Why every kid should have an Apple Ic

Today, there are more Apples in schools than any other computer. Unfortunately, there are still more kids in schools than Apples. So innocent youngsters (like your own) may have to fend off packs of bully nerds to get some time on a computer. Which is why it makes good sense to buy them an Apple Ic Personal Computer of their very own.

The Ic is just like the leading computer in education, the Apple Ile. Only smaller. About the size of a three-ring notebook, to be exact.

Even the price of the Ic is small—under $1300.

Of course, since the Ic is the legitimate offspring of the Ile, it can access the world's largest library of educational software. Everything from Stickybear Shapes™ programs in all. More than a few of which you might be interested in yourself.

For example, 3-in-1 integrated business software. Home accounting and tax programs for preschoolers to SAT test preparation programs for college hopefuls. In fact, the Ic can run over 10,000

With a Ic, your kid can do something constructive after school. Like learn to write stories. Or learn to fly. Or even learn something slightly more advanced. Like multivariable calculus.

Not to mention fun programs for the whole family. Like "Genetic Mapping" and
"Enzyme Kinetics."

And the Apple IIC comes complete with everything you need to start computing in one box:

Including a free 4-diskette course to teach you how—when your kids get tired of your questions.

An RF modulator that can turn almost any TV into a monitor.

As well as a long list of built-in features that would add about $800 to the cost of a smaller-minded computer.

128K of internal memory—twice the power of the average office computer.

A built-in disk drive that would drive up the price of a less-senior machine.

And built-in electronics for adding accessories like a printer, a modem, an AppleMouse or an extra disk drive when the time comes.

So while your children's shoe sizes and appetites continue to grow at an alarming rate, there's one thing you know can keep up with them: Their Apple IIC.

To learn more about it, visit any authorized Apple dealer. Or talk to your own computer experts.

As soon as they get home from school.

*The FTC is concerned about price-fixing. So this is only a Suggested Retail Price You can pay more if you really try to © 1981 Apple Computer Inc. Apple and the Apple logo are registered trademarks of Apple Computer Inc. Sticker for Sticker is a trademark of Optimum Resources. For an authorized Apple dealer nearest you call (800) 338-9096. In Canada, call (800) 268-7796 or (800) 268-7637.
FEATURES

INTRODUCTION .......................................................... 96
THE HP INTEGRAL PERSONAL COMPUTER by Phillip Robinson .......................... 98
Hewlett-Packard's new all-in-one system makes UNIX truly portable.
CLARCIA'S CIRCUIT CELLAR: BUILD A SERIAL EPROM PROGRAMMER
by Steve Ciarcia .......................................................... 104
Steve devises an affordable version of an essential tool for hackers.
THE MACINTOSH OFFICE by John Markoff and Phillip Robinson ................. 120
AppleTalk networks the Macintosh and its new laser printer.
C TO PASCAL by Ted Carnevale ........................................ 138
This program can make the conversion process less tedious.
SIMULATE A SERVO SYSTEM by Don Stauffer .................................... 147
Model complex engineering problems on personal computers.
INTRODUCTION TO IMAGE PROCESSING by Jeffrey L. Star .................. 163
Manipulate images to make them more informative.

THEMES

INTRODUCTION .......................................................... 174
THE BIRTH OF A COMPUTER conducted by John C. Nash ......................... 177
In this interview, James H. Wilkinson discusses the building of a computer designed by Alan Turing.
A LOW-COST DATA-ACQUISITION SYSTEM by Kyohisha Okamura and Kamypb Agha-Tafra ... 199
A compromise between cost and quality, this system is adequate for many research projects.
FOURIER SMOOTHING WITHOUT THE FAST FOURIER TRANSFORM by Eric E. Aubanel and Keith B. Oldham .......................................................... 207
The authors present an in-depth look at a technique for removing noise from your data.
PARANOIA: A FLOATING-POINT BENCHMARK by Richard Karpinski ............ 223
Test the quality of your software, not just its speed.
MODELING MASS-ACTION KINETICS by Alan Curtis ................................. 239
In the future, microcomputers may have a substantial role in major scientific computations.
VIEWING MOLECULES WITH THE MACINTOSH by Earl J. Kirkland .......... 251
A BASIC program provides 3-D images of complex molecules.
LABORATORY INTERFACING by Lincoln E. Ford, M.D. ............................... 263
A medical researcher examines the capabilities and limitations of an important laboratory device.
INTERFACING FOR DATA ACQUISITION by Thomas R. Clune .................. 269
Three interfaces are compared.

