-protected. The protection scheme does not interfere with normal operations.

Lock-It-Up is also available in an IBM PC version. Licensing begins at \$495. Contact Double-Gold, Suite 29, 3900 Moorpark Ave., San Jose, CA 95117, (408) 554-9133.

Circle 631 on inquiry card.

Low-Cost Modula Compiler

Modula Corporation is releasing a 590 Modula-2 compiler for the Macintosh this month. The compiler runs under the Macintosh's operating system, and it allows you to use the Macintosh's built-in graphics and mouse toolkit.

This compiler generates an extended version of M-code, which is a compact code designed especially for Modula. It interprets M-code programs at run time without disrupting the Mac's user interface. M-code benchmark programs that make heavy use of procedure calls and toolkit graphics are said to run 75 percent as fast as pro-

grams compiled to 68000 native code on the Lisa and downloaded to the Mac.

The Modula-2 compiler is supplied with the basic I/O modules described in the book *Programming in Modula-2* by Niklaus Wirth. You can write assembly-language routines and link them to Modula-2 programs.

The Modula-2 compiler comes with I/O library and documentation. For further information, call or write Modula Corporation, 950 North University Ave., Provo, UT 84604, (800) 545-4842; in Utah, (801) 375-7400. Circle 632 on inquiry card.

DBM for IIc

Precision Software's Superbase database-management and information-retrieval system for the Apple IIc portable computer uses B+ direct-tree indexing for record access. This program offers menu-driven operation, direct commands to the database, or use of a user-programmable interface to create custom applications packages within the Superbase environment.

Apple IIc Superbase costs \$169. Contact Precision Software (USA) Inc., Suite 1100, 820 Second Ave., New York, NY 10017, (212) 490-1825. Circle 634 on inquiry card.

Detailed Multiyear Real Estate Analysis

Real Estate Investor II for the Apple computer performs a detailed multiyear analysis of before- and after-tax cash flows and rates of return from any type of improved real estate. It offers nine different loan types and includes variable parameters and eight depreciation

methods. It computes return on investment, return on equity, internal rate of return, and financial management rate of return.

Real Estate Investor II will also provide a detailed sale analysis, including sensitivity analysis, and produce a formatted multi-page report. It's written in

AppleSoft BASIC. The list price is \$295. C language versions for the IBM PC, the Tandy 2000, Wang Professional, and CP/M-based systems are available. Contact REMS Software, 526 Northwest Second St., Corvallis, OR 97330, (503) 757-8887. Circle 633 on inquiry card.

SOFTWARE • OTHER COMPUTERS

Moses

Moses (Modula-2 Support Environment System) is the first product in TDI's Liberator line of Modula-2-based software. It is a portable operating system written in Modula-2 that requires only a conventional character-oriented video display, 128K bytes of memory, and a floppy-disk drive.

The Moses package includes a

Modula-2 compiler, a screen editor, a symbolic debugger, a modifiable menu-driven user interface with windows, and a library of routines and utilities. The compiler and editor are linked so that compiler errors return the user to the editor with up to 128 errors flagged for ease of correction.

The system is available for the Sage II and IV computers, with

versions for other 68000- and 16032-based computers available soon. The price was not available at press date but was estimated to be between \$250 and \$500; source code for the system will be available at additional cost. For more information, contact TDI Ltd., 29 Alma Vale Rd., Bristol BS8 4NI, England; tel: (0272) 742796. Circle 635 on inquiry card.

Word Processor Runs on TI Professional

RWord, a word-processing package first introduced for MC68000 and 990 series computers, is available for the TI Professional Computer and the IBM PC. Made up of a group of integrated programs, R Word offers such features as mail merge, table mathematics, spelling check, and database capabilities.

R Word combines eight different color choices for creating backgrounds, reverse video, and underlined or highlighted text. A three-level file structure used for document organization contains 9 directories with 32 categories in each directory and 32 documents in each category.

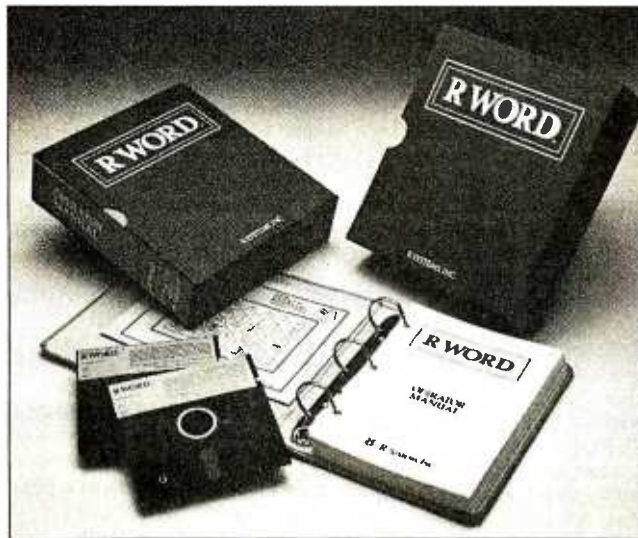
Complicated documents employing headers, footers, tables, and footnotes can be produced with R Word. Its six text-editing modes are text, word, sentence, line, paragraph, and page. Miscellaneous features include

automatic page numbering, table of contents, document assembly, on-screen formatting, automatic text alignment, global search and replace, screen prompts, and Help screens.

R Word requires 256K bytes

of memory and single or dual floppy-disk drives. The suggested retail price is \$395. Contact R Systems Inc., 11450 Page-mill Rd., Dallas, TX 75243, (214) 343-9188.

Circle 636 on inquiry card.



BASIC Compiler Works Under FLEX/OS-9

K-BASIC, a BASIC-language compiler that converts BASIC programs to machine code, is now available for systems running FLEX, OS-9, or Color OS-9. Because compiled programs have less overhead than interpretive BASIC programs, according to the manufacturer, Lloyd I/O, you can expect greater speed and larger programs and data files.

K-BASIC has three general data types, REAL, STRING, and INTEGER, and four INTEGER sizes, 8, 16, 32, and 64 bit. Its real numbers are 15-digit precision, with an exponent of ± 99 . Each type can be dimensioned and defined to absolute addresses. K-BASIC has a variety of directives, statements, and functions not normally found in BASIC interpreters. Line

numbers or labels are not required on every line. Variable names are significant to 12 characters, and labels are significant to 16 characters. K-BASIC includes debugging features and error processing.

K-BASIC is \$199. The manual alone is \$15. Contact Lloyd I/O, 19535 Northeast Glisan, Portland, OR 97230, (503) 666-1097. Circle 637 on inquiry card.

CAD Package Aids Mechanical Engineers

Sumicom's CAD 10 for its System 830 is suitable for architects, interior designers, mechanical engineers, and other professionals using diagrams and schematics.

CAD 10 uses all of the System 830's hardware, including its soft function keys, function keys F1 through F10, high-resolution capabilities, pixel-addressable graphics, and internal printer. The program addresses the 830's color graphics chip directly and expands the pixels from 250,000 to 800,000. It permits easy transposition of floor plans and schematics, and diagrams or two-dimensional drawings can be displayed in as many as eight colors.

You can draw symbols and transcribe them into scaled drawings. CAD 10 allows you to edit, update, and reorganize drawings. Its Delete function key lets you cancel the last element drawn, and the Next function key lets you search through your drawing and cancel or add to the design without starting from the beginning.

An alignment grid with sub-menu lets you design or copy any symbol at 10 times the actual size, which improves accuracy. A drawing board with 800 by 1000 raster points on the screen lets you assemble symbols into an actual drawing. Fifty symbols, with an average of 20 elements each, can be transferred from the symbol file to a drawing. CAD 10 parameter functions permit a choice of eight colors, the selection of four sizes of lines for pen-plotter printing, and rotation of symbols from 0 to 270 degrees. A zoom feature is provided.

Utilities include a program that permits the assembly of individual symbols stored in various data files into a new symbol set of a new data file. CAD 10 is \$595. Contact Sumicom Inc., 17862 East 17th St., Tustin, CA 92680, (714) 730-6061.

Circle 638 on inquiry card.

(continued)

SELC Like Protocols for Wang

Relay Version 3.1 for the Wang PC is a communications software system covering routing, file, record, and third-generation SELC like synchronous communications protocols. It comes with an editor and provisions for remote and unattended operations. The suggested price is \$195.

Relay supports simultaneous unattended individual file transfers including binary files and can automatically make the functions of such unattended transfers as the relay transfer modes, the Relatools W211 and the Relay P211A, a complete menu and keyboard driven operation, and to facilitate use, often help screens.

One key feature is its directory of computers, which can take complete values for every communication parameter for each computer entered any of which can be called or answered with a single keyboard individual remote include the name of the system, its telephone number, data rate type of system, and configuration specifications for communications. Configuration options establish such characteristics as data rate parity, full or half-duplex, port selection, and

other toggles for XMODEM protocols, automatic line feed, local echo, and APL mode. A turnaround character and a delay after each line can be specified. Control codes can be displayed.

In conjunction with an intelligent modem, Relay will provide auto dialing. It has the ability to reset remote system operations, including modified commands, remote system responses, and signals if local XMODEM command which fails or DCE activity is specified periods fail to see your. You can perform DCE commands from within Relay even during a connection.

Relay handles relay file you build or modify ASCII files, and its command tables include 20 functionality and 10 APL commands. It provides two levels of password protection.

A Wang PC with full types of data and disk drive XMODEM version 1.0 or later, an asynchronous communications adapter, and a modem with 9600C cable are required. Contact VSA Personal Computing Inc., 60 East 43rd St., New York, NY 10017, (212) 697-4747. Circle 479 on inquiry card.

Two for OS/2

Microfit and Plotfit for the Span OS/2 are available directly from Microfit.

Microfit, a graphics package, consists of a searchable library of more than 100 graphics routines, any of which can be incorporated into a Visualfit program during its test phase. You can draw lines, rectangles, circles, and characters of any size or angle, and it can scale, translate, and rotate graphic objects. It features a virtual window with automatic line clipping and multiple and soft screens.

Microfit requires Visualfit+; it comes on two disks with documentation and a 3.5-inch

graphics demonstration. The price is \$60 (US).

A collection of graphics utilities, Plotfit provides programs for such common applications as bar and line graphs, pie charts, bar codes, trend lines, and tag and coding plots. One of the utilities can be entered either interactively or from a disk file. All Plotfit utilities are standalone programs that do not require a programming language. The suggested price is \$60 (US), which includes on-line documentation. For more information, contact Microfit, 88 1/2 Conroy, New Castle, NY 14303, (716) 363-7100. Circle 478 on inquiry card.

Sourcebook for Software Writers

More than 300 computer publishing software from the general public have supplied information to The Software Writer's Marketplace by Dennis Joyce and John Carl Pickering. Displaying instructions on researching the market, structuring viable programs, and writing acceptable documentation are included in this 327-page paperback.

Once your program is written, The Software Writer's Marketplace guides you through the chores associated with selling your work to a publisher, beginning with an initial letter of inquiry and ending with the contract signing. A section on copyright information is provided.

The Software Writer's Marketplace is \$295. Contact Planning Press, 121 South Townsend St., Philadelphia, PA 19103, (215) 367-9300.

Circle 481 on inquiry card.

Computer Cables

Candy Cables Corporation distributes more than 500 computer interfaces. A catalog of these interfaces has been compiled.

Standard interfaces listed include RS-232 serial cables with PVC jacket or ribbon cable feet long, monitor cables, parallel printer cables with PVC jackets or ribbon eight feet long, 20-foot extended data cables, 20-foot low-cap terminated shield cables with metal heads, and disk-drive cables. Special cables for serial printers and modems are also listed, as are switch boxes and computer and printer controls. Special cables can be obtained.

The catalog lists dealer costs and suggested retail prices. The minimum order required. Contact Candy Cable Corp., 920 San Marcos Blvd., San Marcos, CA 92068, (619) 443-4299. Circle 482 on inquiry card.

Magazine on Language Had July Debut

Computer Language, a technical magazine dedicated solely to programming language, debuted in July. It covers assembly language, C, Pascal, BASIC, FORTRAN and applications and systems programming, and reports on major developments in the software-engineering field.

Among the topics discussed are algorithmic applications, problem solving, language portability features, useful utilities, artificial intelligence editors, language selection criteria, and

telecommunications. It offers tips on marketing your own software, as well as software and hardware reviews, regular columns, and reader forums.

Regular monthly publication will begin in October. Annual subscriptions are \$15. The cover price is \$2.95. Contact Computer Language Co., Publications Inc., 174 Townsend St., San Francisco, CA 94103, (415) 397-0253.

Circle 483 on inquiry card.

WHERE DO NEW PRODUCTS REAR COME FROM?

The new products listed in this section of *BYTE* are called from the thousands of press releases, letters, and telephone calls we receive each month from manufacturers and distributors. The basic criteria for selection for publication are a direct product reaching reader interests, and is a new or improved "introduction" of an old item. If you want your product to be considered for publication, no charge send information about it, including price and date of sale, and telephone number where a reader could get more information. Send this to the New Products Editor, *BYTE*, P.O. Box 175, New York, NY 10001.

IBM PC 128K
(1) 360k DSDD Drive
Diskette Adaptor Card
Color Graphic Card
10 Mb Hard Disk System
\$2995.00

IBM PC 128K
(1) 360k DSDD Drive
Diskette Adaptor Card
IBM Monochrome Card
IBM Monochrome Monitor
\$2195.00

IBM PC Portable
(1) 360k DSDD Drive
Diskette Adaptor Card
Amber Display
256K Ram
\$2450.00

DISPLAY BOARDS

LazerColor \$199
Hercules Card 349
QuadColor I 239
PC Peacock 295

EXPANSION BOARDS

AST 6-pac 64K 225
Quadram EXII 64K 245
10Mb Hard Disk 899
Baby Blue II 599

MONITORS

Roland DG121 (comp) \$129
Roland DG122 (mono) 149
PGS HX12 RGB 495
Max 12 Amber (mono) 195
Sakata 12" green 129
Sakata Color (comp) 295
Sakata Color (RGB) 495
EXPANSION ACCESSORIES
64K Upgrade (9/IC's) 50

MODEMS

Hayes 1200 Int \$429
Hayes 1200 Ext 489
Qubie Int 289
Anchor 1200 289

PRINTERS

Epson FX80 475
Epson Fx100 725
Brother HR-15 575
Brother HR-25 750

IBM XT 128K

\$3895.00

TAVA SYSTEM ONE

(2) 360K DSDD Disk Drives
Keyboard
(2) RS-232 Serial Ports
(1) Parallel Printer Port
Color Graphic Board
Roland DG121s Monitor

\$1895.00

TAVA SYSTEM TWO

(2) 360K DSDD Disk Drives
Keyboard
(2) RS-232 Serial Ports
(1) Parallel Printer Port
Color Graphic Board
Roland DG121G Monitor
10 MEGABYTE HARD DISK

\$2795.00

DEALER AND
CORPORATE
VOLUME PRICING

501 W. Glenoaks Boulevard
Glendale, CA 91202
(818) 999-1183

compumax



SUNTRONICS CO., INC.

12621 Crenshaw Blvd., Hawthorne, CA 90250

1-800-421-5775 (ORDERS ONLY) (213) 644-1140 (CA. Order & INF.)

STORE HOURS : 9:00 a.m. to 6:00 p.m. (Mon.-Fri.) 10:00 a.m.-5:00 p.m. (Sat.)

IBM™ Compatible XT

Features:

- ✓ Intel 8088 CPU
- ✓ Intel 8087 Math Co-Processor (Option)
- ✓ Expandable on-board to 256K
- ✓ 128K RAM w/Parity
- ✓ 8 IBM Compatible Expansion Slots
- ✓ 4 Channel DMA 8237
- ✓ 8 Channel Interrupt 8259
- ✓ Mother Board dimension same as IBM PC

Price:

- Mother Board w/128K RAM and ROM **\$475.00**
- Computer Cabinet **\$99.00**
- 83 Key full-function Keyboard **\$120.00**
- 100 WATT Power Supply **\$130.00**
- Monochrome Graphic Card w/Printer Port **\$350.00**
- Color Graphic Card (Display 16 colors) **\$199.00**
- FDD Controller Card w/Cable **\$149.00**
- Parallel Printer Card **\$75.00**
- Dual ASYNC & RS232 Port **\$99.00**
- 320KB DS/DD Slimline Disk Drive **\$189.00**
- SAM WOO IBM Style Amber or Green Monitor (Composite Video) **\$99.00**
- IBM Parallel Cable 10' **\$29.95**
- IBM Prototype Board (SUN-208) **\$19.50**
- MICROLOG Z-80B Co-Processor, Multi-function (Run CP/M80 Software) **\$499.00**
- Apparat EPROM Blaster **\$129.00**
- IBM Up-Grade Kit (4164) **\$44.00/per kit**

Apple Compatible Products

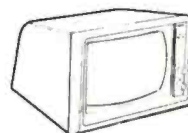
- SUN Z80 Card (w/o Software) **\$55.00**
- SUN 80 Column Card (w/Soft switch) **\$97.00**
- Power Supply (5 Amp) **\$59.95**
- Cooling Fan **\$42.00**
- Apple Compatible Disk Drive (slimline) **\$175.00**
- Parallel Printer Card **\$39.00**
- Floppy Disk Controller **\$47.00**
- EPROM Programmer (2716, 2732, 2764) **\$75.00**
- APPARAT PROM Blaster **\$119.00**
- ALS Z-Card (Z80 CPU) **\$149.00**
- ALS 80 Column Card **\$159.00**
- AFDC-1 Floppy Disk Drive Controller **\$55.95**
- Run DOS 3.3 with any standard Shugart compatible 5 1/4" Disk drive (2 drives per card, Does not read 1/2 track)
- Apple Prototype Board (SUN-722) **\$5.95**

S-100 Products

- 64K Static Memory Board (6116) w/o RAM A & T **\$155.00**
- 64K Static Memory Board (6116) w/RAM A & T **\$339.00**
- Uses 6116 CMOS RAMS, 1/2 Amp Max, w/64K @6MHz Extended Addressing, Bank Select 4-16K Blocks, 2716 EPROM can replace any 6116RAM, 8 Bit IEEE 696.
- SBC-880 Single Board Computer (Z80A) A & T **\$149.00**
- UFDC-1 5 1/4" and 8 Floppy Disk Controller (BIOS available) A & T **\$245.00**
- Clock/Calendar A & T **\$115.00**
- Prototype Board (SUN-721) **\$9.95**

General Products

SAM WOO HIGH RESOLUTION DISPLAY



- ✓ 22 MHz Bandwidth
- ✓ Composite Video
- ✓ Anti-glare Screen
- ✓ Passes FCC.UL Approved
- ✓ 1000 Lines or 132 Characters Across

AMBER or GREEN \$99.00

- RAM 4164-150NS or 200NS **\$4.95**
- 5 1/4" Diskette, SS/DD Soft sector Box of 10 ea **\$15.50**
- 5 1/4" Diskette DS/DD Soft sector Box of 10 ea **\$23.00**
- 80 CPS Dot Matrix Printer (CP-80) **\$245.00**

TTL IC, ROM, RAM & CPU CHIPS, CONNECTORS & IC SOCKETS ARE AVAILABLE, PLEASE CALL !!

TERMS : VISA, MASTER Card, C.O.D (Cash or Certified Check Required). Check (Allow 2-3 WKS for Clearing) Shipping & H/C \$3.00 for 3 Lbs plus \$0.50 for each add Lb. Calif. residents add Calif. Sales Tax.

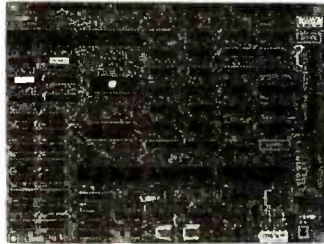
IBM & Apple are registered trade mark of IBM & Apple

WAVE MATE UNBEATABLE VALUES

Highest Performing Z-80 Micros Available • 16-Bit Performance 8-Bit Price

BULLET™ SBC

- 4 Mhz Z80-A CPU, DMA, CTC, DART, PIO
- 128KB Bank Selected RAM: 4K-16K EPROM
- DMA FDC for 5¼", 8" and 3½" drives
- Two RS-232 serial ports; Centronics printer port; SCSI hard disk interface
- + 5 volts only at 1.75 amps; no adjustments; 8" x 10.7" size
- CP/M Plus (3.0) included: 2-user MP/M II optional

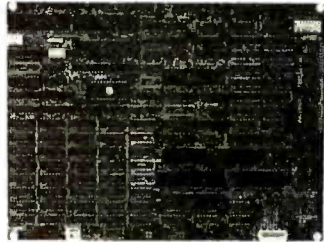


CP/M Plus included

\$449

SUPER BULLET™ SBC

- All BULLET SBC features are included
- Additional 128KB RAM (256 KB total)
 - Additional 2 RS 232 serial ports (4 total) using SIO
 - MP/M II for 2, 3, and 4 users included

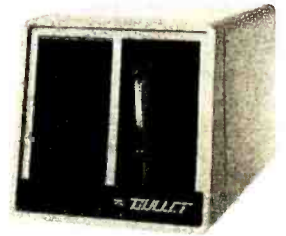


CP/M Plus & MP/M II included

\$995

BULLET™ IV

- BULLET SBC with CP/M Plus (3.0)
- Two mini floppy drives with 1.6MB formatted capacity
 - Compact enclosure with power supply and cables

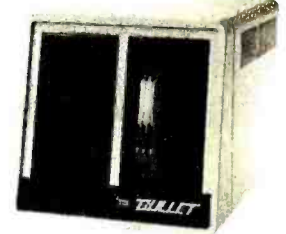


CP/M Plus included

\$1149

SUPER BULLET™ 510

- SUPER BULLET SBC with CP/M Plus (3.0) & 4 user MP/M II
- 10MB hard disk with 800KB floppy for back up
 - Compact enclosure with power supply and cables



CP/M Plus & MP/M II included

\$2595

APOLLO MARKETING

(A division of Calif. Digital)

22048 Sherman Way #316 • Canoga Park, CA 91303 (818) 883-8390 • TELEX 194369
In U.K. call: (021) 471-1999 • In Germany call: (089) 48.37.74

Quantity discounts available • OEM and dealer inquiries welcome
C-BIOS source codes and schematic available • All Wave Mate manufactured products have a limited one-year warranty •
VISA, MC, Cashier Check or Money Order accepted
"BULLET" and "SUPER BULLET" are Trade Marks of Wave Mate, Inc.
"CP/M Plus" and "MP/M II" are Trade Marks of Digital Research, Inc.

Savings\$

DO IT YOURSELF! An IBM® PC/XT Compatible

To start, you need a high-quality Switching Power Supply and a heavy duty Mainframe to cabinet your Cpu Board, Power Supply, Cards, Drives, etc.



#HSC 130-40
\$179.00/ea.
130 WATT.

Switching Power Supply

- +5V/15A, +12V/4.2A, -12V/0.25A, -5V/0.3A
- Built-in Fan
- Power Switch
- Cables w/Connectors for Cpu Board and 4 Disk Drives
- 2 Switched AC Outlets for Printer & Monitor
- One Full Year Warranty



Model #FC-630

Cabinet only
\$99.00/ea.

- Heavy duty welded steel
- 2 Full or 4 Half Height Disk Drives allowed
- IBM® Look-alike

64K D-RAM
150ns-200ns
\$49.00/9 pcs.

765AC 8272A
8275 8237A-5
8284A

TMS 9980
\$19.00/ea

DEALER & OEM's INQUIRY INVITED



FORTRON CORP.

4447 ENTERPRISE ST.
FREMONT, CA 94538

Dealer & OEM 415-490-8403
415-490-8171



TLX 176632
800-821-9771

Terms: Shipping immediately from stock usually, or within 4 weeks if run out of inventory. Minimum \$5.00 shipping + handling. Personal check requires 2 weeks clearance before shipping. 6.5% sales TAX required for CA. residents.

Circle 356 for Dealer Inquiries. Circle 357 for End-User inquiries.

It's True — We Did It!

Don't be foolish. Buy Direct!

Looking for a printer? The OKIDATA 82A for \$300 will put an end to that!



EAGLE

OUR PC FLYS

IBM Compatible

Simply a better PC. All models

available for immediate delivery

Call **Lowest \$**

SPIRIT Call **Best Seller**



Mannesmann Tally

- Standard — 7 x 9 160 CPS
- NLO — 40 x 18 40 CPS
- 2K Buffer and Tractor Standard

160 L 80 col. Call **Best Seller**

180 L 132 col. Call **Best Seller**

LOWEST Price In U.S.



IDS

- Proportional Spacing
- 8 Character Styles
- 200 CPS Bi Directional
- Color Optional
- Sheet Feed • Graphics
- 34K Buffer

Prism 80

Prism 132 and Micro Prism \$ Call



Red Hot Special!

BELOW Dealer Cost!

Novation J-CAT

- 300 BPS Modem
- Originate/Auto Answer
- Sizzling \$Call**

CHECK THE NEW TOPAZ U.P.S.!

**CALL TODAY!!
LOWEST PRICES ANYWHERE!**



ALTOS
PANASONIC
TELEVIDEO
SANYO
TOPAZ
TRANSTAR

FREEDOM
HAYES
NOVATION
VDS
EAGLE
RITEMAN

OMNITEC
VENTEL
AMDEK
BMC
MICOM
DATASOUTH

TAXAN
DIABLO
NEC
EPSON
STAR GEMINI
ERA-2

OKIDATA
SOFTWARE
COMREX
DAISYWRITER
JUKI
WYSE

WIDGET
ADDS
DEC
C. ITOH
SILVER-REED
MANY OTHERS

Use Your AMERICAN EXPRESS CARD!

For Price Quotes and Ordering Call:

1-800-328-8905

For Technical Information and
Arizona Orders, Call:
602-949-8218

For Shipping and Order Status Information,
Call: 602-990-7556



LIBERTY GROUP, Inc.

4231 Winfield Scott Plaza • Scottsdale, AZ 85251

Everything in
computer related
products:

- Computers
- Modems
- Printers
- Software
- Monitors
- Terminals
- Accessories

**School & Corporate
P.O.'s Welcome**

Prices listed reflect a cash discount and are subject to change without notice. We welcome Certified and Cashiers Checks, Bank Wires and Money Orders. C.O.D.s are shipped with a minimum C.O.D. charge. Allow 3-7 days for personal checks to clear. Product is subject to availability. Equipment is in factory sealed boxes with manufacturer's warranty. There will be a re-stocking charge for returned merchandise. Call first for an RMA number. Software not warranted for suitability. No return of Software which has been opened. Add 2% for shipping & handling charges (minimum \$2.50). All equipment shipped FOB Scottsdale, Az 85251. Circle 336 on inquiry card.

MEGA-BYTES FOR MICRO-BUDGETS

expand your system...shrink your cost.

Why pay more for top quality products when our prices are consistently among the lowest anywhere?
We invite you to compare prices, then call us.

MISC. PERIPHERALS	SALE PRICE
HAYES SMARTMODEM 1200B (IBM-PC).....	\$399.50
HAYES SMARTMODEM 1200 (RS-232).....	489.50
HAYES CHRONOGRAPH.....	189.50
ROLAND DG XY800 6 PEN PLOTTER.....	799.50
BAUSCH&LOMB DMP-29 PLOTTER.....	1885.00
PENCEPT PENPAD 320.....	900.00

EPSON PRINTERS	SALE PRICE
MX-100.....	\$475.00
FX-80.....	489.00
FX-100.....	689.00
RX-80.....	309.00
RX-80 F/T.....	375.00
LQ-1500.....	1135.00

DYSAN DISKETTES (Boxes of 10 each)	SALE PRICE
104/1 5 1/4" SINGLE SIDE, SINGLE DENSITY.....	\$31.20
104/1D 5 1/4" SINGLE SIDE, DOUBLE DENSITY.....	32.98
104/2D 5 1/4" DOUBLE SIDE, DOUBLE DENSITY.....	38.99
3740/1 8" SINGLE SIDE, SINGLE DENSITY.....	32.39
3740/1D 8" SINGLE SIDE, DOUBLE DENSITY.....	40.19
3740/2 8" DOUBLE SIDE, SINGLE DENSITY.....	40.19
3740/2D 8" DOUBLE SIDE, DOUBLE DENSITY.....	46.89

COMPUTERS AT LOW PRICES

CALL FOR CONFIGURATIONS
AND OPTIONS

MEMOTECH MTX-512
SHARP PC-5000 PORTABLE
LEADING EDGE PC
IBM PC-XT

PRINCETON GRAPHICS SYSTEMS

HX-12 Limit - One to a Customer..... Cash Price \$459.00

GREAT LAKES (PEGASUS) HARD DISK SYSTEMS SALE PRICE

10 MEGABYTE INTERNAL.....	\$1149.00
10 MEGABYTE EXTERNAL.....	1295.00
23 MEGABYTE EXTERNAL.....	1895.00
40 MEGABYTE EXTERNAL.....	2449.00
65 MEGABYTE EXTERNAL.....	3249.00
140 MEGABYTE EXTERNAL.....	4995.00
TAPE DRIVE 23 MEGABYTE INTERNAL.....	950.00
TAPE DRIVE 23 MEGABYTE STAND ALONE.....	1249.00

ORDERS ONLY 800-858-4810
IN CALIF. 800-821-6662



COMMERCIAL BUSINESS SYSTEMS
2858 S. ROBERTSON BLVD., LOS ANGELES, CA 90034



INFORMATION
(213) 559-0596

Phone orders accepted on Visa and Mastercard only. California residents add 6.5% sales tax. No C.O.D. Actual shipping and handling charge added to all orders. Prepaid orders as follows: Money orders or cashier's check—merchandise shipped upon receipt. Personal checks must clear before shipping. 20% restocking fee. Prices and availability subject to change. \$100 minimum order.

SUNNY LOW LOW COST POWER SUPPLIES (LINEAR & SWITCHING) FOR S-100, DISK DRIVES



S-100 & DISK POWER SUPPLIES: OPEN FRAME, ASSY. & TESTED, 6 OUTPUTS, ADJU. & FUSES PROTECT.

ITEM	IDEAL FOR	+5V OVP	* -5 or -12V	* +24 or +12V	+8V	±16V	SIZE W x D x H	PRICE
S ₃	12 SLOT & 2 FLOPPY (1 Floppy & 1 Hard Disk)	5A	1A	5-7A PEAK	13A	3A	10" x 6" x 5"	105.95
S ₄	6 SLOT & 2 FLOPPY	4A	1A	4-5A PEAK	8A	3A	8 3/8" x 5" x 4 3/4"	95.95

DISK POWER SUPPLIES: OPEN FRAME, ASSY. & TESTED, REGULATED, ADJUSTABLE & FUSES PROTECT.

ITEM	IDEAL FOR	+5V OVP	* -5 or -12V	* +24 or +12V	+8V Unreg.	±12V	SIZE W x D x H	PRICE
R ₀	2 x 8" SLIMLINE	2.5A		2.5A - 5A Peak			5" x 4" x 4"	51.95
R ₁	2 x 8" or 2 x 5 1/4" DISK	4A	1A	3A - 5A Peak	2A		8" x 4" x 3 3/4"	56.95
R ₂	3 x 8" (or 5 1/4") FLOPPY	6A	1A	6A - 8A Peak			10" x 4 7/8" x 3 3/4"	71.95
R ₃	or 1x Floppy & 1x Hard	6A	1A	6A - 8A Peak		1A	9" x 6 1/4" x 4 3/8"	98.95

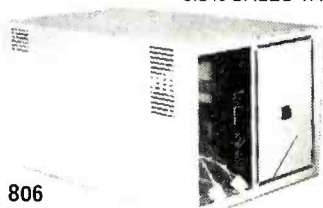
AC & DC POWER CABLES WITH CONNECTOR FOR 2 DRIVES 8.00

SHIPPING FOR EA. PWR SUPPLY: \$5.50 IN CALIF.;
\$8.00 IN OTHER STATES; \$18.00 IN CANADA.
FOR EA. TRANSFORMER: \$5.00 IN ALL STATES;
\$12.00 IN CANADA. CALIF. RESIDENTS ADD
6.5% SALES TAX.

S-100 POWER SUPPLY KITS (OPEN FRAME WITH BASE PLATE, 3 HRS. ASSY. TIME)

ITEM	(IDEAL FOR)	+8V	-8V	+16V	-16V	+28V	SIZE: WxDxH	PRICE
KIT 1	15 CARDS	15A	---	2.5A	2.5A	---	12" x 5" x 4 7/8"	54.95
KIT 2	20 CARDS	25A	---	3A	3A	---	12" x 5" x 4 7/8"	61.95
KIT 3	DISK SYSTEM	15A	1A	3A	3A	5A	13 1/2" x 5" x 4 7/8"	69.95

DEALER
INQUIRIES
INVITED



6 SLOT MAINFRAME ASSY & TESTED ONLY ~~\$399.95~~ \$299.95 + SHIPPING \$18.00

EACH MAINFRAME (ITEM NO. 806 OR 516) CONTAINS: EMI FILTER • FUSE HOLDER • AC POWER CORD • POWER SWITCH & INDICATOR • RESET SWITCH • 4Y: COOLING FAN • S-100 BUS 6 SLOT CARD CAGE • (110/220 VAC, 50/60 HZ) POWER SUPPLY FOR DISK DRIVES & S-100 SLOTS • 2 EA. DC POWER CABLES WITH CONNECTOR AND MOUNTING HARDWARE FOR DISK DRIVES • 9 EA. CUT-OUTS: 7 FOR DB25 CONNECTOR, 1 FOR 50 PIN CONNECTOR & 1 FOR CENTRONICS • CUSTOM FINISH & LOGO-LESS • COMPACT SIZE • LIGHTWEIGHT, 28 LBS. ITEM #806 FOR 2 EA. 8" THINLINE FLOPPY (TANDON TM848-1 & B48-2 OR EQUIV.), OR ONE HARD DISK, POWER SUPPLY: +8V/8A, ±16V/3A, -5V/5A OVP, -5V/1A & 24V/5A. SIZE: 12" (W) x 19.5" (D) x 9.8" (H).

*SPECIFY VOLTAGE WHEN ORDERING

No. 806
Mainframe

MAILING ADDRESS:
P.O. BOX 4296
TORRANCE, CA 90510
TELEX: 182558

SUNNY INTERNATIONAL
(TRANSFORMERS MANUFACTURER)
(213) 328-2425 MON-SAT 9-6

SHIPPING ADDRESS:
22129 1/2 S. VERMONT AVE
TORRANCE, CA 90502



EXPOTEK

"WE TURN AROUND FOR YOU"

24-HOUR WATTS

800-528-8960 Including Alaska and Hawaii

CUSTOMER SERVICE (602) 482-0400 • 2017 E. CACTUS • PHOENIX, AZ 85022

All prices are for cash, cashiers check or money order. Allow 3 weeks bank clearance for personal checks. C.O.D.'s, Visa/MC, and P.O.'s accepted at additional charge. Prices subject to change. Returns must have authorization number (call 602-861-1141), and are subject to a restocking charge.

TERMINALS	FOR IBM PC		PRINTERS
Adds A-1 Green \$485 A-2 Green 490 Viewpoint 60 619 Hazeltine Espirit I 485 Espirit II 540 Qume QVT 102 Green 535 QVT 102 Amber 550 QVT 103 Green 840 QVT 103 Amber 850 Televideo 910 + 549 925 699 950 899 970 975 Wyse Wyse 100 680 Wyse 300 1020 Expirit III 735 Visual Visual 50 Green 599 Visual 55 Green 720 Zenith Z-29 629	IBM PC Call Save \$ AST Research Six Pak Plus—from \$279 Combo Plus II—from 279 Mega Plus—from 309 I/O Plus—from 139 Quadram Quadlink 489 Quadboard 289 Quad 512 Plus 249 Quadcolor 229 SOFTWARE Lotus 1-2-3 \$319	Micropro WordStar/MailMerge 349 InfoStar 299 SpellStar 159 CalcStar 99 Microstuf Crosstak 105 Microsoft Multiplan 159 Ashton Tate dBASE II 389 Fnday! 185 Ram Memory 4164-150 59/9 per set	Comrex ComWriter II Letter Quality \$459 C. Itoh Pro-writer I (8510A) Par 319 Pro-writer (8510A) Serial 419 1550 Parallel 499 1550 BCD SERIAL 549 F-10 40CPS (Letter Qual.) .. 899 F-10 55CPS (Letter Qual.) . 1179 A-10 20CPS (Letter Qual.) . 449 Daisywriter Daisywriter 2000 999 Daisywriter Cable 40 Datasouth DS120 595 DS180 1155 DS220 1590 Diablo 620 (25CPS/Serial) 875 630 (40CPS/Multi-F) ... 1710 IDS Save \$ Juki 6100-18 439 Mannesman-Tally 160L 589 180L 829 NEC 3550 (For IBM PC) 1499 3510 1219 7710 1649 Qume 1140 W/IBM Interface . 1359 1155 W/IBM Interface . 1489 Riteman Portable 279 Star Micronics Gemini 10X Call Gemini 15X Call Silver Reed EXP 550P 575 Transtar 120 P 499 315 Color Printer 499 Sheet Feeders & Tractors Call
COMPUTERS Altos 580-20 3629 586-20 5549 586-40 Call 986-40 Call Columbia Call Eagle Call Franklin Call Quasar Call NEC Portable Call Northstar Advantage 2160 Advantage w/5MB 3345 Advantage w/15MB 4315 Televideo Systems 802H 4210 803 1815 1605 IBM Compatible .. Call 806/20 4775 800 A (user station) 999 Teleport Call Zenith Call	MODEMS Anchor Mark I (RS-232) \$ 79 Mark II (Atari) 79 Mark III (TI-99) 109 Mark IV (CBM/PET) 125 Mark V (Osborne) 95 Mark VI (IBM-PC) 169 Mark VII (Auto Ans./Auto Dial) 119 Mark XII (1200 Baud) 299 TRS-80 Color Computer 99 9 Volt Power Supply 9 Hayes Smartmodem 300 219 Smartmodem 1200 479 Smartmodem 1200B 459 Micromodem II 265 Micromodem I Plus 299 Micromodem IIE 269 Micromodem 100 299 Smart Com II 89 Chronograph 199 Novation J-Cat 99 SmartCat 103 179 SmartCat 103/212 399 AutoCat 219 212 AutoCat 549 Apple Cat II 249 212 Apple Cat 569 Apple Cat 212 Upgrade 309 Cat 139 D-Cat 149 PC-Cat 339 U.S. Robotics 212A Auto Dial 469 Password 375	ACCESSORIES 3M 5 1/4" SS/DD 19/Box 5 1/4" DS/DD (96TPI) 45/Box Memorex 5 1/4" SS/DD 19/Box 5 1/4" DS/DD 24/Box Elephant 5 1/4" SS/SD 16/Box 5 1/4" SS/DD 22/Box 5 1/4" DS/DD 28/Box Head 5 1/4" Disk Head Cleaner (2 Disk) 14 5 1/4" Disk Head Cleaner (1 Disk) 9 Koala Pad Commodore 64 69 Apple 79 IBM 89 Kraft Joystick 41 Apple Paddles 34 IBM Paddles 34 IBM Joystick 46 Print Wheels & Ribbons All Types Call DISK DRIVES CDC 5 1/4" 9409-DS/DD 379 Tandon 5 1/4" TM 100-1-SS/DD 160K 150 5 1/4" TM 100-2A DS/DD 320K 225 TM101-496 TPI Quad Den) 339 8" TM648-2(DS/DD) 1.2 MG 400 Indus GT—Apple 239 GT—Atari 349 Micro-Sci A-2 (35TR) 189 A-20 (35TR) 169 A-40 (40TR) 269 Rana Elite I 249 Elite II 399 Elite III 509 1000 319	Transient Protection With A Solid Reputation™  <p>General Semiconductor Industries, Inc. \$99⁹⁵ \$63⁰⁰</p>
MONITORS Amdek Video 300 GREEN 129 Video 300 AMBER 145 Color 1 Plus 225 Color II Plus 425 Comrex 9" Green 69 9" Amber 69 NEC JB 1201 155 JB 1260 115 Taxan 12" Amber 125 Zenith 12" Green Screen 95 12" Amber Screen 120	"STRONG ENOUGH TO STAND ON" LOCKING FILE CASE Can Stack, Hang on Wall, and Has Carrying Handle. SPECIAL \$18⁹⁰ 	SPECIAL PRICES Okidata Save \$ Epson Save \$ Toshiba (1351) Save \$	

COMPUTER CONNECTION



OLYMPIC MARATHON SALE CONTINUES - SAVE \$\$\$

★ ★ GOLD MEDAL SPECIALS ★ ★

★★★★★ IBM ★★★★★	★★★★★ TANDON ★★★★★
IBM PC, 64K, 1 Drive \$1550	TM100-2 for IBM PC \$ 179
IBM PC, 64K, 2 Drives 1745	TM 65-2, 1/2 Height, 320K 189
★★★★★ TEAC ★★★★★	★★★★★ CITOH ★★★★★
55B, 1/2 Height, 320K \$ 159	Prowriter 8510AP, 120 cps \$ 325
★★ 64K MEM. UPGRADE ★	★★★★★ OKIDATA ★★★★★
64K, 150ns, 1 yr. war. \$ 48	ML93P, 160 cps, Corr. Qual. \$ 639
	ML92P, 160 cps, Corr. Qual. 419

FREE 2-Piece, Anti-Static Dust Cover with Purchase of IBM PC or XT

PRINTERS

OKIDATA	
ML82A, 10" carriage \$ 298	
ML83A, 15" carriage 539	
ML92P, 160cps 419	
ML93P, 160cps 639	
C. ITOH	
Prowriter 8510AP, 120cps 325	
Prowriter II 1550AP, 15" 120cps ... 545	
Starwriter F10-40PU, 40 cps 969	
EPSON	
RX80FT, 120cps \$ 359	
FX80, 10", 160 cps 485	
FX100, 15" 160cps 699	
JUKI	
6100LQ 15", 18cps w/propor. spac. \$ 439	
STAR MICRONICS	
Gemini 110X, 120cps \$ 265	
Gemini 15X, 120cps 379	
MANNESMANN TALLY	
160L, 160 cps \$ 575	
PANASONIC	
1091 w/Tractor, 120cps, 1 yr. war. ... \$ 369	
BROTHER	
HR 15 \$ 399	

CALL FOR QUANTITY PRICING

DISPLAY MONITORS

USI	
P1 2(12" Green) \$ 110	
P13(12" Amber) 110	
AMDEK	
V300G, 12" Green \$ 119	
V300A, 12" Amber 139	
V310A for IBMPC 159	
Color II, 13" Color Composite 289	
Color II, RGB 399	
BMC	
12 UW(12" Green) \$ 89	
9191 Plus 229	
NEC	
JB 1201M, 80 col. \$ 149	
JB 1205M(A) w/audio 149	
JC 1216 RGB Hi-Res IBM comp. 389	
TAXAN	
IBM Green Monochrome #121 \$ 155	
IBM Amber Monochrome #122 159	
RGB IBM w/cable #420 469	
RGB Super Hi-Res #415 425	
RGB/Comp. Med. Res. #210 299	
PRINCETON GRAPHICS	
HX12, RGB for IBM \$ 469	

PRINTER ACCESS.

ORANGE MICRO	
Grappler + \$ 112	
Buffered Grappler +, 16K exp. 64K 169	
FOURTH DIMENSION	
Par. Card & Cable for Apple \$ 49	
TRACTORS	
Okidata for 82A & 92 \$ 49	
Juki Bi-Directional 129	
PRACTICAL PERIPHERALS	
Mic/Buf IIP, 16K \$ 145	
Mic/Buf IIS, 16K 149	
CABLES	
Any Computer to Parallel Printer \$ 29	

PERSONAL SYSTEMS

APPLE	
Apple IIe Starter System \$1195	
SANYO	
MBC550-2 w/1 Drive & sftwr \$ 945	
MBC555-2 w/2 Drives & more sftwr. 1250	
TAVA	
1 Par. & 2 Ser. Ports, 128K, 2 - 320K Drives, Color Card \$1725	

DISK DRIVES

SIEMENS	
FD100-B \$ 145	
Drives For Apple & Franklin MICRO-SCI	
A2 \$ 189	
QUENTIN RESEARCH	
Apple Mate \$ 199	
RAMA SYSTEMS	
Eitel \$ 229	
Eitel II 349	
Eitel III 429	
PANASONIC	
1/2 Height 360K \$ 165	
JMR	
JMR 100% Apple Comp. Drive \$ 179	
Controller Card 55	

IF YOU SEE IT ADVERTISED FOR LESS, CALL US FIRST FOR LOWEST QUOTE!

MAIL ORDER:

12841 S. Hawthorne Blvd., No. 585
Hawthorne, California 90250

ORDER DESK:

[213] 514-9019

Mon.-Fri. 8 a.m. to 6 p.m.
Sat. day 11 a.m. to 3 p.m.
We accept VISA, MasterCard, C.O.D. (w/Deposit).
Certified Checks or Wire Transfer. Shipping
minimum \$4.00. Some items subject to back order.
CA Res. add 6% Tax. Prices subject to change.



THE BYTE BROKER

WHERE YOUR BUCK TAKES A BIGGER BYTE

COMREX CR-II

\$ 399

EPSON RX-80

\$ 289

NEC PC 8201A

\$ 475

EPSON LQ-1500

\$ 1275

TOSHIBA P1340

\$ 795

SYMPHONY

\$ 495

AMDEK 310A

\$ 159

BROTHER HR-25

\$ 675

ANCHOR MARK XII

\$ 269

dBASE III

\$ 495

IBM P.C. - 256K RAM, 2 360K DRIVES, COLOR CARD & HIGH RES. MONITOR...\$2499

COLUMBIA 1600-1 - 128K RAM 2 ea. 320K DRIVES, 2 SER. & 1 PAR. PORTS, CLOCK/CALENDAR COLOR CARD, & COMES W/FREE \$2000 SOFTWARE PKG...\$2495

TELEVIDE TPC 1 PORTABLE - 64K RAM, 2 ea. 360K DRIVES CP/M W/GSX GRAPHICS DRIVER 9" MONITOR W/640 X 240 RES. PAR. & SER. PORTS. FREE INTEGRATED SOFTWARE PKG...\$1695

HARD DISKS

(W/ CONTROLLER)
RAWA 5 MB...\$849
PEGASUS 10 MB\$1149
I-2 21 MB...\$1795
PEGASUS 40 MB\$2445

PRINTERS

PROWRITER...\$359
BROTHER HR-15...\$419
DIABLO 620...\$875
EPSON FX-80...\$499
EPSON FX-100...\$699
JUKI 6100...\$449
OKIDATA 92P...\$459
TOSHIBA P1351\$1395

MONITORS

AMDEK COLOR 1...\$279
AMDEK COLOR II...\$419
BMC 12AU...\$89
PRINCETON HX-12...\$499
PRINCETON SR-12...CALL
** MAX-12...\$199
SAKATA SG-1000...\$99
SAKATA SC-100...\$279
TAXAN 420...\$509

MODEMS

ANCHOR MARK VI...\$179
" VOLKSMODEM...\$65
HAYES SMART 300...\$219
" SMART 1200B...\$419

MICROMODEM IIF...\$229
PROMETHEUS PRODUCT'S
PROMODEM 1200...\$389
RIXON R212A...\$459
US RBTCS PASSWORD...\$475

IBM PERIPHERALS

AST SIX PAK PLUS...\$274
AST MEGAPLUS...\$299
P.C. MOUSE...\$239
PERSYST COLOR CARDS\$239
PERSYST MONO CARD...\$249
" QUADCOLOR 1...\$209
TECMAR GRAPH. CARD...\$279
" GRAPHICS MASTER\$259

SOFTWARE

ASHTON TATE FRIDAY...\$209
" FRAMEWORK...CALL
CONT. HOME ACCT...\$109
HARVARD PROJECT MGR...\$279
IUS EASYWRITER II...\$289
MICROSOFT MULTIPLAN...\$189
WORDSTAR PRO-PACK...\$399
pfs:WRITE, FILE, REPORT, & GRAPH...\$109 ea.
SORCIM SUPERCALC 3...\$149
WORDPERFECT...\$299

IBM 64K UPGRADE W/PARITY...\$46

WE CARRY ALMOST EVERY COMPUTER/PERIPHERAL LINE

PRICES FOR PREPAID ORDERS ONLY & ARE SUBJECT TO CHANGE

CALL 1 (800) 841-6414

WE ACCEPT VISA & MASTERCARD MINIMUM SHIPPING \$4.00

P.O. BOX 1048 SLC, UT 84110

MEGA-BOARD™

new!

Ideal for

- **COMPUTERISTS**
- **OEM MANUFACTURERS**
- **DEVELOPMENT LABS**
- **UNIVERSITIES**
- **INDUSTRIAL APPLICATIONS**

THE ULTIMATE OEM/PC COMPATIBLE SINGLE BOARD COMPUTER

FULL IBM - PC* COMPATIBILITY!

DEALERS AND OEM MANUFACTURERS QUANTITY DISCOUNTS AVAILABLE

Standard Keyboard Interface
(Full PC compatible)

Hardware Reset
(Overcomes reset flaw in PC)

Eight Compatible I/O Interface Connectors

(Full PC compatible)
(compatible with all IBM-PC* plug-in cards)

Power Connector
(Full IBM* pinout compatible)

Special J1 Interface

(Allows horizontal mounting of compatible expansion cards for easy bus expansion and custom configuring) (Board has 62 pin gold plated compatible connector)

8088 Processor
(Same as PC)

8087 Numeric Processor
(Same as PC)

Peripheral Support Circuits
(Same as PC)

Extended ROM Capability

(Runs all compatible PC ROMS) (Jumper programmable to accommodate all popular 8K, 16K, 32K and 64K ROM chips and NEW EE ROMS! VPP power pin available for EP ROM burning!) (External VPP voltage required)

Configuration Switches
(Same as PC)

Speaker/Audio Port
(Same as PC)

Board Size

10.5 inch X 13.5 inch

Wire Wrap Area
To facilitate special custom applications!

ORDER NOW!!!

Full Mega-Byte Ram Capacity! On board!

(With parity)

- 256K Bytes using 64K chips
- 1 Mega Bytes using 256K chips

ONLY!
\$99⁹⁵
Evaluation Board Kit

MEGA-BOARD™ Evaluation Board Kit!

(Blank board with full assembly instructions and parts list.)

Includes highest quality PC board with gold plating, silk screen, solder mask

- MEGA-BOARD™** with full assembly instructions \$99.95
- USERS MANUAL** with theory of operation, schematics, block diagram, application notes \$19.95
- MEGA-BIOS™** fully compatible MS-DOS/PC-DOS BIOS \$29.95

ORDER NOW!!!

SATISFACTION GUARANTEED!

10-day money back guarantee if not completely satisfied.

DTC™ DISPLAY TELECOMMUNICATIONS CORPORATION

4100 SPRING VALLEY ROAD
SUITE 400
DALLAS, TX 75234
(214) 991-1644

TERMS: Shipment made 2 to 5 weeks from receipt of order. VISA, MC, money order, company check accepted. COD'S require \$25 deposit. Balance UPS COD. Please add \$2.00 shipping and handling per order.

*IBM and IBM PC are trademarks of International Business Machines

©1983 Display Telecommunications Corporation

PAL, EPROM PROGRAMMERS & UV ERASERS FROM \$49.95

LOGICAL DEVICES INC.

Where Reliability and Customer Support is of utmost Importance

SEE OUR AD ON PAGE 32



ORDER TOLL FREE
1-800-EEI-PROM
(1-800-331-7766)

Circle 86 on inquiry card.

SPECTACULAR LOWEST PRICES maxell DISKS LIFETIME WARRANTY



\$180 ea MD 1 5/4" Qty 20
\$240 ea MD 2 5/4" Qty 20

5 1/4" MD1-DDM SS/DD/96TPI .. \$2.65
5 1/4" MD2-DDM DS/DD/96TPI .. \$3.30
8" FD-1 SS/SD or DD .. \$2.85
8" FD-2 DS/DD .. \$3.30

1-800-328-3472

Dealer inquiries invited. COD's and charge cards accepted. All orders shipped from stock within 24 hrs.



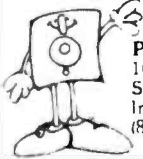
North Hills Corporation
3564 Rolling View Dr.
White Bear Lake, MN 55110
MN Call Collect 1-612-770-0485

Maxell Floppy Disks

The Mini-Disks with maximum quality.



Dealer inquiries invited. C.O.D.'s accepted. Call FREE (800) 235-4137.



PACIFIC EXCHANGES
100 Foothill Blvd. San Luis
San Luis Obispo, CA 93401.
In Cal. call (800) 592-5935 or
(805)543-1037.

Circle 243 on inquiry card.

IBM®

XT COMPATIBLE OEM COMPONENT SALE

Computer Case \$150.00
Key Board-KT5150 \$199.00
Power Supply \$225.00
Mother Board-Bare \$ 95.00
Mother Board without ICs \$225.00
Mother Board with ICs \$525.00

Dealers/OEM Buyers
Quantity Discounts Available.

All items are 100% XT compatible as replacement kits. Boards with ICs are tested and burn-in. Evaluation units are available at \$3,500 with 128K RAM, 10M Hard Disk, Floppy Drive, RGB Card, RS232 Serial, Parallel and Game Ports.

Subject to stock on hand
Price change without notice

IBM is a trademark of International Business Machine



HiTech International, Inc.
1180 Miraloma Way, Suite M
Sunnyvale, CA 94086
(408) 738-0601 TLX 171854 IBC

Circle 146 on inquiry card.

*IBM® PC Compatible



E-PROMS Call! Lowest Prices Anywhere

*4164-150/200 480
2764-250 675
6116-P3 499
HMM 256K Call for quote
IBM® PC, XTs... Cheapest anywhere

Disk Drives: (F.O.B. Tampa)

*TM-100-2 16995
*Half-Heights-2 16995
*10.mb Microscience w/cable & controller 89999

Add \$3.95 shipping to all orders • Prices subject to change • PO's on approval • C O D OK • All new, no surplus, no seconds. QUANTITY DISCOUNTS
4920 Cypress St., Ste. 100, Tampa, FL 33607
In FL and for info, call 813-875-0299

FOR ORDERS ONLY, 800-237-8910



8 AM-7 PM EDT

Circle 245 on inquiry card.

COBOL CROSS REFERENCE

Required:

IBM-PC, DOS-2.0, 128K memory, & one disk drive.

Limits:

1,400 data names & 11,000 references.

Prints cross reference and/or source code.
Accepts most versions of COBOL as input.
This is a stand alone program which will flag duplicate data names and invalid references.

Your name will appear in the report heading.

Please print your name and address distinctly.

Send a check or money order (\$95.00) to:

META SYSTEMS INC., OF ALASKA
2806 Iris Drive
Anchorage, AK 99503

Circle 198 on inquiry card.

SPEED UP YOUR dBASE PROGRAMS

with dB/RA, dBRX, dHELPER & RA+

Add arrays, math functions, syntax checking, animation & windowing.

Call or write for details!



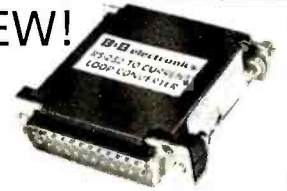
GRYPHON microproducts

P.O. BOX 6543 SILVER SPRING, MD. 20906
(301) 946-2585

Circle 136 on inquiry card.

RS-232 TO CURRENT LOOP CONVERTER

NEW!



Uses high speed optical isolators in both Transmit and Receive Data lines. An optional power supply is available to power the Current Loop. Order Now! Only \$49.95. Optional Loop Supply—\$14.95. Add \$1.75 for postage and handling (IL Res. add 6% sales tax). We accept MC, VISA, FREE: expanded illustrated catalog of interface and problem equipment. Phone: (815) 434-0846.

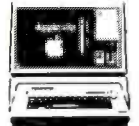
B & B electronics
MANUFACTURING COMPANY
P.O. Box 1008B, OTTAWA, IL 61350

Circle 31 on inquiry card.

HARMONY 800-221-8927
or 800-441-1144
212-627-1000

2357 Coney Island Ave., Brooklyn, N.Y. 11223

IBM-PC
\$1549.95
OKIDATA 92
\$379.95



PRINTERS	APPLE	FRANKLIN	
OKIDATA92	378	12000LHS	1255
OKIDATA93	584	1000PRO	764
GEMINIHX	244		
GEMINIYX	329		
RADIX 10	539	89 10M	4099
SURE ED550	479	114 PCBT	57
JUN 8008	364	129 ADOTL64K	129
PROWRITER	314	129 ADOTL DRIVE	189
STARWRITER	899	699 MONOCARD	209
EPSONRIBO	274	COLORCARD	199
EPSONRIBOF	859	PRINTERCARD	79
EPSONR100	509	148 TALL GRASS 12	2499
EPSONR100	439	399 HERCULES MASTER	299
BROTHER 15	359	124 A516PACK 64K	239
BROTHER 25	579	144 QUADBOARD	799
HEC3550	1479		
PANA 1090KXP	264	HEC 1215	
		MODEMS	
EAGLE		HAYES530	189
PC 2	1299	HAYES 1200	449
PCXL	1894	709 HAYES 1200B	394
FILE 10	999	869 MICROMODEM	224
		550 DD	
COMMODORE		1209 KAYPRO	
COMMODORE 64	189		1149
DISCRIVE	209		1719
MONITOR	219		2369

WE ALSO CARRY A FULL LINE OF COMMODORE AND ATARI PRODUCTS
PRICES & AVAILABILITY SUBJECT TO CHANGE WITHOUT NOTICE

Circle 140 on inquiry card.



COMPUTER DISCOUNT PRODUCTS

HUGE Inventories • APPLE-IBM Specialists

★ ASK ABOUT OUR FAIR PRICE POLICY - IT'S GUARANTEED! ★



Additional 10% OFF Your Order Of Any FIVE Educational Programs Includes D.L.M. Edware, Spinnaker, & Learning Co.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★

DISKETTES

	10	100
DYSAN 5" SS/DD	31.99	299.99
DYSAN 5" DS/DD	38.99	369.99
MAXELL 5" SS/DD	27.99	259.99
MAXELL 5" DS/DD	37.99	359.99
VERBATIM 5" SS/DD	24.99	235.99
VERBATIM 5" DS/DD	35.99	344.99

MEMOREX 3 1/2" (MAC) 41.99

DISKBANK
Media Mate



SYSTEM
5 1/4"
HOLDS 50
\$22

SHARPEN YOUR SKILLS THIS SUMMER!

ALGEBRA I-III, Ap	31.99
ALGEBRA I, IBM	34.99
FLIGHT SIM II, Ap	37.99
FLIGHT SIM, IBM	34.99
FRACTION FEVER, Ap/IBM	21.99
MASTERTYPE, Ap	29.99
MASTERTYPE, IBM	34.99



SPINNAKER

FOR APPLE & IBM

ALPHABET ZOO	19.99
DELTA DRAWING	32.99
FACEMAKER	21.99
HEY DIDDLE	19.99
KINDERCOMP	19.99
MOST AMAZING THING	26.99
RHYME & RIDDLE	19.99
SNOOPER TROOPS I & II	27.99
STORY MACHINE	21.99

APPLE SOFTWARE

BPI (GL, AP, AR, PAY, INV)	ea275.99
BRODSERBUNO Arcade Machine	39.99
Bank Street Writer	44.99
Cmd. Loderunner	ea24.99
CENTRAL POINT Copy II +	25.99
OLM Alien Addition	27.99
Alligator Mix	27.99
Demolition Division	27.99
Dragon Mix	27.99
Meteor Multiplication	27.99
Minus Mission	27.99
Verb Viper/Word Invasion	ea37.99
Word Radar/Spelling Wiz	ea37.99
EDUWARE Counting Bee	23.99
Decimals / Fractions 3.0	ea34.99
Haris on Basic	61.99
PSAT Word Attack	39.99
SAT Word Attack	39.99
JACK REPORT	74.99
KENSINGTON Format II	119.99
KOALA Spider Eater	23.99
LEARNING CO Bumble Games	26.99
Bumble Plot/Magic Spell	ea26.99
Gertrudes Puzzle/Secret	ea26.99
MopTown Parade/Hotel	ea26.99
Rocky's Boots	34.99
MICROLAB Miner 20-49er	27.99
MICROSOFT Multiplan	165.99
ODESTA Chess	45.99
Orkin	37.99
PFS Report	85.99
File	85.99
Graph	85.99
Write	85.99
SENSIBLE SPELLER	87.99
SUBLOGIC Night Mrs. Pinball	32.99
THUNDERCLOCK	99.99
ULTIMA III	39.99

Continental

APPLE GRAPHICS BOOK	14.99
CPA (GL, AP, AR, PAY) (AP)	ea149.99
FCMFL 1st CLASS MAIL (AP)	59.99
FCMFL 1st CLASS MAIL (IBM)	71.99
HOME ACCOUNTANT (AP)	44.99
HOME ACCOUNTANT (IBM)	84.99
PROPERTY MGMT. (AP, IBM)	295.99
TAX ADVANTAGE (Ap)	39.99
TAX ADVANTAGE (IBM)	49.99

ULTRAFILE (IBM) 119.99

KENSINGTON MICROWARE



SYSTEM SAVER

- Surge Suppression
- Fits Apple Stand
- Dual Outlet
- U.L. Listed

\$ 65

INFOCOM

FOR APPLE & IBM	
DEADLINE, ENCHANTER	ea32.99
PLANETFALL	32.99
SUSPENDED	32.99
WITNESS	32.99
ZORK I-III/STARCROSS	ea24.99
SORCERER	37.99

ACCESSORIES

FLIP N FILE (Original)	17.99
FLIP N FILE w/Lockkey (25)	17.99
FLIP N FILE w/Lockkey (50)	27.99
HAYES 300 Baud Smartmodem	199.99
1200 Baud Smartmodem	474.99
LIBRARY CASE	1.99
KENSINGTON PC Saver	29.99
PRINTERS C/ITOH	379.99
Epson FX80	549.99
Epson FX80	349.99
Okidata 82-93	SCALL
PRINTER STAND Sm. (plxgls)	24.99
PRINTER STAND Lg. (plxgls)	29.99
RIBBONS Brother	5C#
MX & FX 80	4.99
MX & FX 100	7.99
OKI 82, 83, 92, 93 & Germn	2.99

FINGERPRINT: Epson Upgrade
RX, FX, MX 44.99

APPLE HARDWARE

ALS CRM 30	259.99
AUTO REPEAT KEY	19.99
BASIS 108	SCALL
DAN PAYMAR Lower Case 1 (rev 1-6)	25.99
Lower Case 2 (rev 7)	19.99
DARK STAR Snapshot II	65.99
EASTSIDE Wildcard	79.99
Wildcard I	11.99
FOURTH DIMENSION Drive	216.99
HAYES Modem IBM	235.99
KOALA PAD	85.99
KRAFT Joystick	44.99
Paddles	31.99
LEGEND 128K Ram	359.99
MICROSOFT A-2 Drive	209.99
MOUNTAIN Rampus + 32K	159.99
ORANGE MICRO Grappier +	114.99
Bullerboard	119.99
Bullerboard Grappier +	179.99
PADDLE ADAPPLE	24.99
TITAN TECH 128K Ram	379.99
Accelerator II	444.99
Nightgine 64k	199.99
TG Joystick	34.99
Paddles	25.99

IBM

1/2 Height DS/DD Drive	239.99
ALPHA Typefaces	79.99
ASHTON TATE dBase II	399.99
Friday	184.99
Encyclopeda	59.99
AST Mega Plus	299.99
Six Pack Plus	279.99
BRODERBUND Serpentine	26.99
Load Runner	24.99
CAI Masters	ea31.99
Subjects	ea16.99
CENTRAL POINT Copy II PC	25.99
CROSSTALK	139.99
HAYDEN Pewriter	129.99
HAYES 1200B Modem	439.99
KRAFT Joystick	44.99
LIFETREE VoiceWriter	119.99
LOTUS 1-2-3	SCALL
MICROLAB Miner 20-49er	27.99
MICROSOFT Mouse	129.99
Multiplan	165.99
MONOGRAM Dollars & Sense	129.99
NORTON Utilities	55.99
PC CRAYON	49.99
Tutor	47.99
PFS Write	99.99
File	99.99
Report	89.99
Graph	99.99
POOL 1.5	27.99
SIERRA ON-LINE Frogger	26.99
SIR-TECH Wizardry	44.99
SUBLOGIC Night Mrs. Pinball	32.99
TG Joystick	44.99
TITAN 64K BOARD	49.99
VISCORP Viscalc	164.99
Schedule,	ea199.99

PLANTRONICS ColorPlus 375.99

Sierra ON-LINE INC

FROGGER (Ap)	21.99
GENERAL MANAGER	146.99
HOME WORD	49.99
SCREENWRITER II	81.99
ULTIMA II	36.99
BC QUEST FOR TIRES	NEW!
OILS WELL	NEW!

Beagle Bros

ALPHA PLOT	24.99
APPLE MECH., FLEX TEXT	ea19.99
BEAGLE BASIC, DOUBLE TAKE	ea24.99
DOS BOSS	15.99
FRAME-UP	16.99
GPLE	32.99
PRONTO DOS	19.99
TIP DISK #1	14.99
TYPEFACES	14.99
UTILITY CITY	19.99


QUADRAM

APIC (APPLE // PARALLEL)	129.99
eRAM 80 column 64K IE	SCALL
MICROFAZER 8K Parallel	139.99
MICROFAZER 8K Serial	159.99
QUADCARD I or II (64K)	269.99
QUADCOLOR I	205.99
QUADCOLOR I UPGRADE	209.99
QUAD 512+(64K)	219.99

QUADLINK 479.99

Videx

ENHANCER II	99.99
FUNCTION STRIP	34.99
HARDSWITCH	16.99
MICROMODEM CHIP	24.99
PSID	169.99
PRE-BOOTS Apple Writer	14.99
Apple Writer for Ultraterm	23.99
Viscalc	39.99
Viscalc Memory Expansion	71.99
Viscalc for Ultraterm	54.99
SOFTSWITCH	25.99
ULTRALINK	SCALL
ULTRATERM	249.99
VIDEOTERMw/SS + INV	219.99

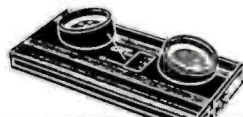
CDP Is Your
AUTHORIZED  **MicroPro** DEALER!
This month We'll Match
Any Published Price
Same Terms - At Time Of Order
This Issue Only \$CALL

MONITORS

PRINCETON RGB HY-12	485.99
TAXAN 420 RGB	499.99
USI Pt 1 9" Green 20 mh	99.99
USI Pt 2 12" Green 20 mh	119.99
USI Pt 3 12" Amber 20 mh	129.99
USI Pt 4 9" Amber 20 mh	109.99
USI 1400C Color Composite	279.99

Novation

103 Smart Cat	169.99
103/212 Auto Cat	399.99
J Call	99.99
Access 123 (IBM)	469.99
Appicat I	249.99
Appicat Upgrade 1200 Baud	309.00
Cat Modem	135.99
Expansion Module	29.99



- SINCE 1977 -
RETAIL SHOWROOMS
IN CALIFORNIA:
San Jose • (408) 241-2300
San Mateo • (415) 571-1658
San Francisco • (415) 626-2244

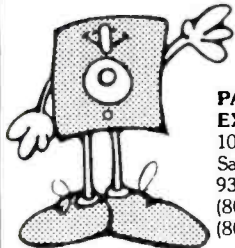
COMPUTER DISCOUNT PRODUCTS
860 S. Winchester Blvd., San Jose, California 95128
MAIL, PHONE, WILL-CALL SERVICE FROM FROM 6AM (PST)
- CALL (408) 985-0400 -

- No Charge For Credit Cards
- Prices Subject To Change
- Software Sales Are Final
- International Orders Welcome
- Min. UPS Chg. \$4 + Ins.
- Min. US Postal Chg. \$10
- P.O.'s Welcome - Call First



Verbatim flexible disks

Call Free (800) 235-4137 for prices and information. Dealer inquiries invited. C.O.D. and charge cards accepted.



PACIFIC EXCHANGES
100 Foothill Blvd.
San Luis Obispo, CA
93401. In Cal. call
(800) 592-5935 or
(805) 543-1037.

Circle 243 on inquiry card.

STAND-BY POWER SUPPLY



- 200 WATTS
- 10 MINUTE BACKUP TIME
- BATTERY INCLUDED

Fits most desktop and portable computers. Complete, just plug it in. 4-(3 prong) outlets on back protected by line filters. Neat, clean appearance on desk. Don't risk damage or data loss with POWER FAILURES.

MODEL BC200-10

\$288*

Units available to 1000 Watts

312-490-9239
SHEPHERD MARKETING
P.O. BOX 941339
SCHAUMBURG, IL 60194

*Add \$7 each shipping & handling

Circle 279 on Inquiry card.

Analog and Power Control I/O..... in a Single Board Computer



6801 Micro Control System designed for DISTRIBUTED, CONTROL or STAND-ALONE use: 6801 or 68701 MPU with 2K ROM or EPROM, 128 RAM, timer. Eight 12-bit analog inputs, 8-bit analog output, 8 AC or DC inputs or outputs, serial I/O, digital I/O, power supply.



Wintek Corp.
1801 South Street
Lafayette, IN 47904
317-742-8428

Circle 332 on inquiry card.

Buy/Sell Used Hardware Without Risk!!!

In addition to receiving a monthly newsletter containing latest computer information and sales, membership allows you 1 free ad plus additional ads at reduced prices. Buyer selects ad, sends purchase price to Computer Swap Shop who holds same in escrow and notifies seller who ships to buyer. Buyer has 7 days to examine the equipment and if satisfied, seller receives sales price less small commission; otherwise, money is refunded. You must be a member to buy or sell with Computer Swap Shop Inc.

NO RISK! BONDED.

Send \$20 subscription fee to:

Computer Swap Shop, Inc.
Box 2988
Delray Beach, FL 33444

Circle 71 on inquiry card.

VIRTUAL MEMORY FILE MANAGER IBM-PC/XT

DOS 2.00 +, MICROSOFT
& LATTICE C COMPILERS

Check These Features!

- Data, limited only by disk capacity, referenced as if always in memory.
- Multiple, independent swap buffers.
- Multiple files cached in any buffer.
- Highly efficient swap algorithm.
- Automatic file updating.
- Data prefetching supported.
- Data may be locked in memory.
- Memory buffers may be flushed.
- Includes complete heap management.
- Source code available.



\$299

Contact:
MindBank, Inc.
4620 Henry Street
Pittsburgh, PA 15213
412/683-9800

VISA/MASTER CARD ACCEPTED

Circle 220 on Inquiry card.

TROUBLESHOOTING MICROPROCESSOR-BASED EQUIPMENT AND DIGITAL DEVICES

Attend this *highly acclaimed seminar and master the essentials of microprocessor maintenance. Gain a firm understanding of microprocessor fundamentals and learn specialized troubleshooting techniques. \$695.00

1984 FALL/WINTER SCHEDULE

- Washington, DC - September 11-14
- Boston - September 18-21
- Phoenix - October 9-12
- Los Angeles - October 16-19
- Atlanta - November 6-9
- Miami - November 13-16

*References provided upon request.

MICRO SYSTEMS INSTITUTE
Garnett, Kansas 66032
(913) 898-3265

Circle 343 on Inquiry card.

Guarantee + Savings NEW Memorex DISKETTES

- 19**⁹⁵ One side, double or single density. 10 per box. All soft sector. Min. 2 boxes.
23⁹⁵ Two sides, double density. 10 per box. Soft sector for IBM and compatibles.
42⁹⁵ New 3 in. microdisk cartridge. One side, double density. Macintosh, Lisa, H-P.

Orders shipped same day received
Priced per box—minimum 2 boxes
Visa, MasterCard, checks accepted
Money-back guarantee
Order with confidence!

All prices for box of 10
Add \$2.50 shipping & handling

1-800-292-1492

Nationwide

312-726-7879

In Illinois

DISK WORKS

131 W. Madison St., P.O. Box 11375
Chicago, IL 60602

Circle 344 on inquiry card.

MEMORY MODULES

8Kx8 CMOS Ram

Designed for the briefcase portables
Radio Shack Model 100
NEC PC-8201A
Olivetti M10

Its easy to expand your memory! Our module just plugs in to the socket. Complete installation instructions are included. We guarantee full satisfaction and ease of installation or return within 30 days for a prompt refund.

Each part is fully tested and warranted for 1 year. We have stock and will ship within one day of your order.

Save up to \$50.00 on each module. Single unit price is \$69.95 — includes shipping and handling.

Call for quantity pricing:

Nation Wide: 1 - (800) 732-5012
California Residence: 1 - (805) 987-4788

CALL NOW

PURPLE COMPUTING
2068 Ventura Blvd.
Camarillo, CA 93010



Circle 258 on inquiry card.

HALF HEIGHT DRIVES



- SHUGART: SA 455**
Double Sided, 40 TRK/Side \$189
CDC: 9428
Double Sided, 40 TRK/Side \$195
PANASONIC: 551-2
Double Sided, 40 TRK/Side \$179

- 120 Day Warranty
- Free Shipping
- No Charge For Credit Cards
- Order Toll Free



1-800-531-5475 (Outside Of Texas)
(512) 250-1489 (In Texas)

Texas Residents Add 5% Sales Tax.

CompuAdd Corp.

13010 Research Blvd., Suite 101
Austin, Texas 78750

Circle 59 on inquiry card.

74LS00

74LS00	.60	74LS166	2.50
74LS01	.60	74LS168	1.35
74LS02	.60	74LS169	1.35
74LS03	.60	74LS170	2.50
74LS04	.75	74LS173	1.50
74LS05	.75	74LS174	1.50
74LS08	.75	74LS175	1.50
74LS09	.75	74LS181	2.50
74LS10	.65	74LS190	1.45
74LS11	.75	74LS191	1.45
74LS12	.75	74LS192	1.35
74LS13	.95	74LS193	1.35
74LS14	1.25	74LS194	1.45
74LS15	.75	74LS195	1.35
74LS20	.60	74LS196	1.35
74LS21	.75	74LS197	1.35
74LS22	.75	74LS221	1.35
74LS26	.75	74LS240	1.85
74LS27	.75	74LS242	1.85
74LS28	.75	74LS243	1.65
74LS40	.75	74LS244	2.25
74LS42	.95	74LS245	3.95
74LS48	.95	74LS247	1.65
74LS51	.60	74LS248	1.65
74LS54	.60	74LS249	1.65
74LS55	.60	74LS251	1.75
74LS73	.95	74LS253	1.75
74LS74	1.42	74LS258	1.50
74LS75	.95	74LS259	2.95
74LS76	.95	74LS260	1.15
74LS78	.95	74LS261	3.75
74LS83A	1.15	74LS266	1.35
74LS85	1.25	74LS273	1.75
74LS86	.75	74LS275	4.95
74LS90	.95	74LS279	.95
74LS92	.95	74LS283	1.25
74LS93	.95	74LS290	1.25
74LS95	.95	74LS293	1.25
74LS96	1.25	74LS295	1.65
74LS107	.75	74LS298	1.65
74LS109	.75	74LS323	4.95
74LS113	.95	74LS324	2.15
74LS114	.95	74LS347	2.55
74LS122	1.05	74LS348	2.55
74LS123	1.35	74LS352	1.65
74LS124	1.35	74LS353	1.95
74LS125	.95	74LS363	1.95
74LS126	.95	74LS365	1.25
74LS132	1.35	74LS366	1.25
74LS133	.95	74LS367	.95
74LS136	.95	74LS368	.95
74LS138	1.10	74LS373	2.50
74LS139	1.10	74LS374	4.95
74LS145	1.75	74LS375	1.25
74LS148	1.75	74LS377	1.95
74LS151	1.25	74LS378	2.55
74LS153	1.25	74LS385	1.95
74LS154	1.70	74LS379	2.55
74LS155	1.25	74LS386	1.25
74LS156	1.35	74LS381	3.95
74LS157	1.25	74LS390	2.55
74LS158	1.25	74LS393	2.55
74LS160	1.25	74LS395	2.55
74LS161	1.25	74LS424	3.95
74LS162	1.25	74LS640	3.95
74LS163	1.25	74LS668	2.75
74LS164	1.65	74LS645	4.95
74LS165	1.25	74LS670	2.50
		74LS690	2.50

74S00

74S00	.75
74S02	.75
74S03	.75
74S04	.75
74S05	.75
74S08	.95
74S09	.95
74S10	.95
74S11	.95
74S15	.95
74S20	.95
74S22	.95
74S30	.95
74S32	.95
74S38	1.95
74S40	.95
74S51	.95
74S64	.95
74S65	.95
74S74	1.50
74S86	1.25
74S112	1.25
74S113	1.25
74S114	1.25
74S124	3.65
74S133	.95
74S134	1.25
74S135	1.65
74S136	2.25
74S138	1.95
74S139	1.95
74S140	1.25
74S151	1.95
74S153	1.95
74S157	1.95
74S158	1.95
74S160	2.95
74S161	3.95
74S163	3.95
74S174	2.25
74S175	2.25
74S188	3.55
74S194	2.55
74S195	2.55
74S196	2.55
74S225	7.75
74S240	2.95
74S241	2.95
74S242	3.95
74S243	3.95
74S251	2.25
74S253	2.25
74S257	1.95
74S258	1.25
74S260	1.25
74S280	2.95
74S283	3.95
74S287	3.95
74S288	3.95
74S289	4.95
74S373	3.95
74S374	3.95
74S387	3.95
74S471	7.95
74S472	7.95
74S473	7.95
74S474	9.95
74S475	9.95

GENERAL PURPOSE BOARDS
BLANK BOARD — HOLES ON 100" GRID, No ETCHED CIRCUIT
EXCEPT CONTACT FINGER

	No. Contacts	Size	Contact Centers	Price
P 441-1	22/44	4.5" x 6"	156"	9.95
P 442-1	22/44	4.5" x 9"	156"	10.95
P 721-1	36/72	4.5" x 6"	100"	9.95
P 722-1	36/72	4.5" x 9"	100"	10.95

D— SUBMINIATURE CONNECTORS

Description	Solder Cup		Right Angle PC Mounting		Hood	
	Pin	Socket	Pin	Socket	Grey	Black
Part No.	DXXP	DXXS	RDXXP	RDXXS	DXXCGY	DXXC
Contacts	9	2.05	2.65	3.90	3.20	1.55
	15	2.05	3.60	3.70	5.40	1.55
	25	2.50	3.25	4.50	4.80	1.25
	37	4.75	7.10	9.40	10.95	2.95
	50	6.00	9.25	---	---	3.50

MODEMS

HAYES	IBM PC SMARTMODEM 1200B, Plug-in	449.00
	SMARTCOM II COMMUNICATIONS SOFTWARE	99.00
	SMARTMODEM 300, AUTO ANS/DIAL, 300 BAUD, RS232	199.00
	SMARTMODEM 1200, AUTO ANS/DIAL, 1200 BAUD, RS232	475.00
	SMARTMODEL Iie, 300 BAUD, AUTO ANS/DIAL, Plug-in	249.00
	SMARTCOM I COMMUNICATIONS SOFTWARE	79.00

RESISTORS

WATT	5% CARBON FILM	FROM 1 OHM TO 10M OHM
50 pcs	.99	.02 ea
100 pcs	1.89	.019 ea
1000 pcs	9.50	.010 ea
5000 pcs	42.50	.009 ea

WATT	5% CARBON FILM	
50 pcs	1.25	.025 ea
100 pcs	2.35	.024 ea
1000 pcs	11.50	.012 ea
5000 pcs	52.50	.011 ea

JOYSTICK FOR APPLE II \$19.95

Joy Stick for IBM P/C \$22.95

8087 MATHEMATICS \$189.00 CO-PROCESSOR

Apple II/Ie Compatible Disk Drive \$139.00

FOR APPLE II & Iie 16K RAM CARD \$39.95
Compatible with DOS 3.3 CPM, Visicalc, PASCAL, 1 YR WARRANTY

CONTROLLER CARD \$44.95

Speedy EPROM Programmer for Apple II \$149.00
Programming 2716, 2732, 2732A, 2764, 27128, 2516, 2532, 2564 in 30 seconds, software control programming, no additional hardware required.

New Multichannel Hobby Microwave Antenna System
Freq. Range: 2.1 - 2.7 GHz

- Includes:
1. Wide Band Probe With Down Converter
 2. 20" White Painted Dish
 3. 60' and 3' Coax Cable Set
 4. Steel Case 5 - 20 DCV Tuneable Power Supply
 5. Mounting Accessories and Instructions
- ALL FOR \$97.95**

IC SOCKETS

WW = WIRE WRAP

1 - 99	100
8 PIN WW	.55
14 PIN WW	.65
16 PIN WW	.65
18 PIN WW	.89
20 PIN WW	1.00
22 PIN WW	1.15
24 PIN WW	1.19
28 PIN WW	1.45
40 PIN WW	1.89

LP = LOW PROFILE

6 PIN LP	.10
8 PIN LP	.12
14 PIN LP	.14
16 PIN LP	.16
18 PIN LP	.18
20 PIN LP	.28
22 PIN LP	.28
24 PIN LP	.30
28 PIN LP	.40
40 PIN LP	.48
64 PIN LP	4.10

U/V EPROM ERASER General Industries \$37.50

SUPER COOLING FANS FOR APPLE WITH SURG \$37.50

MOSS EPRON

2708	5.95
2716-450	3.95
2732-450	5.95
2732-250	6.95
2764-450	7.95
2764-250	9.95
2764-300	9.95
27128-250	25.95
TMS2516	4.95
TMS2716	7.95
TMS2532	5.95

STATIC RAM

2101	2.95
5101	4.95
2114-450	1.95
2114-200	2.15
2147	4.95
6116-4	5.75
6116-3	6.75
6116-2	7.95
6116LP-4	6.75
6116LP-3	6.95
6116LP-2	8.95

SOUND CHIPS

76477	2.95
76489	8.95
AY3-8910	9.95
AY3-8912	12.95



CRYSTALS

32.758khz	1.75
1.0mhz	3.95
1.8432	3.95
2.0	2.95
2.097152	2.95
2.4576	2.95
3.2768	2.95
3.579535	.95
4.0	2.95
5.0	2.95
5.0688	2.95
5.185	2.95
5.7143	2.95
6.0	2.95
6.144	2.95
6.5536	2.95
8.0	2.95
10.0	2.95
10.738635	2.95
12.00	2.95
14.31818	2.95
15.0	2.95
16.0	2.95
17.430	2.95
18.0	2.95
18.432	2.95
20.0	2.95
22.1184	2.95
32.0	2.95

1984 IC Master Manual \$79.95 plus \$5.00 shipping

DYN. RAM

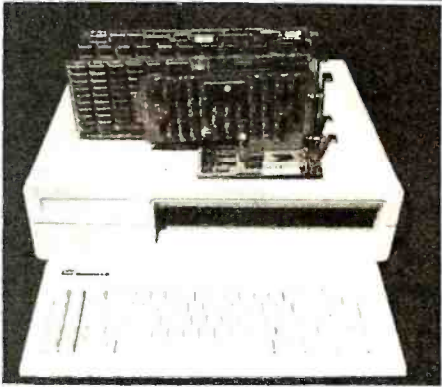
4116-200	1.95
4116-150	2.25
4116-120	2.95
4164-200	6.75
4164-150	6.95

MISC

8031	24.95
8035	5.95
8039	12.50
8085	14.95
8086	24.95
8087	189.00
8088	24.95
8155	12.95
8212	3.25
8237A	22.95
8250	14.95
8251	9.95
8253	9.95
8255	9.95
8257	5.95
8259	5.95
8279	9.95
8284	9.95
8286	24.95
8288	21.95
8748	55.00
6502	4.95
68000	39.95
Z80ACPU	3.95

DEALER AND OEM ARE INVITED
Completed Unassembled System Hardware Only

Build Your IBM™ PC/XT Compatible at Competitive Prices \$1,687



- MULTIFUNCTION BOARD**
- 2 serial ports, 1 parallel port real time clock, 64K RAM up to 256K RAM 249.00
 - Floppy disk drive controller board 169.00
 - Hard disk controller board/DTC 5150BX 299.00
 - Color graphic board 299.00
 - Monochrome + color + graphic board 299.00
 - Panasonics disk drive, 320k, half height 159.00
 - Hard disk drive 10 MB/Shugart SA712 699.00
 - 100W power supply with fan 169.00
 - Case 119.00
 - Manual 25.00
 - Keyboard 149.00
 - High resolution color RGB monitor/Taxan 449.00
 - High resolution green monitor/Taxan 129.00
 - Monitor stand 19.95
 - Hayes 1200B modem 449.00
 - Hayes 1200 modem 475.00
 - Tandon TM100-2A 199.00
 - 64K Memory Expansion Kit 44.95
 - 50 5 1/4 Diskette Store 19.95
- MOTHER BOARD:**
- 8088 CPU with socket for co-processor 8087
 - 8088 is supported by 8259A interrupt controller and 8237 DMA controller
 - 2 (two) 28 pin sockets for ROM
 - 8 (eight) expansion slots
 - No RAM on board (RAM is on multifunction board)
- Bare Board 69.00
Ready Board 199.00
(With IC sockets, resistors, capacitors, connectors, crystals, transistors soldered)
Tested Board (w/o ROM) 399.00
IC kit 199.00
- IBM is the trademark of International Business Machines. Prices subject to change without notice.

7400 SERIES CALL FOR PRICE

- CAPACITORS**
- Ceramic Disc
 - Electrolytic
 - Tantalum
 - Mylar
 - Monolithic

TERMS For shipping include \$2.00 for UPS Ground or \$3.00 for UPS Blue Label Air. Items over 4 lbs. require additional shipping charges. \$10.00 minimum order.

IBM is a trade mark of International Business Machines Corporation. Apple is a trade mark of Apple Computer.

Price is subject to change without notice.
Handwellcorp
4962 EL CAMINO REAL • LOS ALTOS, CA 94022 • (415) 962-9265
TXL 171947 HANDWELL LTOS

dy Jan Dyan CORPORATION

SPECIAL DISKETTE OFFER

The Dyan quality difference is yours to try with advanced production techniques that assure every diskette to be 100% error-free.

PLUS! If you call, write, or utilize reader service in response to this ad—we'll send you our full-range catalog of computer supplies with Special Offers good for further savings on Dyan diskettes and many other quality products.

LYBEN COMPUTER SYSTEMS
1250-E Rankin Dr., Troy, MI 48083
Phone: (313) 589-3440

Simply #1 in Service & Reliability

DISCOVER THE DYAN DIFFERENCE

Circle 185 on inquiry card.

State-Of-The-Art INTELLIGENT PRINTER BUFFER

- **TWO** printers controlled simultaneously
- **SMART-MERGE** (allows address lists and form letters to be merged in the buffer)

INTELLIGENT, microprocessor controlled:
• **ABORTS** a job instantly • **VERIFIES** job stats instantly • **CHECKS** status of available memory • **TWO-WAY** communication via a unique ASCII command structure.

SMARTY is available with either centronics or serial interface and 64K or 256K of RAM. **SMARTY** is also available as a board level product for integration into your system or in an attractive 5" x 7" box with its own power supply. Suggested retail price: \$349.00. Major credit cards accepted. Call for dealer and OEM discounts!

Phoenix Electronic Development Corporation
618 Venice Boulevard
Marina del Rey, CA 90291
(213) 827-2511

Circle 248 on inquiry card.

PRINTER RIBBONS

	PRICE	PER RIBBON	PER DOZEN
ANADIX 9500	10.50	109.80
APPLE DMP	5.25	52.20
C. ITOH PROWRITER	5.25	52.20
EPSON MX-FX 70/80	5.00	48.00
EPSON MX-FX 100	6.75	69.00
GEMINI 10-10X-15-15X	2.50	23.40
IBM HARMONICA 1/2"	6.75	78.00
IBM HARMONICA 3/4"	7.95	92.40
IBM 4-COLOR	15.75	180.00
IDS MICROPRISM-480	5.75	58.80
IDS PAPER TIGER 460/560	6.75	78.00
IDS PRISM	7.95	92.40
IDS 4-COLOR	15.75	180.00
NEC - 3500 M/S Non Flip	6.25	69.00
NEC - 3500 NYLON	9.00	96.00
NEC PC-8023A	5.25	52.20
OKIDATA 80/82/83/92	2.50	23.40
OKIDATA - 84	5.00	57.00
RADIO SHACK DMP-2100	7.50	87.00
RADIO SHACK LP VI & VIII	5.75	58.80
SILVER REED EX 550 S/S	5.00	57.00
SILVER REED EX 550 NYLON	9.00	105.00
TOSHIBA - 1350	7.50	87.00
XEROX 610/620 M/S	5.95	66.00

Add \$3.00 Ship. & Hand. — To Order Call
Toll Free 1-800-742-1122
In MI (313) 569-3218 or Write for our Catalog
DWIGHT COMPANY, INC.
15565 Northland Drive - West Tower
Southfield, Michigan 48075-6496

Circle 113 on inquiry card.