REVIEWS

INTRODUCTION .......................................................... 286
REVIEWER'S NOTEBOOK by Glenn Hartwig ............................................. 289
NEW WORD by Joni Helborn and Nanci Reel .......................................... 291
A word processor from some of the creators of WordStar.
UNIX System V, the new standard in multi-user microcomputer operating systems, gives you high performance features along with the portability and flexibility of a standard.

Cromemco computers can make UNIX System V even better. Because our systems are designed with UNIX in mind. First of all, we offer UNIX System V with Berkeley enhancements. Then, our hardware uses advanced features like 64K of on-board cache memory and our high speed STDC controller to speed up disk operations—very important with UNIX.

More capability and expandability

We have a high-speed, 68000-based CPU that runs at 10 MHz, coupled with a memory manager that uses demandpaging and scatter loading to work with UNIX, not for it.

We provide room for expanding RAM to 16 megabytes—with error detection and correction—for running even the most sophisticated and advanced microcomputer programs. And the power to accommodate up to 16 users—all with plenty of memory. But we give you even more.

A complete solution

We give you a choice in systems: the System 100 series, expandable up to 4 megabytes of RAM, and the System 300 series, expandable to 16 megabytes. A high speed 50 megabyte hard disk drive is standard on the systems. And you can expand the hard disk capacity up to 1200 megabytes using standard SMD drives. You can add floating point processing. High resolution graphics, Video digitizing and imaging. Communications through standard protocols. Mainframe interface.

And software support is here to meet your needs. We offer major programming languages, database management systems, communications software, including SNA architecture, X.25 protocol, and Ethernet, even a program to interface to an IBM PC if you need to. And, of course, access to the broad range of standard UNIX applications programs that is growing dramatically every day.

Easy to use.

We also make our systems easier to use, because we install the operating system before we ship your computer. No complicated installation procedures. And the Berkeley enhancements give you the standard UNIX System V operating system, but with the added convenience of these widely acclaimed improvements.

Cromemco's System 100 and System 300 computers: designed to be the highest performance UNIX systems available anywhere.

Just call or visit one of our UNIX System V Official System Centers to see for yourself. They'll also give you a copy of our new publication, "What you should know before you buy a UNIX system."

Or contact us directly.

We'll be glad to show you how to get a better UNIX system.

Corporate Headquarters: Cromemco, Inc., 280 Bernardo Avenue, P.O. Box 7400, Mountain View, CA 94039. (415) 969-4710. In Europe:

Cromemco GmbH, 6236 Eschborn 1, Frankfurter Str. 33-35, P.O. 5267, Frankfurt Main, Germany.
SERVICE AND SUPPORT

When computers are working they keep us entertained, or at least occupied. That's why happy customers seldom praise the retail stores and mail-order businesses that sold them their computer equipment, and why we hear much more criticism of computer dealers. Often retail salespeople are derided for knowing little about the computers and software they sell and mail-order firms for providing less customer support than retail stores.

But the reality varies from store to store and transaction to transaction. I have had nothing but good experiences with mail-order companies, including free replacement of 100 floppy disks when three of ten in the first box wouldn't format properly. I've bought software, a modem, a printer, and various supplies through phone orders to mail-order businesses.