SPECTACULAR

LOWEST PRICES
3M DISKETTES
LIFETIME WARRANTY

\$168 ea 5 1/4" SS/DD (744) Qty 20
\$219 ea 5 1/4" DS/DD (745) Qty 20

5 1/4" SS/QD/96TPI ... \$2.55
5 1/4" DS/QD/96TPI ... \$3.20
8" SS/SD \$2.00
8" SS/DD \$2.45
8" DS/DD \$2.95

1-800-328-3472

Dealer inquiries invited. COD's and charge cards accepted. All orders shipped from stock within 24 hrs.



North Hills Corporation
3564 Rolling View Dr.
White Bear Lake, MN 55110
MN Call Collect 1-612-770-0485

**THE OFFICIAL
NUMBER TO CALL
TO FIND OUT
MORE ABOUT
THE UNOFFICIAL
APPLE LOGO:
617-492-8816**



Terrapin, Inc., 380 Green Street,
Cambridge, MA 02139, (617) 492-8816

Circle 304 on inquiry card.

ELIMINATE CABLE SWAPPING
of a price NO ONE can beat!



PI-01\$ Two-way \$ 59.95
PI-03\$ Three-way \$ 89.95
PI-05\$ Five-way \$109.95
PI-08\$ Eight-way \$209.95
PARALLEL TWO-WAY \$ 94.95

- TRANSFER SWITCH FEATURES**
- PI-SWITCH lets you SAFELY SHARE multiple SERIAL (RS-232) devices.
 - Great for printers, modems, etc.
 - Handsome black and beige case/female DBC-25 connectors
 - Switches pins 1-7 & 20 or set any way you need before shipping.
 - Male connectors available.

ONE (1) YEAR WARRANTY

TERMS: M.O. Check, Mastercard, Visa, COD.
UPS ground \$2/ each, 2nd air \$4/each. COD add \$2 per order.

Please call for your CUSTOM switch needs.
SAB-LINK, Inc.
7301 N.W. 41 Street, Miami, FL 33166
(305) 592-6092
Dealer inquiries welcome!

Circle 273 on inquiry card.

GILTRONIX SWITCHES ARE THE BEST CHOICE.

... and here are 10 good reasons why:

- | | |
|---|---|
| <p>IBM PC</p> <ol style="list-style-type: none"> 1. Serial (RS232) or Parallel (Centronics) 2. Prompt Delivered Products 3. Nationality Advertised Products 4. Broad Product Line 5. Over 30,000 Units Sold to Date 6. Sales and Technical Support | <p>APPLE</p> <ol style="list-style-type: none"> 7. F.C.C. Approved Units 8. Manual and Automatic Units 9. Highest Quality PC Board Switch Technology 10. Buy Direct From Giltronix, or From Any Authorized Distributor |
|---|---|
- Manual Units—2 to 6 Ports
Automatic Units—3 to 15 Ports

Apple is a registered trademark of International Business Machines Corporation.



3780 Fablan Way
Palo Alto, CA 94303
(415) 493-1300

ORDER HOT-LINE: 1-800-531-1300 (Outside of Callarea)

Circle 135 on inquiry card.

S-100 EPROM PROGRAMMER

EPROM-32

- Field-proven board meets IEEE-696 standard.
- Programs 1K through 32K (byte) EPROMs.
- Textual zero-insertion-force programming socket.
- EPROM is programmed through I/O ports and can be verified through I/O ports or located in memory space for verification.
- Programming voltage generated on-board.
- Personality Modules adapt board to EPROMs:
PM-1—2508, 2758 PM-3—2732, 2732A PM-6—68764
2516, 2716 PM-4—2564 PM-8—27128
PM-2—2532 PM-5—2764 PM-9—27256
- Feature-packed CP/M-compatible control software includes fast programming algorithm.
- One year warranty

\$269.95*
(A & T)

MicroDynamics Corporation

Suite 245 • 1355 Lynnfield Road • Memphis, TN 38119
(901)-682-4054

* Price includes EPROM-32, documentation and two Personality Modules (specify). Additional Modules—\$7.95. Control software on 5 1/4" SSDD diskette—\$29.95. UPS ground—\$2.00. UPS air—\$4.00. COD—\$1.65. foreign add \$15.00. VISA and MASTERCARD welcome.

Circle 208 on inquiry card.

TDK

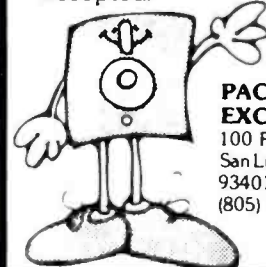
flexible disks

Call Free (800)235-4137

for prices and information.

Dealer inquiries invited.

C.O.D. and charge cards accepted.



PACIFIC EXCHANGES
100 Foothill Blvd
San Luis Obispo, CA
93401 (In Cal. call
(805) 543-1037)

Circle 243 on inquiry card.

Lycy Computer Marketing & Consultants

TO ORDER
CALL US

TOLL FREE 800-233-8760
In PA 1 717-327-1824

MANNESMANN TALLY

SPIRIT 80 \$299.00
MTL-160L \$559.00
MTL-180L \$775.00

NEC

NEC8023 \$369.00
NEC8025 \$699.00

PRINTER INTERFACING

AVAILABLE FOR COMMODORE
VIC. APPLE. ATARI. IBM-PC.
TRS 80, TI, AND OTHERS

BLUE CHIP

M12010 \$279.00
M12010 C-64 \$279.00
D4015 \$1399.00

CARDCO

LQ1 \$449.00
LQ2 \$279.00
LQ3 \$339.00
PRINTER INTERFACE \$39.75
PRINTER INTERFACE WITH
FULL GRAPHICS \$65.75
LIGHT PEN \$29.75
5 Slot Expansion 64 \$54.00
64 Write NOW \$39.00
64 Mail NOW \$29.00
2J Write NOW \$29.00
64 Keypad \$29.00
Universal Cass. Int. \$29.75
Printer Utility \$19.75
6 Slot Expansion \$79.95
3 Slot Expansion \$24.95

JUKI

6100 CALL

RITEMAN

INFO RUNNER CALL

STAR

MICRONICS

GEMINI 15X \$379.00
DELTA 10 \$449.00
DELTA 15 \$525.00
RADIX 10 \$575.00
RADIX 15 \$675.00
POWERTYPE SCALL
SWEET P(Model 100) \$549.00
STX80 \$149.00

GEMINI 10X \$259.00



SAVE ON THESE IN-STOCK PRINTERS

CITOH

GORILLA GX-100 \$169.00
GORILLA SERIAL \$199.00
PROWRITER 8510 \$335.00
PROWRITER II \$575.00
8600 \$899.00
STARWRITER... \$929.00
PRINTERMASTER \$1199.00
SHEET FEEDER \$425.00
620 \$929.00
630 \$1699.00
8510 SP \$499.00
8510 SCP \$559.00
A10 LETTER OUAL \$499.00

EPSON

RX-80 \$269.00
RX-80FT \$299.00
FX-80 \$439.00
FX-100 \$639.00

OKIDATA

80 \$199.00
82A \$299.00
83A \$569.00
84 \$959.00
92 \$409.00

LEGEND

880 \$259.00
1000 \$279.00
1200 CALL
1500 CALL
1018 CALL

PANASONIC

1090 \$279.00
1091 \$309.00
1092 \$459.00

OVER 2000 SOFTWARE TITLES IN STOCK

CATALOG AVAILABLE

HARD DISK DRIVES

FOR

IBM, APPLE, TRS80

10 MEG \$975.00
20 MEG \$1399.00
30 MEG CALL

* D.O.S. EXTRA

AMDEK

VIDEO 300 \$139.00
VIDEO 300A \$149.00
COLOR 1+ \$269.00
COLOR 11+ \$399.00

GORILLA

12" GREEN \$82.00
12" AMBER \$89.00

NEC

JB1260 GREEN \$99.00
JB1201 GREEN \$145.00
JB1205 AMBER \$145.00
JC1215 COLOR \$269.00
JC1216 \$399.00

SAKATA

SC100 COLOR... \$229.00
SG1000 GREEN \$99.00
SA AMBER \$109.00

MONITORS

TAXAN

100 GREEN \$115.00
105 AMBER \$125.00
210RGBCOMPOSITE... \$269.00
400 RGB MEDRES \$295.00
410 RGB HI RES \$349.00
420 RGB HI RES (IBM)... \$475.00
121 GREEN \$145.00
122 AMBER \$149.00

ZENITH

ZVM 122A AMBER \$95.00
ZVM 123G GREEN \$85.00
ZUM 124IBM-PC \$129.00
ZUM COLOR \$275.00
ZUM 133 RGB \$389.00
ZUM 135 RGB \$449.00
ZUM 136 \$589.00

PRINTING PAPER

3000 SHEETS
FANFOLD \$42.75
1000 SHEETS
FANFOLD \$19.75
1000 SHEETS LETTER... \$21.95
200 SHEETS LETTER... \$8.99
150 RAG STATIONERY... \$10.99
MAILING LABELS (1 in) ... \$9.75
14x11 1000 FANFOLD... \$24.75

MODEMS

ANCHOR MARK I \$45.75
ANCHOR MARK II \$45.95
HAYES SMART \$239.00
HAYES MICRO II \$309.00
MICROBIT 1000C \$129.00
CAT \$144.00
D-CAT \$155.00
J-CAT \$115.00
APPLE CAT II \$279.00
212 APPLE CAT \$589.00



DISKETTES

ELEPHANT

5 1/4" SSSD \$16.75
5 1/4" SSDD \$19.95
5 1/4" DSSD \$25.95

MAXELL

5 1/4" MD-1 \$24.75
5 1/4" MD-2 \$34.75

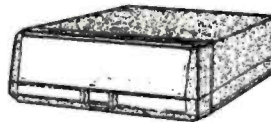
CERTRON CASSETTES

CC-10 (12) \$15.99
CC-20 (12) \$17.99

PERCOM

AT88S1 \$249.00
AT88S1 PD \$299.00

ADD-ON DRIVES CALL
AT 88 DOUBLER \$119.00



INNOVATIVE CONCEPTS

FLIP-N-FILE 10 \$3.75
FLIP-N-FILE 15 \$8.95
FLIP-N-FILE 25 \$18.95
FLIP-N-FILE 50 \$17.75
FLIP-N-FILE (RomHolder)... \$17.75

DISK DRIVES

RANA 1000 \$299
INDUS GT.... \$325

CONCORD

ATARI 176K MASTER... \$289.00
ATARI 348K MASTER... \$369.00
ATARI ADD-ON DRIVES... \$CALL

TRACK DRIVES

AT-D2 \$329.00
AT-D2 TURBO PAK \$22.95
AT-DH CALL
PRINTER CABLE \$22.95



TO ORDER



CALL TOLL FREE

800-233-8760

or send order to
Lycy Computer
P O Box 5088

Customer Service 1-717-327-1825 Jersey Shore PA 17740

Circle 189 on inquiry card. POLICY

In stock items shipped within 24 hours of order. Personal checks require four weeks clearance before shipping. No deposit on C O D orders. Free shipping on prepaid cash orders within the continental U S. PA residents add sales tax. All products subject to availability and price change. Advertised prices show 4% discount offered for cash, add 4% for Master Card or Visa. DEALER INQUIRIES INVITED

INTRODUCING THE CYPHER™

A COMPLETE 68000 & Z 80 SINGLE BOARD COMPUTER SYSTEM WITH ULTRA-HIGH-RES GRAPHICS!!

● 68000 & Z80 DUAL PROCESSORS (BEST OF BOTH WORLDS)
● 256K TO 1 MEGABYTE MEMORY
● DOUBLE DENSITY FLOPPY DISK CONTROLLER (IF DR 50)
● DMA CONTROLLER FOR FAST IMAGE TRANSFERS TO/FROM VIDEO MEMORY
● RS232 SERIAL PORTS (250)
● 28 BIT ADDRESS MANAGEMENT FOR Z80
● LATER PC BUSES, 1417, FITS IN API CASES, FULL EXPANSION BUS

● ULTRA HIGH RESOLUTION GRAPHICS PROGRAMMABLE UP TO 1024 X 1024 RESOLUTION (GREAT FOR CAD SYSTEMS)
● REAL TIME CLOCK MULTITASKING CAPABILITY
● TWO CHANNELS OF DMA AND AXL 12 BIT RESOLUTION MUSIC MONITOR
● 16K TO 64K BOOT EPROM
● 16K TO 64K BASIC MEMORY
● PROGRAMMABLE 68450 RATE GENERATOR
● PARALLEL ASCII KEYBOARD INPUT (IF PC KEYBOARD COMPATIBLE)

BASE SYSTEM INCLUDES: 68000 & Z80 PROCESSORS, 68450 VIDEO CONTROLLER, 68010 INTERRUPT CONTROLLER, 68015 ADDRESS DECODE, 68016 SERIAL PORTS, 68017 WITH MEMORY BUS SERIAL I/O, 128K DRAM, 45 3.5" FLOPPY DISK CONTROLLER \$1499.95

OPTIONAL: 68010 INTERRUPT CONTROLLER, 68015 ADDRESS DECODE, 68016 SERIAL PORTS, 68017 WITH MEMORY BUS SERIAL I/O, 128K DRAM, 45 3.5" FLOPPY DISK CONTROLLER \$1499.95

PC BUSES: 1417, FITS IN API CASES, FULL EXPANSION BUS \$1499.95

APACHE PROMOS: APACHE PROMOS 1000 1 80.00 APACHE PROMOS 2000 2 160.00 APACHE PROMOS 3000 3 240.00 APACHE PROMOS 4000 4 320.00

MOTEL COMPUTER SYSTEMS LIMITED 172 BELTAVEN DRIVE WILLOWDALE, ONTARIO, CANADA M2N 1Z6 (416) 221-2340

Circle 345 on inquiry card.

wabash®

When it comes to Flexible Disks, nobody does it better than Wabash.

MasterCard, Visa Accepted.
Call Free: (800) 235-4137

PACIFIC EXCHANGES
100 Foothill Blvd
San Luis Obispo, CA 93401 (In Cal call (805) 543-1037)

Circle 243 on inquiry card.

WE SELL WHAT YOU NEED... NOT JUST WHAT WE STOCK. PLUS... LOW PRICES, TECH SUPPORT AND RELIABILITY.

DISKETTES		
SSDD - 8 IN.	3M	MEMOREX \$2.20/50 \$2.35/100
SSDD - 8 IN.		\$2.70/50 \$3.05/100
SSDD - 5 1/4 IN.		\$2.10/50 \$2.10/100
DSDD - 5 1/4 IN.		\$2.85/50 \$2.85/100
DSDD - 96 TPI 5 1/4 IN.		\$4.30/50 \$4.45/100
PLASTIC STORAGE BOX WITH KEY FOR 100 DISKETTES ... \$24.00		
TAPES AND CARTRIDGES (3M)		
OC100A	\$16.20/1-10	\$14.10/10-
OC300XL	\$24.75/1-10	\$21.50/10-
2400 FT TAPESEAL	\$15.00/10-50	\$14.35/50-
BLACK WATCH		
2400 FT TAPE SEAL	\$16.25/10-50	\$15.60/50-
WINCHESTER DRIVES		
10MB (FORMATTED)		\$535
15MB (FORMATTED)		\$750
20MB (FORMATTED)		\$980
32MB (FORMATTED)		\$1155
FLOPPY DRIVES		
IBM/RADIC SHACK S. SIDE	INTERNAL	EXTERNAL \$195
IBM/RADIC SHACK O. SIDE		\$335
APPLE		\$210
HARD DISK SUBSYSTEMS		
	5MB	10MB 15MB
APPLE	\$1250	\$1450 \$1650
IBM	\$1300	\$1500 \$1700

Met-Chem
Met-Chem International Corporation
2811 Dilwell Avenue, Hamden, Conn. 06518
Phone: (203) 248-3212 or 1-800-638-2436

Circle 197 on inquiry card.

6 times faster

Super Fast Z80 Assembly Language Development Package

Z80ASM

- Over 6000 line/minute
- Generates COM, HEX, or REL files
- Cross-Reference
- Zlog mnemonics
- Time and Date in listing
- Long labels

SLRNK

- One or two pass operation
- Cross-reference
- COM or HEX output
- Flexible address control

Most formats available for Z80 CPM, CDOS, and TURBODOSS

\$199.95

SLR Systems

For more information or to order, call:
1-800-833-3061 in Pa. (412) 282-0864
1622 North Main Street, Butler, PA 16001
VISA or Mastercard

Circle 280 on inquiry card.

NEW!

SafeSkin
KEYBOARD PROTECTOR

Remains in place during keyboard use. Prevents damage from liquid spills, dust, ashes, etc. Fits like a second skin, excellent feel. Homerow and numeric locators. Available for: IBM-PC, Apple IIe. Send \$29.95, check or M.O., Visa & MC include exp. date and signature. Specify computer type. Dealer Inquiries invited. Free brochure available.

MERRITT Computer Products, Inc.
2925 LBJ, #180 / Dallas, Texas 75234
(214) 942-1142

Circle 196 on inquiry card.

August Special

RENT SOFTWARE

dBase II 100.00
Wordstar 75.00
SuperCalc 3 50.00
PFS Software 20.00

FREE CATALOG
Games/Business/Utilities/Education

1-800-221-1031 California
1-800-221-4568 All Others
619-481-0559 San Diego

SOFTRENT™

Circle 281 on inquiry card.

INFACER

Books • Software • Hardware Add Ons • for your ATARI 800XL/800 XL, Commodore 64, VIC-20, Sinclair, Timex, Apple II, Osborne-DSI

BOOKS FOR ATARI 400/800XL/800XL SOFTWARE IN MACHINE LANGUAGE

ATARI BASIC - Learning by Using
An excellent book for the beginner. Many short programs and detailed exercises. All important features of the ATARI computers are described in clear drawings, special sounds, keys, paddles, joystick, specialized screen routines, graphics, sound, appearance, ports, ROMs and internal CPU.

Order No. 164 \$7.95
Small Business Software for all ATARI computers

SUPERIAL (500 addresses on 1 disk)
Completely written in FORTH. Comes on auto-boot disk. No cartridge, no DOS, no FORTH language required.

Order No. 7312 \$49.00

SUPERINVENTORY (1000 items on 2 disks)
Completely written in FORTH. Same as above. (Disk only)

Order No. 7320 \$49.00

BUSPACK1 (written in FORTH). Complete order entry, inventory, mailing and customer disk only.

Order No. 7313 \$58.00

ATCASH
Convert your ATARI 800 into a powerful cash register. (Disk only).

Order No. 7303 \$49.95

Inventory program in BASIC
Order No. 7301 (C) \$29.95
Order No. 7300 (D) \$29.95

Mailing List in BASIC
Order No. 7312 (C) \$19.95
Order No. 7313 (D) \$24.95

Inventory program in BASIC
Order No. 7314 (C) \$19.95
Order No. 7315 (D) \$24.95

Dealer and Distributor inquiries are invited.

ELCOMP PUBLISHING, INC.
53 Republic Lane
Pomona, CA 91768
Phone: (714) 823-8314, Telex: 298191

Circle 120 on inquiry card.

—MODEMS—

*Signalman MARK XII \$249.95
1200/300 Baud Auto Dial/Ans
Hayes™ Compatible

*VOSKMODEM 300 Baud \$59.95
Limited Offer/FREE Source Memb.

*The Complete Handbook of Personal Computer Comm. \$12.95

—COMPUTER—

Sanyo MBC-555 \$1075
Printers & MBC-555 Package
Order: (800) 235-6646 OP 555
Calif. (800) 235-6647 OP 555

VISA/MC ACOM Electronics
Add 3% Dept. 120
Shipping 4151 Middlefield Rd.
Add 2% Palo Alto, CA 94303

Circle 7 on inquiry card.

The Statistician

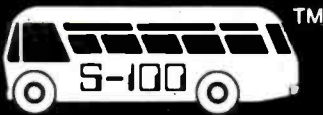
CPM IBM-PC TRS-DOS XENIX

- Multiple Regression
- Stepwise Ridge
- All Subsets
- Backward Elimination
- Time Series Analysis
- Descriptive Statistics
- Transformations
- Survey Research
- Nonparametrics
- XY Plots
- ANOVA
- Random Samples
- Data Base
- Search & sort
- Hypothesis tests

Please call **TOLL FREE**
1-800-334-0854 (Ext. 814)

for more information or write:
Quant Systems
Box 628
Charleston, SC 29402
VISA/MC Accepted

Circle 261 on inquiry card.



S-100
ESTABLISHED 1977

SALES 800 - 528-3138
TECHNICAL 602-991-7870
MODEM ORDERS 602-948-1387
TELEX: 16 5025 FTCC SEC PHX.

CompuPro®

SYST 816/A SINGLE-USER	\$4,299
SYST 816/B 2-USERS	\$4,999
SYST 816/C MULTI-USER	\$6,399
SYST 816/D 10MHz B086	\$9,299
SYST 816/E 10MHz 68000	\$7,099
SYST 816/10 4-USERS	\$4,296
TO ADD 40Mb. H.D. TO ABOVE ADD:	\$1,900
SYST 816/10-H20 20Mb H.D.	\$6,399
SYST 816/10-H40 40Mb H.D.	\$7,096
CPU Z 6MHz A&T	\$229
CPU 8086/88 A&T	\$349
H&A 8087 PIGGYBACK/8085/88	\$539
CPU 8086 10MHz A&T	\$569
CPU 86/87 6MHz A&T	\$739
CPU 68K W/MMU OPTION A&T	\$629
CPU 68K 10MHz CSC	\$600
RAM 17 64K STATIC A&T	\$349
RAM 16 64K STATIC 8&16 A&T	\$389
RAM 21 128K STATIC 8&16 A&T	\$699
RAM 22 266K STATIC 8&16 A&T	\$1,229
M-DRIVE/H 512K RAM-DISK	\$895
INTERFACER 3-8 SERIAL A&T	\$489
INTERFACER 4-3 SERIAL/2 PARALLEL	\$319
SYSTEM SUPPORT 1 A&T	\$319
DISK 1 A&T	\$349
DISK 2 A&T 8" H.D. CNTRL SET	\$559
DISK 3 A&T 5 1/4" H.D. CTRL	
W/ CP/M 80&86	\$559



T8-4 EXTENDER BD. W/ LOGIC PROBE	\$67
ICB-10 OPTO ISOLATOR CNTRL A&T	\$165
ICB-10K OPTO ISOLATOR CNTRL KIT	\$146
ZB-1 EXTENDER BD. W/ ZIF & SWITCH	\$119

FLUKE FLUKE 77	
DVO METER	\$119
0.3% DC ACCURACY	



CPU 8/16 EXECUTES Z80 & 8088 CODE.	
5 1/4" & 8" FLPY CTRL. 2S. B	
VECTORED & REAL TIME INTERRUPTS	\$689
256K STATIC RAM/ CLK/CAL. BATT.	\$1,425
DYNAMIC RAM 512K (2Mb W/ 41256)	\$1,132
SBC-300 MASTER OR SLV-6MHz. 64K.	
1S, 1P, SASI PORT	\$595
VFW-III FLPY 5 1/4" & 8" & 5 1/4" H.D. CNTRL	\$645
VERSAFLOPPY II 4 FLPY CTRL 5 1/4" & 8"	\$295
EXPANDORAM IV 256K W/ PARITY	\$825
EXPANDORAM IV 256K W/ EDC	\$1,435
HDC UP TO 4 5 1/4" H.D. W/ 2S. IP.	
CP/M 80 & 86 B10S INCLD.	\$458
I/O 8 W/8 ASYNCHRONOUS RS232	\$435
I/O 4 ANYNCH.	\$505
I/O 4 SYNCH/ 4 ASYNCH.	\$575

Cromemco

ZPU Z-80 CPU	\$299
EXC S-100 EXTENDER BD.	\$49
SMDI SMD HARD.DISK I/O	\$675



SUPER SIX 128-6MHz	\$575
SUPER SLAVE 128-6MHz	\$519
SUPER 186/256	\$1,499
CP/M 3.0	\$350
TURBODOS MULTI-USER	\$625
DMA-MICRO MAGNUM 5Mb FIXED & 5Mb REMOV. CARTG. BARE DRV.	\$1,595
HDC-1001-5 5 1/4" H.D. CONTROLLER	\$419



CPZ 48006 6MHz MASTER	\$739
256KMB MEMORY BOARD	\$709
CPS-MX 64K RAM SLAVE 4MHz	\$339
CPS-MX 64K RAM SLAVE 6MHz	\$389
CPS-BMX 128K RAM SLAVE 4MHz	\$495
CPS-BMX 128K RAM SLAVE 6MHz	\$529

MORROW

MD2 SYSTEM W/MDT60 TERMINAL & EPSON RX80FT PRT.	\$1,599
MD3 AS EQUIP. ABOVE W/PEARL DBMS	\$1,999
MD-3E AS EQUIP. ABOVE WITH ONLY CPM 2.2 NEW WORD CO-PILOT	\$1,499
MD3-MDCP88-256 AS EQUIP. ABOVE W/ 8088 CO-PROC. & 256K RAM UPGRD.	\$2,498
MDP-3 PORT. SAME AS MD3 EXCEPT 5X7" SCR.N. & EPSON RX80FT PRT.	\$1,899
MD11 SYSTEM W/11 Mb H.D., CP/M 3.0, 128 RAM, MDT60 TERMINAL & EPSON RX80FT PRT.	\$2,995
MD-16 SAME AS MD11 W/ 16.44Mb	\$3,495
MD-34 SAME AS MD11 W/ 34Mb	\$4,995



TRUE SINE WAVE. 100% BATTERY OPER. W/NO SWITCH-OVER. BYPASS STATIC SWITCH	
750 WATTS @ 15 MIN. #370-811-100	\$1,575
1 HR. W/AUXILIARY BATTERY	\$149



QUASIDISK 512K RAM-DISK W/ON-BD. DRV. STATUS LED'S. WRITE PROTECT. DMA E-Z INSTALL W/SAMPLE CP/M BIOS	\$895
512K PIGGY-BACK EXPANSION	\$695
BATTERY BACK-UP W/PWR. SUPPLY	\$169

MFIO ALL-IN-ONE I/O BD. IEEE S-100/696	
8 ASYNCH. SERIAL, 2 PARA., BAUD RATE GEN., CLOCK-CAL/BATT., PROG. PRIORITY INTERRUPT W/8 LEVEL CTRL	
PERSONALITY BDS. & CBLS OPTIONAL	\$469

SERIAL OPTION BD. FOR MFIO	\$25
CENTRONICS PARA. OPTION FOR MFIO	\$39
STD. PARALLEL OPTION BD. FOR MFIO	\$25



"C" LANGUAGE COMPILER-86	\$229
CP/M PLUS (3.0)	\$245
CBASIC COMPILER 80	\$325
PASCAL MT-86	\$390
PL/I-86 W/ PROG. UTILITIES	\$488
DR ASSEMBLER PLUS TOOLS	\$130
ACCESS MNGR. 80 = \$195	86 = \$260
DISPLAY MNGR. 80 = \$260	86 = \$325
SPEED PROG. PKG. 80 = \$130	86 = \$163
GSX 80 = \$55	86 = \$65

Atrix \$1,495

DUALSSDD 5 1/4" FLPY, 2S, 1P, IEEE488, MX80 PRT. REAL TIME CLOCK, 2 MODEMS, 8" FLPY INTERFACE. CP/M80, MBASIC, CBASIC, COMMUN. PERFECT WRITER, SPELLER, CALC. FILER & FANCY FONT IN 33LB. PORTABLE	
--	--

TERMINALS & MONITORS

FREEDOM 110 TERMINAL - AMBER	CALL
FREEDOM 200 TERMINAL - AMBER (EMUL TELEVIDEO 950 & ADM 31)	CALL
LIBERTY FREEDOM 220G	
DEC VT220 EMUL. W/ FULL SUPERSET OF VT100	CALL
USI AMBER 12" HI-RES MONITOR (20MHz)	\$109
WYSE-50 14", 132 COL., EMUL. TVI 910, 920, 925. ADDS-VP & HAZELTINE 1500	\$519

PRINTERS

BROTHER HR-15 SERIAL	\$425
BROTHER HR-25 SERIAL	\$725
DAISY WRITER 2000 W/48K	\$998
EPSON MX, RX & FX IN STOCK	CALL
OKIDATA 92P	\$319
OKIDATA 93P	\$689
TALLY MT160L S-OR-P W/TRACTOR	\$569



DP9625B. 132 COL., 240 CPS, 72/144	\$1,245
DP9725B. 132 COL., 200 CPS, COLOR	\$1,349
DP6500. 132 COL., 500 CPS, TRACTOR	\$2,486



MICROBUFFER EPSON "CARD"	
MBS 16/32K SERIAL	\$119
MBS 32K SERIAL	\$153
MBS 64K PARALLEL	\$195

MICROBUFFER IN-LINE "STAND ALONE"	
MBIS SERIAL 64K	\$244
MBIP PARALLEL 64K	\$244
MICROBUFFER II+ 16K, APPLE II, II+, IIE	\$181
PROCLOCK/APPLE II, II+, IIE	\$119
SERIAL/APPLE II, II+, IIE W/ RS232, COMMUNICATIONS & GRAPHICS	\$119
GRAPHICARD W/ ON-BD. S.W./35 PRT	\$69

INDUSTRIAL QUALITY

CABINETS

DUAL 1/2 HI HORIZ. 5 1/4" FLPY.	\$75
SINGLE STD HI HORIZ. 5 1/4" FLPY	\$59
DUAL 1/2 HI VERT. 8" FLPY	\$195
SINGLE STD. HI VERT. 8" FLPY	\$195

DISK DRIVES

DMA 5Mb REMOV. CART. W/5Mb	
FIXED WINCH. BARE DRIVE	\$1,595
S-100'S SUBSYS. - DUAL DSDD 8" FLOPPY, QUANTUM 40 Mb H.D., DISK 1 & 3, CP/M80 & 86	\$3,999
S-100'S 5 1/4" 40Mb QUANTUM H.D. SUB-SYSTEM W/DISK 3 & CP/M80 & 86	\$2,895
MAXTOR XT-1065 5 1/4" 65Mb H.D.	\$2,249
MAXTOR XT-1105 5 1/4" 105Mb H.D.	\$2,995
MAXTOR XT-1140 5 1/4" 140Mb H.D.	\$3,749
QUANTUM Q540 5 1/4" 40Mb H.D.	\$1,395

Tandon 100-2 5 1/4" DSDD \$189



142 DSDD 5 1/4" HI	\$189
242 DSDD 8 1/4" HI	\$395
842 DSDD 8 1/4" STD HI	\$455

TOSHIBA

FOR IBM-PC & PORTABLE
HIGHEST ENGINEERING QUALITY

5 1/4" 1/2 HI FLPY. DIRECT DRV. 1 YR WARR.	\$155
MD1D 5 1/4" SSDD BOX/10	\$19.95
MD2D 5 1/4" DSDD BOX/10	\$28.95
MD2D 96TPI 5 1/4" DSDD	
80 TRACKS BOX/10	\$36.95
FD2D-1024N 8" DSDD BOX/10	\$33.95

Circle 271 for Dealer inquiries. Circle 272 for End-User inquiries.

S-100 DIV./696 CORP.
14425 North 79th Street
Scottsdale, Arizona 85260

FULL DEALER SUPPORT
VISIT OUR SHOWROOM
Hrs. 8:30AM - 5:00PM M-F

Subject to Available Quantities
Prices Quoted Include
Cash Discounts
Shipping & Insurance Extra

DUST COVERS

For Personal Computers and Small Business Systems, Peripherals, Game Units - Protective, Long-Lasting Vinyl Resists Both Dust and Liquids.

- CHOICE OF COLORS -

- | | |
|-----------|-------------------|
| Amdek | Franklin Ace |
| Apple | IBM |
| Atari | Kaypro |
| BMC | Okidata |
| Columbia | Rana Systems |
| Commodore | Star Micronics |
| Corona | Televideo |
| Eagle | Texas Instruments |
| Epson | PLUS OTHERS |

GROUP/VOLUME DISCOUNTS AVAILABLE

FOR FREE BROCHURE WRITE:

ENCHANTED FOREST
P.O. Box 5261, Newport Beach, CA 92662
(118 Onyx)

Dealer Inquiries Invited

Marymac
INDUSTRIES

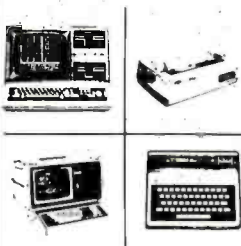
800-231-3680

Pan American
ELECTRONICS

800-531-7466

Radio Shack TRS-80's

People you Trust to give you the very best!



- Lowest Price.
- Reliable Service
- Quality Products

22511 Katy Fw., Katy (Houston) Texas 77450
(713) 392-0747 Telex 774132

Circle 192 on inquiry card.

GREAT DISKETTES Super low prices SYNCOM

The low Priced, high quality diskette with a LIFETIME WARRANTY Packed in polybags of 10 with Tyvek envelopes, labels and reinforced hubs.

One of the best buys we've seen. **LIFETIME WARRANTY!**
\$139 ea. 5 1/4" SSDD **\$185**
QTY 20 5 1/4" DSDD ea. QTY 20

OTHER GREAT VALUES

DISKETTE 70—Holds 70 5 1/4" diskettes in dust free safety \$14.95 ea. + \$3.00 Shpg.
DISK CADDIES—Flip up style holds 10 5 1/4" diskettes \$1.65 ea. + 20 Shpg.

Shipping: 5 1/4" DISKETTES—Add \$3.00 per 100 or fraction thereof. OTHER ITEMS: Shipping charges as shown in addition to diskette shipping charges. Payment: VISA or MC. COD orders only. add \$3.00. Taxes: Illinois customers, please add 8%.

Nationwide: 1-800-621-6827
In Illinois: 1-312-944-2788

Minimum Order: \$35.00
WE WILL BEAT ANY NATIONALLY ADVERTISED PRICE!

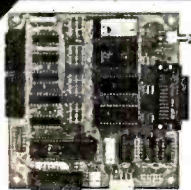
DISK WORLD!

Suite 4806 • 30 East Huron Street • Chicago, Illinois 60611

SYNCOM

Circle 106 on inquiry card.

NOW INCLUDES
TINY BASIC
FORTH AVAILABLE



SIBEC 51 8051/52 DEVELOPMENT BOARD

8051-Based Single-Board Computer with Monitor/Debugger

- 4 28-pin byte-wide sockets; monitor will program EEPROMS.
- Perfect for System Development and Educational Applications

\$335

Binary Technology

P.O. BOX A-59 • HANCOVER, NH 03755 • 603 643-2881

Circle 38 on inquiry card.

T & A SYSTEMS

MODEMS	LIST	COST
U.S. Robotics Passwork 300/1200 Autodial/Auto Answer	\$449	\$350
Riscu #212A1 (300/1200 10 no. Autodial/Auto Log on)	\$499	\$399
Peurl (300/1200)	\$525	\$399
Hayes 1200 Smart Modem	\$699	\$510
Max 224 (2400/1200 300 Selectable (8 month warranty))	\$1195	\$890
General Data Comm 4800 (800, works multipoint)	\$1575	\$1395
Universal Data Systems 9600 A/B (9600 Dialup)	\$2650	CALL \$

CRTS	LIST	COST
Liberty Electronics Freedom 100 (20 Function Keys Full Editing)	\$495	CALL \$
Teletex 3000 (7x10 Matrix Status Line)	\$599	\$495
Visual 50 (Green Phosphor screen)	\$695	\$595
Teletex 950	\$1195	CALL \$
Leur Ziegler ADM 11	\$695	CALL \$
Kimtron (New Product Fully DEC Compatible)	\$795	CALL \$

PRINTERS	LIST	COST
Panasonic 1091 (120 CPS Dot Matrix, 3 Print Modes)	\$599	CALL \$
Teletex 1014 (20 CPS Daisy Wheel Serial & Parallel Ports Std)	\$649	\$457
Siemens P188 (Ident 150 CPS Ink Jet)	\$900	CALL \$
Teletex 74045 CPS Daisy Wheel)	\$1595	CALL \$

SWITCHES	LIST	COST
Giltronix (24 Wire A/B Switch)	\$159	CALL \$
Idc A/B Switch 24 Pin	\$130	CALL \$

HARD DISK	LIST	COST
Mountain (10 MEG for Apple, Franklin, IBM)	\$2495	CALL \$

MONITOR	LIST	COST
Panasonic TR120 (High Resolution 1100 Lines)	\$220	\$150

P.O. Box 692 Wheeling, IL 60090

800-323-2666

*We stock a complete product line of above manufacturers

Circle 161 on inquiry card.

APPLEWARE, INC.

The Apple Users Group Software Library

For the first time enjoy your Apple to its fullest capacity, using speciallypackaged disks with over 60 outstanding programs each (not available from any other source)

Each packed disk includes an extensive variety of interesting, useful and entertaining programs indispensable to all computerists! Mixed category packed disks include:

BUSINESS • EDUCATIONAL • DATA BASE • GAMES • UTILITIES • SCIENCE • MUSIC • GRAPHICS • FINANCE

Library Disk I, II and III are mixed categories. Single category disks are: **GAMES • UTILITIES • GRAPHICS • INTEGER • SCIENCE • TECH • MUSIC & AUDIO**

Individual disks available at \$59.95 each

Order direct from this ad and Save up to \$150! Buy Library Disk I, II and III and get a special bonus disk FREE over 260 programs for \$179.95 + \$4 shipping. BUT for the Best Value, receive any 9 disk set (returning over 600 of our best programs for only \$55 each for a package price of \$389. Certified Postage plus handling paid!

*Send one-time membership fee of \$15. (no fee charged to institutions) for 1000+ program catalog and gain access to a library of over 10,000 programs at a special 15% discount. (Foreign memberships \$28. U.S.)

For Orders Only Call now
TOLL FREE: 1-800-327-8664
Florida: 1-305-987-8665

Or Write:
Appleware, Inc.
6400 Hayes Street
Hollywood, Fla. 33024

Program Disks compatible with Apple II, II+, IIe, III Emul., Franklin Ace and IBM Quad

MasterCard
VISA

Circle 24 on inquiry card.

PROGRAMMING IN 'C'?

At last, a BTREE LIBRARY ready to use!

We have already done the work of developing a 'GENERIC' BTREE LIBRARY

Just set our defines in your main and link with our "BTREE.LIB."

Our BTREE library makes no assumptions about your DBM application.

You control your data files and use our BTREE functions to maintain your keys.

You control the length of your keys.

You control the values of your keys.

You control the size/speed trade-offs.

You can have multiple keys per BTREE.

You can have multiple BTREE data bases.

This is quality software you can use for serious DBM software development.

Documentation and BTREE LIBRARY: **\$99.00**
(Ca. residents add 6.5% sales tax)
Dealer Inquiries Invited.

INTEGRATED COMPUTER SOLUTIONS

175 Bernal Rd., Suite 240
San Jose, Ca. 95119
(408) 629-8675

Circle 159 on inquiry card.

DISK DRIVES

(For PC, Mod I, III & IV)

Qume 142A	\$209
Teac FD55B	\$179
Tandon TM100-2	\$209
Tandon TM101-4	\$295
CDC 9409	\$219
Case and PS.	\$ 45

PC EXPANSIONS

Maynard Disk Controller	\$162
Sandstar Series	Scall
Internal 10MB HD systems: WS4	\$959
WS1	\$990
Quadboard (64K)	\$269
Quadcolor I	\$199
AST SixpackPlus (64K)	\$269
MegaPlus (64K)	\$269
I/O Plus	\$114
2nd SP, PP or Game	\$ 35
HERCULES graphics board	\$349
HAYES Modems 300	\$209
Smartmodem 1200	\$489
Smartmodem 1200B	\$435
Set of 9 chips (64K)	\$ 55

VLM Computer Electronics

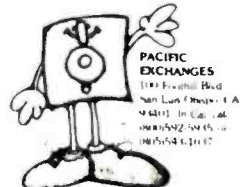
10 Park Place • Morristown, NJ 07960
(201) 267-3268 Visa, MC, Check or COD

Scotch Diskettes

Rely on Scotch® diskettes to keep your valuable data safe. Dependable Scotch diskettes are tested and guaranteed error-free. The low abrasivity saves your read/write heads. They're compatible with most diskette drives.



(800)235-4137



Dealer inquiries invited

Circle 243 on inquiry card.



IBM PC SYSTEMS

THE EXPERT SAYS YOU NEED 256K RAM. AND THE PRICE IS LOW.
#1 SYSTEM: 2-360K DRIVES, 256K RAM, GRAPHICS VIDEO CARD. \$2165
#2 SYSTEM: 2-360K DRIVES, 256K RAM, MONOCHROME VIDEO CARD, PRINTER PORT \$2825

IBM PC-XT SYSTEMS

#1 SYSTEM: STANDARD UNIT - LIST \$4395 \$3875
#2 SYSTEM: 256K, GRAPHICS VIDEO \$4075
#3 SYSTEM: 256K, MONOCHROME VIDEO \$4210



TAVA PC

TAVA PC SYSTEMS

ALL TAVA'S INCLUDE SERIAL PORTS, 1 PARALLEL PORT, 2 DSDD THINLINE DRIVES, A VIDEO INTERFACE (EITHER GRAPHICS OR MONOCHROME), 256K RAM, AND A 12" MONOCHROME CRT.

FREE SOFTWARE: WORD PROCESSOR, DATA BASE, SPELLING, ELECTRONIC MAIL.

TAVA #1: GRAPHICS VIDEO \$1795
 TAVA #2: MONOCHROME VIDEO \$1845
 TAVA PC-XT #1: 10 MBYTE HARD, GRAPHICS VIDEO ... \$2795
 TAVA PC-XT #2: 10 MBYTE HARD, MONOCHROME VIDEO \$2845



SANYO 550-2

-\$ 987

SANYO 555-2

-\$1325

SANYO MBC550 SYSTEMS

NOW WITH FACTORY INSTALLED DOUBLE SIDED DRIVE AND DOS 2.1.

MBC550-2 w/3 SOFTWARES \$ 985
 MBC555-2 w/6 SOFTWARES \$1315

RECOMMENDED OPTIONS:

128K EXTRA RAM (256K TOTAL) \$ 100
 SERIAL PORT \$ 80
 AMBER CRT \$ 140
 COLOR RGB CRT-TAXAN #415 \$ 495
 MODEM SOFTWARE \$ 65

MODEMS

HAYES SMARTMODEM 300 \$ 215
 HAYES SMARTMODEM 1200 \$ 479
 HAYES 1200-B "IBM INTERNAL" \$ 395
 HAYES 1200-B WITH SOFTWARE \$ 445
 HAYES MICROMODEM II-E \$ 295
 NOVATION ACCESS 1-2-3 \$ 445
 RIXON PC212A "IBM INTERNAL" \$ 395

SOFTWARE-PC

MICROSOFT WORD WITH MOUSE \$ 295
 FRAMEWORK \$ 485
 LOTUS SYMPHONY \$ 485
 R:BASE 4000 \$ 305
 LOTUS 1-2-3 \$ 325
 IUS ACCOUNTING SOFTWARE \$ 425
 MJA ACCOUNTING SOFTWARE \$ 395
 MULTIMATE \$325



NEC ADVANCED PERSONAL COMPUTER - THE APC

STANDARD HARDWARE PACKAGE INCLUDES:

- 8086 16BIT CPU
- 640 x 475 PIXEL CRT
- GREAT KEYBOARD
- 128K RAM, EXPANDABLE TO 512K
- 8" FLOPPIES WITH 1 MBYTE EACH
- 48 DEFINABLE FUNCTION KEYS

STANDARD SOFTWARE PACKAGE INCLUDES

- MS-DOS 2.0
- dBASE II
- WORDSTAR 3.3
- MULTIPLAN

NEC APC-1 DRIVE, GREEN #H01 \$2095
 NEC APC-2 DRIVE, GREEN #H02 \$2550
 NEC APC-2 DRIVE, COLOR #H03 \$3150
 NEC APC-1 DRIVE, COLOR #H04 \$2575
 NEC 10MBYTE WINCHESTER #H26 \$2175



NEC APC-III

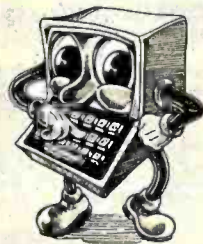
NEC ADVANCED PERSONAL COMPUTER-III

NEC LEADS THE MARKET WITH UNIX, SPEED, SUPERIOR VIDEO QUALITY, AND EXCELLENT DESIGN.

ALL PRICES MINIMUM 20% DISCOUNT

"MOST OF OUR BUSINESS IS BY REFERRAL FROM SATISFIED CUSTOMERS."

FIND OUT WHY!"



ADD 4% FOR AMERICAN EXPRESS. ADD 2% FOR VISA/MASTER CARD. 20% PREPAID DEPOSIT REQUIRED ON COD ORDERS. CALIFORNIA RESIDENTS ADD SALES TAX. PRICES MAY CHANGE. CALL TO VERIFY PRICES AND DELIVERY

EXPERT COMPUTERS

21804 ROSCOE BLVD., SUITE 18
 CANOGA PARK, CA 91304

(818) 344-6063

(800) 528-9537

LETTER QUALITY PRINTERS

C. TROH/TEC: THESE DAISYWHEEL PRINTERS USE DIABLO WHEELS, INK CARTRIDGES, AND SOFTWARE CODES.

F-10-18 18CPS \$ 495
 F-10-40 40CPS \$ 550
 F-10-55 55CPS \$1275
 AHATI LQ-20P 20CPS, 132 COLUMN \$ 395
 DYNAX-BROTHER HR-15 \$ 410
 HR-15 TRACTOR \$ 105
 HR-15 CUT SHEET FEEDER \$ 185
 DYNAX-BROTHER HR-25 \$ 675
 HR-25 TRACTOR \$ 120
 HR-25 CUT SHEET FEEDER \$ 210
 BROTHER HR-35 \$ 895
 JUKI 6100 20CPS \$ 455
 NEC SPINWRITERS #2050 \$ 965
 NEC #3550 \$1685
 NEC #7730 \$1845
 SILVER-REED EXP500P \$475
 SILVER-REED EXP550P AKA SANYO PR5500 \$555

DOT MATRIX PRINTERS

BMC CP-80 w/CARBON INK \$ 265
 C. TROH/TEC 180CPS \$ 495
 180CPS-WIDE \$ 695
 180CPS-COLOR \$ 575
 180CPS-COLOR-WIDE \$ 795
 EPSON FX-80 \$ 445
 EPSON FX-100 \$ 730
 GEMINI 10-X \$ 269
 GEMINI 15-X \$ 415
 MANNESMANN-TALLY MT160L \$ 595
 MT180L \$ 795
 OKIDATA 92-FOR IBM \$ 435
 OKIDATA 93 \$ 685
 PROWRITER 120CPS, STD \$ 345
 PROWRITER 2 120CPS, WIDE \$575



SAKATA MONITORS

SC-100 COLOR COMPOSITE 13" \$275
 SC-200 COLOR RGB FOR IBM 13" \$460
 SC-300 COLOR RGB FOR IBM 13" \$695
 SC-1000 GREEN 12" \$125
 SC-1000 AMBER 12" \$135

NEC PC6201 LAP COMPUTER \$575



COMPAQ 2 DRIVE, 256K \$2365
 MICROSOFT "WORD" w/MOUSE \$295

QUBE

PC212AS PC INTERNAL MODEM \$ 295
 212E EXTERNAL MODEM \$ 310
 SB200 200 WATT STANDBY POWER \$ 345
 XT300 300 WATT STANDBY POWER \$ 455
 PF5150 IMPROVED KEYBOARD \$ 165

TSENG LABORATORIES ULTRA-PAK

132 x 44 COLUMN VIDEO INTERFACE WITH GRAPHICS FOR THE IBM MONOCHROME CRT. INCLUDES PARALLEL PORT, SERIAL PORT, CLOCK. OPTIONAL FLOPPY DISK CONTROLLER OR 64K-384K RAM PACK. NOW WITH "C" OPTION FOR COMPATIBLE COMPUTERS.

ULTRA-PAK LIST \$680 ... \$495
 DISK-PAK LIST \$220 ... \$185
 RAM-PAK (64K EXPANDABLE TO 384K) LIST \$245 ... \$205

PROFIT SYSTEMS

MULTIGRAPH (80 x 40 VIDEO w/GRAPHICS & PRINTER PORT \$465
 MULTIGRAPH OPTION BOARD (132 COLUMNS, 16 COLORS) \$185
 MULTI-USER SUBSYSTEM: FOR 4 USERS, HARDWARE & SOFTWARE \$650



APPLE COMPATIBLE
Prices for dealers in quantities of 25 or more.
End Users Inquiries welcomed.

Disk Drive \$135.00 ea.
Controller Card \$35.00 ea.
Computer Case \$55.00 ea.
Keyboard \$70.00 ea.
(Numeric and Function Keys)
Switching Power Supply . . \$45.00 ea.
Joystick (Heavy Duty) . . . \$15.00 ea.
Slim Fan \$25.00 ea.

ELECTRADE CO. (408) 946-2541
780 Trimble Rd. Suite 605
San Jose, CA 95131

Circle 121 on inquiry card.

SAVE MORE THAN EVER ON 3M Scotch® DISKETTES

LIFETIME WARRANTY!

\$169 ea. 5 1/4" SSOD (746) Qty 20
\$223 ea. 5 1/4" DSDD (745) Qty 20

5 1/4" SSOD—96TPI (746) \$2.60 ea.
5 1/4" DSDD—96TPI (747) \$3.25 ea.
8" SSOD (740) \$2.05 ea.
8" SSOD (741) \$2.50 ea.
8" DSDD (743) \$3.10 ea.

Shipping: 5 1/4" DISKETTES—Add \$3.00 per 100 or fraction thereof. 8" DISKETTES—Add \$4.00 per 100 or fraction thereof. OTHER ITEMS: Shipping charges as shown in addition to diskette shipping charges. Payment: VISA or MasterCard. COD orders only, add \$3.00. Taxes: Illinois customers, please add 8%.

Hours: 9 AM-5 PM Central Time
For fast service call
Nationwide: 1-800-621-6827
In Illinois: 312-944-2788

DISK WORLD!
Suite 4806 • 30 East Huron Street • Chicago, Illinois 60611

Authorized Distributor
Information Processing Products **3M**

Circle 107 on inquiry card.

PRINTER CABLES \$30.00
SHIPPING INCLUDED

INTERFACE CABLES Parallel Printer Interface Cable	INTERFACE CABLES RS232 Serial Interface Cable
Apple Centronics Columbia Epson Eagle IBM PC Kaypro NEC WANG Zenith	TELEVIDEO DB 25 Male/Female Cable Length up to 10 feet

*SPECIAL PRICING AVAILABLE TO DEALERS
CUSTOM CABLES AVAILABLE ON REQUEST*

FABRICATION CONCEPTS, INC.
8230 Miralani Drive • San Diego, CA 92126
(619) 271-4522

Circle 128 on inquiry card.

for the Intel **bryte FORTH 8031** micro-controller

FEATURES
—FORTH-79 Standard Sub-Set
—Access to 8031 features
—Supports FORTH and machine code interrupt handlers
—System timekeeping maintains time and date with leap year correction
—Supports ROM-based self-starting applications

COST
130 page manual —\$ 30.00
8K EPROM with manual—\$100.00

Postage paid in North America.
Inquire for license or quantity pricing.

Bryte Computers, Inc.
P.O. Box 46, Augusta, ME 04330
(207) 547-3218

Circle 42 on inquiry card.

AFFORDABLE M-68000 COMPUTER SYSTEM



M68KCPU 6-10 MHz CPU, 20K static RAM, 16K EPROM, on board monitor, two RS-232 serial ports, 16-bit parallel port, 5 timer/counter expansion bus.
Bare board..... \$ 99.95
Complete Kit..... \$595.00

MD512K 128-512K static RAM, floppy disk controller & hard disk interface Bare board..... \$ 99.95
Complete Kit (128K)..... \$725.00

M68KE Enclosure with power supply, fan, filter, 4 slot card cage..... \$249.00

M68KASM M68000 Macro Cross Assembler for CP/M80, IBM PC, TRS-80 and Apple II computers..... \$199.00

UPS shipping & handling \$ 4.00
COD orders add \$ 3.00
Foreign orders add \$20.00
California residents add 6.5% tax

EMS Educational Microcomputer Systems (714) 553-0133
P.O. Box 16115 • Irvine, CA 92713

Circle 119 on inquiry card.

TOP QUALITY APPLE COMPATIBLE PERIPHERALS

THOROUGHLY TESTED AND WARRANTED FOR 120 DAYS

Cooling Fan	\$22	Z-80 Card	\$33
16K Ram	\$28	80 Column Card	\$55
Eprom Writer	\$42	RS 232 Card	\$36
Parallel Printer Card	\$35	Switching Power Supply	\$46
Keyboard	\$55	Computer Case	\$45

PACE AP-50 Disk Drive (Shugart SA 390 Mechanism) \$ 140

THE ABOVE PRICES ARE FOR DEALERS, QUANTITY 25+. COD, FOB NAPERVILLE, IL 60540
END USER INQUIRIES ALSO WELCOME.

PACE SYSTEMS, INC.
24 W 500 MAPLE AVE., NAPERVILLE, IL 60540
(312) 355-9722

Circle 242 on inquiry card.

IBM FLEXIBLE DISCS

WE WILL NOT BE UNDER-SOLD!! Call Free (800)235-4137 for prices and information. Dealer inquiries invited and C.O.D.'s accepted.



PACIFIC EXCHANGES
100 Foothill Blvd.
San Luis Obispo, CA 93401 In Cal. call (800)592-5935 or (805)543-1037

VISA

Circle 243 on inquiry card.

5 1/4" DISK DRIVES

New Low Price!

TANDON: TM 100-2 Double Sided, 40 TRK/Side \$209

TANDON: TM 100-1 Single Sided, 40 TRK. \$169

CDC: 9409 Double Sided, 40 TRK/Side..... \$219

- 120 Day Warranty
- Free Shipping
- No Charge For Credit Cards
- Order Toll Free

1-800-531-5475 (Outside Of Texas)
(512) 250-1489 (In Texas)
Texas Residents Add 5% Sales Tax.

CompuAdd Corp
13010 Research Blvd., Suite 101
Austin, Texas 78750

Circle 60 on inquiry card.



RS232C IBM PC Compatible Paper Tape Transmitter/Model 612

Stops and starts on character at all speeds, uses manual control or X-on, X-off 90-260 volt, 50-60 Hz power. 50-9600 baud, up to 150 char/sec synchronous or asynchronous; gated internal or external clock, RS 232C, current loop or parallel output, reads 5-8 level tape. 7-11 frames per character, even or odd parity. Desk top or rack mount.

Addmaster Corporation, 415 Junipero Serra Drive, San Gabriel, CA 91776, (213) 285-1121, Telex 674770 Addmaster SGAB

Circle 11 on inquiry card.

LINE-POWERED AUTO-ANSWER DIRECT-CONNECT MODEM \$89.95

300 Baud, full duplex, analog loopback for self test, carrier detect, receive data, and transmit data. LED indicators

List Price \$129.95 _____ \$89.95

SMARTMODEM Hayes

Sophisticated direct-connect auto-answer/auto dial modem, touch tone or pulse dialing. RS232C interface programmable

Smartmodem 1200 _____	\$699	\$475.00
1200B for IBM PC _____	\$599	\$399.95
Smartmodem 300 _____	\$289	\$199.00
Hayes Cronograph _____	\$249	\$199.95
Micromodem 100 _____	\$399	\$299.95
Micromodem IIe _____	\$299	\$239.95
PLEASE Software _____	\$395	\$299.95
Smartcom II _____	\$149	\$99.95

J-CAT MODEM

1/5 the size of ordinary modems, Bell 103, manual or, auto-answer. Automatic answer/originate, direct connect, built-in self-test, two LEDs and audio beeps provide status information

Novation J-Cat _____ \$149 \$114.95

ULTRA-VIOLET EPROM ERASERS

Inexpensive erasers for industry or home

Spectronics w/o timer _____	\$99	\$69.95
Spectronics with timer _____	\$139	\$94.95
Logical Devices _____	\$89	\$49.95

ISOBAR

The ISOBAR looks like a standard multi outlet power strip but contains surge suppression circuitry and built-in noise filters, plus 15amp circuit breaker

4 receptacle _____	\$89	\$59.95
8 receptacle _____	\$99	\$69.95

Complete Computer \$400.00!

THE LITTLE BOARD with FREE! CP/M 2.2

Miniature single board CP/M computer designed to mount directly on top of a 5 1/2" floppy disk drive (7.75" x 5.75"). Contains Z 80A CPU, 64K RAM, Boot Eprom, terminal port, modem port, parallel printer port, floppy disk controller, and CP/M 2.2 included FREE!

Little Board with CP/M _____	\$400	\$348.95
Support package _____	\$50	\$48.95
Serial Cable _____	\$13	\$11.95
Diskless Monitor Eprom _____	\$30	\$24.55

**SATISFACTION
GUARANTEED
OR YOUR
MONEY BACK!**

BONDWELL 12

COMPLETE COMPUTER

SAVE \$500.

\$1095⁰⁰

with FREE! SOFTWARE & MODEM



**BUILT-IN
SPEECH
SYNTHESIZER**

- ▶ Wordstar
- ▶ Mailmerge
- ▶ Calcstar
- ▶ Datastar
- ▶ Reportstar
- ▶ CP/M & BASIC
- ▶ KAYPRO compatible
- ▶ Speech Synthesizer

90 day warranty
30 day exchange
Local service through
nationwide field
service team.

4MHz Z-80A, 64K RAM, 9-inch hi-res non-glare amber monitor, composite video output, two 180K disk drives, full size 63 key keyboard with separate numeric keypad and 16 programmable function keys, speech synthesizer, two serial ports, centronics parallel printer port, bit mapped graphics, sculpted high-impact plastic case, only 26 lbs.

(Sale subject to FCC approval)
BONDWELL 14 with twice the storage \$1395.00

Better than Radio Shack and H.P.!

NEC LAP SIZE 8201A COMPUTER

240 x 64 LCD display, full keyboard with function and cursor control keys, 16K RAM expands to 96K, standard serial and parallel ports, FREE! software included
PC-8201A _____ \$799 \$598.95

**BUY NOW AND GET AN
AC BATTERY AND
NICAD BATTERY PACK FREE!**

APPLE ACCESSORIES ON SALE!

Full Height Disk Drive _____	\$299	\$179.95
Half-Height Disk Drive _____	\$249	\$184.95
Controller _____	\$100	\$59.95
8 inch 2 Meg. system _____	\$2495	\$1395.00
CP/M 3.0 Card _____	\$399	\$249.95
Z-Card with CP/M _____	\$169	\$139.95
16K RAM Card _____	\$99	\$39.95
Best 80 Column Card _____	\$219	\$139.95
Printer card & cable _____	\$109	\$49.95
Fan w/surge protect _____	\$99	\$59.95
Koala Pad _____	\$125	\$89.95
Grappler Plus _____	\$175	\$119.95
Buffered Grappler/16K _____	\$245	\$175.95
Buffered Grappler/64K _____	\$345	\$239.95

SUPER DISKETTE SPECIAL!

We bought out a major manufacturer's overstock and we are passing the savings on to you! Single-sided, double-density package of ten with FREE! plastic case

Box of 10 w/FREE! case _____ \$34 \$18.95

JADE Computer Products

Continental U.S. 800/421-5500 Inside California 800/262-1710 Los Angeles Area 213/973-7707

QUICK SERVICE, FRIENDLY SUPPORT, AND

SATISFACTION GUARANTEED OR YOUR MONEY BACK!

AND WE'VE GOT A TRACK RECORD WE'RE PROUD OF TO BACK IT UP—
EIGHT YEARS OF SERVICE TO THOUSANDS OF SATISFIED CUSTOMERS!

10 MEGABYTE HARD DISK FOR IBM PC

Plug-n-Run, ready to go • complete with controller card, data cable, and mounting hardware • totally PC/XT compatible • faster than XT • handles 4 different operating systems • streamer tape back-up available

	List	Your Price
10 mbyte internal	\$1795	\$995.00
10 mbyte external	\$2095	\$1195.00
15 mbyte internal	\$1995	\$1395.00
15 mbyte external	\$2295	\$1595.00
26 mbyte internal	\$2495	\$1995.00
26 mbyte external	\$2795	\$2249.00

Tape Back-up option CALL FOR BEST PRICE

HI-RES MONITORS

	List	Your Price
AMDEK 300G	\$179	\$119.95
AMDEK 310A	\$230	\$169.95
AMDEK 300A	\$199	\$149.95
AMDEK COLOR I	\$379	\$259.95
AMDEK COLOR II	\$559	\$419.95
AMDEK COLOR IV	\$995	\$499.95
PGS MAX-12	\$269	\$199.95
PGS HX-12	\$699	\$469.95
PGS SR-12	\$799	\$649.95
QUADCHROME	\$795	\$499.95
COMREX CR6800	\$649	\$499.95

KEYTRONICS KEYBOARDS

KEYTRONICS KEYBOARD — \$209 \$149.95

HIGH SPEED 8087 APU

List Price \$295 — SALE PRICE \$199.95

STB BOARDS FOR IBM PC

	List	Your Price
RIO PLUS 64K	\$395	\$329.95
RIO PLUS 128K	\$495	\$349.95
RIO PLUS 256K	\$595	\$449.95
RIO PLUS 384K	\$795	\$549.95
SUPER RIO 64K	\$419	\$329.95
SUPER RIO 128K	\$519	\$379.95
SUPER RIO 256K	\$619	\$479.95

PLACE ORDERS TOLL FREE

Continental USA
(800) 421-5500

Inside California
(800) 262-1710

Los Angeles Area
(213) 973-7707

We accept cash, checks, credit cards, or purchase orders from qualified firms and institutions.

Minimum prepaid order \$15.00 California residents add 6½% tax. Export customers outside the US or Canada please add 10% to all prices. Prices and availability subject to change without notice. Shipping and handling charges via UPS Ground 50c/lb. UPS Air \$1.00/lb. minimum charge \$3.00 Prices quoted are for pre-paid orders only

SOFTWARE FOR IBM PC

	List	Your Price
MICROSOFT WORD	\$395	\$249.95
FRAMEWORK	\$695	\$439.95
dBASE II	\$700	\$429.95
D-BASE III	\$695	\$449.95
R:BASE 4000	\$495	\$319.95
SMART KEY	\$89	\$69.95
MOVE-IT	\$125	\$89.95
MULTIPLAN	\$250	\$169.95
ACCOUNTING PARTNER	\$395	\$249.95
CROSSTALK	\$195	\$129.95
PROKEY	\$75	\$54.95
MULTIMATE	\$495	\$299.95
SUPERCALC III	\$395	\$249.95
TRANSEND PC	\$189	\$139.95

MICROSOFT FOR IBM PC

	List	Your Price
MOUSE w/WORD	\$495	\$339.95
MOUSE	\$199	\$129.95
SYSTEM CARD 64K	\$395	\$279.95
SYSTEM CARD 256K	\$625	\$429.95

320K DISK DRIVES

DOUBLE-SIDED, DOUBLE-DENSITY
FOR IBM PC

\$199.95

CHOICE OF
Tandon
Teac
Shugart

LOCAL AREA NETWORKS For IBM PC

QUADNET II	\$995	\$879.95
QUADNET VI	\$1995	\$1689.95
QUADNET IV	\$2295	\$1989.95
AST-PCnet II	\$495	\$399.95
ORCHID TECHNOLOGY	\$595	\$499.95

DISKETTES For IBM PC

High quality double-sided, double-density diskettes, certified to be absolutely error free. Box of ten, warranted for one year
Box of 10 w/FREE plastic case — \$39 \$19.95

AST FOR IBM PC

	List	Your Price
SIX PAK PLUS 64K	\$395	\$269.95
SIX PAK PLUS 256K	\$695	\$489.95
SIX PAK PLUS 384K	\$945	\$569.95
MEGA PLUS 64K	\$395	\$269.95
MEGA PLUS 256K	\$665	\$429.95
MEGA PLUS 512K	\$1095	\$799.95
I/O PLUS	\$165	\$119.95
MP 64K	\$295	\$199.95
MP 128K	\$395	\$249.95
MP 192K	\$495	\$299.95
MP 256K	\$595	\$349.95

IBM VIDEO BOARDS

HERCULES COLOR	\$245	\$198.95
HERCULES GRAPHIC	\$499	\$339.95
PLANTRONICS COLOR+	\$549	\$379.95
QUADCOLOR I	\$295	\$209.95
QUADCOLOR II	\$275	\$209.95
AMDEK MAI	\$649	\$349.95
AST MONOGRAPH+	\$595	\$449.95

64K RAM UPGRADE FOR IBM PC

High speed RAM upgrade kit with FREE! parity (error detection) and one year warranty

	List	Your Price
64K KIT For IBM PC	\$90	\$44.95
128K KIT For IBM PC	\$180	\$88.95
192K KIT For IBM PC	\$270	\$133.95
256K KIT For IBM PC	\$360	\$178.95
384K KIT For IBM PC	\$540	\$268.95

QUADRAM FOR IBM PC

QUADBOARD No RAM	\$295	\$234.95
QUADBOARD 64K	\$395	\$275.95
QUADBOARD 128K	\$495	\$339.95
QUADBOARD 256K	\$595	\$399.95
QUADBOARD 384K	\$795	\$595.95
QUADLINK	\$680	\$449.95
QUAD 512 PLUS 64K	\$325	\$239.95
QUAD 512 PLUS 256K	\$550	\$389.95
QUAD 512 PLUS 512K	\$895	\$549.95
QUAD COLOR I	\$295	\$209.95
QUAD COLOR II	\$275	\$199.95
AST MONOGRAPH+	\$595	\$449.95
QUAD VIEW	\$345	\$259.95

SUPER PRICES ON PRINTERS!

NEW! EPSON LQ-1500

200 CPS & LETTER QUALITY!

24 pin head, 200 CPS draft mode, 67 CPS letter quality mode

LQ-1500 _____ SAVE \$200.00
TRACTOR _____ \$89 \$54.95
SHEET FEEDER _____ \$499 \$439.95

SAVE \$200⁰⁰

NEW! 80 CPS DIABLO DAISYWHEEL PRINTER!

80 CPS, serial and parallel interfaces, extended character set, fully IBM compatible, built-in buffer, computerized front panel

FREE AUTOMATIC
DUAL BIN SHEET FEEDER!
DIABLO 80 CPS _____ \$3495 \$2995.00
CABLE Specify _____ \$70 \$59.95

SPECIAL SALE PRICE!

EPSON MX-100FT FREE Graftrax-Plus

With FREE! GRAFTRAX-PLUS
100 CPS, friction and tractor feed, 15 inch platten, one year warranty
List Price \$749.00

SALE PRICED AT **\$489⁹⁵**

EPSON CALL US FOR OUR BEST PRICE!

EPSON RX-80 100 CPS w/tractor, graphics
CALL FOR OUR BEST PRICE
EPSON RX-80FT 100 CPS w/FREE! graphics
Friction & tractor feed _____ SAVE \$150.00
EPSON MX-80FT 80 CPS w/FREE graphics
Friction & tractor feed _____ SAVE \$150.00
EPSON FX-80 160 CPS w/FREE graphics
Friction & tractor feed _____ SAVE \$50.00
EPSON FX-100 160 CPS 15" platten
Friction & tractor feed _____ SAVE \$150.00

OKIDATA PRICES SLASHED!!!

FREE! Plug-n-play option with purchase
of 92, 93, or 84

160 CPS. Correspondence Quality

OKI 92 Parallel _____ \$599 \$419.95
OKI 93 Parallel _____ \$995 \$649.95
2K Serial Board _____ \$120 \$99.95
IBM PC ROMS For 92 _____ \$59 \$49.95
IBM PC ROMS For 93 _____ \$59 \$59.95
Extra 82/92 83/93 Ribbons (2) _____ \$19 \$9.95
82/92 Tractor _____ \$89 \$54.95

120 CPS & 200 CPS OKIDATAS

OKI 82 120 CPS _____ \$499 \$329.95
OKI 83 120 CPS _____ \$775 \$569.95
OKI 84 Parallel 200 CPS _____ \$1395 \$899.95
OKI 84 Serial 200 CPS _____ \$1495 \$999.95
2K Serial Board _____ \$150 \$119.95
IBM PC ROMS For 82/83 _____ \$49 \$39.95
IBM PC ROMS For 84 _____ \$99 \$89.95

350 CPS, Near Letter Quality, High-Resolution Graphics

OKI 2350 Parallel _____ \$2695 \$1899.95
OKI 2350 Serial _____ \$2775 \$1999.95

A-B PRINTER SWITCH

Allows your computer to run either of two printers. Standard parallel switch box

Printer Switch _____ \$149 \$99.95
Extra Cable _____ \$40 \$29.95

OPEN SATURDAYS
10:00am—4:00pm PST

PLACE ORDERS
TOLL FREE!

LETTER QUALITY PRINTERS ON SALE!

	List	Your Price
Diablo 630 40 CPS _____	\$2340	\$1699.95
Tractor For 630 _____	\$250	\$219.95
Starwriter F-10 40 CPS _____	\$1895	\$999.95
Starwriter F-10 55 CPS _____	\$1995	\$1299.95
Tractor For F-10 _____	\$250	\$219.95
Coinrex CR-II 5K parallel _____	\$599	\$489.95
Coinrex CR-II 5K serial _____	\$644	\$589.95
Tractor For CR-II _____	\$120	\$99.95
Keyboard For CR-II _____	\$199	\$179.95
Sheet Feeder For CR-II _____	\$259	\$199.95
Silver Reed 500 14 CPS _____	\$599	\$499.95
Tractor For 500 _____	\$149	\$124.95
Silver Reed 550 18 CPS _____	\$699	\$599.95
Tractor For 550 _____	\$159	\$129.95
Silver Reed 770 _____	\$1295	\$999.95
Tractor For 770 _____	\$159	\$139.95
Juki 6100 18 CPS _____	\$599	\$499.95
Tractor For 6100 _____	\$149	\$124.95
NEC 3550 33 CPS _____	\$2250	\$1699.95
Tractor For 3550 _____	\$265	\$229.95

TOSHIBA P1351 HIGH SPEED & LETTER QUALITY!

High quality 24 pin head, 192 CPS draft mode,
96 CPS letter quality

P1351 _____ \$1895 \$1449.95
TRACTOR _____ \$195 \$174.95
SHEET FEEDER _____ \$1095 \$899.95

PRINTER ACCESSORIES

IBM PC STYLE CABLE _____ \$54 \$28.95
STANDARD PARALLEL CABLE _____ \$40 \$28.95
APPLE CARD & CABLE _____ \$109 \$49.95
TRS-80 MDL-3 CABLE _____ \$109 \$49.95
COLUMBIA MPC CABLE _____ \$50 \$39.95
RS-232 SERIAL CABLE _____ \$30 \$24.95
PRINTER STANDS _____ AS LOW AS \$19.95
RIBBONS _____ AS LOW AS \$4.99

MICROFAZER BUFFERS Quadram

Expandable to 64K (parallel model expands to 512K)

Parallel in/Parallel out	List	Your Price
8K _____	\$169	\$139.95
32K _____	\$225	\$164.95
128K _____	\$445	\$269.95

Serial in/Parallel out	List	Your Price
8K _____	\$199	\$169.95
32K _____	\$260	\$199.95

Parallel in/Serial out	List	Your Price
8K _____	\$199	\$169.95
32K _____	\$260	\$199.95

Serial in/Serial out	List	Your Price
8K _____	\$199	\$169.95
32K _____	\$260	\$199.95

MICROBUFFER Practical Peripherals

Stand-alone Microbuffers	List	Your Price
Parallel, 32K _____	\$299	\$229.95
Parallel, 64K _____	\$349	\$269.95
Serial, 32K _____	\$299	\$229.95
Serial, 64K _____	\$349	\$269.95
64K add-on board _____	\$179	\$149.00

Microbuffers for Apple II	List	Your Price
Parallel, 16K _____	\$259	\$189.95
Parallel, 32K _____	\$299	\$229.95
Serial, 16K _____	\$259	\$189.95
Serial, 32K _____	\$299	\$229.95

Microbuffers for Epson Printers	List	Your Price
Parallel, 16K _____	\$159	\$129.95
Serial, 8K _____	\$159	\$129.95

LOWEST PRICES! STAR MICRONICS

GEMINI 10X _____ \$269.95
Call For Prices on Gemini 15X, Delta 10 & 15,
Radix 10 & 15, Power Type LQ

JADE

Computer Products

4901 West Rosecrans Ave. Hawthorne, California 90250

The Source For All IBM Compatible Products



PC UPGRADE

- ★ 64K of Memory
- ★ 9 - 4164
- ★ 1,000 pcs

1 set for **\$47**
2 sets for **\$90**



IBM PC

- ★ 256K Disk Controller
- ★ 1 - 360K Disk Drive
- ★ Keyboard

List \$1995 **\$1695**



IBM PC XT

- ★ 256K, 10 Meg Hard Disk
- ★ 1 - 320K Drive★ Keyboard

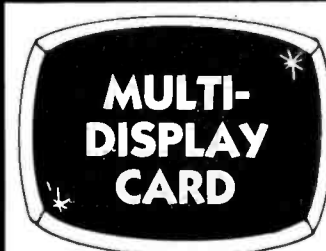
List \$4395 **\$3795**



TEAC DISK DRIVE

- ★ FD55B
- ★ Slimline, 360K

List \$299 **\$155**



MULTI-DISPLAY CARD

- ★ Monochrome or Color Composite or RGB Video
- ★ Light Pen & RF Mod Ports
- ★ Parallel Printer Port
- ★ 640 x 200

List \$459 **\$299**



PC PEACOCK COLOR BOARD

- ★ IBM Color Card Compatible
- ★ With Parallel Centronics Printer Port

List \$399 **\$219**



EPSON PRINTER

- ★ FX80
- ★ 160 cps
- ★ With Near Letter Quality Printing

List \$599 **\$439**



OKIDATA PRINTER

- ★ ML93A
- ★ 160 cps
- ★ 15" Wide Carriage

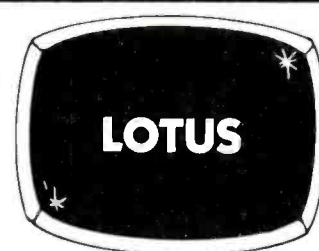
List \$995 **\$639**



SANYO COMPUTER

- ★ MBC555-2
- ★ 2 - 360K Disk Drives
- ★ Bundled Software

List \$1595 **\$1275**



LOTUS

- ★ Lotus 123
- ★ PC Spread Sheet

List \$495 **\$309**

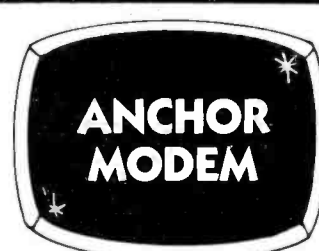
★ Symphony
List \$695 **\$529**



PIPELINE COLOR CARD

- ★ Same as IBM
- ★ Color Composite Video

List \$249 **\$189**



ANCHOR MODEM

- ★ Mark XII
- ★ 1200 Baud
- ★ Hayes Compatible

List \$399 **\$239**



The Source!



- We Accept MC, Visa, Wire Transfers, Certified Checks
- COD's Available
- All Prices Reflect a Prepaid Discount

- Shipping Minimum 4.50
- Purchase Orders Accepted
- This Ad Supersedes all Others

Prices Subject to Change

The Source!



CALL TOLL-FREE (800) 841-0905

For Lowest Prices & Fast Delivery

IBM & COMPATIBLE COMPUTERS

IBM

PC w/64K, 1 Drive \$1567
 PC w/64K, 2 Drives 1743
 PCXT, 256K 10 Meg Disk 3795

COMPAQ

Compaq 128K, 1 Drive \$1950
 Compaq, 256K, 2 Drive 2295

COLUMBIA

1600-1, 2-Drives(360K) \$2495
 1600-4, 12MB Hard Disk 3875
 MPC-XP Portable 2395

SANYO

MBC 550, 1-Drive, software \$ 699
 MBC 555, 2-Drives, 160K ea. 1035
 MBC 550-1, 1-Drive, 320K 979
 MBC 555-2, 2-Drives, 320K ea. 1275
 Optional Serial Port 89
 Optional Drive w/Software 199

TAVA

2-Drives, 128K, 2 Ser. 1 Par. Port, Color Graphics Card & Hi-Res. Green Monitor \$1789

MODEMS

HAYES MICRO INC.

Smart Modem 300 \$ 205
 Smart Modem 1200 489
 1200B for PC 399

ANCHOR

Mark VII 300 Baud \$ 89
 Mark XII 1200 Baud 239

PROMETHEUS

ProCom 1200 \$ 349

RIXON

PC212A, 1200 Baud Stand Alone.. \$ 399

U.S. ROBTICS

Password, 1200 Baud \$ 319

DISKETTES

PIPELINE

Dbl./Dbl. Reinforced Hub 1 year warranty \$ 18
 Flip File Holds 70 (smk. plexiglass) . 16

PRINTERS

OKIDATA

ML 92A (160 cps) \$ 405
 ML 93A (160 cps) 637
 92 & 93 Plug & Play 49

STAR MICRONICS

Gemini 10X, 120 cps \$ 249
 Gemini 15X, 120 cps, 15" car. 389

JUKI

6100, 18 cps ltr. qual. \$ 439
 Tractor Feed 129

EPSON

RX80 \$ 269
 RX80FT 309
 RX80 439
 FX100 659

MONITORS

AMDEK

300G, 12" Green \$ 129
 300A, 12" Amber 139
 310A, 12" Amber Monochrome 165
 Color I + Color Composite 299
 Color II + RGB w/Cable 409

PRINCETON GRAPHICS

PGS HX12 \$ 469
 PGS MAX12 189
 PGS SR12 640

IBM COMPATIBLE DISK DRIVES

TANDON

TM-55-2, 1/2 Height (360K) \$ 195
 TM-100-2 (360K) \$ 179

TEAC

FD55B, 1/2 Height (360K) \$ 155

MATSUSHITA

Same as Panasonic, 1/2 Ht. 360K \$ 145

CDC

9409, (360K) \$ 199

INTERFACE CARDS FOR IBM AND COMPATIBLES

AST RESEARCH

SixPac + 64K Par. & Ser. Software . \$ 259
 Mega + 64K exp. to 512K Ser. Port . 259
 MegaPack 256K option for Mega . 269
 I/O + Ser. & Optional Par. Game . 149
 Additional Ports 49

QUADRAM

Color I \$ 209
 Color II 229
 Quadlink 449
 64K 279
 Quad Board II 269

HERCULES

Color Graphics Card \$ 329

PLANTRONICS

Color + \$ 379

IBM

Dos 2.1 \$ 57
 Monochrome Monitor or Adaptor . 229

FLOPPY DISK CONTROLLERS

Maynard \$ 169
 Maynard w/Ser. Port 229
 Maynard w/Par. Port 229
 Sigma Controller 159

DUST COVER

Covers Monitor, Mainframe & Keyboard \$ 19

MORE ACCESSORIES

Koala Graphics Tablet \$ 85
 8087 Co-Processor 179
 Kraft Joystick 39
 Par. Printer Cable 29

USI

Paradise \$ 299

PC

Color Card \$ 189

The Source!



ORDER DESK:
 (213) 970-0177
 (800) 841-0905
 (OUTSIDE CALIFORNIA)

MAIL ORDER:
 1142 Manhattan Avenue, CP21
 Manhattan Beach, CA 90266

CUSTOMER SERVICE:
 (213) 970-0177

Mon.-Fri. 8:00 a.m. to 6:00 p.m.
 Saturday 9:00 a.m. to 1:00 p.m.

DoKau

COMPUTER PRODUCTS, Inc.

ORDER TOLL FREE

(800)
538-8800

(CALIFORNIA RESIDENTS)

(800)
848-8008



STATIC RAMS

2101	256 x 4 (450ns)	1.90
5101	256 x 4 (450ns) (cmos)	3.90
2102-1	1024 x 1 (450ns)	.88
2102L-1	1024 x 1 (450ns) (LP)	.98
2102L-2	1024 x 1 (250ns) (LP)	1.45
2111	256 x 4 (450ns)	2.45
2112	256 x 4 (450ns)	2.95
2114	1024 x 4 (450ns)	.99
2114-25	1024 x 4 (250ns)	1.10
2114L-4	1024 x 4 (450ns) (LP)	1.20
2114L-3	1024 x 4 (300ns) (LP)	1.30
2114L-2	1024 x 4 (200ns) (LP)	1.40
2125	1024 x 1	2.49
2147	4096 x 1 (55ns)	4.90
TMS4044-4	4096 x 1 (450ns)	3.45
TMS4044-3	4096 x 1 (300ns)	3.95
TMS4044-2	4096 x 1 (200ns)	4.45
MK4118	1024 x 8 (250ns)	9.90
TMM2016-200	2048 x 8 (200ns)	4.10
TMM2016-150	2048 x 8 (150ns)	4.90
TMM2016-100	2048 x 8 (100ns)	6.10
HM6116-4	2048 x 8 (200ns) (cmos)	4.70
HM6116-3	2048 x 8 (150ns) (cmos)	4.90
HM6116-2	2048 x 8 (120ns) (cmos)	8.90
HM6116LP-4	2048 x 8 (200ns) (cmos) (LP)	5.90
HM6116LP-3	2048 x 8 (150ns) (cmos) (LP)	6.90
HM6115LP-2	2048 x 8 (120ns) (cmos) (LP)	9.95
Z-6132	4096 x 8 (300ns) (Qstat)	33.95
HM6264P-15	8192 x 8 (150ns) (cmos)	38.95
HM6264LP-15	6192 x 8 (150ns) (cmos)	48.95

LP = Low Power Qstat = Quasi-Static

DYNAMIC RAMS

TMS4027	4096 x 1 (250ns)	1.95
UP0411	4096 x 1 (300ns)	2.95
MMS280	4096 x 1 (300ns)	2.95
MK4108	8192 x 1 (200ns)	1.90
MMS298	8192 x 1 (250ns)	1.80
4116-200	16384 x 1 (200ns)	.70
4116-150	16384 x 1 (150ns)	1.20
2118	16384 x 1 (150ns) (5v)	4.90
4164-250	65536 x 1 (250ns)	5.45
4164-200	65536 x 1 (200ns) (5v)	5.45
4164-150	65536 x 1 (150ns) (5v)	6.45

5V = Single 5 Volt Supply

EPROMS

1702	256 x 8 (1us)	4.45
2708	1024 x 8 (450ns)	2.49
2758	1024 x 8 (450ns)	2.49
2758	1024 x 8 (450ns) (5v)	5.90
2716	2048 x 8 (450ns) (5v)	2.95
2716-1	2048 x 8 (450ns) (5v)	5.90
TMS2516	2048 x 8 (450ns) (5v)	5.45
TMS2716	2048 x 8 (450ns) (5v)	7.90
TMS2532	4096 x 8 (450ns) (5v)	5.90
2732	4096 x 8 (450ns) (5v)	4.45
2732-250	4096 x 8 (250ns) (5v)	8.45
2732-200	4096 x 8 (200ns) (5v)	11.45
2764	8192 x 8 (450ns) (5v)	6.45
2764-250	8192 x 8 (250ns) (5v)	7.45
2764-200	8192 x 8 (200ns) (5v)	16.45
TMS2564	8192 x 8 (450ns) (5v)	14.45
MCS68764	8192 x 8 (450ns) (5v) (24 pin)	38.95
27128	16384 x 8 Cal	24.45

5v = Single 5 Volt Supply

74LS00

74LS00	.23	74LS173	.68
74LS01	.24	74LS174	.54
74LS02	.24	74LS175	.54
74LS03	.23	74LS181	2.10
74LS04	.23	74LS189	8.90
74LS05	.24	74LS190	.88
74LS08	.27	74LS191	.88
74LS09	.28	74LS192	.78
74LS10	.24	74LS193	.78
74LS11	.34	74LS194	.68
74LS12	.34	74LS195	.68
74LS13	.44	74LS196	.78
74LS14	.58	74LS197	.78
74LS15	.34	74LS221	.88
74LS20	.24	74LS240	.94
74LS21	.28	74LS241	.98
74LS22	.24	74LS242	.98
74LS26	.28	74LS243	.98
74LS27	.28	74LS244	1.25
74LS28	.34	74LS245	1.45
74LS30	.24	74LS247	.74
74LS32	.28	74LS248	.98
74LS33	.54	74LS249	.98
74LS37	.34	74LS251	.58
74LS38	.34	74LS253	.58
74LS40	.24	74LS257	.58
74LS42	.48	74LS258	.58
74LS47	.74	74LS259	2.70
74LS48	.74	74LS260	.58
74LS49	.74	74LS266	.54
74LS51	.24	74LS273	1.45
74LS54	.28	74LS275	3.30
74LS55	.28	74LS279	.48
74LS63	1.20	74LS280	1.95
74LS73	.38	74LS283	.68
74LS74	.34	74LS290	.88
74LS75	.38	74LS293	.88
74LS76	.38	74LS295	.98
74LS78	.48	74LS298	.88
74LS83	.59	74LS299	1.70
74LS85	.68	74LS323	3.45
74LS86	.38	74LS324	1.70
74LS90	.54	74LS352	1.25
74LS91	.88	74LS353	1.25
74LS92	.54	74LS363	1.30
74LS93	.54	74LS364	1.90
74LS95	.74	74LS365	.48
74LS96	.88	74LS366	.48
74LS107	.38	74LS367	.44
74LS109	.38	74LS368	.44
74LS112	.38	74LS373	1.35
74LS113	.38	74LS374	1.35
74LS114	.38	74LS377	1.35
74LS122	.44	74LS378	1.13
74LS123	.78	74LS379	1.30
74LS124	2.85	74LS385	1.85
74LS125	.48	74LS386	.44
74LS126	.48	74LS390	1.15
74LS132	.58	74LS393	1.15
74LS133	.58	74LS395	1.15
74LS136	.38	74LS399	1.45
74LS137	.98	74LS424	2.90
74LS138	.54	74LS447	.36
74LS139	.54	74LS490	1.90
74LS145	1.15	74LS624	3.95
74LS147	2.45	74LS640	2.15
74LS148	1.30	74LS645	2.15
74LS151	.54	74LS668	1.65
74LS153	.54	74LS669	1.85
74LS154	1.85	74LS670	1.45
74LS155	.68	74LS674	9.60
74LS156	.68	74LS682	3.15
74LS157	.64	74LS683	3.15
74LS158	.58	74LS684	3.15
74LS160	.68	74LS685	3.15
74LS161	.64	74LS688	2.35
74LS162	.68	74LS689	3.15
74LS163	.64	74LS783	23.95
74LS164	.68	81LS95	1.45
74LS165	.94	81LS96	1.45
74LS166	1.90	81LS97	1.45
74LS168	1.70	81LS98	1.45
74LS169	1.70	25LS2521	2.75
74LS170	1.45	25LS2569	4.20

7400

7400	.18	7482	.94	74172	5.90
7401	.18	7483	.49	74173	.74
7402	.18	7485	.58	74174	.88
7403	.18	7486	.34	74175	1.75
7404	.18	7489	2.10	74176	.88
7405	.24	7490	.34	74177	.74
7406	.28	7491	.39	74178	1.10
7407	.28	7492	.49	74179	1.70
7408	.23	7493	.34	74180	.74
7409	.18	7494	.64	74181	2.20
7410	.18	7495	.54	74182	.74
7411	.24	7496	.69	74184	1.95
7412	.29	7497	2.70	74185	1.95
7413	.34	74100	1.70	74190	1.10
7414	.48	74107	.29	74191	1.10
7416	.24	74109	.44	74192	.78
7417	.24	74110	.44	74193	.78
7420	.18	74111	.54	74194	.84
7421	.34	74116	1.50	74195	.84
7422	.34	74120	1.15	74196	.78
7423	.28	74121	.28	74197	.74
7425	.28	74122	.44	74198	1.34
7426	.28	74123	.48	74199	1.34
7427	.28	74125	.44	74221	1.34
7428	.44	74126	1.44	74246	1.34
7430	.18	74128	.54	74247	1.24
7432	.28	74132	.44	74248	1.80
7433	.44	74136	.49	74249	1.90
7437	.28	74141	.64	74251	.74
7438	.28	74142	2.90	74259	2.20
7440	.18	74143	2.90	74265	1.30
7442	.48	74145	.59	74273	1.90
7443	.64	74147	1.75	74276	1.20
7444	.68	74148	1.75	74279	.74
7445	.68	74150	1.30	74283	1.95
7446	.68	74151	.54	74284	3.70
7447	.68	74152	.64	74285	3.70
7448	.68	74153	.54	74290	.94
7450	.18	74154	1.20	74293	.74
7451	.22	74155	.74	74298	.84
7453	.22	74156	.64	74351	2.20
7454	.22	74157	.54	74365	.64
7460	.22	74159	1.60	74366	.64
7470	.34	74160	.84	74367	.64
7472	.28	74161	.68	74368	.64
7473	.33	74162	.84	74376	2.15
7474	.32	74163	.68	74390	1.70
7475	.44	74164	.84	74393	1.30
7476	.34	74165	.84	74425	3.10
7480	.58	74166	.95	74426	.84
7481	1.05	74167	2.90	74490	2.50
		74170	1.60		