My experiences in retail stores have been mixed. I once heard a salesman tell a customer that Pickles and Trout were programming languages (they actually were two people who produced a version of CP/M for the Tandy Model II). On another occasion the sales staff of a retail store refused to go through the bother of taking an order for VisiCalc or to hold a copy for me from the next shipment. I went back several times only to find VisiCalc sold out again and no one willing to take my order. (Finally, I bought VisiCalc through mail order and had no problems.) On the other hand, the retail salespeople at the computer store where BYTE made some recent purchases not only know what they are doing but also give technical support when things go wrong.

STREET ADDRESSES

There is room for improvement in both mail-order and retail computer sales practices. The great concern with mail-order businesses is well expressed in a letter we received from John C. Gunn, director of consumer affairs for Priority One Electronics of Chatsworth, California: "Although we are primarily an industrial distributor, a measurable portion of our revenue comes from our 'mail-order' ads. We frequently hear horror stories about some poor soul who sent his money to a mail drop or post office box somewhere... and never saw any product or a dime of his dough. Incidents such as this hurt all of us."

Priority One took an interesting practical step to counteract this problem. "To assist in protecting unwitting consumers from unscrupulous advertisers," Gunn writes, "we lobbied strongly for the passage of a bill introduced by California Assemblyman Jack O'Connell. This law requires all advertisements in our state to carry the street address of the company placing the advertisement." We commend Priority One for its efforts to protect the interests of customers of mail-order businesses.

REMOTE DIAGNOSTICS

The convergence of computer and communications technologies offers an unprecedented opportunity for improving customer support. When a personal computer is connected to the telephone system through a modem, and if the operating system and hardware are still capable of taking input from the serial port, then someone at the other end of the telephone line should be able to take control of the computer and put it through a series of diagnostic tests.

The availability of such remote diagnostics would be a great convenience for computer users, retail stores, mail-order businesses, and manufacturers. Remote diagnostics would be much less expensive than shipping costs and would reduce or eliminate the problems sometimes caused by the consumer's inability to describe a problem in a way meaningful to technicians. Instead of lugging the machine back to the store or packing it up for shipment, the consumer could just connect the computer to the telephone and watch the diagnostics at work. In many instances, the consumer could learn what was wrong and how much it might cost to fix before sending out the equipment. The service organization would know what type of repair was coming and be prepared to fix it. In some cases the machine wouldn't have to be sent out at all; there could be a software fix or a board swap.

Some companies already furnish diagnostic disks. These disks are valuable, but because of a lack of information needed to interpret the results of the tests, they tend to leave the customer poorly informed. Remote diagnostics would permit the service organization to use additional tests to identify the problem more precisely and then to tell the customer more about the extent of the repairs and potential costs.

Since repair bills can range from $75 to more than $1000, mystery breeds distrust. Consumers often express suspicion about repair costs of the automobile and other familiar machines. Similar feelings of distrust about repairs of computer equipment could become much more pervasive. Remote diagnostics could reduce mystery and improve consumer confidence in the computer industry. We hope the use of remote diagnostics becomes standard industry practice.

—Phil Lemmons, Editor in Chief
Maxell Gold.
The floppy disk that turns Apple's golden, keeps AT&T on-line, and makes every Texas Instrument a gusher.

Whether you're exploring for profits, reaching out for projections, or polishing your argument, there's a Maxell floppy disk perfect for your computer. Consider the unique way we pack and bind our oxide particles for quality over the long run. Or our lifetime warranty. Maxell. The Gold Standard in floppy disks. Precious metal for virtually every computer made.
SEEQUA SHOWS YOU HOW TO GET AN IBM PC FOR JUST $1595.

BUY A CHAMELEON BY SEEQUA.

The Chameleon by Seequa does everything an IBM PC does. For about $1000 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 x 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 microprocessor 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 $1595. 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.
CP/M for the Macintosh

IO Software, Fort Worth, TX, is selling a version of CP/M-68K for Apple's 128K-byte Macintosh for $395, including Digital Research's C Compiler and Macro Assembler. CP/M 2.2 emulation is available for $195 extra but runs only on a 512K-byte Macintosh. A 512K-byte Macintosh is also required to access the mouse and pull-down menus. CP/M-68K disks are not compatible with other Macintosh disks.