6500

6502	1 Mhz	4.90
6504	1 Mhz	6.90
6505	1 Mhz	8.90
6507	1 Mhz	9.90
6520	1 Mhz	4.30
6522	1 Mhz	6.90
6532	1 Mhz	9.90
6545	1 Mhz	21.50
6551	1 Mhz	10.65

6800

68000	58.95
6800	3.90
6802	7.90
6808	12.90
6809E	18.95
6809	10.95
6810	2.90
6820	4.30
6821	3.20
6828	13.95
6840	11.95
6843	33.95
6844	74.95
6845	13.95
6847	10.95
6850	3.20
6852	15.70
6860	9.90
6862	10.95
6875	6.90
6880	2.20
6883	21.95
68047	23.95
68488	18.95

2 Mhz

6502A	2 Mhz	6.90
6522A	2 Mhz	9.90
6532A	2 Mhz	10.95
6545A	2 Mhz	26.95
6551A	2 Mhz	10.95

3 Mhz

6502B	3 Mhz	9.90
-------	-------	------

1 Mhz

68800	9.95
68802	21.25
68809E	28.95
68809	28.95
68810	6.90
68821	6.90
68845	18.95
68850	5.90

74S00

74S00	.31	74S163	1.90
74S02	.34	74S168	3.90
74S03	.34	74S169	3.90
74S04	.34	74S174	.94
74S05	.34	74S175	.94
74S08	.34	74S181	3.90
74S09	.39	74S182	2.90
74S10	.34	74S188	1.90
74S11	.34	74S189	6.90
74S15	.34	74S194	1.44
74S20	.34	74S195	1.44
74S22	.34	74S196	1.44
74S30	.34	74S197	1.44
74S32	.39	74S201	6.90
74S37	.87	74S225	7.90
74S38	.84	74S240	2.15
74S40	.34	74S241	2.15
74S51	.34	74S244	2.15
74S64			

DISC CONTROLLERS

1771	14.95	2797	84.95
1791	23.95	6843	33.95
1793	25.95	8272	38.95
1795	48.95	UPD765	38.95
1797	48.95	M88876	28.95
2791	79.95	M88877	33.95
2793	79.95	1691	16.95
2795	84.95	2143	17.95

CRYSTALS

1.0000 MHz	3.69	8.0000 MHz	2.89
1.8432 MHz	3.69	10.0000 MHz	2.89
2.0000 MHz	2.69	10.7386 MHz	2.69
2.0972 MHz	2.69	12.0000 MHz	2.69
2.4576 MHz	2.89	14.3182 MHz	2.69
3.2768 MHz	2.69	15.0000 MHz	2.89
3.5795 MHz	2.69	16.0000 MHz	2.69
4.0000 MHz	2.69	17.4300 MHz	2.69
4.1943 MHz	2.69	18.0000 MHz	2.69
4.9180 MHz	2.69	18.4320 MHz	2.69
5.0000 MHz	2.69	19.6608 MHz	2.69
5.0688 MHz	2.69	20.0000 MHz	2.69
5.1850 MHz	2.69	22.1184 MHz	2.69
5.2429 MHz	2.69	32.0000 MHz	2.69
5.7143 MHz	2.69	36.0000 MHz	2.69
6.0000 MHz	2.69	48.0000 MHz	2.69
6.1440 MHz	2.69	49.4350 MHz	2.69
6.4000 MHz	2.69	49.8900 MHz	2.69
6.5536 MHz	2.69		
32.768 KHz	1.69		

CRYSTAL CLOCK OSCILLATORS

PART NO.	FREQUENCY	PRICE
1.000	1.0000 MHz	9.95
1.843	1.8432 MHz	9.95
2.000	2.0000 MHz	9.95
4.000	4.0000 MHz	9.95
8.000	8.0000 MHz	9.95
10.000	10.0000 MHz	9.95
16.000	16.0000 MHz	9.95
18.432	18.4320 MHz	9.95
19.660	19.6608 MHz	9.95
20.000	20.0000 MHz	9.95
32.000	32.0000 MHz	9.95

VOLTAGE REGULATORS

7805T	.74	7905T	.84
78M05C	.34	7908T	.84
7808T	.74	7912T	.84
7812T	.74	7915T	.84
7815T	.74	7924T	.84
7824T	.74	7905K	1.44
7805K	1.34	7912K	1.44
7812K	1.34	7915K	1.44
7815K	1.34	7924K	1.44
7824K	1.34	79L05	.78
78L05	.68	79L12	.78
78L12	.68	79L15	.78
78L15	.68	LM323K	4.90
78H05K	9.90	UA78S40	1.90
78H12K	9.90		

C, T = TO-220 K = TO-3
L = TO-92

DIP SWITCHES

4 POSITION	.84
5 POSITION	.89
6 POSITION	.89
7 POSITION	.94
8 POSITION	.94

IC SOCKETS

(1 to 99)

8 pin ST	.12	8 pin WW	.58
14 pin ST	.14	14 pin WW	.68
16 pin ST	.16	16 pin WW	.68
18 pin ST	.19	18 pin WW	.98
20 pin ST	.28	20 pin WW	1.04
22 pin ST	.29	22 pin WW	1.34
24 pin ST	.29	24 pin WW	1.44
28 pin ST	.39	28 pin WW	1.64
40 pin ST	.48	40 pin WW	1.94

ST = Solder tail WW = Wirewrap

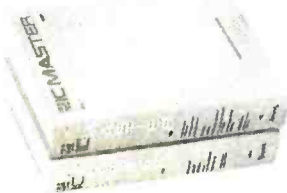
ZIF SOCKETS

16 pin ZIF	5.90
24 pin ZIF	7.90
28 pin ZIF	8.90

ZIF = TEXTTOOL (Zero Insertion Force)

1984

- THE IC MASTER -
Your ticket to fast and
easy IC selections
\$ 89.95



IBM Expansion KIT
Upgrade Chips
4164 200ns 9 @ 5.45 ea.

micromax

VIEWMAX-80 149.95

- 80 Column card for Apple II+
- Video Soft Switch
- Inverse Video
- 2 Year Warranty



VIE WMAX-80e 129.95

- 80 Column card for Apple IIE
 - 64K RAM expandable to 128K
- 64K RAM Upgrade 43.60**



QUV-T8/1
EPROM Eraser



QUV-T8/1 Economy Model:

Low cost EPROM eraser in plastic enclosure. The UV element is in the lid and you place the EPROMs in the bottom half. No timer or switch option.

- Erases up to 8 EPROMs in 15 - 20 minutes.
- 12,000 uWatts at 1" distance.
- 90-Day Warranty **49.95**

The FLIP SORT™

The new Flip Sort™ has all the fine qualities of the original with some added benefits: a new design and 50% greater capacity. Holds 75 diskettes and the price is now lower than ever — **\$16.95**



ATHANA

BULK 5 1/4" DISKETTES
(NO LABEL)

SS/SO	15.90
SS/DO	16.90
DS/DO	22.90
SS/DO	10/14.90
100 up	CALL

APPLE ACCESSORIES

80 Column Apple II+	149.95
80 Column Apple IIE	129.95
Z80 Apple II+	89.00
Z80 Apple IIE	89.00
16K Card	39.95
Cooling Fan	38.95
Power Supply	74.95
Joystick	29.95
RF Modulator	13.95
Disk Drive	199.00
Controller Card	59.95

APPLE COMPATIBLE DISK DRIVE



199.00

- Shugart mechanism, made in U.S.A.
- Directly replaces Apple Disk II
- Fully compatible with Apple Controller or other Apple compatible controllers.
- One Year Warranty

CONTROLLER CARD... 59.95

COOLING FAN

38.95



APPLE COMPATIBLE POWER SUPPLY

74.95



- Powers Apple type systems
- +5V @ 5A +12V @ 3A
- -5V @ .5A -12V @ .5A
- Includes Instructions

The Flip Sort PLUS™

The new Flip Sort PLUS™ adds new dimensions to storage. Its smoked acrylic elegance holds over 100 diskettes with all the features you expect from the Flip Sort Family — **\$24.95**



APPLE COMPATIBLE JOYSTICK

29.95



16K RAM Card - Apple II+
• 2-Year Warranty



Assembled & Tested **39.95**
For the APPLE HOBBIEST DoKay KITS:

16K RAM card..... 24.95
80 Column Card II+ ... 89.95
Z80 Card 69.95
Printer Card 24.95
80 Column Card IIE ... 89.95
KEYBOARD (99/4)
48keys 4" x 10" **6.95**



Reg. Power Supply
Model 4A/PS (99/4)
3 DC Outputs:

12V @ .4A, +5V @ 1.1A
-5V @ .2A Highly Filtered

6.95



TERMS: Minimum order \$10.00. For shipping and handling, include \$2.50 for UPS ground or \$3.50 for UPS Blue (air). For each additional air pound, add \$1 for UPS Blue shipping and handling. California residents must include 6% sales tax; Bay area and LA residents include 6 1/2% sales tax. Prices are subject to change without notice. We are not responsible for typographical errors. We reserve the right to limit quantities and to substitute manufacturers. All merchandise subject to prior sale.

CALL for VOLUME Quotes

HOURS: Mon. - Fri. 7:30 to 5:00
Saturdays 10:00 to 3:00

VISIT OUR RETAIL STORE

2100 De La Cruz Blvd.
Santa Clara, CA 95050
(408) 988-0697

ALL MERCHANDISE IS 100% GUARANTEED

Telex: 756440

DoKay

California Digital

17700 Figueroa Street • Carson, California 90248



FREE

Plastic library case supplied with all diskettes purchased from California Digital.

DISKETTES AS LOW AS \$16.50

FIVE INCH SINGLE SIDED DOUBLE DENSITY			
SubSector	Each box	10 Boxes	100 Boxes
CAL DIGITAL CAL-501 CAL-510 CAL-516	18.95	17.50	16.50
SCOTCH MMM-744/0 VRR-525/01 VRR-525/16	24.95	22.75	21.75
VERBATIM MRX-3481 MRX-3483 MRX-3485	24.95	22.75	21.75
MEMOREX MRX-3481 MRX-3483 MRX-3485	24.95	21.75	17.75
MAXELL MXL-MD1 MXL-MH1/10 MXL-MJ1/10	24.95	22.75	21.25
DYSAN DYS-104/10 DYS-107/10 DYS-105/10	35.00	33.00	30.50
FIVE INCH DOUBLE SIDED DOUBLE DENSITY			
CAL DIGITAL CAL-551 CAL-551 N/A	24.95	22.75	20.50
SCOTCH MMM-745/0 MMM-745/1 VRR-550/10 VRR-550/16	37.95	35.95	31.25
VERBATIM VRR-550/10 VRR-550/16	37.95	35.95	32.75
MEMOREX MRX-3491 MRX-3493	32.95	31.25	26.25
MAXELL MXL-MD2 MXL-MD2/10 MXL-MD2/16	37.95	35.95	33.75
MAXELL / 96 MXL-MD2/96	45.00	43.00	41.25
DYSAN DYS-104/20 DYS-105/20 DYS-204/20	42.50	40.50	35.50
DYSAN / 96 N/A N/A	49.95	47.95	45.75

EIGHT INCH SINGLE SIDED SINGLE DENSITY			
SCOTCH MMM-740/0	28.50	27.50	23.80
MEMOREX MRX-3062	27.75	26.60	22.25
VERBATIM VRR-34/9000	31.50	29.50	25.60
DYSAN DYS-3740/1	35.75	32.75	29.75

EIGHT INCH SINGLE SIDED DOUBLE DENSITY			
SCOTCH MMM-741/0	33.95	31.75	29.15
MEMOREX MRX-3090	31.95	27.75	26.15
VERBATIM VRR-34/8000	35.25	33.25	28.75
DYSAN DYS-3740/1D	40.75	38.75	32.25
MAXELL MXL-FD1	45.50	39.75	35.15

EIGHT INCH DOUBLE SIDED DOUBLE DENSITY			
SCOTCH MMM-743/0	45.95	43.25	37.50
MEMOREX MRX-3102	37.95	36.75	31.50
VERBATIM VRR-34/4001	41.75	37.50	32.25
DYSAN DYS-3740/2D	54.65	49.75	40.50
MAXELL MXL-FD2	52.50	48.75	40.45

MODEMS \$319



The CT5212AH Modem is 300/1200 Auto Answer/Auto Dial, Hayes Compatible, Microfit, Lotus, Compaq communications software \$35.00 additional.

Signalman Mark 1, 1200 baud. Hayes compatible.
Signalman Mark 1, direct connect with terminal cable.
CTS 212AH 1200 baud, auto dial. Hayes compatible.
Hayes Smart Modem 1200 baud, auto answer, auto dial.
Hayes 1200B for use with the IBM/PC, 1200 baud.
Hayes Smartmodem, 300 baud only, auto answer, auto dial.
Hayes Micromodem II, 103 Apple direct connect.
Universal Data 103LP, line power, answer & originate.
Universal Data 103LP, full 1200 baud duplex, line power.
Novation "J" Cat. direct connect, auto answer

SEL-MK12	259.00
SEL-MK1	75.00
CTS-212AH	319.00
HYS-212AD	479.00
HYS-1200B	429.00
HYS-103AD	229.00
HYS-AM2	279.00
UOS-103P	169.00
UOS-212LP	359.00
NOV-JCAT	115.00

MITSUBISHI \$179



California Digital has purchased over one thousand factory new Mitsubishi M4853 5 1/4" disk drives from the Eagle Computer Company. The drives are half height double sided 96 track per inch. The M4853 interfaces the same as the Shugart SA465. We are currently offering these drives at only \$179.00. This is far below distributor cost. Offer is subject to remaining inventory on hand at time of order. MIT-4853

MEMORY

16K DYNAMIC 4116 150ns. 1.95	2732 EPROM 450ns. 4.95
2764 EPROM 350ns. 6.95	16K STATIC 6116 200ns. 4.95

4164 DYNAMIC MEMORY 150ns \$5.95

DYNAMIC MEMORY			
4027 4K dynamic 250ns.	ICM-402750	1.31	32+ 100+
1116 150ns 16K	ICM-4116150	1.99	1.85 1.75
4116 200ns 16K	ICM-4116200	1.75	1.65 1.45
4164 150ns 64K 128 refresh	ICM-4164150	5.95	5.85 5.55
41256 150ns 256K	ICM-41256150	Available	
DP8049 dynamic controller	ICT-8409	39.00	35.00 29.00
EPROMS			
2708 450ns 1K x 8	ICE-2708	4.95	4.75 4.55
2716 450ns 2K x 8	ICE-2716	4.50	4.25 3.97
2716 7MS 450ns Tri-voltage	ICE-2716TMS	7.95	7.65 7.25
2732 450ns 4K x 8	ICE-2732	4.50	3.75 3.55
2732 350ns 4K x 8	ICE-273250	6.50	6.00 7.60
2743 450ns 4K x 8	ICE-2743	9.50	8.90 9.50
2764 450ns 8K x 8	ICE-2764	8.95	6.95 6.95
27128 350ns 16K x 8	ICE-27128	18.95	
STATIC MEMORY			
21L02 200ns 1K static	ICM-21L02200	1.49	1.29 1.15
21L02 450ns 1K static	ICM-21L02450	1.29	1.15 1.05
2111 450ns 2K static	ICM-2111450	2.99	2.85 2.75
2114 300ns 1K x 4	ICM-2114300	1.95	1.86 1.75
4041 7MS 450ns 4K x 1	ICM-4041450	3.49	3.25 2.99
4257 300ns 4K x 1	ICM-4257300	2.59	2.25 1.99
6116 P4 200ns 2K x 8	ICM-6116200	4.85	4.65 4.50
6116 P3 150ns 2K x 8	ICM-6116150	5.25	
6167 2167 100ns 16K x 1 (20pin)	ICM-6167100	9.95	

CONNECTORS

S-100 Gold	DB25P
GOLD S-100 EDGE CARD CONNECTORS catalog each 10-99 100+	'D' TYPE catalog each 10-99 100+
Imperial s/f 250 CNE-IMS 2.95 2.50 2.19	DE9P male CND-9P 1.60 1.40 1.30
Salting Hiro. CNE-H100 4.19 3.85 3.47	DE9S female CND-9S 2.25 2.00 1.90
S-100 Wide W. CNE-W10 3.95 3.50 3.19	DE Hood CND-9H 1.50 1.35 1.20
Altair 140 s/f CNE-100A 4.95 4.50 4.19	DA15P male CND-15P 2.35 2.10 1.90
156' CENTER EDGE CARD CONNECTORS	DA15S female CND-15S 3.25 3.10 2.90
20 pin socket CNE-D20 4.35 3.80 2.50	CND-15H 1.60 1.35 1.20
43/72 Moto s/f CNE-72S 6.60 6.15 5.75	DB25P male CND-25P 1.95 1.75 1.35
36/72 D/G s/f CNE-72S 5.95 5.50 5.19	DC25S female CND-25S 2.55 2.35 1.99
Other connectors available upon request.	DB25 hood CND25H 1.35 1.15 77
REBBER CONNECTORS	DC37P male CND-37P 4.20 3.95 3.65
DB25P female CND-25P 5.65 5.25 4.15	DC37S female CND-37S 5.95 5.75 5.50
DB25S female CND-25S 5.95 5.59 4.50	DC37 hood CND-37H 2.25 1.95 1.65
57-3036P male CNE-36P 7.95 6.75 5.90	DC50P hood CND-50H 2.50 2.40 2.10
20 pin edge CND-D20 4.35 3.80 2.50	Hardware 2/25el CND-2HS 89 69 42
26 pin edge CNE-D26 4.95 3.50 2.70	AMPHENOL / CENTRONICS TYPE
25 pin socket CNI-D25 3.20 2.15	57-3036P 36P CND-36P 7.95 6.35 3.97
34 pin edge CNI-D34 4.95 4.20 3.10	IEEE488 C cor CND-74P 7.95 6.35 5.35
50 pin socket CNI-D50 3.50 2.35 1.37	DISK DRIVE POWER CONNECTORS
50 pin socket CNI-D50 3.95 3.50 4.00	8 pin D.C. CND-8P 1.95 1.29 89
50 pin socket CNI-D50 4.95 4.60 3.80	8 3 AC Sign's CND-3SS 1.69 1.09 69
	8 3 AC D.C. CND-3DS 1.69 1.09 69
	S'1 4 pin D.C. CND-4DC 1.79 1.19 99
	3 pin DIN recpt. CND-3P 2.59 1.99 1.59

BLOWOUT SALE \$129



California Digital has recently participated in the purchase of several thousand Siemens FDD 100-8 floppy disk drives. These units are electronically and physically similar to that of the Shugart 801R. All units are new and shipped in factory sealed boxes. Manual and power connectors supplied free upon request. Your choice 115 Volt, 60 Hz. or 230 Volt, 50Hz.

NOTE: European customers, we have a large quantity of 230 volt 50 Hz. units warehoused in Frankfurt Germany. Arrangements can be made to call these devices in quantities of 50 or more at a fraction reducing import duty and freight charges.

REMEX DOUBLE SIDED \$219

California Digital has just purchased a large quantity of Remex RFD-4000 Eight inch double sided disk drives. Remex is the only double sided disk drive that has a double gimbal mounted head assembly that guarantees lower head tracking. This drive is mechanically solid. Remex has always been known for producing premiere products for the floppy disk market. The Remex company is a subsidiary of the Ex-cell-o Corporation, a Fortune 500 Company.

Five Inch Single Sided Drives			
TEAC FD-54A half height	129	123	119
SHUGART SA400L	189	179	175
SHUGART SA200 3/4 Height	159	149	139
TANDON TM100-1 full height	169	165	179
Five Inch Double Sided Drives			
TEAC FD55B half height	139	135	129
CONTROL DATA 9409 IBM/PC	229	219	215
CONTROL DATA 9428 half ht.	229	219	215
SHUGART SA455 Half Height	259	249	239
PANASONIC JA551/2N (SA455)	169	159	155
SHUGART SA465 Half Ht. 96TPI	289	279	269
TANDON 100-2 full height	197	193	185
TANDON 101-4 96TPI 80 Track	369	355	351
MITSUBISHI 4851 Half Height	259	249	245
MITSUBISHI 4853 1/2 Ht. 96TPI	179	175	169
MITSUBISHI 4854 1/2 Ht., 8" elec.	465	449	439
QUME 142 Half Height	239	229	219
Eight Inch Single Sided Drives			
SHUGART 801R	385	375	365
SIEMENS FDD 100-8	129	125	119
TANDON 848E-1 Half Height	369	359	349
Eight Inch Double Sided Drives			
SHUGART SA851R	495	485	475
QUME 842 "QUME TRACK 8"	459	449	445
TANDON 848E-2 Half Height	459	447	439
REMEX RFD-4000	219	219	209
MITSUBISHI M2894-63	447	439	433
MITSUBISHI M2896-63 Half Ht.	459	449	409
Three Inch Disk Drives			
SHUGART SA300 with diskette	229	219	209
Five Inch Winchester Hard Disk Drives			
FUJITSU M2235AS 27 M/Bytes	999	959	889
RODINE RO-208 53 M/Byte	1589	1493	1427
MAXTORXT1065 65 M/Byte	1995	1965	1939
SHUGART 712 13 M/Byte, 1/2 Ht	795	765	725
TANDON 503 19 M/Byte	795	775	755

UPON REQUEST, ALL DRIVES ARE SUPPLIED WITH POWER CONNECTORS AND MANUAL

ENCLOSURES

California Digital manufactures an assortment of stock and custom disk drive enclosures. If the volume is justified we will custom design an enclosure for your application. The following stock disk drive enclosures are available. All include power supplies the 8" enclosures are supplied with exhaust fans.

Horizontal mount two 8" full height drives.	\$279.00	Horizontal mount one full height or two half height 8" disk drives.	\$239.00
Vertical mount two full height 8" disk drives.	\$299.00	Horizontal mount two full height 5 1/4" disk drives	\$139.00

Telex 753607



Shipping: First five pounds \$3.00, each additional pound \$5.00. Foreign orders: 10% shipping, excess will be refunded. California residents add 6 1/2% sales tax. • COD's discouraged. Open accounts extended to state supported educational institutions and companies with a strong "Dun & Bradstreet" rating. Retail location: 17700 Figueroa Street, Carson CA. 90248.

TOLL FREE ORDER LINE
(800) 421-5041
TECHNICAL & CALIFORNIA
(213) 217-0500

California Digital

17700 Figueroa Street • Carson, California 90248

Eagle \$895

In conjunction with the California Digital has agreed to assist in the liquidation of approximately 1000 Eagle IIE/2 Computers. These units features a 12" non-glare green phosphor CRT, typewriter style keyboard with separate numeric cluster. This unit provides two 5 1/4" drives for a combined storage capacity of 780 K/Byte. The Eagle II contains a 4Mhz Z-80A, DMA disk interface, two RS-232C serial ports, Centronics style printer interface, along with an auxiliary parallel port. Software included consists of ULTRACALC electronic spread sheet, SPELL-BINDER word processor, CBASIC2, CP/M 2.2, and an exclusive Eagle menu driven utility package. These units are all "factory new" and are being offered far below their suggested price of \$1995. This is your opportunity to purchase a complete CP/M system for only \$895. EAG-2E2

Epson Comrex PLOTTER \$189



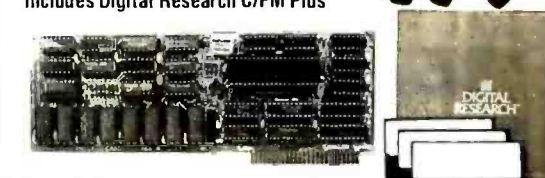
The Comrex Comscriber I is the ideal solution to make short work of translating financial and other numeric data into a graphic presentation. Complete with menu driven software for use with either IBM/PC or Apple II. Along with this are included multicolor plotter pens, demonstration software and interface cable. The Comscriber I was originally priced to sell at \$795. This is your opportunity to purchase a high value graphic plotter at only \$189. IBM/PC COM-C1PC, Apple COM-C1A2

NEC RGB COLOR MONITOR \$259



The NEC JC-14010 is a 13" medium/high resolution RGB monitor suitable for use with the Sanyo MBC-550/555 or the IBM/PC. The monitor features a resolution of 400 dots by 240 lines. Colors available are Red, Green, Blue, Yellow, Cyan, Magenta, Black and White. These monitors are currently being used in applications far more critical than microcomputers. The NEC monitor carries the Lillton-Monroe label and was originally scheduled for use in their "Office of the Future" equipment. A change in Monroe's marketing strategy has made these units excess inventory which were sold to California Digital. We are offering these prime "new" RGB monitors at a fraction of their original cost. Sanyo compatible NEC-14015; IBM/PC Computer compatible NEC-1401/PC

Advanced Logic Systems CP/M 3.0 CARD \$179



California Digital has just purchased from Digital Research over eight hundred of the Advanced Logic Systems CP/M 3.0 cards. This unique product offers performance up to 300% faster than existing Apple CP/M cards. Featuring a 6Mhz, Z80B micro-processor, 64K/Byte of on board memory, with CP/M 3.0 along with GSX 80 graphics and CBASIC. The ALS card supports larger programs with enhanced CP/M editing features. Manufacturers suggested price on the CP/M board is \$399, while supplies last California Digital is offering this card at only \$179. ALS-Z80

PRINTERS

MATRIX PRINTERS		
Star Gemini 10K 120 char/sec	STR-G10K	279.00
Star Gemini 15K, 100 char/sec 15" paper	STR-G15K	389.00
Star Gemini Delta 10, 160 Char/sec	STR-D10	399.00
Star Gemini 10KT 100 char/sec tractor	VST-080PT	195.00
Tombra PI 150, 182 char/sec, letter quality	TOS-1350	1495.00
Okidata 82A serial & parallel 9" paper	OKI-82A	347.00
Okidata 2350 lineal 350 char/sec	OKI-2350	427.00
Okidata 835A parallel 15" paper	OKI-835A	557.00
Okidata 84A parallel 15" paper	OKI-84A	597.00
Okidata 2350 lineal 350 char/sec	OKI-2350	195.00
Epson RX 8010 120 Char/sec	EPS-FR80	317.00
Epson FX 100 15" 160 char/sec with graphics	EPS-FR100	529.00
Epson MX100 with graphics, 15" paper	EPS-MX100	719.00
NEC80234 parallel 9" paper, graphics	NEC-80234	589.00
Andrus 9501B high speed with graphics	ADK-9501B	1029.00
Andrus 9620B 200 char/sec, parallel	ADK-9620B	1129.00
Quaker 7030 correspondence quality 180 char/sec	DTK-7030	1539.00
Prinomat 8510 parallel 9" paper	PRD-8510P	319.00
Prinomat II parallel 15" paper, graphics	PRD-2P	689.00
Dataproducer 8100 30 bonding printer (500 LPM)	DPS-8000	1995.00
Prinomat P 800 high speed printer 300 lines per minute	PRP-8000	4250.00
Prinomat P 800 ultra high speed 600 lines per minute	PRP-P800	5750.00

MONITORS

BMC 12 A green phosphor 15MHz composite video	BMC-12A	789.50
BMC 12 high resolution, 20MHz	BMC-12BH	119.00
Amitek 300A 12 amber phosphor, high resolution	AMK-300G	1289.50
Amitek 310A designed for IBM/PC, amber	AMK-310A	1389.50
Zenith ZVM122 Amber Phosphor 12" 40/80 column switch	ZVM-122	319.50
Zenith ZVM123 green phosphor 12" 40/80 column switch	ZVM-123	349.50
NEC JB1201 green phosphor 18" high composite video	NEC-JB1201	159.00
NEC JB1260 commercial grade composite	NEC-JB1260	119.00
Akrofolia 23 open frame black white composite video	AKO-23	159.00
Molitoria 12 open frame black white composite video	MO-12	159.00
Cominco 9200 high resolution 15" 40/80 column switch	CON-9200	59.00

ASCII KEYBOARD \$49



California Digital has purchased over 5000 of these Microtronix keyboards from the General Dynamics Corporation. 93 ASCII encoded Hall effect switches encodes 8 function keys and 14 key numeric cluster make this keyboard an excellent value at only \$49. MIC-93GD 5 lbs. We also have available a matching General Dynamics trim panel. \$10. Non encoded Hitek 58 key metal contact keyboard. HIK-58 \$24.95. Matching 15 key numeric cluster \$9.95. Both only \$29.95. HIK-5815. Not pictured, .49 key set for modified Hollerith coded Microtronix Hall effect keyboard. REMOVED from punch card equipment. \$14.95. DIT-4839. ASCII encoded available.

16BIT MICROPROCESSORS

Octoprocessor CPU 8088/280 & computer	OCT-88280	795.00
Octoprocessor CPU 8088/280 & computer	OCT-88280	895.00
Godbout 280 2.1Mhz 280 microprocessor	G280-280	750.00
Intel 80286 16MHz 286 microprocessor	TEL-80286	1995.00
Intel 80286 16MHz 286 microprocessor	TEL-80286	1995.00

8 BIT MICROPROCESSORS

Godbout 280 2.1Mhz 280 microprocessor	G280-280	750.00
Intel 80286 16MHz 286 microprocessor	TEL-80286	1995.00
Intel 80286 16MHz 286 microprocessor	TEL-80286	1995.00

FLOPPY DISK CONTROLLERS

Godbout 280 2.1Mhz 280 microprocessor	G280-280	750.00
Intel 80286 16MHz 286 microprocessor	TEL-80286	1995.00
Intel 80286 16MHz 286 microprocessor	TEL-80286	1995.00

CPM OPERATING SYSTEM

Digital Research CP/M 3.0 B 5.25 disc	DRP-CP300	249.00
Digital Research CP/M 3.0 B 5.25 disc	DRP-CP300	249.00
Digital Research CP/M 3.0 B 5.25 disc	DRP-CP300	249.00

HARD DISK CONTROLLERS

Godbout 280 2.1Mhz 280 microprocessor	G280-280	750.00
Intel 80286 16MHz 286 microprocessor	TEL-80286	1995.00
Intel 80286 16MHz 286 microprocessor	TEL-80286	1995.00

EPROM BOARDS

Intel Access EPROM board programs 27256 IAD P100	IAE-27256	465.00
Digital Research EPROM board, 27K	DRP-27K	119.00

STATIC MEMORY BOARDS

Godbout Ram 16 64K 16bit data bus	G01-1616	459.00
Godbout Ram 16 64K 16bit data bus	G01-1616	459.00
Godbout Ram 16 64K 16bit data bus	G01-1616	459.00

DYNAMIC MEMORY BOARDS

California Digital 256K expandable 1Meg	CAL-256K	585.00
California Digital 256K expandable 1Meg	CAL-256K	585.00

INTERFACE BOARDS

Godbout Interface II 2 serial ports	G01-133A	299.00
Godbout Interface III 3 serial 2 parallel	G01-133A	299.00
Godbout Interface III with 5 serial ports	G01-133A	299.00

SPECIAL FUNCTION BOARDS

Hayes S-100 Microcomputer 300 baud	HYS-S100	375.00
GT Computer circuit board battery	GTC-CC40	139.00
Godbout System support board - KEPRIMOD-SYS1	G01-133A	350.00

MAINFRAMES & MOTHER BOARDS

LEOS Data Systems 22 slot	EDP-100	695.00
Godbout 12 slot mother board assembled	G01-1202	675.00
California Computer 2200 12 slot	CAL-2200	379.00

WORD PROCESSING PRINTERS

NEC7710 55 character/sec, serial interface	NEC-7710	1979.00
NEC7730 55 character/sec, par interface	NEC-7730	1979.00
NEC2550 popular printer designed for the IBM/PC	NEC-2550	1789.00
NEC2050 designed for IBM/PC 20 char/sec, par	NEC-2050	995.00
Silver Reel EP1500 14 char/sec, par interface	SRP-EP1500	458.00
Silver Reel EP1550 17 char/sec, par interface	SRP-EP1550	659.00
Dalco 630 40 char/sec, serial	DLB-630	1765.00
Dalco 620 proportional spacing, horiz. & vert. roll 20 ceps.	DLB-620	879.00
Quik 600 18 char/sec, graphic mode	QUK-600	499.00
Bolton HRIA daisy wheel, parallel interface	BTH-HR1P	695.00
Bolton HRIA serial interface	BTH-HR1S	695.00
Stamwriter F10 serial 40 char/sec	PRD-F10P	1125.00
Stamwriter F10 parallel 40 char/sec	PRD-F10P	1125.00
Comrex CR1 word processing printer, serial int.	CRP-CR1S	729.00
Comrex CR2 daisy wheel, proportional spacing, par I	CRP-CR2S	955.00

TERMINALS

Freedom 100 split screen, detachable keyboard	LIB-100	495.00
Quik 102 green phosphor terminal	QUK-102	539.00
Visual 10 Green screen	VSL-50G	650.00
Ampex Datalog 175 amber screen two page, func. keys	APX-D125G	575.00
Wayse 50 12 green phosphor	WYF-50	719.00
Wayse 50 12 green phosphor	WYF-50	595.00
Wayse 100 12 green split screen, metal enclosure	WYF-100	795.00
Wayse 200 8000 40 char/sec, split screen	WYF-200	1195.00
Zenith 29 terminal V152 compatible detachable keyboard	ZTH-29	765.00
Televideo 910 Plus, block mode	TVI-910P	575.00
Televideo 925 detachable keyboard, 22 function keys	TVI-925	759.00
Televideo 950 graphical, split screen, 22 func.	TVI-950	950.00
Televideo 970 14" green 132 column European	TVI-970	1095.00

Telex 753607

Shipping: First five pounds \$3.00, each additional pound \$.50. Foreign orders: 10% shipping, excess will be refunded. California residents add 6 1/2% sales tax. COD's discouraged. Open accounts extended to state supported educational institutions and companies with a strong "Dun & Bradstreet" rating. Retail location: 17700 Figueroa Street, Carson CA. 90248.

TOLL FREE ORDER LINE
(800) 421-5041
TECHNICAL & CALIFORNIA
(213) 217-0500

ADVANCED COMPUTER PRODUCTS

SEND \$2.00 for 1984 CATALOG

IBM PC MULTICARD™

"MULTICARD" multifunction card for the IBM PC & XT expandable to 256K. Thousands of this popular card have already been shipped by ACP.

- 64-256K
- Parallel Port
- Serial Port
- 1 Year Warranty
- Disk Emulator Software
- Printer Spooler Software
- Clock/Calendar
- Clock Software

\$229.00 w/64K **\$229.00**

S-100 64K "CMOS" RAMCARD

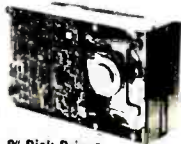


Unbelievable Price!
\$249.00

Assembled and Tested

- ACP has sold over 1000 of these IEEE compatible, low-priced, high-reliability 64K Static RAM Cards.
- Single 5-Volt operation.

SIEMEN'S SALE



You can now purchase Shugart compatible 8" Disk Drives below your existing factory direct pricing!

These Prices are the lowest ever published.

*Siemens's DSDD FDD200-B... \$199.00

Also, with purchase of Disk Drives you can buy the Vista V-1000 Dual Case with Power Supply and Cable for only \$375.00... Regular Price \$495.00

Offer Limited! Factory Warranty 90 Days! Shipped Immediately from Stock! OEM Quantities

8" Disk Drives
\$139.00

DOT MATRIX PRINTER

COEX 80-FT

- ✓ 9x7 Dot Matrix, 80 CPS, 84-Directional Printing
- ✓ 2K Buffered Memory
- ✓ 80, 96, 132 Columns, Graphics and Block Printing
- ✓ Selectable Char Pitch, Line Spacing and Feed



\$169.00

COEX Interface Card to Apple... \$49.95

ACP HAS DISK DRIVES

APPLE II™ COMPATIBLE

Thin Line Drive
\$199.00

APPLE COMPATIBLE DISK DRIVES

VISTA Solo 5 1/4" Std.	\$199.00
CUMANA 5 1/4" Std.	219.00
RANA Elite 1	249.00
Elite 2	339.00
Elite 3	499.00
Elite Controller	82.00
SUPER 5 Alps A40 Thinline	199.00
TEAC T40 Thinline	239.00
TEAC T80 Doublesided Controller	329.00
	58.00



TANDON 100-2

PC Compatible • Double Sided

\$199.00

TM100-1.....\$169.00

TOSHIBA Half-High

PC Compatible • Double Sided

\$169.00



OTHER DRIVES WE STOCK

TANDON 848-2 Thinline	\$479.00	SHUGART 801R	\$399.00
TEAC F558	189.00	QUIME Datarack 8	449.00
SEAGATE 10MB Hard Disk	699.00	CEC 1800 DS (320K)	224.00
MPI 852	239.00	SDGATE ST506 (6MB Win.)	499.00

64K RAMS Set of 9 \$50.00

Apple Compatible BUSINESS

APPLIED SOFTWARE Versatorm	ACP PRICE \$299.00
Versatorm Hard Disk	399.00
ARTSICI Magic Window II	95.00
MacCombo	149.00
ASHTON-TATE GBASE II (CP/M)	385.00
Friday (CP/M)	99.00
BGL (GL, AR, AP, Pay, Inv)	ea. 299.00
BRODERBUND Bank Street Writer	49.00
BUSINESS SOLUTIONS The Incred Jack	149.00
CONTINENTAL (GL, AR, AP, Pay)	ea. 189.00
Home Accountant	49.00
DATAMOST Real Estate Inv.	99.00
DOW JONES Market Manager	249.00
Market Analyzer	289.00
Market Microscope	549.00
EAGLE Money Decisions	149.00
FOX & GELLER Clockcode	ea. 189.00
d Utility	69.00
d Graph	199.00
HAYDEN Pie Writer	99.00
Compler Plus	79.00
Basic Compiler	45.95
HOWARDSON Tax Preparer	149.00
Real Estate Analyzer	139.00
KENSINGTON Format II	99.00
LIGHTNING Mastertype	35.00
LIVING VIDEOTEK Think Tank	135.00
MICROPRO Wordstar	249.00
Mailmerge or Spellstar	139.00
Wordstar Prot. 4 Pak	449.00
Info Pak or InfoStar	Call
MICROSOFT Multiplan	179.00
Multitool Financial	79.00
Multitool Budget	119.00
MEGAHAUS Megawriter	139.00
PEACHTREE Series 4 (GL, AR, AP)	379.00
Series 9 (Text, Spell, Mail)	399.00
PERFECT SOFTWARE	Call
QUARK Word Juggler (II)	199.00
Lexicheck (II)	99.00
Call for Apple III	
SIERRA ON-LINE	
Screenwriter II	99.00
Screenwriter Professional	149.00
General Manager II	169.00
Dictionary	79.00
SOFTWARE PUBLISHING PFS:File	89.00
PFS:Graph or PFS:Report	89.00
STATE OF THE ART	49.00
STONEWALL DB Master 4.0	249.00
BB Utility 1 or 2	79.00
SYSTEMS PLUS Act Plus (GL, AR, AP) Set	599.00
VISICORP Visicab 3.3	179.00
Visical Enhanced	199.00
Visical or Visical	179.00
HOME & EDUCATION	
BRODERBUND Chopfliter	\$28.00
Drol or Loderunner	28.00
Arcade Machine	44.00
Apple Panic	\$375.00
BUDGECO Raster Blastier	24.00
Pinball Construction Set	29.00
COUNTERPOINT SOFTWARE	
Easy Games for Young Children	26.00
DATAMOST Aztec	29.00
Pig Pen or Shark Attack	23.00
DATASOFT Zaxxon	31.00
EDU-WARE Compuath	37.00
Algebra I, II or III	30.00
Compuated or Compupeal	33.00
EINSTEIN Memory Trainer	73.00
ELECT. ARTS Music Construction	Call
HARCOURT Computer SAT	Call
HAYDEN Sargent	29.00
INFORM Zork I, II or III	29.00
Deadline	36.00
KOALA Modules (8 available)	Call
LEARNING COMPANY	
Juggles Rainbow	36.00
Sumble Games	48.00
Gertrude's Secrets	59.00
L & S Crossword Magic	41.00
MICROFUN Miner 2049er	Call
MICROLAB	Call
MICROSPY Decathlon	25.00
Typing Tutor II	19.00
MONDRAM Dollars & Sense	74.95
ORIGIN Exodus:Ultima III	41.95
PENQUIN The Orest	16.00
SENSIBLE Sensible Speller	99.00
SIERRA ON-LINE Frogger	28.00
SIRTECH Legacy of Ulygimay	29.00
Knight of Diamonds	29.00
SOUTHEASTERN Data Capture 4.0	54.95
SPINNAKER Alphabet Zoo	20.00
Delta Drawing	35.00
Fraction Fever	23.00
Kindercomp	21.00
F. maker	28.00
SUBLOGIC Flight Simulator or Pinball	26.00
SUNDEX-No. 1 Rated Home Finance	74.95
CPA Personal Accountant	74.95
CPA Personal Investor	74.95
Personal Payables	42.95
TERRAPIN Logo	59.00
TRANSEND Transend I	75.00
VIRTUAL Micro Cookbook	28.00
UTILITIES/SYSTEM	
BEAGLE Apple Mechanic	\$23.00
Apple Plot or Pronto DOS	26.00
Beagle Basic	26.00
DOS Boss	17.00
Double Take or Utility City	26.00
CENTRAL POINT Filer	16.00
Copy II Plus	31.00
LOCKSMITH	79.00
MICROSOFT A.L.S.	85.00
Cobol 80	575.00
Fortran 80	155.00
PENQUIN CGS System	79.00
PHOENIX Zoom Graphix	31.00
SOUTHWEST Mer Fin	49.95

TOLL FREE

800-854-8230

TWX
910-595-1565

APPLE™ COMPATIBLE

DISK CONTROLLER
Only **\$49.95**

Apple Compatible

Printer Interface
w/Apple to Epson Cable **\$49.95**

Apple IIe Compatible

80 Column Card w/64K **\$99.95**

APPLE COOLING FAN

with Surge Suppression
\$49.95

QUENTIN/FORTH DIMENSION

Apple II/IIe Compatible Disk Drive

Totally compatible to Apple Drives.

Only **\$199.95**

Controller.....\$49.95

Just plug in and run.

Apple II 16K RAM CARD

Compatible with Z80 Softcard™ . PASCAL CP/M™

Full 1 Year Warranty. Top Quality by COEX

NEW LOW ACP PRICE **\$49.95**

Also from COEX, NEW EPSON Parallel Interface for Apple. With cable...\$49.95

QUENTIN

DUAL DISKS PRO DOS COMPATIBLE

Dual Half Height Drives w/Controller

Only **\$299.95**

CLEARANCE SALE

ACP has on hand several hundred demo 5 1/4" and 8" Disk Drives from virtually all manufacturers. Most are priced at \$99.00 ea.

CALL FOR CURRENT AVAILABILITY.

Mail Order: P.O. Box 17329 Irvine, CA 92713
Retail: 1310B E. Edinger, Santa Ana, CA 92705
(714) 558-8813
542 W. Trimble, San Jose, CA 95131
(408) 946-7010

apple computer

An Authorized Dealer

Complete Apple Support Facility
Complete Apple Service Center
We service most Floppy Disk Drives



Apple IIe w/64K	ACP PRICE \$779.00
Apple IIe Business System	2995.00
Includes: Apple IIe w/128K, Dual Disk, 80 Column Card, Monitor II, Profile Extension Option	
Apple IIe Entry System	995.00
Includes: Apple IIe w/64K, Disk II w/Controller	
Apple IIe Professional System	1795.00
Includes: Apple IIe w/128K, Dual Disk, 80 Column Card, Monitor II	
Imagewriter Dot Matrix Printer	545.00
Apple Color Printer	779.00
Apple Monitor 1200	495.00
Apple II 256K System	2695.00
Apple III Plus 256K System	2995.00
Apple III Plus Business System	4495.00
Lisa 2	3495.00
Macintosh System	2495.00
Apple IIe w/64K, Disk II w/Controller	1299.00

Apple Compatible Hardware

ALS CP/M 3.0 Plus Card	LIST \$399.00	ACP \$299.00
COMPUTER ACCESSORIES		
Power Control Center P12	99.00	99.00
COEX 16K Ram	99.00	99.00
Parallel Printer Card w/Cable	99.00	49.95
Apple II Prototype Card	29.00	20.00
Apple I Extender Card	29.00	20.00
64K Extended 80 Column	199.00	99.95
CORVUS Hard Disk Omninet	Call	
EASTSIDE Wildcard (11" w/64K)	89.00	89.00
Wildcard 2 (Ite)	875.00	875.00
Wildcard Plus (64K in 10 sec)	149.00	
FINGERPRINT Epson Enhancer	49.00	
GBSON Light Pen	249.00	
IS PKASO Interface (II/III)	199.00	139.00
PKASO Interface (III)	199.00	159.00
KENSINGTON System Saver	89.95	69.95
PC Saver	49.95	39.95
KEYTRONICS KB200 II + Keyboard	298.00	225.00
KOALA Graphics Pad	125.00	95.00
KRAFT Joystick	65.00	48.00
Game Paddles	50.00	39.00
MCT Speed Demon	295.00	249.00
MP2 128K Bubble Memory	699.00	699.00
M&R Sup'r Mod II RF Modulator	69.00	49.00
Sup'r Fan	50.00	38.00
MICROPRO 6MHz Applicard + Word	Call	
MICROSOFT Z-80 Softcard	395.00	249.00
Z-80 Softcard Plus	645.00	479.00
Softcard Premium Pak (II+)	875.00	499.00
Softcard Premium Pak (Ite)	495.00	395.00
MOUNTAIN COMPUTER		
CPS Multifunction	239.00	169.00
Music System	395.00	335.00
A/D Plus D/A	350.00	299.00
MICROTEK Dumping Buf. w/64K	349.00	265.00
ORANGE MICRO		
Grappler Plus	175.00	129.00
16K Bufferboard	175.00	129.00
Grappler Bufferboard w/16K	245.00	199.00
PCPI Applicard w/128K, 6MHz	595.00	499.00
8088 Coprocessor	595.00	499.00
Apple II w/16K Buffer	495.00	429.00
PERISOF (All w/1 Year Warranty)		
PrinterInt Int'l. Printer I/O	99.00	79.00
Messenger Univ. Serial I/O	135.00	109.00
Timelink Realtime Clock	110.00	89.00
Grallink Graphics I/O	175.00	139.00
Bufferboard w/16K Buffer	189.00	159.00
PERIPHERALS		
Microbuffer 16K (Epson Parallel)	159.00	Call
Microbuffer 32K (Epson Parallel)	199.00	Call
Microbuffer 16K (Epson Serial)	179.00	Call
Microbuffer 32K (Epson Serial)	219.00	Call
Microbuffer In-line 64K (Parallel)	349.00	279.00
Microbuffer In-line 64K (Serial)	349.00	279.00
PROMETHEUS Versacard 4 in 1	199.00	166.00
QUADRAM Quadlink	680.00	499.00
Microclizer 16K (Parallel)	189.00	169.00
Microclizer 16K (Serial)	220.00	195.00
Microclizer 32K (Parallel)	225.00	199.00
SATURN/TITAN		
32K Ramcard	219.00	189.00
64K Ramcard	349.00	289.00
128K Ramcard	499.00	399.00
Accelerator II Card	599.00	449.00
Neptune 64K + 80	199.00	
Neptune 128K + 80	299.00	
Neptune 152K 80	349.00	
STREET Echo II (Apple)	149.00	99.00
Echo II Serial (In-line)	249.00	199.00
SYNETIX Sprite I	149.00	129.00
Sprite II	249.00	224.00
Superspine	395.00	359.00
Flashcard 144K	445.00	389.00
Flashcard 288K	629.00	549.00
TG PRODUCTS		
Joystick	59.95	49.95
Select-a-port	59.95	49.95
Trackball	64.95	54.95
Joystick w/Toggle Ite	64.95	54.95
VIDEX Videoterm (80)	345.00	199.00
UltraTerm (132)	379.00	279.00
Enhancer II	149.00	99.00
VISTA COMPUTER		
A500 w/ Disk Controller	379.00	299.00
A500 5 1/4" Disk Controller	99.00	49.95
V1200 Amlyn 6.2Mb	1549.00	1099.00
VOTRAX Type N'Tak	259.00	199.00
Personal System		

1984 CATALOG AVAILABLE SOON • 64K UPGRADE KITS - ONLY \$50.00

ADVANCED COMPUTER PRODUCTS

Serving Computer Professionals Since 1976

TOLL FREE 800-854-8230

IBM PC



★ COLOR SPECIAL ★
THE COLOR GRAPHICS CARD
(Same designer as Colorplus Card)
PRICE
\$229.00 BREAKTHRU!
1 year Warranty **\$229.00**

HARDWARE

AST SixpakPlus w/OK(SPC)	\$229.00
Megapack II w/OK(SC)	229.00
I/O Plus II (CS)	115.00
Game Serial/Parallel Options	35.00
Monographics Graphics Card	445.00
CHALKBOARD	Call
COEX IBM PC Extender Card	29.00
IBM PC Prototype Card	36.00
DAVONG Hard Disk Drives	Call
KENSINGTON PC Saver	39.00
KEYBOARD IBM PC Compatible	149.00
KEYTRONICS 5150/5151 (PC&XT)	169/199
KOALA	96.00
KRAFT or TG	
IBM PC Joystick	59.00
Game Paddles	29.00
MICROSOFT Mouse	169.00
M&R PC XT Exp Chassis (6 slots)	439.00
MOUSE SYS Mouse for PC	196.00
PERSYST Time Spectrum w/64K	289.00
PTI Back-up Power 200 400W	328.00
QUADRAM Quadboard II w/OK	229.00
Quadlink (Apple Prog.)	479.00
Quaddisk (up to 72MB)	Call
Microfazer MP64 w/64K	179.00
VISTA Multicard Plus OK	199
Maxicard w/64K (up to 576K)	229.00
PC Master (10 I/O)	329.00
Diskmaster (Floppy Cont.)	169.00
Diskframe Hard Disk	Call
PC Clock I/O	129.00

SOFTWARE

dBASE II/Friday	\$378.00/\$168.00
Condor	\$389.00
SuperCalc I/II/III	\$790.00/\$159.00/\$228.00
Multiplan Vers. 1.1	\$138.00
Microsoft Mouse/Word	\$319.00/Call
Wordstar 3.3	\$258.00
Micropro Pro Pak	\$378.00
Rbase 4000	\$328.00
T. K. Solver!	\$268.00
PFS	File 88.00 Graph 88.00 Write 88.00 Report 78.00

PRINTERS/MONITORS

BROTHER HR-25P/25S	\$799/819
HR-15P/15S	479/499
HR-35P or 35S	1089.00
COEX 80FT (80cps)	Sale \$169.00
DAISY WRITER 2000 (40cps)	1199.00
DTC DasyPrinter 380Z	11.59
DYNAX DX-15P/15S	529/549
DIABLO 630API Serial	1890/2650
630 IBM 620 Ser.	2290/995
EPSON FX-80/100	549/739
FX-80/80FT	299/399
FX-150	499.00
NEC Spinwriter 3550	1885.00
OKIDATA Model 82AP 83AP	339/629
Model 84P 84S	995/1049
Model 92P 92S	525/575
Model 93P 93S	769/869
Model 84 IBM	1039.00
Model 82 IBM	549/639
SILVER REED EXP500P	490.00
EXP550P	630.00
EXP770P	1049.00
TRANSTAR 315 (4 Color)	499.00
STAR Gemini 10X/15X	269/429
Delta 10-15 (160cps)	529/879
Radix 10-15	720/850
Powerline LQP	109.00
Call for New Star PC Compatible Family	
TOSHIBA	Call
SANYO PP500LO	399.00
AMDEK Video 300G A	145.00/155.00
Video 310A amber (IBM)	159.00
Color I (Composite)	299.00
Color I Plus (each non analog)	329.00
Color II RGB (IBM) analog	449.00
Color II Plus	479.00
Color III RGB (IBM)	399.00
Color IV RGB (IBM) analog	779.00
BMC or ELKA 12" Green	89.00
PGS HX-12 RGB (650x240)	Call
SR-12 RGB (650x480)	Call
MAX-12 Amber	Call
SANYO 6500 Med-Res	269.00
7500 Hi-Res	389.00
TAXAN 400 RGB Med-Res.	329.00
420 Hi-Res IBM	559.00
12" TTL Green Amber	179/189
ZENITH ZVM-131 123 Grn.	379.00
ZVM-131 13 Color	379.00
ZVM-135 Color Hi-Res	519.00

DISKETTES

DYSAN 5 1/4" SS DD	10 \$55	\$28
DYSAN 5 1/4" DS DD	10 \$65	36
IBM 5 1/4" SS DD	10 \$60	43
IBM 5 1/4" DS DD	10 \$65	47
VERBATIM 525-01 SS DD	10 \$45	20
VERBATIM 550-01 DS DD	10 \$55	29
MAXELL M1 SS DD	10 \$50	22
MAXELL M2 DS DD	10 \$60	32
Flip Storage Box 5 1/4" (80 disks)		18
BULK SPECIAL SS	10 25	16
With Sleeve and Box	100 195	149

IBM ACCESSORIES

COMPUCABLE		
Keyboard/driver dust covers (set)	\$16.00	
CURTIS Tilt/Swivel Monitor ped.	43.00	
PC Pedestal (IBM Mono)	58.00	
PGS Quadchrome disp. Adapter	9.00	
Vertical PC Stand	20.00	
Mono Extension Cable	43.00	
Keyboard Ext Cable	35.00	
AC Plug Adpt (any mon. to PC)	8.00	
EOP PROTECTION DEVICES		
The Lemon/Peach	39.00/63.00	
The Orange/Lime	94.00/58.00	
GILTRONIX SWITCH BOXES		
2 Way 8 Lines	90.00	
4 Way 8 Lines	179.00	
2 Way Centronics	199.00	
RIBBONS	Each Dozen	
Epson MX-80	5.75	59.00
Epson MX-100	10.95	120.00
Star Gemini 10/15	2.50	26.00
Okidata 80/82/83	3.50	44.00
Okidata 84/82/93	4.95	55.00
NEC 3550	11.95	135.00

MODEMS

BIZCOMP Model 2120 (Internal)	449.00
HAYES Smartmodem 1200	529.00
Smartmodem 1200B	
(w/ Smartcom II)	429.00
Smartmodem 300	219.00
Smartmodem II	99.00
Smartmodem IBM Cable	25.00
NOVATION Access 1-2-3	388.00

TERMS: We accept VISA, MC, MD, Cashiers and Personal checks. School and Company PG's. We do not charge your card until we ship. Personal checks require drivers license and credit card. No Surcharge. Added on VISA or MC, COO's over \$500 require 20% deposit with order. Add 3% shipping and handling for UPS. We offer same day shipment. Prices subject to change without notice. We reserve the right to substitute manufacturer. We are not responsible for typographical errors. Retail Sale Prices May Vary. IBM® trademark of International Business Machines Corporation. Quadboard II™ trademark of Quadram Corp. Supak Plus™ trademark of AST Research Inc.

MULTI CARD II™ (exp.) \$199.00

(INTRODUCTORY OFFER)
Advanced Computer Product's best selling multifunction card for the IBM PC & XT (plus compatibles) now has been improved with expansion capability to a full 384K and at no charge an additional game port. You also get Print Spooler and Disk Emulation Software plus a full year SWAP-OUT Warranty at no extra charge. Why pay more when you can get the same function and performance as Quadboard II™ and AST Sixpak Plus™ for substantially less money. You compare! Try it at no obligation. 10 day no questions asked return privilege.

FUNCTION	Multicard II	Quadboard II	Sixpak Plus
Memory	0 to 384K	0 to 384K	0 to 384K
Parallel/Serial	Yes	Yes	Yes
Clock/Calendar	Yes	Yes	Yes
Game Port	Yes	Yes	No (\$50 list Opt.)
Software	Yes	Yes	Yes
Warranty	1 Year	1 Year	1 Year
ACP Price with OK	199.00	229.00	229.00

EXPANSION MEMORY

- 64K Upgrade (Set of 9 64K RAMS) ... \$50.00
- 256K RAM's (256K x 1) ... \$79.00 ea
- 16K RAM's (16K x 1) ... 10/\$9.99
- 8087 CPU (Arithmetic Processor) ... \$199.00

IO/XT (Serial, Parallel, Clock/Calendar) ... \$129.00

The most popular expansion card for the short slot of your IBM XT. All these functions on one card optimized to fit in one slot. 1 year warranty.

COLOR/GRAPHICS/COLOR/GRAPHICS	
● Plantronics COLORPLUS™	\$399.99
● Hercules GRAPHICS CARD	\$369.99
● Graphics X Software	\$142.00
● Quadram QUADCOLOR I&II	\$199.00/Call
● Scanoplak COLORGRAPHICS	\$269.99
● Amdek MAI	\$438.99
● Hercules COLOR CARD w/ Par. port	\$229.99
● Paradise MULTIDISPLAY	\$378.99
● CONOGRAPHIC CARD	\$895.99
● MA Sys PEACOCK	\$299.99

IBM PC COMPATIBLE DISK DRIVES

Tandon TM-100-1 Single Sided (160K)	\$169.00
Tandon TM-100-2 Double Sided (320K)	199.00
Control Data 9409 Double Sided (320K)	224.00
TEAC* 55B 1/2 high Double Sided (320K)	189.00
Toshiba* 1/2 high Double Sided (320K)	169.00
*IBM PC Mounting Hardware for 1/2 highs	4.95
Vista "Diskmaster" 5 1/4" & 8" Diskcontroller	169.00

ACP has on hand several hundred demo 5 1/4" and 8" disk drives from virtually all manufacturers. Most are priced at \$99.00 ea. Call for current availability.

MAIL ORDER: P. O. Box 17329 Irvine, CA 92713
Retail: 1310 E. Edinger, Santa Ana, CA 92705 (714) 558-8813
542 W. Trimble, San Jose, CA 95131 (408) 946-7010

TOLL FREE
800-854-8230
TWX
910-595-1565

64K UPGRADE - ONLY \$50.00 • CUSTOM CABLES AVAILABLE

WE STOCK CABLES • RIBBONS • DISKETTES • SPARE PARTS

SPECIALS

CCU 16K Card

- ★ Apple 16K Memory Card
- ★ 2 Year Warranty

List \$69 **\$39**

IBM PC System

- ★ 2, Disk Drives 360K each
- ★ 256K of Memory
- ★ IBM Mono Monitor and IBM Mono Card

List \$2900 **\$2395**

Apple IIc

- ★ 128K of Memory
- ★ Weighs less than 8 pounds

List \$1295 **\$1175**

Diskettes

- ★ 5¼", sgl. side/dbl. density
- ★ w/Reinforced Hub

10 for **\$16**

100 for **\$140**
Not Bulk Packed

Omni Graph Interface

- ★ Grappler Compatible
- ★ Full Hi-Res Graphics
- ★ Cable & Software Included

List \$99 **\$69**

Apple Macintosh

- ★ 32 Bit Microprocessor
- ★ 2, Serial Ports
- ★ 9" Hi-Res, 512 x 342

List \$2495 **\$2195**

Tandon Blowout

- ★ TM100-2 **\$179**
- ★ TM848-1 **\$239**

Dynax DX15

- ★ 13 cps
- ★ Letter Quality

List \$599 **\$409**

Okidata ML84P

- ★ Microline 84P
- ★ 200 cps

List \$1395 **\$849**

Sanyo Computer

- ★ MBC 555-2
- ★ 2, 360K Disk Drives
- ★ All Software

List \$1595 **\$1275**

CCU HAS THE LARGEST DISK DRIVE SELECTION AND We Will Beat All Competitors

Apple Compatible Drives

	QUANTITY		
	1	2	10
Micro Sci			
A-2, 35 Track Controller	\$200	\$190	\$180
	70	60	50

Rana Systems

Elite I	\$235	\$230	\$225
Elite II, Dbl. Head	355	345	335
Elite III, Quad Density	455	445	435
Controller/Controls 4 Drives	90	80	75

Half Height

FD525A Fully Apple com.	\$140	\$130	\$120
-------------------------	-------	-------	-------

5¼" Disk Drives

	QUANTITY		
	1	2	10
Teac			
FD55A, 160K	\$160	\$150	\$140
FD55B, 360K	170	160	150
FD55F, Quad Density	200	190	180
All Teac's are Half Heights			
Tandon			
TM100-1, 160K	\$200	\$190	\$180
TM100-2, 360K	179	174	170
TM101-4, Quad Density	280	270	260
TM55-2, 360K ½ Height	220	210	200
MPI			
B-52, 360K PC Compatible	\$200	\$190	\$180
Shugart			
SA400, 160K	\$190	\$180	\$170
SA455, 360K ½ Height	200	190	180
SA465, Quad Den. ½ Height	230	220	210
Mitsubishi			
4851, ½ Height	\$220	\$210	\$200
4853, Quad Den. ½ Height	169	169	169
Control Data Corp.			
CDC 9409, 360K	\$200	\$190	\$180
CDC 9409T, Quad Density	300	250	200
Matsushita			
JA-155	\$150	\$140	\$130
Chinon			
FD55A (same as Teac) 160K	\$140	\$130	\$120

8" Disk Drives

	QUANTITY		
	1	2	10
Siemens			
FDD-100-8	\$119	\$115	\$110
FDD-200-8	180	170	160
Shugart			
801R, Sgl./Dbl.	\$340	\$330	\$320
851R, Dbl./Dbl.	430	420	410
Tandon			
TM848-1, Sgl./Dbl. ½ Ht.	\$240	\$230	\$220
TM848-2, Dbl./Dbl. ½ Ht.	390	380	370
Mitsubishi			
M2894-63, Dbl./Dbl.	\$400	\$390	\$380
M2896-63, Dbl./Dbl. ½ Ht.	400	390	380
Qume			
DT8, Datatrak 8	\$450	\$440	\$430
5¼" & 8" Power Supply & Cabinets			
QUANTITY			
1 2 10			
PC Products 5¼"			
Single Cabinet w/pwr	\$ 70	\$ 60	\$ 50
Dual Thinline Cab w/pwr	80	70	60
Dual Cabinet & Power	80	70	60
All have 6 month warranty			
PC Products 8"			
Sgl. Cabinet w/pwr & fan	\$220	\$210	\$200
Dual w/pwr for 2 thinlines	230	220	210
Dual w/pwr & fan	270	260	250

**VISIT OUR REMODELED RETAIL SHOWROOM
5 MINUTES FROM
LOS ANGELES INTERNATIONAL AIRPORT**

(800) 847-1718

Your Largest Computer Dealer

COMPUTER SYSTEMS

Apple	
CPU Only	\$ 749
Macintosh	2195
Portable	1175
Compaq	
Portable (PC Compatible) 2, 360K Drives	
256K of Memory	\$2295
Franklin	
Ace 1000, 64K	\$ 675
Ace 1200 OMS w/ Monitor	1395
Kaypro	
Kaypro II	\$1149
Kaypro 4+	1695
Kaypro 10	2395
IBM	
PC64K, 2-Drives	\$1850
XT Hard Disk Drive, 128K	3895
PC Portable	2295
SANYO	
MBC-550 PC Compatible	\$ 699
MBC-555 2-Drives, more software	1049

APPLE ADD ON'S

ALS	
Z Card	\$ 119
CPM 3.0 Card	169
Astar	
RF Modulator	\$ 15
Fan w/ Surge	29
Kensington	
System Saver	\$ 69
Koala	
Graphics Tablet	\$ 89
Kraft	
Joystick	\$ 44
Micro Max	
Viewmax 80, 80 col. card	\$ 139
Viewmax 80E (F for IIE) 64K	129
Micro Soft	
16K Card	\$ 69
Premium Soft Card IIE	369
Multiplan	189
Soft Card (Z80)	239
Micro Tek	
Bam 16, 16K Memory	\$ 59
Serial Interface	89
TG	
Joystick	\$ 39
Select-A-Port	31
Paddles	34

IBM ADD ON'S

Ast Research	
Six Pack +	\$ 265
Mega +	265
IBM	
Monochrome Adapter	\$ 229
ColorCard	239
Piantronics	
PC + w/ Software	\$ 389
Quadram	
Quad Color Card	\$ 219
Quad Link	459
64K Upgrade	
64K of Memory	\$ 48
USI Research	
Paradise Systems multi-display card	\$ 329

MODEMS

Anchor	
Mark VII 300Baud	\$ 139
Mark XII, 1200Baud	249
Hayes Micro Computer	
Smart Modem 300 Baud	\$ 199
Smart Modem 1200 Baud	489
Smart Modem 1200B for PC	399
Micro Modem IIE	239
Novation	
J-Cat	\$ 119
AppleCat II	259

PRINTERS

Dynax	
DX15, Letter Quality	\$ 409
DX25	729
Epson	
RX-80 (120 cps)	\$ 299
RX-80FT (120 cps) Friction & Tractor	319
FX-80 (160 cps)	459
FX-100 (160 cps) 15" Carriage	699
Okidata	
82A (120 cps) Par & Ser Inter.	\$ 299
83A (15" Carriage)	569
84P (200 cps) Friction & Tractor	849
New Series Okidata	
92P (160 cps)	\$ 419
93P (15" Carriage)	669
Star Micronics	
Gemini 10X (120 cps)	\$ 269
Gemini 15X (120 cps) 15" Carriage	399
Power type (18 cps) Ltr. qual.	399

PRINTER INTERFACES

Cables	
IBM to Printer	\$ 29
Kaypro to Printer	29
RS232 Cables	29
Fourth Dimension	
Card & Cable	\$ 49
Microtek	
Dumpling GX (Grappler Compatible)	\$ 89
Dumpling GX exp to 64K	149
Dumpling GX 16K w/ 16K exp to 64K	169
for each additional 16K	15
Okidata Options	
Tractor for 82 & 92	\$ 59
Serial Interface	99
Orange Micro	
Grappler +	\$ 114
Grappler + w/ 16K	179
Star or Epson	
Epson Serial Interface	\$ 119
Star Serial Interface	59

MONITORS

Amdek	
Color I + Composite Video	\$ 279
Color II + RGB Video	419
300C, 12" Green	139
300A, 12" Amber	149
310A, Monochrome Amber	179
BMC	
9191 Color New Version	\$ 239
IBM	
Monochrome Hi-Res Green	\$ 239
Princeton Graphics	
PGSHX12, IBM Copy	\$ 469
PGSSR-12, Hi-Res Color	649
PGSMAX-12, 12" Monochrome	199
USI	
PI 1, 9" Green, Hi Res, 20MHZ	\$ 100
PI 2, 12" Green, Hi Res, 20MHZ	100
PI 3, 12" Amber, Hi Res, 20MHZ	100
PI 4, 9" Amber, Hi Res, 20MHZ	100
Zenith	
ZVM122, Hi-Res Green	\$ 109
ZVM123, Hi-Res Amber	109

5 1/4" DISKETTES

CCU	
Sgl/DbI reinforced hub	\$16 100 for 140
DbI/DbI reinforced hub	19 100 for 170
Not Bulk Packed	
Dysan	
Sgl/DbI	\$33 100 for 300
DbI/DbI	39 100 for 370
Maxell	
MD1 Sgl/DbI	\$25 100 for 235
MD2 DbI/DbI	38 100 for 360
Verbatim	
Sgl/DbI	\$26 100 for 240
DbI/DbI	36 100 for 340

8" DISKETTES

Dysan	
Sgl/Sgl	\$34 100 for 320
DbI/DbI	53 100 for 480
Maxell	
Sgl/DbI	\$44 100 for 380
DbI/DbI	50 100 for 469
Verbatim	
Sgl/Sgl	\$30 100 for 280
DbI/DbI	40 100 for 360

DISK ACCESSORIES

Verbatim	
8" or 5 1/4" Head Cleaning Kit	\$ 9
Flip Tub	
5 1/4" Holds 50 disks, plexiglass	17
5 1/4" Holds 70 disks, plexiglass	21

Computer Components Unlimited

A California Corporation Circle 57 on inquiry card.

RETAIL STORE:
11976 Aviation Blvd.
Inglewood, CA 90304

MAIL ORDER:
P.O. Box 1936
Hawthorne, CA 90250



No Surcharge for Credit Cards

This Ad Supersedes All Others

Sales Desk

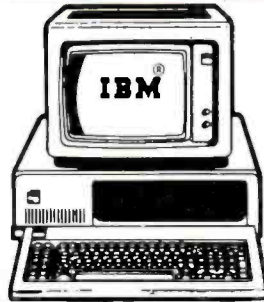
(800) 847-1718 (213) 643-5188
Outside California Inside California

Customer Service & Technical
(213) 643-5191

All merchandise new. We accept MC, Visa, Wire Transfer, COD Call, Certified Check, P.O.'s from qualified firms, APO accepted, Shipping: Minimum \$4.50 first 5 pounds. Tax: California Res. Only add 6 1/2% sales tax.

Prices Subject to Change

IBM PC \$1899
256K, two disk drives 360K each,
Drive Controller and Keyboard



IBMPC w/10MB
256K, one floppy Drive, Keyboard
10 MB Hard Disk with Controller \$2599

BOOTS FROM HARD DISK Backup also available

IBM PORTABLE
256K, two disk drives \$2199

IBMPC w/30MB
256K, one floppy Drive, Keyboard
30 MB HardDisk with Controller
and Booster Power Supply \$3999

BOOTS FROM HARD DISK Backup also available

★ PRICE WAR ★ CALL US LAST WITH YOUR BEST QUOTES ★

PRINTERS		HARD DRIVES		NETWORKING	
EPSON FX-80 \$489 FX-100 \$599 LQ-1500 CALL		UP TO 140 MB BACKUP ALSO AVAILABLE CALL		ORCHID TECHNOLOGY PC Net PLUS Starter Kit \$999	
OKIDATA INCLUDES PLUG & PLAY 92P \$399 93P \$649 84P \$799		EVEREX 10MB \$899 w/Controller and 2 Year Warranty		CORVUS OMNINET	
NEC 2050 \$799 3550 \$1,499		MAYNARD 10MB/30MB 10MB/WS-1 \$899 10MB/WS-2 \$1,049 30MB CALL		SANTA CLARA SYSTEMS PC Terminal CALL	
DYNAX DX-15 \$399		TALL GRASS TECHNOLOGY		MULTI-DISPLAY CARDS	
BROTHER HR-25 \$649 HR-35 \$799		20 MB w/20 MB Backup \$3,299 35 MB w/45 MB Backup \$4,495 70 MB w/60 MB Backup CALL		AST MonoGraph Plus w/clock & PP \$369 Serial Port Option \$30	
IDS PRISM 132C \$1,499 COLOR PRINTER		FLOPPY DRIVES		QUAD Color I .. \$199 Color II .. \$199	
SHEET FEEDERS AND TRACTORS CALL		TEAC HALF 55B-DSDD \$149 HEIGHT 55F-QUAD \$199		EVEREX Graphics Edge \$399	
PLOTTERS		Full Ht - DSDD \$199		TECMAR Graphics Master \$449	
AMDEK AMPLOT II - 6 Pens \$799		CDC Half Ht. - DSDD \$179		HERCULES Mono Graphics \$329 Color Graphics \$199	
HEWLETT PACKARD 7470A - 2 Pens \$949 7475A - 6 Pens \$1,699		TANDON 100-2 \$179 Full Ht. DSDD		NEW STB Graphix Plus II \$349	
ROLAND DXY-101 - 1 Pen \$599 DXY-800 - 8 Pens \$799		★ SUPER SPECIAL ★		PLANTRONICS Color Plus \$366	
houston instrument DMP 40 - 2 Pens \$799 DMP 29 - 8 Pens \$1799		64K RAM \$45 Set of 9 chips		PARADISE Multi-display Card \$299	
MONITORS		IBM PC Color/Graphics Card \$199 MonoChrome/Printer Card \$199		Tseng Labs Ultra PAK \$499	
PGS MAX-12 Amber \$179 HX-12 \$449 SR-12 \$599		PGS HX-12 \$449		MULTI-FUNCTION CARDS	
ROLAND CC 141 14" RGB \$599		TEAC Disk Drive FD55B, 360K slimline, PC Compatible \$149		NEW QUADBOARD O-K (to 384K) \$199	
AMDEK 300 Green \$119 300 Amber \$139 310 Amber \$159		KEYTRONIC Deluxe Keyboard KB5151 \$199		AST SIX PAK with 64K (to 384K) \$249	
MODEMS		ERA 2 MODEM \$329 PC Internal 1200 Baud w/software, 4 Yr. Warranty		EVEREX Magic Card O-K (to 384K) \$229	
MICROCOM ERA 2 Internal \$329 Standalone \$439		COMPAQ 256K, 2 Disk Drives \$1,999		MISC. ADD ONS	
HAYES SMARTMODEM 1200 1200B \$399 1200 \$479		   COD NO SURCHARGE: VISA & MC 3%, AMEX 5%		PRACTICAL PERIPHERALS MICROBUFFER CALL	
QUBIE Internal \$299 Standalone \$329				CABLE Parallel or Serial \$20	
				IBM PC DOS 1.1 .. \$20 DOS 2.1 .. \$50	
				IBM PC Floppy Drive Controller \$139	
				COMPUTER ACCESSORIES POWER DIRECTOR \$109	
				STANDBY POWER SUPPLY 200 WATTS.....\$299 300 WATTS.....\$399 Surge Protection, up to 30 minutes Standby Power	

APPLE COMPATIBLE HARDWARE

INTERFACE FOR TYPEWRITER, CENTRONICS AND WORDSTAR COMPATIBLE

Model #	Price
T1 Olivetti Praxis 30, 35, 40	\$99
T2 Olivetti Praxis 41	
T3 Silver Reed Ex 42, 43, 44 + Penman	
T4 Adler Satellite 11 and Alpha Royal 2001	
T5 Olympia Compact and Swiftec 1146 CM	

INFRARED INTERFACE FOR REMOTE OPERATION WITHOUT CABLES

IRR Board, Receiver station	\$99
for use with one or all:	
IRN Numerical Pad Visual compatible	\$49
IRK Full keyboard with lower case	\$129
IRC Four direction cursor control	\$29

TO ORDER CALL (408) 734-4631

or write:



INTERFACE

Advanced Transducer Devices, Inc.
1287 Lawrence Sta. Rd., Sunnyvale, CA 94089

Additional \$2.50 per order for shipping
Calif. residents add 6% tax

Circle 14 on inquiry card.



Solve your disc problems, buy 100% surface
tested Dysan diskettes. All orders shipped
from stock, within 24 hours. Call toll FREE
(800) 235-4137 for prices and information.
Visa and MasterCard accepted.



PACIFIC EXCHANGES

100 Foothill Blvd.
San Luis Obispo, CA
93401. (In Cal. call
(805) 543-1037)

Circle 243 on inquiry card.

C SOFTWARE DEVELOPMENT PCDOS/MSDOS

- FULL C COMPILER PER K&R
 - Inline BOB7 or Assembler Floating Point
 - Full 1 MB Addressing for Code or Data
 - Transcendental Functions
 - MSDOS 1.1/2.0 LIBRARY SUPPORT
 - Program Chaining using Exec
 - Environment Available to Main
 - c-window™ C SOURCE CODE DEBUGGER
 - Variable Display & Alteration Using C Expression
 - FAST BOB8/BOB8 ASSEMBLER
- Combined Package — \$199**
- Call or write:
c-systems Fullerton, CA 92634
P.O. Box 3253 714-637-5362
TM c-systems

computers for less

Hayes Smartodem 1200	\$469.00
Prometheus Pro-Modem	\$339.00
Gemini 10X	\$269.00
Brother HR-15	\$399.00
Okidata 92P	\$409.00
Tava P.C.	\$1895.00
IBM P.C.	\$2395.00
Lotus 1-2-3	\$309.00
Maxell SS/DD	\$20.00
Maxell DS/DD	\$32.00

(619) 579-2730

3855 Avocado Blvd., Suite 140-227
La Mesa, California 92041

Prices reflect 2 1/2% Cash Discount • Quantities Limited

Circle 73 on inquiry card.

FREE SOFTWARE RENT THE PUBLIC DOMAIN!

User Group Software isn't copyrighted, so no fees to pay! 1000's of CP/M and IBM software programs in .COM and source code to copy yourself! Games, business, utilities! All FREE!

CP/M USERS GROUP LIBRARY

Volumes 1-92, 46 disks rental—\$45

SIG/M USERS GROUP LIBRARY

Volumes 1-90, 46 disks rental—\$45

Volumes 91-172, 40 disks rental—\$45

SPECIAL! Rent all SIG/M volumes for \$85

MOST FORMATS AVAILABLE! SPECIFY.

IBM PC-SIG (PC-DOS) LIBRARY

Volumes 1-135, 5 1/4" disks \$135

Public Domain User Group Catalog Disk \$5 pp. (CP/M only) (payment in advance, please)
Rental is for 7 days after receipt, 3 days grace to return. Use credit card, no disk deposit.

Shipping, handling & insurance—\$7.50 per library.
(619) 941-0925 information,
(619) 727-1015 anytime order machine
Have your credit card ready!

Public Domain Software Center

1533 Avohill Dr.
Vista, CA 92083



AM EX.

Circle 250 on inquiry card.

IBM PC/XT COMPATIBLE

Computer Case	\$140.00
Keytronic Keyboard	\$180.00
PC 65 Watt Power Supply	\$150.00
XT 100 Watt Power Supply	\$190.00
PC/XT Bare Board	\$ 90.00
Shugart SA455 320KB Floppy Disk	\$169.00
Shugart SA712 10MB Hard Disk	\$625.00
Shugart SA606 10MB Hard Disk	\$375.00
Hard Disk Controller	\$325.00
Floppy Disk Controller w/Serial,	
Parallel, Game Ports	\$250.00
Color Graphic Card	\$210.00
Monochrome Card	\$225.00

OEM/DEALER INQUIRIES WELCOME

ELECTRADE CO. (408) 946-2541
780 Trimble Rd., Suite 605
San Jose, CA 95131

Circle 122 on inquiry card.

SAVE ON MEMOREX DISKETTES

\$159 ea. 5 1/4" SSDD Qty. 20
\$289 ea. 5 1/4" DSDD Qty. 20

5 1/4" SSDD-96TPI \$249 ea. 5 1/4" DSDD-96TPI \$325 ea.
Boxed in 10's with Tyvec sleeves, reinforced hubs and labels.

DISKETTES FOR MACINTOSH & HP-150
AT TERRIFIC SAVINGS!

3 1/2" Memorex \$3.99 ea.

See our big ad in this issue for other great values!
Shipping: 5 1/4" or 3 1/2" DISKETTES—Add \$3.00 per 100 or fewer diskettes. Payment: VISA and Mastercard accepted. COD orders only, add \$3.00 handling charge. Taxes: Illinois residents, please add 8% sales tax.

**WE WILL BEAT ANY NATIONALLY ADVERTISED PRICE
ON THE SAME PRODUCTS AND QUANTITIES!**

Nationwide: 1-800-621-6827

Illinois: 1-312-944-2788

Hours: 9AM - 5PM Central Time

Minimum Order: \$35.00

DISK WORLD!, Inc.

Suite 4806 • 30 East Huron Street • Chicago, Illinois 60611

MEMOREX

Circle 108 on inquiry card.

Apple Macintosh
IBM, XT, Hard disks
Eagle, Compaq, Columbia
NCR, Olivetti, Leading Edge
Multiusers
up to 16/TermSyst.
Printers/Plotters
Monitors, Disk Drives
Modems, Diskettes
Software
for PC & Multiusers
Printers: Epson, Okidata
Gemini, Radix, NEC, HP

COMPUTER EXPO INC. SOURCE COMPUTERS

(213) 208-0352 208-0259
(213) 906-1984 906-1634

Circle 66 on inquiry card.

EPROM PROGRAMMER



APPROTEK 1000
ONLY

\$249.95

COMPLETE WITH
PERSONALITY
MODULE

117 AC POWER-RS232
6 BAUD RATES - HANDSHAKE TO HOST
ALLOWS READ, WRITE, VERIFY & COPY
Comes complete with CPM & BASIC Driver
Program Listings for most small micros

Full 1 Year Warranty

Programs the following: 5 Volt 24 or 28 pin
devices, 27xx series through 27256.
25xx series, 68768 plus others.
Specify Personality Module desired with order.
Additional Personality Modules only \$15.00 ea.

TO ORDER: CALL OR WRITE

APROPOS TECHNOLOGY

1071-A AVENIDA ACASO Add
CAMARILLO, CA 93010 \$4.00 Shipping-USA
(805) 482-3804 VISA or MC Add 3%

Circle 25 on inquiry card.

PRICE BREAKTHROUGH

STATIC RAMS

2101	256 x 4 (450ns)	1.95
5101	256 x 4 (450ns) (cmos)	3.95
2102-1	1024 x 4 (450ns)	.89
2102L-4	1024 x 1 (450ns) (LP)	.99
2102L-2	1024 x 1 (250ns) (LP)	1.45
2125	1024 x 1 (45ns)	2.49
2111	256 x 4 (450ns)	2.95
2111L	256 x 4 (250ns) (LP)	2.95
2112	256 x 4 (450ns)	2.99
2114	1024 x 4 (450ns)	8/9.95
2114-24	1024 x 4 (250ns)	8/10.95
2114L-4	1024 x 4 (450ns) (LP)	8/12.95
2114L-3	1024 x 4 (300ns) (LP)	8/13.45
2114L-2	1024 x 4 (200ns) (LP)	8/13.95
TC5514	1024 x 4 (650ns) (cmos)	4.95
2147	4096 x 1 (5ns)	4.95
TMS4044-4	4096 x 1 (450ns)	3.49
TMS4044-3	4096 x 1 (300ns)	3.49
TMS4044-2	4096 x 1 (200ns)	4.49
UPD411	4096 x 1 (100ns)	3.95
MK418	1024 x 8 (100ns)	9.95
TMM2016-200	2048 x 8 (200ns)	4.15
TMM2016-150	2048 x 8 (150ns)	4.95
TMM2016-100	2048 x 8 (100ns)	6.15
HME116-4	2048 x 8 (200ns) (cmos)	4.75
HME116-3	2048 x 8 (150ns) (cmos)	4.95
HME116-2	2048 x 8 (120ns) (cmos)	8.95
HME116LP-4	2048 x 8 (200ns) (cmos) (LP)	5.95
HME116LP-3	2048 x 8 (150ns) (cmos) (LP)	6.95
HME116LP-2	2048 x 8 (120ns) (cmos) (LP)	10.95
TC5516	2048 x 8 (250ns) (cmos)	9.95
TMS4016	2048 x 8 (200ns)	6.95
Z 5132	4096 x 1 (300ns) (Qstat)	34.95
HME264P-15	8192 x 8 (150ns) (cmos)	39.95
HME264LP-15	8192 x 8 (150ns) (cmos)	49.95

LP = Lower Power Qstat = Quasi-Static

DYNAMIC RAMS

TMS4027	4096 x 1 (250ns)	1.99
2107	4096 x 1 (200ns)	1.95
NMS5280	4096 x 1 (300ns)	1.95
TMS4060	4096 x 1 (300ns)	1.95
UPD411	4096 x 1 (300ns)	1.95
TMS4050	4096 x 1 (300ns)	1.95
MK4108	8192 x 1 (200ns)	1.95
NMS5298	8192 x 1 (250ns)	1.95
4116-300	16384 x 1 (300ns)	8/11.75
4116-250	16384 x 1 (250ns)	8/7.95
4116-200	16384 x 1 (200ns)	8/12.95
4116-150	16384 x 1 (150ns)	8/14.95
4116-120	16384 x 1 (120ns)	8/29.95
2118	16384 x 1 (150ns) (5v)	4.95
MK4332	32768 x 1 (200ns)	9.95
4164-200	65536 x 1 (200ns) (5v)	5.44
4164-150	65536 x 1 (150ns) (5v)	5.44
4164-120	65536 x 1 (120ns) (5v)	8.95
MCM6665	65536 x 1 (200ns) (5v)	8.95
TMS4164	65536 x 1 (150ns) (5v)	8.95
TMS4416	16384 x 4 (150ns) (5v)	9.95
41256-150	262144 x 1 (150ns) (5v)	54.95
41256-200	262144 x 1 (200ns) (5v)	49.95

5v = Single 5 volt supply

EPROMS

1702	256 x 8 (1us)	4.50
2708	1024 x 8 (450ns)	3.95
2758	1024 x 8 (450ns) (5v)	5.95
2716-6	2048 x 8 (650ns)	2.95
2716	2048 x 8 (450ns) (5v)	3.95
2716-1	2048 x 8 (350ns) (5v)	5.95
TMS2516	2048 x 8 (450ns) (5v)	5.50
TMS2716	2048 x 8 (450ns)	7.95
TMS2532	4096 x 8 (450ns) (5v)	5.95
2732	4096 x 8 (450ns) (5v)	4.95
2732-250	4096 x 8 (250ns) (5v)	8.95
2732-200	4096 x 8 (200ns) (5v)	11.95
2732A-4	4096 x 8 (450ns) (5v) (21vPGM)	6.95
2732A-2	4096 x 8 (250ns) (5v) (21vPGM)	9.95
2764	8192 x 8 (450ns) (5v)	6.95
2764-250	8192 x 8 (250ns) (5v)	7.95
2764-200	8192 x 8 (200ns) (5v)	19.95
TMS2564	8192 x 8 (450ns) (5v)	14.95
MCM68764	8192 x 8 (450ns) (5v) (24pin)	39.95
MCM68766	8192 x 8 (350ns) (5v) (24pin)	42.95
27128-30	16384 x 8 (300ns) (5v)	29.95
27128	16384 x 8 (250ns) (5v)	34.95

5v Single 5 Volt Supply 21vPGM Program at 21 Volts

★ ★ ★ HIGH-TECH ★ ★ ★

SSI 263 SPEECH SYNTHESIZER

- ★ MICROPROCESSOR COMPATIBLE
- ★ 5 BIT CONTROL REGISTERS
- ★ ENHANCE YOUR MOCKINGBOARD OR BUILD STEVE CIARCIA'S SWEET TALKER II (BYTE MARCH '84)

39.95

★ ★ ★ SPOTLIGHT ★ ★ ★

- ★ Computer managed inventory - virtually no back orders!
- ★ Very competitive prices!
- ★ Friendly staff!
- ★ Fast service - most orders processed within 24 hours!

CRYSTALS

32.768 khz	1.95
1.0 mhz	3.95
1.8432	3.95
2.0	2.95
2.097152	2.95
2.4576	2.95
3.2768	2.95
3.579545	2.95
4.0	2.95
5.0	2.95
5.0888	2.95
5.185	2.95
5.7143	2.95
6.0	2.95
6.144	2.95
6.5536	2.95
8.0	2.95
10.0	2.95
10.738635	2.95
14.31818	2.95
15.0	2.95
16.0	2.95
17.430	2.95
18.0	2.95
18.432	2.95
20.0	2.95
22.1184	2.95
32.0	2.95

CMOS

4000	.29	4528	1.19
4001	.25	4531	.95
4002	.25	4532	1.95
4006	.89	4538	1.95
4007	.29	4539	1.95
4008	.95	4541	2.64
4009	.39	4543	1.19
4010	.45	4553	5.79
4011	.25	4555	.95
4012	.25	4556	.95
4013	.38	4581	1.95
4014	.79	4582	1.95
4015	.39	4584	.75
4016	.39	4585	.75
4017	.69	4702	12.95
4018	.79	74C00	.35
4019	.39	74C02	.35
4020	.75	74C04	.35
4021	.79	74C08	.35
4022	.79	74C10	.35
4023	.29	74C14	.59
4024	.65	74C20	.35
4025	.29	74C30	.35
4026	1.65	74C32	.39
4027	.45	74C42	1.29
4028	.69	74C48	1.99
4029	.79	74C73	.65
4030	.39	74C74	.65
4034	1.95	74C76	.80
4035	.85	74C83	1.95
4040	.75	74C85	1.95
4041	.75	74C86	.39
4042	.69	74C89	4.50
4043	.85	74C90	1.19
4044	.79	74C93	1.75
4046	.85	74C95	.99
4047	.95	74C107	.89
4049	.35	74C150	5.75
4050	.35	74C151	2.25
4051	.79	74C154	3.25
4053	.79	74C157	1.75
4060	.89	74C160	1.19
4066	.39	74C161	1.19
4068	.39	74C162	1.19
4069	.29	74C163	1.19
4070	.35	74C164	1.39
4071	.29	74C165	2.00
4072	.29	74C173	.79
4073	.29	74C174	1.19
4075	.29	74C175	1.19
4076	.79	74C192	1.49
4078	.29	74C193	1.49
4081	.29	74C195	1.39
4082	.29	74C200	5.75
4085	.95	74C221	1.75
4086	.95	74C244	2.25
4093	.49	74C373	2.45
4098	2.49	74C374	2.45
4099	1.95	74C901	.39
14409	12.95	74C902	.85
95H90	7.95	14410	12.95
2513-001 UP	9.95	14411	11.95
2513-002 LOW	9.95	14412	12.95
		14419	7.95
		14433	14.95
		4502	.95
		4503	.65
		4508	1.95
		4510	.85
		4511	.85
		4512	.85
		4514	1.25
		4515	1.79
		4516	1.55
		4518	.89
		4519	.39
		4520	.79
		4522	1.25
		4526	1.25
		4527	1.95

UARTS

AY5-1013	3.95
AY3-1015	6.95
PT1472	9.95
TR1602	3.95
2350	9.95
IM6402	7.95
IM6403	8.95
INS8250	10.95

GENERATORS

BIT-RATE

MC14411	11.95
BR1941	11.95
4702	12.95
COM5016	16.95
COM8116	10.95
MM5307	10.95

FUNCTION

MC4024	3.95
LM566	1.49
XR2206	3.75
8038	3.95

MISC.