Superex, Micromax Unveil Macintosh Business Software

Superex Business Software, Yonkers, NY, announced 25 new products for the Macintosh, priced from $20 to $800. The least expensive item is also the only hardware product introduced: MacSpeak is a $19.95 external speaker. All products should be available this month.

Also included are business programs for cost estimating, time billing, inventory, finance, business letters, sales, and wholesaling. A complete accounting package with Accounts Payable and Receivable and General Ledger modules is $750. A Home Executive program is $90.

Four engineering packages—for civil, mechanical, chemical, or electrical engineers—are $100 each. A MacScience series includes Physics or Chemistry formulas for $100 each. Statistics and job-hunting programs were also announced.

Micromax, San Diego, CA, introduced Gallery, a business-accounting software series. The Finance module, which includes General Ledger, Accounts Payable and Receivable, and Cash Disbursement, is $795; industry-specific vertical applications are also planned.

Conetic Introduces Desktop Management Software

Conetic Systems Inc., San Leandro, CA, introduced Higgins, a specialized relational database program for the IBM PC XT or PC AT that includes an appointment calendar, telephone/address file, expense report, and message features. Information entered into the program is linked to related files; for example, the telephone directory is checked when an appointment is made. Information for up to seven people can be tracked on one computer. A local-area-network version that exchanges nonprivate schedule information is also available. The single-user version of Higgins is $395.

Lantech Offers UNIX-like Operating System for $129

Lantech Systems Inc., Dallas, TX, announced uNETix 2.0, a multitasking operating system for the IBM PC that it says is compatible with AT&T's UNIX operating system but costs just $129. Using optional $100 window-management software, PC users can execute up to 10 applications concurrently; one of those could be a PC-DOS application running under Lantech's $50 PC Emulator.

While a hard disk is recommended, Lantech says the operating system can run on a twodisk system. A separate version of uNETix is available for use in local-area networks.

Smalltalk for PCs

Digitalk, Los Angeles, CA, introduced Methods, a Smalltalk-80 object-oriented development system for the IBM PC. The $250 system includes a compiler, debugger, and text editor; it uses a text-based windowing system with pop-up menus. Methods requires an IBM PC with 512K bytes of RAM and two 360K-byte disk drives.

Software Systems, San Francisco, CA, is also developing a Smalltalk for the Apple II, with later versions planned for 8088- and 68000-based systems.
Software Teledelivery Efforts Falter

At last year's Winter Consumer Electronics Show, several companies announced or discussed plans for electronic delivery of software. Some, including Xante, Romox, and Cumma Technology, planned to download to erasable programmable read-only memory (EPROM) cartridges at dealer terminals. Others including Control Video's GameLine and the Nabu Network's cable service, downloaded programs directly to computers or video games.

Xante, Romox, and Cumma have all ceased operations, mainly because of poor dealer response and the general collapse of the cartridge video-game market. Nabu's cable TV-based software downloading service continues to operate in Ottawa, Ontario, despite financial troubles. Control Video Corp., Vienna, VA, said poor distribution and the general video-game slump led it to cancel its GameLine service for the Atari 2600 VCS.

Control Video is now testing a new service which allows subscribers to play 20 games available each month as often as they wish for a $14.95 monthly fee, which includes rental of a 2000-bps modem from BellSouth. MasterLine is now available for Apple II and Commodore 64 owners in Atlanta, Los Angeles, Houston, and Washington, DC.

Separately, NBC announced that it would cancel the NBC Teletext service in late January.