UPD7201	29.95
TMS99532	29.95
ULN2003	2.49
3242	7.95
3341	4.95
MC3470	4.95
MC3480	9.00
11C90	13.95
95H90	7.95
2513-001 UP	9.95
2513-002 LOW	9.95

CLOCK

CIRCUITS

MM5314	4.95
MM5369	3.95
MM5369-EST	4.25
MM5375	4.95
MM58167	12.95
MM58174	11.95
MSM5832	3.95

KEYBOARD

CHIPS

AY5-2376	11.95
AY5-3600	11.95
AY5-3600 PRO	11.95

6800

68000	49.95
6800	2.95
6802	7.95
6803	19.95
6808	13.90
6809E	14.95
6809	11.95
6810	2.95
6820	4.35
6821	2.95
6828	14.95
6840	12.95
6843	34.95
6844	25.95
6845	14.95
6847	11.95
6850	3.25
6852	5.75
6860	7.95
6875	6.95
6880	2.25
6883	22.95
68047	24.95
68488	19.95

DISC CONTROLLERS

6800 1MHZ	1795
68800	10.95
68802	22.25
68809E	29.95
68809	29.95
68810	6.95
68821	6.95
68840	19.95
68845	19.95
68850	5.95
68800 2 MHZ	2143

6500

6502	1 MHZ	4.95
6504	6.95	
6505	8.95	
6507	9.95	
6520	4.35	
6522	6.95	
6532	9.95	
6545	22.50	
6551	11.85	
6502A	6.95	
6522A	9.95	
6532A	11.95	
6545A	27.95	
6551A	11.95	
6502B	9.95	

DISC CONTROLLERS

1771	16.95
1791	24.95
1793	26.95
1795	29.95
1797	49.95
2791	54.95
2793	54.95
2795	59.95
2797	59.95
6843	34.95
6845	34.95
6847	39.95
UPD765	39.95
MB8876	29.95
MB8877	34.95
1691	17.95
2143	18.95

8000

8035	5.95
8039	5.95
INS-8060	17.95
INS-8073	49.95
8080	3.95
8085	4.95
8085A-2	11.95
8086	24.95
8087	199.95
8088	29.95
8089	89.95
8155	6.95
8155-2	7.95
8156	6.95
8185	29.95
8185-2	39.95
8741	29.95
8748	24.95
8755	24.95

CRT CONTROLLERS

6845	14.95
68845	19.95
HD46505SP	15.95
MC1372	6.95
68047	24.95
8275	29.95

4164

64K D RAMS 150ns or 200ns

9/\$49.00

74LS00

74LS00	.24	74LS173	.69
74LS01	.25	74LS174	.55
74LS02	.25	74LS175	.55
74LS03	.25	74LS181	2.15
74LS04	.24	74LS189	8.95
74LS05	.25	74LS190	.89
74LS08	.28	74LS191	.89
74LS09	.29	74LS192	.79
74LS10	.25	74LS193	.79
74LS11	.35	74LS194	.69
74LS12	.35	74LS195	.69
74LS13	.45	74LS196	.79
74LS14	.59	74LS197	.79
74LS15	.35	74LS221	.89
74LS20	.25	74LS240	.95
74LS21	.29	74LS241	.99
74LS22	.25	74LS242	.99
74LS26	.29	74LS243	.99
74LS27	.29	74LS244	1.29
74LS28	.35	74LS245	1.49
74LS30	.25	74LS247	.75
74LS32	.29	74LS248	.99
74LS33	.55	74LS249	.99
74LS37	.35	74LS251	.59
74LS38	.35	74LS253	.59
74LS40	.25	74LS257	.59
74LS42	.49	74LS258	.59
74LS47	.75	74LS259	2.75
74LS48	.75	74LS260	.59
74LS49	.75	74LS266	.55
74LS51	.25	74LS273	1.49
74LS54	.29	74LS275	3.35
74LS55	.29	74LS279	.49
74LS63	1.25	74LS280	1.98
74LS73	.39	74LS283	.69
74LS74	.35	74LS290	.89
74LS75	.39	74LS293	.89
74LS76	.39	74LS295	.99
74LS78	.49	74LS298	.89
74LS83	.60	74LS299	1.75
74LS85	.69	74LS323	3.50
74LS86	.39	74LS324	1.75
74LS90	.55	74LS352	1.29
74LS91	.89	74LS353	1.29
74LS92	.55	74LS363	1.35
74LS93	.55	74LS364	1.95
74LS95	.75	74LS365	.49
74LS96	.89	74LS366	.49
74LS107	.39	74LS367	.45
74LS109	.39	74LS368	.45
74LS112	.39	74LS373	1.39
74LS113	.39	74LS374	1.39
74LS114	.39	74LS375	.95
74LS122	.45	74LS377	1.39
74LS123	.79	74LS378	1.18
74LS124	2.90	74LS379	1.35
74LS125	.49	74LS385	3.90
74LS126	.49	74LS386	.45
74LS132	.59	74LS390	1.19
74LS133	.59	74LS393	1.19
74LS136	.39	74LS395	1.19
74LS137	.99	74LS399	1.49
74LS138	.55	74LS424	2.95
74LS139	.55	74LS447	.95
74LS145	1.20	74LS490	1.95
74LS147	2.49	74LS624	3.99
74LS148	1.35	74LS640	2.20
74LS151	.55	74LS645	2.20
74LS153	.55	74LS668	1.69
74LS154	1.90	74LS669	1.89
74LS155	.69	74LS670	1.49
74LS156	.69	74LS674	14.95
74LS157	.65	74LS682	3.20
74LS158	.59	74LS683	3.20
74LS160	.69	74LS684	3.20
74LS161	.65	74LS685	3.20
74LS162	.69	74LS688	2.40
74LS163	.65	74LS689	3.20
74LS164	.69	81LS95	1.49
74LS165	.95	81LS96	1.49
74LS166	1.95	81LS97	1.49
74LS168	1.75	81LS98	1.49
74LS169	1.75	25LS2521	2.80
74LS170	1.49	25LS2569	4.25

74S00

74S00	.32	74S124	2.75	74S197	1.49
74S02	.35	74S132	1.24	74S201	6.95
74S03	.35	74S133	.45	74S225	7.95
74S04	.35	74S134	.50	74S240	2.20
74S05	.35	74S135	.89	74S241	2.20
74S08	.35	74S138	.85	74S244	2.20
74S09	.40	74S139	.85	74S251	.95
74S10	.35	74S140	.55	74S253	.95
74S11	.35	74S151	.95	74S257	.95
74S15	.35	74S153	.95	74S258	.95
74S20	.35	74S157	.95	74S260	.79
74S22	.35	74S158	.95	74S273	2.45
74S30	.35	74S161	1.95	74S280	1.95
74S32	.40	74S162	1.95	74S287	1.90
74S37	.88	74S163	1.95	74S288	1.90
74S38	.85	74S168	3.95	74S289	6.89
74S40	.35	74S169	3.95	74S301	6.95
74S51	.35	74S174	.95	74S373	2.45
74S64	.40	74S175	.95	74S374	2.45
74S65	.40	74S181	3.95	74S387	1.95
74S74	.50	74S182	2.95	74S412	2.98
74S85	1.99	74S188	1.95	74S471	4.95
74S86	.50	74S189	6.95	74S472	4.95
74S112	.50	74S194	1.49	74S474	4.95
74S113	.50	74S195	1.49	74S570	2.95
74S114	.55	74S196	1.49	74S571	2.95

VOLTAGE REGULATORS

7805T	.75	7905T	.85
78M05C	.35	7908T	.85
7808T	.75	7912T	.85
7812T	.75	7915T	.85
7815T	.75	7924T	.85
7824T	.75	7905K	1.49
7805K	1.39	7912K	1.49
7812K	1.39	7915K	1.49
7815K	1.39	7924K	1.49
7824K	1.39	79L05	.79
78L05	.69	79L12	.79
78L12	.69	79L15	.79
78L15	.69	LM323K	4.95
78H05K	9.95	UA78540	1.95
78H12K	9.95		

C, T = TO-220 K = TO-3
L = TO-92

SOUND CHIPS

76477	3.95	AY3-8910	12.95
76488	5.95	AY3-8912	12.95
76489	8.95	MC3340	1.49
SSI-263			39.95

BYPASS CAPS

.01 UF DISC	100/6.00
.01 UF MONOLITHIC	100/12.00
.1 UF DISC	100/8.00
1 UF MONOLITHIC	100/15.00

INTERFACE

8T26	1.59
8T28	1.89
8T95	.89
8T96	.89
8T97	.89
8T98	.89
DM8131	2.95
DP8304	2.29
DS8833	2.25
DS8835	1.99
DS8836	.99
DS8837	1.65
DS8838	1.30



EPROM ERASERS SPECTRONICS CORPORATION

Timer	Capacity Chip	Intensity (uW/Cm ²)	
PE-14	9	8,000	83.00
PE-14T	X 9	8,000	119.00
PE-24T	X 12	9,600	175.00
PL-265T	X 30	9,600	255.00
PR-125T	X 25	17,000	349.00
PR-320T	X 42	17,000	595.00

DATA ACQUISITION

ADC0800	15.55	DAC0800	4.95
ADC0804	3.49	DAC0808	2.95
DAC0806	1.95	DAC1020	8.25
ADC0809	4.49	DAC1022	5.95
ADC0816	14.95	MC1408L6	1.95
ADC0817	9.95	MC1408L8	2.95

CONNECTORS

RS232 Male	2.50
RS232 Female	3.25
RS232 Hood	1.25
S-100 ST	3.95

EXAR

XR 2206	3.75
XR 2207	3.75
XR 2208	3.75
XR 2211	5.25
XR 2240	3.25

INTERSIL

ICL7106	9.95
ICL7107	12.95
ICL7660	2.95
ICL8038	3.95
ICM7207A	5.99
ICM7208	15.95

9000

9316	1.00
9334	2.50
9368	3.95
9401	9.95
9601	.75
9602	1.50
96S02	1.95

LINEAR

LM301	.34	LM348	.99	LM567	.89	LM1812	8.25
LM301H	.79	LM350K	4.95	NE570	3.95	LM1830	3.50
LM307	.45	LM350T	4.60	NE571	2.95	LM1871	5.49
LM308	.69	LM358	.69	NE590	2.50	LM1872	5.49
LM308H	1.15	LM359	1.79	NE592	2.75	LM1877	3.25
LM309H	1.95	LM376	3.75	LM709	.59	LM1889	1.95
LM309K	1.25	LM377	1.95	LM710	.75	LM1896	1.75
LM310	1.75	LM378	2.50	LM711	.79	ULN2003	2.49
LM311	.64	LM379	4.50	LM723	.49	LM2877	2.05
LM311H	.89	LM380	.89	LM723H	.55	LM2878	2.25
LM312H	1.75	LM380N-8	1.10	LM733	.98	LM2900	.85
LM317K	3.95	LM381	1.60	LM741	.35	LM2901	1.00
LM317T	1.19	LM382	1.60	LM741N-14	.35	LM2917	2.95
LM318	1.49	LM383	1.95	LM741H	.40	LM3900	.59
LM318H	1.59	LM384	1.95	LM747	.69	LM3905	1.25
LM319H	1.90	LM386	.89	LM748	.59	LM3909	.98
LM319	1.25	LM387	1.40	LM1014	1.19	LM3911	2.25
LM320 (see 7900)		LM389	1.35	LM1303	1.95	LM3914	3.95
LM322	1.65	LM390	1.95	LM1310	1.49	LM3915	3.95
LM323K	4.95	LM392	.69	MC1330	1.69	LM3916	3.95
LM324	.59	LM393	1.29	MC1349	1.89	MC4024	3.95
LM329	.65	LM394H	4.60	MC1350	1.19	MC4044	4.50
LM331	3.95	LM399H	5.00	MC1358	1.69	RC4136	1.25
LM334	1.19	NE531	2.95	MC1372	6.95	RC4151	3.95
LM335	1.40	NE555	.34	LM1414	1.59	LM4250	1.75
LM336	1.75	NE556	.65	LM1458	.59	LM4500	3.25
LM337K	3.95	NE558	1.50	LM1488	.69	RC4558	.69
LM337T	1.95	NE561	24.95	LM1489	.69	LM13080	1.29
LM338K	6.95	NE564	2.95	LM1496	.85	LM13600	1.49
LM339	.99	LM565	.99	LM1558H	3.10	LM13700	1.49
LM340 (see 7800)		LM566	1.49	LM1800	2.37	MPQ2907	1.95

H TO-5 CAN

T TO-220

K TO-3

RCA

CA 3023	2.75	CA 3082	1.65
CA 3039	1.29	CA 3083	1.55
CA 3046	1.25	CA 3086	8.00
CA 3059	2.90	CA 3089	2.99
CA 3060	2.90	CA 3096	3.49
CA 3065	1.75	CA 3130	1.30
CA 3080	1.10	CA 3140	1.15
CA 3081	1.65	CA 3146	1.85
CA 3160			3.19

TI

TL494	4.20	75365	1.95
TL496	1.65	75450	.59
TL497	3.25	75451	.39
75107	1.49	75452	.39
75110	1.95	75453	.39
75150	1.95	75454	.39
75154	1.95	75491	.79
75188	1.25	75492	.79
75189	1.25	75493	.89
75494			.89

BI FET

TL071	.79	TL084	2.19
TL072	1.19	LF347	2.19
TL074	2.19	LF351	.60
TL081</			

PRICE BREAKTHROUGH

BARGAIN HUNTERS CORNER

POWER SUPPLY SPECIALS
IDEAL FOR HOBBYISTS, BENCHWORK, AND DO-IT-YOURSELFERS.

90 WARRANTY, QUANTITIES LIMITED
POWER GENERAL MODEL 4070-1

- * QUAD OUTPUT SWITCHING POWER SUPPLY
- * GREAT FOR 8" DISK DRIVES
- * 4.25" x 8.25" x 1.65"
- WEIGHT: 1.25 LBS.
- * +5V @ 6A +12V @ 1A
- 12 @ 1A +24V @ 1.5A

\$44.95

KEPCO/TDK MODEL MRM174KF

- * QUAD OUTPUT SWITCHING POWER SUPPLY
- * 6.2" x 7.4" x 1.7"
- WEIGHT: 1.6 LBS.
- * +5V @ 5A +12V @ 2.8A
- +12 @ 2A -12V @ .5A
- * BOTH +12V OUTPUTS CAN BE USED AS +24V

\$59.95

ASTEC AA11190

- * QUAD OUTPUT SWITCHING DESIGN AS USED IN APPLE III
- * +5V @ .4A -5V @ .25A
- +12 @ 2.5A -12V @ .30A
- * 15.5" x 4.5" x 2"
- WEIGHT: .884 LBS.

NOW \$39.95

SIGMA INSTRUMENTS MODEL 2PC2241

- * +5V @ .4A -15V @ 1.5A
- * 12.25" x 4" x 4.75"
- WEIGHT: 2.46 LBS.

NOW ONLY \$9.95

PLEASE INCLUDE SHIPPING AND HANDLING CHARGES
SPECIALS END 9-30-84

TRANSISTORS

2N918	.50	MPS3706	.15
MPS918	.25	2N3772	1.85
2N2102	.75	2N3903	.25
2N2218	.50	2N3904	.10
2N2218A	.50	2N3906	.10
2N2219	.50	2N4122	.25
2N2219A	.50	2N4123	.25
2N2222	.25	2N4249	.25
PN2222	.10	2N4304	.75
MPS2389	.25	2N4401	.25
2N2484	.25	2N4402	.25
2N2905	.50	2N4403	.25
2N2907	.25	2N4857	1.00
PN2907	.125	PN4916	.25
2N3055	.79	2N5086	.25
3055T	.69	PN5129	.25
2N3383	.30	PN5139	.25
2N3414	.25	2N5209	.25
2N3583	.40	2N6028	.35
2N3585	.40	2N6043	1.75
PN3585	.25	2N8045	1.75
MPS3838	.25	MPS-A05	.25
MPS3840	.25	MPS-A08	.25
PN3843	.25	MPS-A55	.25
PN3844	.25	TIP29	.65
MPS3704	.15	TIP31	.75
		TIP32	.79

IC SOCKETS

1-99	100
8 pin ST	.13 .11
14 pin ST	.15 .12
16 pin ST	.17 .13
18 pin ST	.20 .18
20 pin ST	.29 .27
22 pin ST	.30 .27
24 pin ST	.30 .27
28 pin ST	.40 .32
40 pin ST	.49 .39
64 pin ST	4.25 call

ST = SOLDER TAIL

8 pin WW	.50 .49
14 pin WW	.69 .52
16 pin WW	.69 .58
18 pin WW	.99 .90
20 pin WW	1.09 .98
22 pin WW	1.39 1.28
24 pin WW	1.49 1.35
28 pin WW	1.69 1.49
40 pin WW	1.99 1.60

WW = WIREWRAP

RF MODULATOR

(ASTEC UM1082) QUANTITIES LIMITED

- * PRESET TO CHANNEL 3
- * USE TO BUILD TV-COMPUTER INTERFACE
- * +5 VOLT OPERATION

NOW ONLY \$6.95

LED LAMPS

1-99	100-up
JUMBO RED	.10 .09
JUMBO GREEN	.16 .15
JUMBO YELLOW	.16 .15
LED MOUNTING HARDWARE	.10 .09

LED DISPLAYS

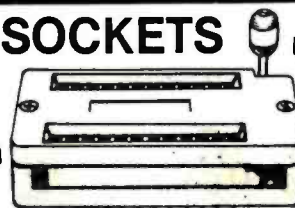
HP 5082-7760	.43"	CC	1.29
MAN 72	.3"	CA	.99
MAN 74	.3"	CC	.99
FND-357 (359)	.375"	CC	1.25
FND-500 (503)	.5"	CC	1.49
FND-507 (510)	.5"	CA	1.49
TIL-311 4x7	.270"	HEX W/LOGIC	9.95

DIP SWITCHES

4 POSITION	.85
5 POSITION	.90
6 POSITION	.90
7 POSITION	.95
8 POSITION	.95

ZIF SOCKETS

ZIF = Zero Insertion Force



LEADS	UNIT PRICE
14	5.95
16	5.95
24	7.95
28	8.95
40	10.95

OPTO-ISOLATORS

4N26	1.00	MCA-7	4.25
4N27	1.10	MCA-255	1.75
4N28	.69	IL-1	1.25
4N33	1.75	ILA-30	1.25
4N35	1.25	ILO-74	2.75
4N37	1.25	H11C5	1.25
MCT-2	1.00	TIL-111	1.00
MCT-6	1.50	TIL-113	1.75

RESISTORS

1/4 WATT 5% CARBON FILM
ALL STANDARD VALUES
FROM 1 OHM TO 10 MEG OHM

50 PCS. SAME VALUE	.025
100 PCS. SAME VALUE	.02
1000 PCS. SAME VALUE	.015

BYPASS CAPS

.01 UF DISC	100/6.00
.01 UF MONOLITHIC	100/12.00
.1 UF DISC	100/8.00
.1 UF MONOLITHIC	100/15.00

DIODES

1N751	5.1 volt zener	.25
1N759	12.0 volt zener	.25
1N4148	(1N914) switching	25/1.00
1N4004	400PIV rectifier	10/1.00
KBPO2	200PIV 1.5amp bridge	.45
KBPO4	400PIV 1.5amp bridge	.55
VM48	Dip-Bridge	.35

MUFFIN FANS

4.88" Square	14.95
3.125" Square	14.95

HEAT SINKS

TO-3style	.95
TO-220style	.35

SWITCHES

SPDT mini-toggle	1.25
DPDT mini-toggle	1.50
SPST mini-pushbutton	.39

CAPACITORS

TANTALUM

	6V	10V	15V	20V	25V	35V
.22uf						.40
.27						.40
.33						.40
.47					.35	.50
.68						.45
1.0		.40	.40	.45	.45	
1.5				.45	.50	
1.8						.75
2.2		.35	.40	.45	.65	
2.7		.40	.45	.50	.90	
3.3		.45	.50	.55	.60	.65
3.9			.45			
4.7	.45	.55	.80	.85	.85	
6.8			.70	.75		
10	.55	.65	.80	.85	.90	1.00
12	.85		.85	.90		
15	.75	.85	.90			
18			1.25			
22		1.00	1.35			
27			2.25			
39			1.50			
47	1.35					
56	1.75					
100		3.25				
270	3.75					

DISC

10pf	50V .05	470	50V .05
22	50V .05	580	50V .05
25	50V .05	680	50V .05
27	50V .05	820	50V .05
33	50V .05	.001uf	50V .05
47	50V .05	.0015	50V .05
56	50V .05	.0022	50V .05
68	50V .05	.005	50V .05
82	50V .05	.01	50V .07
100	50V .05	.02	50V .07
220	50V .05	.05	50V .07
330	50V .05	.1	12V .10
		.1	50V .12

MONOLITHIC

.1uf-mono	50V .18	.47uf-mono	50V .25
.047uf-mono	50V .15	.01uf-mono	50V .14

ELECTROLYTIC

	RADIAL		AXIAL	
.47uf	50V .14	1uf	50V .14	
1	25V .14	4.7	18V .14	
2.2	35V .15	10	18V .14	
4.7	50V .15	10	50V .18	
10	50V .15	22	18V .14	
47	35V .16	47	50V .20	
100	18V .18	100	15V .20	
220	35V .20	100	35V .25	
470	25V .30	150	25V .25	
2200	18V .80	220	25V .30	
		330	18V .40	
		500	18V .42	
		1000	18V .80	
		1500	18V .70	
		6000	18V .65	
44,000uf	30V 3.95			

VISIT OUR RETAIL STORE

HOURS: M-W-F, 9-5 T-Th., 9-9 Sat. 10-3

PLEASE USE YOUR CUSTOMER NUMBER WHEN ORDERING

TERMS: Minimum order \$10. For shipping and handling include \$2.50 for UPS Ground and \$3.50 for UPS Air. Orders over 1 lb. and foreign orders may require additional shipping charges — please contact our sales department for the amount. CA residents must include 6% sales tax. Bay Area and LA residents include 6.75%. Prices subject to change without notice. We are not responsible for typographical errors. We reserve the right to limit quantities and to substitute manufacturer. All merchandise subject to prior sale.

© Copyright 1984 JDR Microdevices



JDR Microdevices

1224 S. Bascom Avenue, San Jose, CA 95128
800-538-5000 • 800-662-6279 (CA)
(408) 995-5430 • Telex 171-110

© Copyright 1984 JDR Microdevices

4164 64K D RAMS 150ns or 200ns 9/\$49⁰⁰

CABINETS FOR 5 1/4" DISK DRIVES

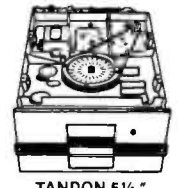
- CABINET #1 \$29.95**
 * Dimensions 8 1/2 x 5 1/8 x 3 1/8"
 * Color matches Apple
 * Fits standard 5 1/4" drives, inc. Shugart
 * Includes mounting hardware and feet
- CABINET #2 \$79.00**
 * Complete with power supply, switch, line cord, fuse & standard power connector
 * Dimensions: 11 1/2 x 5 1/8 x 3 1/8"
 * +5V @ 1 AMP, +12V @ 1.5 AMP
 * Please specify gray or tan
 NOTE: Please include sufficient amount for shipping on above items.

TRANSFORMERS FRAME STYLE

- | | | |
|------------|------|-------|
| 12.6VAC | 2amp | 4.95 |
| 12.6VAC CT | 2amp | 5.95 |
| 12.6VAC CT | 4amp | 7.95 |
| 12.6VAC CT | 8amp | 10.95 |
| 25.2VAC CT | 2amp | 7.95 |
- PLUG CASE STYLE**
- | | | |
|-------|-------|------|
| 12VAC | 250ma | 3.95 |
| 12VAC | 500ma | 4.95 |
| 12VAC | 1amp | 5.95 |
| 12VAC | 2amp | 6.95 |
- DC ADAPTER**
 6, 9, 12 VDC selectable with univ. adapter 8.95
 Please include sufficient amount for shipping on above items.

DISK DRIVES

- TANDON**
 TM100-1 5 1/4" (FOR IBM) SS/DD 199.00
 TM100-2 5 1/4" (FOR IBM) DS/DD 219.00
- MPI**
 MP-52 5 1/4" (FOR IBM) DS/DD 249.00
- TEAC**
 FD-55B 1/2" HEIGHT DS/DD 189.00
- SHUGART**
 SA 400L 5 1/4" (40 TRACK) SS/DD 199.95
- 8" DISK DRIVE**
 FD 100-8 BY SIEMENS, SHUGART 801 EQUIV. \$169.00
 SS/DD — 10/\$149 EA.
 FD 200-8 BY SIEMENS, SHUGART 851 EQUIV. \$239.00
 DS/DD — 10/\$220 EA.
- Please include sufficient amount for shipping on above items.



MICROCOMPUTER HARDWARE HANDBOOK FROM ELCOMP — \$14.95

Over 800 pages of manufacturers data sheets on most commonly used IC's.

Includes:
 * TTL — 74/74LS and 74F
 * CMOS
 * Voltage Regulators
 * Memory — RAM, ROM, EPROM
 * CPU's — 6800, 6500, Z80, 8080, 8085, 8086/8
 * MPU support & interface — 6800, 6500, Z80, 8200, etc.

ORDER TOLL FREE
800-538-5000
800-662-6279
 (CALIFORNIA RESIDENTS)



CENTRONICS

- | | | | |
|-----------|--------------|---------------|------|
| IDCEN36 | Ribbon Cable | 36 Pin Male | 8.95 |
| IDCEN36/F | Ribbon Cable | 36 Pin Female | 8.95 |
| CEN36 | Solder Cup | 36 Pin Male | 7.95 |

RIBBON CABLE

CONTACTS	SINGLE COLOR		COLOR CODED	
	1'	10'	1'	10'
10	.50	4.40	.83	7.30
16	.55	4.80	1.00	8.80
20	.65	5.70	1.25	11.00
25	.75	6.60	1.32	11.60
26	.75	6.60	1.32	11.60
34	.98	8.60	1.65	14.50
40	1.32	11.60	1.92	16.80
50	1.38	12.10	2.50	22.00

BEST SELLING BOOKS OSBORNE/MC GRAW-HILL

- | | |
|---------------------------|-------|
| Apple II User's Guide | 16.95 |
| CRT Controller's Handbook | 9.95 |
| 68000 Assembly Language | 16.99 |
| Programming | 15.00 |
| CBASIC User Guide | 15.00 |
- SYBEX**
- | | |
|---------------------------------------|-------|
| Z-80 Applications | 15.95 |
| IBM PC DOS Handbook | 9.95 |
| Programming the 8086/8088 | 15.95 |
| The Best of IBM PC Software | 16.95 |
| Microprocessor Interfacing Techniques | 17.95 |

EDGECARD CONNECTORS

- | | |
|-----------|------|
| S-100 ST | 3.95 |
| S-100 WW | 4.95 |
| 72 pin ST | 6.95 |
| 72 pin WW | 7.95 |
| 50 pin ST | 4.95 |
| 44 pin ST | 2.95 |
| 44 pin WW | 4.95 |

DIP CONNECTORS

DESCRIPTION	ORDER BY	CONTACTS								
		8	14	16	18	20	22	24	28	40
HIGH RELIABILITY TOOLED ST IC SOCKETS	AUGATxx-ST	.99	.99	.99	1.69	1.89	1.89	1.99	2.49	2.99
COMPONENT CARRIERS (DIP HEADERS)	ICCxx	.65	.75	.85	1.00	1.25	1.25	1.35	1.50	2.10
RIBBON CABLE DIP PLUGS (IDC)	IDPxx	----	1.45	1.65	----	----	----	2.50	----	4.15

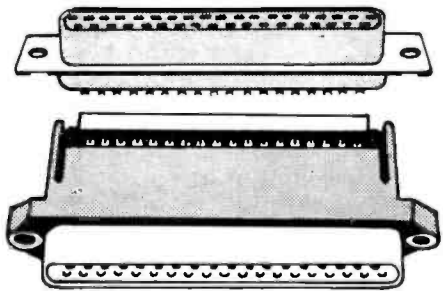
For order instructions see "IDC Connectors" below.

D-SUBMINIATURE

DESCRIPTION	ORDER BY	CONTACTS				
		9	15	25	37	50
SOLDER CUP	MALE DPxxP	2.08	2.69	2.50	4.80	6.06
	FEMALE DBxxS	2.66	3.63	3.25	7.11	9.24
RT. ANGLE	MALE DBxxPR	1.65	2.20	3.00	4.83	---
PC HOLDER	FEMALE DBxxSR	2.18	3.03	4.42	6.19	---
IDC RIBBON CABLE	MALE IDBxxP	3.37	4.70	6.23	9.22	---
	FEMALE IDBxxS	3.69	5.13	6.84	10.08	---
HOODS	BLACK HOOD-B	---	---	1.25	---	---
	GREY HOOD	1.60	1.60	1.25	2.95	3.50

MOUNTING HARDWARE — \$1.00

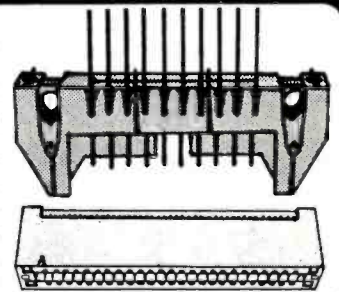
For order instructions see "IDC Connectors" below.



IDC CONNECTORS

DESCRIPTION	ORDER BY	CONTACTS					
		10	20	26	34	40	50
SOLDER HEADER	IDHxxS	.82	1.29	1.68	2.20	2.58	3.24
RT. ANGLE SOLDER HEADER	IDHxxSR	.85	1.35	1.76	2.31	2.72	3.39
WW HEADER	IDHxxW	1.86	2.98	3.84	4.50	5.28	6.63
RT. ANGLE WW HEADER	IDHxxWR	2.05	3.28	4.22	4.45	4.80	7.30
RIBBON HEADER SOCKET	IDSxx	1.15	1.86	2.43	3.15	3.73	4.65
RIBBON HEADER	IDMxx	---	5.50	6.25	7.00	7.50	8.50
RIBBON EDGE CARD	IDExx	2.25	2.36	2.65	3.25	3.80	4.74

ORDERING INSTRUCTIONS: Insert the number of contacts in the position marked "xx" of the "order by" part number listed. Example: A 10 pin right angle holder style header would be IDH10SR.



NEW FOR IBM

PC PEACOCK

COLOR GRAPHICS ADAPTER
BY MA SYSTEMS

- * MED. RES. 320x200
- * HIGH RES. 640x200
- * COMPOSITE AND RGB OUTPUT FOR ALL STANDARD MONITORS
- * LIGHT PEN INTERFACE
- * CHOICE OF 16 COLORS IN HIGH RES. MODE!
- * PARALLEL PORT STANDARD!
- * 2 YEAR WARRANTY!
- * PLUS FULL IBM COMPATIBILITY

\$239⁹⁵

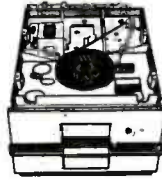


TANDON

TM 100-2

- * SAME DRIVE AS SUPPLIED BY IBM
- * DS/DD - 320K

\$199⁰⁰



TEAC

FD-55B HALF HEIGHT

- * 6ms STEP RATE
- * DS/DD
- * INCLUDES INSTRUCTIONS

\$159⁰⁰



BUY 2 FOR \$299⁰⁰
AND GET FREE MOUNTING BRACKETS!

MAXIMIZER

BY SIGMA DESIGN

- * 1 YEAR WARRANTY
- * MULTI-FUNCTION CARD
- * 64K TO 384K RAM
- * PARALLEL PORT
- * SERIAL PORT
- * CLOCK CALENDAR
- * SOFTWARE INCLUDED: CLOCK UTILITY, RAM DISK AND SPOOLER.

\$259⁰⁰

OPTIONS:

- * SECOND SERIAL PORT
- * GAME ADAPTER



SUMMER APPLE SPECIALS

JDR 16K RAM CARD

- * 2 YEAR WARRANTY
- * EXPAND YOUR 48K APPLE TO 64K
- * USE IN PLACE OF APPLE LANGUAGE CARD

BARE PC CARD 9.95

\$39⁹⁵



JDR HALF-HEIGHT DISK DRIVE

- * TEAC MECHANICS—DIRECT DRIVE
- * 100% APPLE COMPATIBLE—35 TRACK
- * 40 TRACK WHEN USED WITH OPTIONAL CONTROLLER
- * 1 YEAR WARRANTY

\$169⁹⁵

MA SYSTEMS FD-35

- * DIRECT REPLACEMENT FOR APPLE DISK II
- * SHUGART MECHANISM—MADE IN U.S.

\$179⁹⁵

40 TRACK CONTROLLER CARD \$49⁹⁵

OMNIGRAPH

BY MA SYSTEMS
PARALLEL GRAPHICS INTERFACE
FOR APPLE II & IIe

- * HIGH RES. MULTICOLOR GRAPHICS
- * CENTRONICS STANDARD FOR EPSON, OKIDATA...
- * SCREEN DUMP, ROTATION, INVERSION, ZOOM, AND MORE!
- * 1 YEAR WARRANTY!

\$79⁹⁵

MICROMAX

ALL WITH A 2 YEAR WARRANTY

VIEWMAX-80 \$159⁹⁵

* 80 COLUMN CARD FOR APPLE II +

VIEWMAX-80e \$129⁹⁵

* 80 COLUMN CARD FOR APPLE IIe

* 64K RAM EXPANDABLE TO 128K

GRAPHMAX \$129⁹⁵

* HIGH RESOLUTION GRAPHICS

* PRINTER CARD

OTHER ACCESSORIES FOR APPLE II

THUNDERCLOCK

\$129⁹⁵

- * OFFICIAL PRO DOS CLOCK CALENDAR
- * 100% MOUNTAIN SOFTWARE COMPATIBLE
- * BSR CONTROL OPTIONS AVAILABLE

KRAFT JOYSTICK

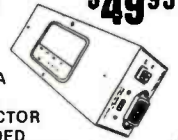
\$39⁹⁵

- * SELF CENTERING
- * AXIS ISOLATION

APPLE COMPATIBLE POWER SUPPLY

\$49⁹⁵

- * USE TO POWER APPLE TYPE SYSTEMS
- * +5V @ 4A + 12V @ 2.5A
- * -5V @ .5A - 12V @ .5A
- * APPLE POWER CONNECTOR
- * INSTRUCTIONS INCLUDED



ACCESSORIES AND PERIPHERALS

MONITORS



BMC MONITOR STAND
MODEL PA-900
Your Display Will
Tilt & Swivel \$29⁹⁵

MONOCHROME

BMC BM JJ1201G GREEN 12" \$89⁹⁵

BMC BM 12EUY 18 MHZ AMBER \$139⁹⁵

BMC BM 12EUN 18 MHZ HIGH RES GREEN \$115⁰⁰

NEC JB1201M - 20 MHZ GREEN \$169⁰⁰

ZENITH ZVM-123 - 15 MHZ GREEN NEW \$105⁰⁰

COLOR

BMC BM-AU9191U COMPOSITE 13" \$279⁰⁰

NO C.O.D. ORDERS PLEASE

BMC BMX-80 PRINTER

- * 80 CPS DOT MATRIX PRINTER
- * PRINTS BI-DIRECTIONAL IN 40, 80, 71 OR 142 COLUMNS IN NORMAL, DOUBLE WIDTH OR COMPRESSED TEST.
- * PRINT SUPERSCRIP AS WELL AS SUPERB GRAPHICS IN CHARACTER OR BIT IMAGE

\$249



5-1/4 DISK FILE

- * ATTRACTIVE, FUNCTIONAL DISK STORAGE SYSTEM
- * 75 DISK STORAGE CAPACITY

\$169⁹⁵



NASHUA DISKETTES

- 5 1/4" WITH HUB RING
- MD1 SOFT, SS/DD 19⁹⁵
- MD1D SOFT, SS/DD 26⁹⁵
- MD2D SOFT, DS/DD 30⁷⁵
- MD2F SOFT, DS/4D 45⁰⁰
- MD110 10 SECTOR, SS/SD 19⁹⁵
- MD2100 10 SECTOR, DS/DD 30⁷⁵
- 8" WITHOUT HUB RING
- FD1 SOFT, SS/SD 24⁷⁵
- FD1D SOFT, SS/DD 30⁰⁰
- FD2D SOFT, DS/DD 36⁷⁵

VERBATIM

- DATALIFE DISKETTES
- SS/DD SOFT SECTOR 29⁹⁵
- SS/DD 10 SECTOR HARD 29⁹⁵



JDR Microdevices

1224 S. Bascom Avenue, San Jose, CA 95128
800-538-5000 • 800-662-6279 (CA)
(408) 995-5430 • Telex 171-110

Apple is a trademark of Apple Computer Corporation

VISIT OUR RETAIL STORE

HOURS: M-W-F, 9-5 T-Th., 9-9 Sat. 10-3

PLEASE USE YOUR CUSTOMER NUMBER WHEN ORDERING

TERMS: Minimum order \$10. For shipping and handling include \$2.50 for UPS Ground and \$3.50 for UPS Air. Orders over 1 lb. and foreign orders may require additional shipping charges — please contact our sales department for the amount. CA residents must include 6% sales tax. Bay Area and LA residents include 6 1/2%. Prices subject to change without notice. We are not responsible for typographical errors. We reserve the right to limit quantities and to substitute manufacturer. All merchandise subject to prior sale.

© Copyright 1984 JDR Microdevices

U·N·C·L·A·S·S·I·F·I·E·D A·D·S

BYTE is concerned about software piracy. Unclassified ads proposing exchanges of software must specify that the software was written by the individual or is in the public domain. BYTE reserves the right to reject any unclassified ad that does not meet this criterion.

.....

NEEDED: Khmer, Lao, and Vietnamese word-processing and dictionary-generating programs. Also, desire interaction with others with similar interests. Maurice Bauhahn, c/o World Vision Foundation of Thailand, POB 1717, Bangkok 10500, Thailand.

NEEDED: Hewlett-Packard 85 or 86 or Apple II or equivalent sought by native geophysicist working on underground-water research to interpret electrical sounding curves. Your donation will help alleviate the drought conditions for the nomads in the Sahara desert. Will pay shipment. N. Mellal, POB 185, Tamanrasset, Algeria.

WANTED: Native American nonprofit educational organization seeks donations of peripherals for a Wang word-processing system with one or more workstations, a letter-quality printer, a cut-sheet feeder, and a telecommunications module. Also seeking donations of Wang and other manufacturer's computer equipment and business software. Shawnodee, Bear Tribe Medicine Society, 1025 North Cannon, Spokane, WA 99201, (509) 326-6561.

NEEDED: Non profit community mental-health center seeks tax-deductible donation of a personal computer with disk drives for Help Line telephone-crisis counseling and suicide-prevention program. Computer to be used for storage and retrieval of community resources referrals and other information used in handling crisis calls. Kathleen Vail, Help Line, c/o Lakeview Center, 1221 West Lakeview Ave., Pensacola, FL 32501.

WANTED: Tax-deductible donations of computers and peripherals (Apple II, IBM PC, VIC-20) to teach computer technology and programming to economically disadvantaged students. Also need printer, monitors, disk drives, and memory expansion. Fairbreak Electronics Club, Suite 102, 1100 Kermit Dr., Nashville, TN 37217, (615) 361-1652.

NEEDED: Evergreen School District's special-education department seeks donations of a personal robot or robotic arm for educational purposes to adapt environments for physically disabled students. Specialized inputs are needed: touch-sensitive screens, light pens, voice-activated computer systems, and speech synthesizers to provide these individuals with access to computer technology. Cynthia L. Campbell, Special Services, 7000 Northeast 117th Ave., Vancouver, WA 98662, (206) 256-6022.

WANTED: Tax-deductible donation of Commodore VIC-20, COM-64, Datasette, disk drive, monitor, or printer to be used by elementary school students to learn programming. Frank Church, Principal, Valley Institute, RFD 3, Bristol, VA 24201, (703) 669-3073.

WANTED: Small Catholic grade school seeks tax-deductible donation of Apple II Plus and/or Ite to introduce children to computers. Dick Stringham, St. Mary's School, 195th St., Mokena, IL 60448, (312) 479-2526.

WANTED: Computer equipment, especially components and peripherals for nonprofit student aerospace group to be used in the simulation, design, and construction of student projects. Have members, will build and debug. Software would be welcome too. American Institute of Aeronautics and Astronautics, Milwaukee Student Branch, 3200 North Cramer St., Milwaukee, WI 53211 or call John Conrad at (414) 964-9058 or Dr. Arthur Sorenson at (414) 963-6076.

WANTED: Tax-deductible donations of microcomputers (TRS-80 Model III or Apple II), disk drives, monitors, and printers for our engineering-department students' usage, especially for the Computer Aided HVAC and CAD courses. Professor M. C. Akisoglu, Engineering Department, CCAC, Allegheny Campus, 808 Ridge Ave., Pittsburgh, PA 15212, (412) 237-2690.

WANTED: Information about a nutritional-analysis

program that computes diabetic exchanges or recipes sought for IBM PC, DEC Pro 350, mainframe, or equivalent. Ieane Rogers, Kilo Foundation, Suite 321E, 777 South New Ballas Rd., St. Louis, MO 63141, (314) 567-5525.

FOR TRADE: Keypunch unit. We will swap for evidence that you are educational, charitable, and are willing to pick it up. Peter Sohn, c/o Abel/Noser, 23rd floor, 90 Broad St., New York, NY 10004.

FOR SALE: Plotter, Houston Instruments Hiplot DMP-29, like new, used only for self-test patterns: \$1550 cash or certified check. You pay UPS. Owner moving overseas. John M. Case, 585 Big Sky Court, Colorado Springs, CO 80919, (303) 599-0744.

WANTED: Used Kaypro or similar business computer with printer under \$1000. Carol D'Agostino, 37 ledwood Place, Valley Stream, NY 11581.

WANTED: Working computer science major would greatly appreciate donation of computer and/or peripheral equipment to allow hands-on experience. R. Day, Apt. 21, 555 Walnut, Long Beach, CA 90802.

FOR SALE: SS-30 F & D 5-inch disk controller: \$75. SS-30 5- and 8-inch disk controller, single/double density and sided: \$175. Heathkit H-9 terminal: \$80. 12-inch video monitor: \$45. ASCII keyboard with TVT board in nice enclosure: \$20. Phil Moore, POB 2312, Florissant, MO 63032.

FOR SALE: CompuPro 8086/8087 CPU board with 8086 only. This is an 8-MHz board in almost brand-new condition: \$400 or best offer. Michael E. Nunamaker, 604 East Clark #5, Champaign, IL 61820, (217) 351-8215.

FOR SALE: Heath H-11 processor with 32K bytes of memory, H-27 dual floppy-disk drive, two serial-interface ports, H-19 monitor. Includes all documentation. Best offer. T. A. Homan, 7741 Stanley Mill Dr., Centerville, OH 45459, (513) 434-3896.

FOR SALE: TRS-80 Model I, 16K with monitor, keyboard, power pack, and four books. \$250. Sean Brown, 400 Second Ave., New York, NY 10010, (212) 725-0379.

FOR SALE: Hewlett-Packard Model 86A personal computer, 64K, with HP 82913A 12-inch monitor, HP 9130A 5¼-inch single, flexible disk drive. Also, HP 82905B impact printer and an HP 82950A modem. Paid \$4170, will sell for \$3000 or best offer. Debbie Parsons, 516 Bank St., Wallace, ID 83873, (208) 752-1116 days.

FOR SALE: Netronics Cosmic EII computer and case with 4K RAM, monitor board, ASCII keyboard, external power supply, and documentation, \$425 value for \$175 or best offer. Eugene Hochhalter, 4110 Dixie, Idaho Falls, ID 83401, (208) 524-3513.

FOR SALE: Timex/Sinclair ZX81, Sinclair 16K RAM, 2040 printer, Memopak 16K RAM, keyboard, 280 assembler, *Programming the Z80, 8080/Z80 Assembly Language, Explorer's Guide to the ZX-81, Zilog Z-80 Assembly Language Programming Manual*. Make an offer. James E. O'Donnell, 25 Main St., Newcomb, NY 12852, (518) 582-4511.

WANTED: Computer science freshman would appreciate your donation of discarded, unused, or repairable computers, printers, parts, or accessories for college work. Iehan Martinez, 11501 Pyreneese Dr., Austin, TX 78759.

FOR SALE: Okidata BMC 80/20 computer, monitor keyboard, disk drives, printer, graphics. Never used: \$1799. Also, Sanyo MBC 550 16-bit computer, 128K RAM, keyboard, 160K disk drive, monitor, parallel-printer port, and color graphics. Never used: \$895. Paul Konitzer, 3856 Clark St., Seaford, NY 11783, (516) 783-7274.

WANTED: Engineering student needs a computer and a disk drive. Any other computer equipment will be appreciated too. I. C. Munoz, Casilla 1035, Concepcion, Chile.

FOR SALE: Three unused Shugart 8-inch SA1002 5.33-megabyte hard-disk drives: \$269 each. Also, have Western Digital's controllers for the drives: \$331 each. Easy to interface to Heath, Apple, IBM, and TRS-80. Herb Merrill, 20 Randy Dr., Taylors, SC 29687, (803) 877-9444.

WANTED: Back issues of BYTE (December 1977, January 1978, March 1979, April 79, December 1981, November 1982, and December 1982). Will give \$10 plus postage for all or \$1 each for single copies. Ken Hamel, Rt. 5 Box 162, Watertown, WI 53094.

WANTED: High school student seeking donations of hardware and manuals. Anything is appreciated. Will pay shipping costs. James F. McGovern Jr., 38 Ledyard Ave., Bloomfield, CT 06002.

NEEDED: High school student seeks software-product brochures. Also, seeks donations of computer hardware for DEC Rainbow and 16-bit TRS-80 and system manuals for the DEC PDP11, Junior Stephens, 356 Wolcott Ave., Windsor, CT 06095.

FOR SALE: Two disk drives, Tandon TM100-1, 5¼-inch (for North Star Horizon), SS/DD drive, no power supply or case: \$170 each. Jim Lovewell, 1490 East Luana, San Leandro, CA 94577, (415) 351-6207.

FOR SALE: CompuPro boards: Interfacer-I: \$175. RAM-17: \$275. CPU-Z 6 MHz: \$175. Disk I and CPM: \$400. System Support with 4MHz-9511: \$375. All for \$1200. Brent Dowd, 5289 South Manitou Rd., Littleton, CO 80123, (303) 789-7512.

WANTED: High school student would like donated Apple computer, cards, peripherals, or any unwanted equipment. Will pay all postage. Kenneth Minkley, 3427 Stony Point Rd., Grand Island, NY 14072, (716) 773-2478.

FOR SALE: Ithaca Intersystems DPS-1 front-panel computer with 4-MHz Z80 CPU, 64K RAM, SIO-1 serial/parallel board, FDC-11 disk-drive controller. Two DS/DD 8-inch Shugart drives with case and power supply. Cost over \$8000, sell for \$5750. Many S100 boards. Exidy Sorcerer (32K) with cassette deck, monitor, and sound plug: \$200. More, Larry Robinette, 823 Byron Rd., Columbia, SC 29209, (803) 776-4000, ext. 251 between 8:30 a.m. and 5:30 p.m.

WANTED: A printer that is compatible with the TRS-80 Model I Level II BASIC Computer. Will pay postage. James B. Burchell, 7320-A Lobaugh St., Ft. Meade, MD 20755, (301) 674-5387.

WANTED: Printed material on the development of the microcomputer industry from 1974 through 1980, such as newspapers from computer shows and early issues of BYTE, *Infoworld*, *Interface Age*, *SCCS Interface*, *Computerworld*, *Personal Computing*, and club newsletters. John McCray, Incarnate World College, 4301 Broadway, San Antonio, TX 78209.

FOR SALE: NorthStar Horizon, 64K, two DDDS drives with disks. Excellent condition: \$1500. Smart Terminal, Actv, good condition: \$150. Televideo Terminal 970 with extra ROM so can also be used as 970/950. Used 15 hours: \$850. Howard Davis, 600 Oakwood St., Rome, NY 13440, (315) 337-5714.

FOR SALE: Back issues of BYTE, Vol. 2 No. 3 (March 1977) to current issue, less October 1978 and December 1979. Best offer or equipment trade. Postage free anywhere in continental USA. Rich Clemens, WVWC-18, Buckhannon, WV 26201.

WANTED: A graduate student seeks donation of an Apple Macintosh, Ite, or IBM PC for research in business-writing strategies to investigate if the interactive composing process of writers is altered by using a computer. Melba Leach, English Department, Indiana University, Ballantine Hall 447, Bloomington, IN 47401.

FOR SALE: Voicebox II for Atari. Used only a few times: \$90. Ike Hudson, 519 Linden, East Lansing, MI 48823.

UNCLASSIFIED POLICY: Readers who have computer equipment to buy, sell, or trade or who are requesting or giving advice may send a notice to BYTE for inclusion in the Unclassified Ads section. To be considered for publication, an advertisement must be noncommercial and nonprofit (individuals or bona fide computer clubs), typed double-spaced, contain 60 words or less, and include name and address. This is a free service; notices are printed as space permits. Your confirmation of placement is appearance in an issue of BYTE as we engage in no correspondence. Please allow at least four months for your ad to appear. Send your notices to BYTE, Unclassified Ads, POB 372, Hancock, NH 03449.

B·O·M·B

BYTE'S ONGOING MONITOR BOX

ARTICLE#	PAGE	ARTICLE	AUTHOR(S)
1	121	Framework	Jadrnicek, Markoff, Shapiro
2	125	The 65816 Microprocessor. Part I: Software	Hendrix
3	129	Circuit Cellar Feedback	Ciarcia
4	132	Benchmarking UNIX Systems	Hinnant
5	137	FORTH-83: Evolution Continues	McCabe
6	145	History and Goals of Modula-2	Wirth
7	157	Tutorial on Modula-2	Gutknecht
8	181	Lilith and Modula-2	Ohran
9	195	An Introduction to Modula-2	Paul
10	215	Pascal, Ada, and Modula-2	Coar
11	238	The Macintosh	Webster
12	254	The IBM PCjr	Archer
13	270	The Sanyo MBC-550	Sudbrink
14	287	Four Logos for the IBM PC	Bridger
15	305	The Juki 6100 Printer	Vose
16	313	Computing at Chaos Manor: Between Conventions	Pournelle
17	339	BYTE Japan: Pasocom Pagodas	Raike
18	347	BYTE West Coast: Macintosh's Other Designers	Markoff, Shapiro
19	361	BYTE U.K.: Microprocessor Design	Pountain

MAY'S SPEEDY RETURNS

Steve Ciarcia's column won first place in the May BYTE. Thus "Trump Card, Part I: Hardware," describing how to speed up the IBM PC, clinches Steve the \$100 jackpot. The User's Column by Jerry Pournelle on "Chaos Manor's Hard-Disk System" took second place, providing Jerry with the \$50 bonus. In third place is a feature written by BYTE's senior technical editor on the West Coast, John Markoff, on "The Apple IIc Personal Computer." The two authors of "Maximizing Hard-Disk Performance," Roy Chaney and Brian Johnson, won fourth place in a feature about how to increase transfer rates. And fifth mention goes to Steve McMahon for his review of "The Kaypro 10," a hard-disk CP/M portable computer. BYTE's readership is responsible for the congratulations due these authors.

BYTE ADVERTISING SALES STAFF:

J. Peter Huestis, Advertising Sales Manager, 70 Main Street, Peterborough, NH 03458, tel. (603) 924-9281

NEW ENGLAND

ME, NH, VT, MA, RI
Paul McPherson Jr. (617) 262-1160
McGraw-Hill Publications
575 Boylston Street
Boston, MA 02116

ATLANTIC

NJ (NORTH), NY, NYC, CT
Dick McGurk (212) 512-3588
McGraw-Hill Publications
1221 Avenue of the Americas—39th Floor
New York, NY 10020

EAST

PA (EAST), NJ (SOUTH),
MD, VA, W.VA., DE, D.C.
Daniel Ferro (215) 496-3833
McGraw-Hill Publications
Three Parkway
Philadelphia, PA 19102

SOUTHEAST

NC, SC, GA, FL, AL, TN
Maggie Dorvee (404) 252-0626
McGraw-Hill Publications
4170 Ashford-Dunwoody Road—Suite 420
Atlanta, GA 30319

MIDWEST

IL, MO, KS, IA, ND, SD, MN, WI, NB
Jack Anderson (312) 751-3740
McGraw-Hill Publications
Blair Building
645 North Michigan Ave.
Chicago, IL 60611

GREAT LAKES, OHIO REGION

MI, OH, PA (ALLEGHENY), KY, IN,
EASTERN CANADA
Dennis Riley (313) 352-9760
McGraw-Hill Publications
4000 Town Center—Suite 770
Southfield, MI 48075

SOUTHWEST, ROCKY MOUNTAIN

UT, CO, WY, OK, TX, AR, MS, LA
Alan Morris (214) 458-2400
McGraw-Hill Publications
Prestonwood Tower—Suite 907
5151 Beltline
Dallas, TX 75240

SOUTH PACIFIC

SOUTHERN CA, AZ, NM, LAS VEGAS
Page Goodrich (714) 557-6292
McGraw-Hill Publications
3301 Red Hill Ave.
Building #1—Suite 222
Costa Mesa, CA 92626

Karen Niles (213) 480-5243, 487-1160

McGraw-Hill Publications
3333 Wilshire Boulevard #407
Los Angeles, CA 90010

NORTH PACIFIC

HI, WA, OR, ID, MT, NORTHERN CA,
NV (except LAS VEGAS), W. CANADA
David Jern (415) 362-4600
McGraw-Hill Publications
425 Battery Street
San Francisco, CA 94111

Bill McAfee (415) 964-0624
McGraw-Hill Publications
1000 Elwell Court—Suite 225
Palo Alto, CA 94303

WEST COAST SURPLUS

AND RETAIL ACCOUNTS
Tom Harvey (805) 964-8577
3463 State Street—Suite 256
Santa Barbara, CA 93105

Post Card Mailings

National
Bradley Browne (603) 924-6166
BYTE Publications
70 Main Street
Peterborough, NH 03458

International Advertising Sales Representatives:

Mr. Hans Csokor
Publimedia
Reisnerstrasse 61
A-1037 Vienna, Austria

Mrs. Gurit Gepner
McGraw-Hill Publishing Co.
PO Box 2156
Bat Yam, 59121 Israel
866 561 321 39

Mr. Fritz Krusebecker
McGraw-Hill Publishing Co.
Liebigstrasse 19
D-6000 Frankfurt/Main 1
West Germany
72 01 81

Mrs. Maria Sarmiento
Pedro Teixeira B. Off. 320
Iberia Mart 1
Madrid 4, Spain
45 52 891

Mr. Andrew Karnig
Andrew Karnig & Associates
Kungsholmsgatan 10
112 27 Stockholm, Sweden
08 51 68 70

Mr. Ken Davey
McGraw-Hill Publishing Co.
17 rue Georges Bizet
F 75116 Paris
France
720 33 42

Mr. Arthur Scheffer
McGraw-Hill Publishing Co.
34 Dover St.
London W1X 3RA
England 01 493 1451

Mr. Savio Pesavento
McGraw-Hill Publishing Co.
Via Flavio Baracchini 1
20123 Milan, Italy
86 90 656

Seavex Ltd
05-49/50 Tanglin Shopping Center
19 Tanglin Rd.
Singapore 1024
Republic of Singapore

Seavex Ltd.
Room 102, Yu Yuet Lal Bldg.
43-55 Wyndham St. Central
Hong Kong

Hiro Morita
McGraw-Hill Publishing Co.
Overseas Corp.
Room 1528
Kasumigaseki Bldg.
3-2-5 Kasumigaseki,
Chiyoda-Ku
Tokyo 100, Japan

READER SERVICE

Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.	
1	1st PLACE SYSTEMS	208	* COMPUPRO	249	117	ECOSOFT	398	
2	2500 AD SOFTWARE	212, 213	* COMPUPRO	286	118	EDGE MICRO SYSTEMS	414	
3	2500 BUYMAIL	190	63	COMPUERVE	8	119	EDUCATIONAL MICROCOMP.	456
4	800 SOFTWARE	84	337	COMPUERVE	231	120	ELCOMP	452
5	A.S.T. RESEARCH	19	338	COMPUTER COLORWORKS	140, 141	121	ELECTRADE CO.	456
* AT & T LONG LINES	346	64	COMPUTER CONNECTION INC.	444	122	ELECTRADE CO.	471	
6	AT & T TECHNOLOGY	36, 37	65	COMPUTER DISCOUNT PROD.	447	* ELLIS COMPUTING INC.	91	
349	AB COMPUTERS	226	66	COMPUTER EXPO	471	* ELLIS COMPUTING INC.	372	
7	ACOM ELECTRONICS	452	67	COMPUTER FRIENDS	280	* EMPIRICAL RESEARCH GROUP	56	
8	ACT (NORTH AMERICA) INC.	136	68	COMPUTER INNOVATIONS	387	* ENCHANTED FOREST	454	
9	ACTION COMPUTER	113	69	COMPUTER MAIL ORDER	416, 417	* EPSON AMERICA	28, 29	
10	ACTION COMPUTER	113	70	COMPUTER PRICE CLUB	102	124	EXPERT COMPUTERS	455
11	ADDMASTER CORP.	456	71	COMPUTER SWAP SHOP	448	125	EXPOTEX	443
12	ADV. COMP. PROD.	466, 467	* COMPUTER WAREHOUSE	267	126	EXPRESS BUSINESS SOFTWARE	291	
13	ADV. SYS. CONCEPTS	108	72	COMPUTERS AND MORE	77	127	EXTENDED PROCESSING	389
14	ADV. TRANSDUCER DEVICES	471	73	COMPUTERS FOR LESS	471	128	FABRICATION CONCEPTS INC.	456
* ALF PRODUCTS	80	74	COMPUTRAX, INC.	318	129	FALCON SAFETY PROD.	62	
15	ALLENBACH INDUSTRIES	128	76	COMPUVIEW PROD. INC.	293	356	FORTRON	440
266	ALPHA OMEGA COMPUTER	370	75	COMPUVIEW PROD. INC.	398	357	FORTRON	440
18	AMARAY CORP.	167	77	CONDOR COMP. CORP.	72	132	FUJITSU AMERICA	191
20	AMER. SQUARE COMP.	246	78	CONROYLAPOINTE	252, 253	133	GENERAL TECHNOLOGY	75
* AMPRO COMPUTERS INC.	396	79	CONROYLAPOINTE	252, 253	134	GIFFORD COMP. SYS.	279	
21	ANTEX DATA SYSTEMS	152	80	CONROYLAPOINTE	252, 253	135	GILTRONIX, INC.	450
* APOLLO MARKETING	440	81	CONTROL DATA	194	136	GRYPHON MICRO PROD.	446	
* APPLE COMPUTER INC.	Cil. 1	83	CORONA DATA SYS.	110, 111	137	GTEK INC.	112	
355	APPLE COUNTRY	397	84	CORONA DATA SYS.	233	* H&E COMPUTRONICS	109	
24	APPLEWARE, INC.	454	85	COSMOS	175	139	HANDWELL CORP.	449
25	APROPOS TECHNOLOGY	471	87	CRE WHOLESALERE PROD.	430	140	HARMONY VIDEO	446
26	ARTIFICIAL INTL. RESEARCH	414	88	CRE WHOLESALERE PROD.	430	141	HAYES MICROCOMP. PROD.	60, 61
27	ARTISOFT	316	89	CRE WHOLESALERE PROD.	430	* HAYES MICROCOMP. PROD.	367	
28	ARTISOFT	316	90	CROMEMCO	5	142	HEATH COMPANY	65
29	ASHTON-TATE	107	91	CUESTA SYSTEMS	324	750	HEATH COMPANY INSERT	384A-B
30	AVOCET	214	92	CUMANA	217	143	HELIX SYS. & DEVL. CORP.	209
31	B&B ELECTRONICS	446	93	DATA ACCESS CORP.	283	144	HELIX SYS. & DEVL. CORP.	209
32	BASF SYSTEMS	79	94	DATA SPEC	185	145	HERCULES COMPUTER TECH.	304
33	BASF SYSTEMS	81	95	DATA SPEC	185	146	HITECH INTL. INC.	446
34	BAY TECHNICAL ASSOC.	23	353	DATA SPEC	378	147	HOLLYWOOD HARDWARE	176
35	BAY TECHNICAL ASSOC.	23	354	DATA SPEC	378	207	HOUSTON INSTRUMENTS	373
38	BINARY TECHNOLOGY	454	97	DATA TRANSLATION	100	148	HUMAN DESIGNED SYSTEMS	103
39	BIZCOMP	281	98	DATASOUTH COMP. CORP.	57	149	I.B.C.	17
40	BORLAND INTL.	20, 21	335	DIGITAL LABORATORIES	332	150	I.B.C.	17
* BORLAND INTL.	63	101	DIGITAL MICROSYSTEMS	247	151	IAR SYSTEMS	76	
41	BOTTOM LINE, THE	323	102	DIGITAL RESEARCH	42, 43	* IBM-(I)S/G SERVICES	297	
42	BRYTE COMPUTERS	456	103	DIGITAL RESEARCH	368, 369	152	IBM CORP.	358, 359
43	BYTE BROKER, THE	444	* DIGITAL RESEARCH COMP.	382	153	IBM NDD-SYS. SUPPLIES	383	
44	BYTE CONNECTION, THE	78	104	DISCOUNT COMPUTER CENTERS	299	154	IMAGE COMP. PROD.	310
* BYTE ADVERTISING MESSAGE	371	* DISKETTE CONNECTION	376	* DISKETTE CONNECTION	376	155	INFOCOM	104, 105
* BYTE APPLE GUIDE	380, 381	344	DISK WORKS	448	156	INMAC	409	
* BYTE COMPUTER SHOW	374, 375	105	DISKWORLD, INC.	92	157	INPUT/OUTPUT TECHNOLOGY	49	
* BYTE SUBSCRIBER NOTICE	409	340	DISKWORLD, INC.	203	158	INTEGRAND	106	
45	BYTEK COMP. SYS. CORP.	309	106	DISKWORLD, INC.	454	159	INTEGRATED COMP. SOLUTIONS	454
* C WARE	228	107	DISKWORLD, INC.	456	160	INTERACTIVE STRUCT.	295	
* C-SYSTEMS	471	108	DISKWORLD, INC.	471	162	INTERFACE INC.	24	
46	C.S.D., INC.	356	109	DISPLAY TELECOMMUNIC. INC.	445	163	INTERFACE INC.	24
* CALIF. DIGITAL	464, 465	110	DOKAY COMP. PROD. INC.	462, 463	317	INTERSTAR CORP.	74	
* CALIF. MICRO COMP.	210	111	DOSS INDUSTRIES	86	164	INTERTEC DATA SYS.	15	
47	CANON U.S.A.	225	112	DOW JONES SOFTWARE	325	165	I.C. SYSTEMS	330
48	CANON U.S.A.	227	113	DWYET CO., INC.	450	166	I.A.D.E. COMP. PROD.	457
49	CANON U.S.A.	229	114	DMYK CORP.	177	167	I.A.D.E. COMP. PROD.	458, 459
51	CDR SYSTEMS	415	115	DYNAX, INC.	87	168	IAMECO ELECTR.	220, 221
346	CHORUS DATA SYSTEMS	379	116	DYSAN CORP.	70, 71	169	IDR MICRODEVICES INC.	472, 473
52	CHROMOD ASSOC.	34	* ECONOMY SOFTWARE	30	170	IDR MICRODEVICES INC.	474, 475	
53	CODE-A-PHONE CORP.	422, 423	<p>.....</p> <p>TO GET FURTHER information on the products advertised in BYTE, fill out the reader service card with your name and address. Then circle the appropriate numbers for the advertisers you select from the list. Add a 20-cent stamp to the card, then drop it in the mail. Not only do you gain information, but our advertisers are encouraged to use the marketplace provided by BYTE. This helps us bring you a bigger BYTE. The index is provided as an additional service by the publisher, who assumes no liability for errors or omissions. *Correspond directly with company.</p>					
54	COGITATE, INC.	102						
55	COMMERCIAL BUSINESS SYS.	442	171	IDR MICRODEVICES INC.	476	172	KEITHLEY/DAS	25
* COMMODORE BUSN. MACHINES	59	173	KEY TRONIC CORP.	344, 345	175	LABORATORY MICROSYS.	38	
57	COMP. COMPNTS. UNLTD.	468, 469	176	LIBERTY GROUP INC.	441	336	LIBERTY GROUP INC.	441
* COMPAQ COMPUTER CORP.	154, 155	177	LOCKHEED-GÉTEX	205	178	LOGICAL DEVICES	32	
58	COMPETITIVE EDGE	378	86	LOGICAL DEVICES	446	180	LOGICAL MICROCOMPUTER	96
59	COMPUADD	448	181	LOGITECH INC.	317	182	LOMAS DATA PRODUCTS	171
60	COMPUADD	456	183	LONG-LIFE ACCESSORIES	418	184	LOTUS DEVELOPMENT	390, 391
61	COMPUMAIL	470	185	LYBEN COMP. SYS.	450	186	LYCO COMPUTER	451
* COMPUMAX	439	187	MACROTECH INTL.	329	339	MAGNUM PC	204	
* COMPUPRO	201	189	MANNESMANN TALLY	183	190	MANX SOFTWARE SYS.	41	
		191	MARC SOFTWARE	243	192	MARYMAD INDUSTRIES	454	
		193	MAYNARD ELECTRONICS	335	194	MC-P APPLICATIONS	197	
		195	MEMOREX MEDIA PROD.	426, 427	196	MERRIT COMP. PROD.	452	
		197	MET-CHEM INTL. CORP.	452	198	META SYSTEMS	446	
		199	MFI ENTERPRISES INC.	90	200	MICRO AGE COMP. STORES INC.	173	
		201	MICRO DATA BASE SYS.	263	202	MICRO DESIGN INTL.	156	
		202	MICRO MANAGEMENT SYS.	222	206	MICRO MART, INC.	98, 99	
		203	MICRO SYSTEMS INSTITUTE	448	343	MICRO SYSTEMS INSTITUTE	448	
		342	MICROCOMPUTER CO.	376	208	MICRODYNAMICS	450	
		210	MICROSHOP	322	* MICROSOFT CORP. (BASIC)	147		
		* MICROSOFT CORP. (FORTRAN)	149	* MICROSOFT CORP. (PASCAL)	151	* MICROSOFT CORP.	302, 303	
		212	MICROSTUF	51, 52, 53	213	MICROSTUF	357	
		215	MICROTECH EXPORTS	192	216	MICROTIME	4	
		217	MICROVOICE CORP.	115	218	MICROWARE	163	
		219	MIDWEST MICRO-PERIPHERALS	16	220	MIND BANK INC.	448	
		221	MINDSET CORP.	178, 179	350	MISCO, INC.	226	
		223	MODULA SYS. CORP.	69	224	MORROW	187	
		225	MOUNTAIN VIEW PRESS	85	345	MOTEL COMPUTERS LIMITED	452	
		226	MTI SYSTEMS CORP.	294	225	MOUNTAIN VIEW PRESS	85	
		227	MULTI-TECH SYSTEMS	58	226	MTI SYSTEMS CORP.	294	
		228	MULTIMATE INTL.	268, 269	227	MULTI-TECH SYSTEMS	58	
		229	MYLSTAR ELECTRONICS	165	228	MULTIMATE INTL.	268, 269	
		230	NASHUA PLUS	413	229	MYLSTAR ELECTRONICS	165	
		231	NEC INFORMATION SYS.	CIII	230	NASHUA PLUS	413	
		232	NETWORK INC.	131	231	NEC INFORMATION SYS.	CIII	
		* NORTH HILLS CORP.	446	* NORTH HILLS CORP.	450	232	NETWORK INC.	131
		233	NORTHWEST DIGITAL SYS.	326	234	NORTRONICS DATA	284, 285	
		234	NORTRONICS DATA	284, 285	235	OKIDATA	207	
		236	OLYMPIA U.S.A. INC.	211	236	OLYMPIA U.S.A. INC.	211	
		237	OPEN SYSTEMS INC/UCCEL	202	237	OPEN SYSTEMS INC/UCCEL	202	
		238	OREGON SOFTWARE	193	238	OREGON SOFTWARE	193	
		239	ORYX SYSTEMS	410, 411	240	OSM COMPUTER	101	
		240	OSM COMPUTER	101	241	PC NETWORK	275	
		241	PAC SYSTEMS, INC.	456	242	PAC SYSTEMS, INC.	456	

BYTE READER SERVICE



For fastest service transfer mailer label from wrapper to coupon provided at the right. Requests cannot be honored unless zip code is given. This card valid for 6 months from cover date.

NOTE—If label is missing or defaced fill out coupon carefully—PLEASE PRINT—this is the only way to get requested material to you.

Name _____
 (Title) _____ (Company) _____
 Address _____ Telephone _____
 City _____ State _____ Zip _____

I purchased this copy by Subscription Newsstand, computer store, or bookstore

1 23 45 67 89	111 133 155 177 199	221 243 265 287 309	331 353 375 397 419	441 463 485 507 529	551 573 595 617 639	661 683 705 727 749	771 793
2 24 46 68 90	112 134 156 178 200	222 244 266 288 310	332 354 376 398 420	442 464 486 508 530	552 574 596 618 640	662 684 706 728 750	772 794
3 25 47 69 91	113 135 157 179 201	223 245 267 289 311	333 355 377 399 421	443 465 487 509 531	553 575 597 619 641	663 685 707 729 751	773 795
4 26 48 70 92	114 136 158 180 202	224 246 268 290 312	334 356 378 400 422	444 466 488 510 532	554 576 598 620 642	664 686 708 730 752	774 796
5 27 49 71 93	115 137 159 181 203	225 247 269 291 313	335 357 379 401 423	445 467 489 511 533	555 577 599 621 643	665 687 709 731 753	775 797
6 28 50 72 94	116 138 160 182 204	226 248 270 292 314	336 358 380 402 424	446 468 490 512 534	556 578 600 622 644	666 688 710 732 754	776 798
7 29 51 73 95	117 139 161 183 205	227 249 271 293 315	337 359 381 403 425	447 469 491 513 535	557 579 601 623 645	667 689 711 733 755	777 799
8 30 52 74 96	118 140 162 184 206	228 250 272 294 316	338 360 382 404 426	448 470 492 514 536	558 580 602 624 646	668 690 712 734 756	778 800
9 31 53 75 97	119 141 163 185 207	229 251 273 295 317	339 361 383 405 427	449 471 493 515 537	559 581 603 625 647	669 691 713 735 757	779 801
10 32 54 76 98	120 142 164 186 208	230 252 274 296 318	340 362 384 406 428	450 472 494 516 538	560 582 604 626 648	670 692 714 736 758	780 802
11 33 55 77 99	121 143 165 187 209	231 253 275 297 319	341 363 385 407 429	451 473 495 517 539	561 583 605 627 649	671 693 715 737 759	781 803
12 34 56 78 100	122 144 166 188 210	232 254 276 298 320	342 364 386 408 430	452 474 496 518 540	562 584 606 628 650	672 694 716 738 760	782 804
13 35 57 79 101	123 145 167 189 211	233 255 277 299 321	343 365 387 409 431	453 475 497 519 541	563 585 607 629 651	673 695 717 739 761	783 805
14 36 58 80 102	124 146 168 190 212	234 256 278 300 322	344 366 388 410 432	454 476 498 520 542	564 586 608 630 652	674 696 718 740 762	784 806
15 37 59 81 103	125 147 169 191 213	235 257 279 301 323	345 367 389 411 433	455 477 499 521 543	565 587 609 631 653	675 697 719 741 763	785 807
16 38 60 82 104	126 148 170 192 214	236 258 280 302 324	346 368 390 412 434	456 478 500 522 544	566 588 610 632 654	676 698 720 742 764	786 808
17 39 61 83 105	127 149 171 193 215	237 259 281 303 325	347 369 391 413 435	457 479 501 523 545	567 589 611 633 655	677 699 721 743 765	787 809
18 40 62 84 106	128 150 172 194 216	238 260 282 304 326	348 370 392 414 436	458 480 502 524 546	568 590 612 634 656	678 700 722 744 766	788 810
19 41 63 85 107	129 151 173 195 217	239 261 283 305 327	349 371 393 415 437	459 481 503 525 547	569 591 613 635 657	679 701 723 745 767	789 811
20 42 64 86 108	130 152 174 196 218	240 262 284 306 328	350 372 394 416 438	460 482 504 526 548	570 592 614 636 658	680 702 724 746 768	790 812
21 43 65 87 109	131 153 175 197 219	241 263 285 307 329	351 373 395 417 439	461 483 505 527 549	571 593 615 637 659	681 703 725 747 769	791 813
22 44 66 88 110	132 154 176 198 220	242 264 286 308 330	352 374 396 418 440	462 484 506 528 550	572 594 616 638 660	682 704 726 748 770	792 814

BYTE's BOMB is your direct line to the editor's desk. Each month, the two top-rated authors receive bonuses based on your evaluation. First look at the list of this month's articles and corresponding article numbers (located on the page preceding the Reader Service list), then rate each article you've read as Excellent, Good, Fair, or Poor, based on your overall impression of the article, by circling the appropriate number in each column below. Your feedback helps us produce the best possible magazine each month.

Article No.	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
Excellent	1	5	4	13	17	21	25	29	33	37	41	45	49	53	57	61	65	69	73	77	81	85	89	93	97
Good	2	6	10	14	18	22	26	30	34	38	42	46	50	54	58	62	66	70	74	78	82	86	90	94	98
Fair	3	7	11	15	19	23	27	31	35	39	43	47	51	55	59	63	67	71	75	79	83	87	91	95	99
Poor	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84	88	92	96	100

Article No.	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
Excellent	101	105	109	113	117	121	125	129	133	137	141	145	149	153	157	161	165	169	173	177	181	185	189	193	197
Good	102	106	110	114	118	122	126	130	134	138	142	146	150	154	158	162	166	170	174	178	182	186	190	194	198
Fair	103	107	111	115	119	123	127	131	135	139	143	147	151	155	159	163	167	171	175	179	183	187	191	195	199
Poor	104	108	112	116	120	124	128	132	136	140	144	148	152	156	160	164	168	172	176	180	184	188	192	196	200

BYTE READER SERVICE



For fastest service transfer mailer label from wrapper to coupon provided at the right. Requests cannot be honored unless zip code is given. This card valid for 6 months from cover date.

NOTE—If label is missing or defaced fill out coupon carefully—PLEASE PRINT—this is the only way to get requested material to you.

Name _____
 (Title) _____ (Company) _____
 Address _____ Telephone _____
 City _____ State _____ Zip _____

I purchased this copy by Subscription Newsstand, computer store, or bookstore

1 23 45 67 89	111 133 155 177 199	221 243 265 287 309	331 353 375 397 419	441 463 485 507 529	551 573 595 617 639	661 683 705 727 749	771 793
2 24 46 68 90	112 134 156 178 200	222 244 266 288 310	332 354 376 398 420	442 464 486 508 530	552 574 596 618 640	662 684 706 728 750	772 794
3 25 47 69 91	113 135 157 179 201	223 245 267 289 311	333 355 377 399 421	443 465 487 509 531	553 575 597 619 641	663 685 707 729 751	773 795
4 26 48 70 92	114 136 158 180 202	224 246 268 290 312	334 356 378 400 422	444 466 488 510 532	554 576 598 620 642	664 686 708 730 752	774 796
5 27 49 71 93	115 137 159 181 203	225 247 269 291 313	335 357 379 401 423	445 467 489 511 533	555 577 599 621 643	665 687 709 731 753	775 797
6 28 50 72 94	116 138 160 182 204	226 248 270 292 314	336 358 380 402 424	446 468 490 512 534	556 578 600 622 644	666 688 710 732 754	776 798
7 29 51 73 95	117 139 161 183 205	227 249 271 293 315	337 359 381 403 425	447 469 491 513 535	557 579 601 623 645	667 689 711 733 755	777 799
8 30 52 74 96	118 140 162 184 206	228 250 272 294 316	338 360 382 404 426	448 470 492 514 536	558 580 602 624 646	668 690 712 734 756	778 800
9 31 53 75 97	119 141 163 185 207	229 251 273 295 317	339 361 383 405 427	449 471 493 515 537	559 581 603 625 647	669 691 713 735 757	779 801
10 32 54 76 98	120 142 164 186 208	230 252 274 296 318	340 362 384 406 428	450 472 494 516 538	560 582 604 626 648	670 692 714 736 758	780 802
11 33 55 77 99	121 143 165 187 209	231 253 275 297 319	341 363 385 407 429	451 473 495 517 539	561 583 605 627 649	671 693 715 737 759	781 803
12 34 56 78 100	122 144 166 188 210	232 254 276 298 320	342 364 386 408 430	452 474 496 518 540	562 584 606 628 650	672 694 716 738 760	782 804
13 35 57 79 101	123 145 167 189 211	233 255 277 299 321	343 365 387 409 431	453 475 497 519 541	563 585 607 629 651	673 695 717 739 761	783 805
14 36 58 80 102	124 146 168 190 212	234 256 278 300 322	344 366 388 410 432	454 476 498 520 542	564 586 608 630 652	674 696 718 740 762	784 806
15 37 59 81 103	125 147 169 191 213	235 257 279 301 323	345 367 389 411 433	455 477 499 521 543	565 587 609 631 653	675 697 719 741 763	785 807
16 38 60 82 104	126 148 170 192 214	236 258 280 302 324	346 368 390 412 434	456 478 500 522 544	566 588 610 632 654	676 698 720 742 764	786 808
17 39 61 83 105	127 149 171 193 215	237 259 281 303 325	347 369 391 413 435	457 479 501 523 545	567 589 611 633 655	677 699 721 743 765	787 809
18 40 62 84 106	128 150 172 194 216	238 260 282 304 326	348 370 392 414 436	458 480 502 524 546	568 590 612 634 656	678 700 722 744 766	788 810
19 41 63 85 107	129 151 173 195 217	239 261 283 305 327	349 371 393 415 437	459 481 503 525 547	569 591 613 635 657	679 701 723 745 767	789 811
20 42 64 86 108	130 152 174 196 218	240 262 284 306 328	350 372 394 416 438	460 482 504 526 548	570 592 614 636 658	680 702 724 746 768	790 812
21 43 65 87 109	131 153 175 197 219	241 263 285 307 329	351 373 395 417 439	461 483 505 527 549	571 593 615 637 659	681 703 725 747 769	791 813
22 44 66 88 110	132 154 176 198 220	242 264 286 308 330	352 374 396 418 440	462 484 506 528 550	572 594 616 638 660	682 704 726 748 770	792 814

To get further information on the products advertised in BYTE, fill out the reader service card with your name and address. Then circle the appropriate numbers for the advertisers you select from the list. Add a 20-cent stamp to the card, then drop it in the mail. Not only do you gain information, but our advertisers are encouraged to use the marketplace provided by BYTE. This helps us bring you a bigger BYTE. The index is provided as an additional service by the publisher, who assumes no liability for errors or omissions.

PLACE
20¢ POSTAGE
HERE

BYTE

READER SERVICE
PO BOX 298
DALTON, MA 01227-0298
USA

PLACE
20¢ POSTAGE
HERE

BYTE

READER SERVICE
PO BOX 298
DALTON, MA 01227-0298
USA

BYTE



SUBSCRIPTIONS

4184

For a subscription to BYTE, please complete this card.

Name _____

Address _____

City _____

State _____ Zip _____ Country _____

Card No. _____

Expiration date _____

Four digits above name—Master Charge only _____

Signature _____ Date _____

Please allow eight weeks for processing. Thank you.

- | | | |
|----------------------------------|-------------------------------|-------------------------------|
| | USA | Canada
Mexico |
| <input type="checkbox"/> 1 year | <input type="checkbox"/> \$21 | <input type="checkbox"/> \$23 |
| <input type="checkbox"/> 2 years | <input type="checkbox"/> \$38 | <input type="checkbox"/> \$42 |
| <input type="checkbox"/> 3 years | <input type="checkbox"/> \$55 | <input type="checkbox"/> \$61 |

- \$53 Europe (air delivery) payment enclosed
 \$37 Elsewhere (surface mail) payment enclosed

(Air mail rates available upon request)

Please remit in US funds drawn on a US bank. Thank you.

- Check enclosed (Bonus: (North American only) one EXTRA issue—receive 13 issues for the price of 12)



- Bill me (North America only)

BYTE



SUBSCRIPTIONS

4184

For a subscription to BYTE, please complete this card.

Name _____

Address _____

City _____

State _____ Zip _____ Country _____

Card No. _____

Expiration date _____

Four digits above name—Master Charge only _____

Signature _____ Date _____

Please allow eight weeks for processing. Thank you.

- | | | |
|----------------------------------|-------------------------------|-------------------------------|
| | USA | Canada
Mexico |
| <input type="checkbox"/> 1 year | <input type="checkbox"/> \$21 | <input type="checkbox"/> \$23 |
| <input type="checkbox"/> 2 years | <input type="checkbox"/> \$38 | <input type="checkbox"/> \$42 |
| <input type="checkbox"/> 3 years | <input type="checkbox"/> \$55 | <input type="checkbox"/> \$61 |

- \$53 Europe (air delivery) payment enclosed
 \$37 Elsewhere (surface mail) payment enclosed

(Air mail rates available upon request)

Please remit in US funds drawn on a US bank. Thank you.

- Check enclosed (Bonus: (North American only) one EXTRA issue—receive 13 issues for the price of 12)



- Bill me (North America only)

*Note our special offer!
Send cash with your order
and receive 13 issues
for the price of 12 for
each year you subscribe.
(North America only, please.)*

Don't Miss An Issue!

Have BYTE delivered to your door.

Each month BYTE will bring you the latest in microcomputer technology.

DISCOVER and IMPLEMENT new ideas. Don't miss the original information presented in the pages of BYTE.

With BYTE you'll always be among the first to know about the important breakthroughs, worthwhile new equipment, and innovative projects in the world of computing.

CHALLENGE US to deliver the very best idea in microcomputers and advanced technology to you. Return the attached card today!

Subscribe to BYTE—the world's leading computer magazine.

PLACE
20c POSTAGE
HERE

BYTE SUBSCRIPTIONS

PO Box 590
Martinsville, NJ 08836
USA

PLACE
20c POSTAGE
HERE

BYTE SUBSCRIPTIONS

PO Box 590
Martinsville, NJ 08836
USA

INTRODUCING PINWRITER DOT MATRIX PRINTERS. AND A HEAD TO HEAD COMPARISON OF WHY THEY'RE BETTER.

Our new multi-mode Pinwriter® dot matrix printers have a lot in common with our Spinwriter® letter-quality printers. Designed and manufactured with the same quality and reliability that has made our Spinwriters the best selling letter-quality printers to PC users. We also gave them many unique capabilities you won't find on other dot matrix printers. Especially at such an affordable price.

More dots, more fonts, more versatility.

One thing that makes Pinwriters stand out from other



Our exclusive 18-pin print head is graphically sharper than a 9-pin printer, as this unretouched photo shows.

dot matrix printers is our printhead. It has 18 pins. Compared to the usual nine. It also has true dual-pass printing. The result: an amazing 240x240 dots per inch.

The quick brown fox

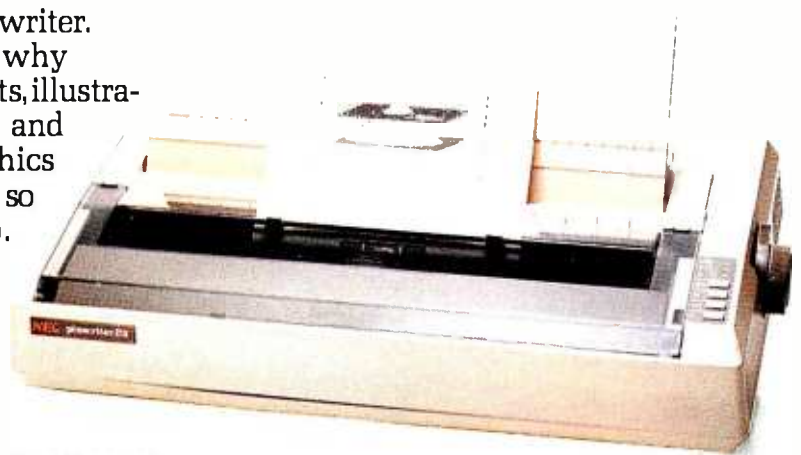
The quicker brown fox

The quickest brown fox

Three speeds cover all your printing needs.

That's why the print is as close to letter quality as you can get without getting a

Spinwriter. And why charts, illustrations and graphics look so crisp.



Our new P2 and P3 dot matrix printers give you everything our Spinwriter letter-quality printers are famous for, including forms handlers.

Pinwriters have something else no other dot matrix printers have. Eight operator-selectable print styles, plus as many as 11 international character sets. And an LED display to tell you which style has been selected.

What else? Three printing speeds. 300, 900 or 1800 words per minute to handle all your printing needs from word processing to data processing.

Plus, a variety of forms handlers to speed up all your paperwork. All made and designed by NEC. And all easily installed and changed by the operator.

For the final word, see your NEC dealer.

Only a demonstration can

Pinwriter and Spinwriter are registered trademarks of NEC Corporation.

show you how clearly superior the Pinwriter is compared to other dot matrix printers. And how versatile it is.

For the Pinwriter retailer nearest you, call 1-800-343-4419. In Massachusetts call 617-264-8635.

And find out why more and more PC users are saying, "NEC and me."

NEC AND ME

NEC Information Systems, Inc.
1414 Mass. Ave.
Boxborough, MA
01719



Circle 231 on inquiry card.

America's #1 Portable Computer Now Cut \$200



Radio Shack's TRS-80 Model 100 Comes with Five Built-In Programs!

- Personal Word Processor
- Appointment Scheduler
- Address/Phone Directory
- Telephone Auto-Dialer
- BASIC Programming Language

Since its introduction, the TRS-80 Model 100 has become the most highly-acclaimed lap-size computer ever. Why? Because it's a true portable that includes a built-in modem and full-size typewriter keyboard. And Model 100 works on batteries or with an optional AC adapter.

Ready to Use

Turn on Model 100 and select a program listed on the easy-to-read display. With the self-contained communication program and modem, you can send and receive data by phone. Add a cassette recorder and use ready-to-run software, too.



You can also expand with a printer, disk storage, standard video display and bar code reader.

Available Nationwide

Get your own Model 100 today at the Radio Shack Computer Center, participating store or dealer nearest you.

8K Model 100 59900 <small>26-3801</small> Was \$799.00 in Cat. RSC-11 <small>As Low As \$35 Per Month On CHLine Credit</small>	24K Model 100 79900 <small>26-3802</small> Was \$999.00 in Cat. RSC-11 <small>As Low As \$45 Per Month On CHLine Credit</small>
--	---

Radio Shack
The Technology Store™

A DIVISION OF TANDY CORPORATION

Prices apply at participating Radio Shack stores and dealers.

Circle 265 on Inquiry card.