NANOBYTES

Intel introduced the 82588 single-chip local-area-network controller. The 82588 can be used in low-cost baseband or broadband networks—including such IEEE 802.3 protocols as IBM's PC Network and the developing STARLAN—at speeds up to 2 megabits per second. Initial pricing will be $45 each in large quantities. Laserstore, Princeton, NJ, plans to sell a 2.5-gigabyte write-once optical streaming-tape drive. The drives should be available in large quantities in mid-1986 for about $2500. Multi Solutions announced a licensing agreement with Computer Engineering & Consulting of Tokyo, under which CEC will translate Multi Solutions' SI operating system for Japanese computers. Currently, SI runs on several 68000-based computers and is being translated by MSI for the IBM PC AT. The agreement guarantees a minimum of $40 million in royalties, according to Multi Solutions. WATCOM Products Inc. has released two products developed at the University of Waterloo in Canada. WATFILE is a $295 data-management system for the IBM PC; JANET/2 is networking software for IBM's PC Cluster system. Alphacom announced a 193-character-per-second printer at $249 that it says is compatible with Epson's RX-80. Corvus and NEC have agreed to jointly develop a single-chip controller for Corvus's Omninet local-area network. Currently, an Omninet controller requires three chips developed by Corvus. Advanced Micro Devices now offers a 10-MHz version of the 80186 processor. Phoenix Software, Norwood, MA, has developed an IBM PC XT-compatible ROM BIOS and is developing software compatible with IBM's PC AT. Phoenix's earlier IBM PC-compatible ROM BIOS code has already been licensed by AT&T, Kaypro, Tandy/Radio Shack, Wyse Technology, and Zaisan. Rumors that Tandy would begin selling ACT computers in its Radio Shack stores are apparently false. Instead, the two companies announced a joint venture to operate a chain of computer stores in Europe, called TA ComputerWorld. The stores will sell both Tandy and ACT computer products. AST Research announced RamStak, a memory-expansion board for the Apple Lisa computer. The board can add up to 2 megabytes of memory to the Lisa; with 512K bytes, it's priced at $1395. Mosaic Electronics, Oregon City, OR, announced Access-M, an expansion card for the Commodore 64 adding up to 1 megabyte of memory. The standard $195 card includes 64K bytes of RAM and RAM-disk software; additional memory is plugged into the card. PortaAPL, a $275 APL interpreter for the Macintosh, was introduced by Portable Software, Cambridge, MA. PortaAPL adds a full-screen editor and access to many Macintosh ROM toolbox routines to the standard APL language but requires a 512K-byte Macintosh. C Line Inc., Chicago, IL, announced a dBASE II-to-cEnglish converter. The $795 program converts standard dBASE II source code into cEnglish, which is then translated by the $900 cEnglish program into C, which is in turn compiled into machine language by a C compiler.

At last year's Winter Consumer Electronics Show, several companies announced or discussed plans for electronic delivery of software. Some, including Xante, Romox, and Cumma Technology, planned to download to erasable programmable read-only memory (EPROM) cartridges at dealer terminals. Others including Control Video's GameLine and the Nabu Network's cable service, downloaded programs directly to computers or video games.

Xante, Romox, and Cumma have all ceased operations, mainly because of poor dealer response and the general collapse of the cartridge video-game market. Nabu's cable TV-based software downloading service continues to operate in Ottawa, Ontario, despite financial troubles. Control Video Corp., Vienna, VA, said poor distribution and the general video-game slump led it to cancel its GameLine service for the Atari 2600 VCS.

Control Video is now testing a new service which allows subscribers to play 20 games available each month as often as they wish for a $14.95 monthly fee, which includes rental of a 2000-bps modem from BellSouth. MasterLine is now available for Apple II and Commodore 64 owners in Atlanta, Los Angeles, Houston, and Washington, DC.

Separately, NBC announced that it would cancel the NBC Teletext service in late January.

NANOBYTES

Intel introduced the 82588 single-chip local-area-network controller. The 82588 can be used in low-cost baseband or broadband networks—including such IEEE 802.3 protocols as IBM's PC Network and the developing STARLAN—at speeds up to 2 megabits per second. Initial pricing will be $45 each in large quantities. Laserstore, Princeton, NJ, plans to sell a 2.5-gigabyte write-once optical streaming-tape drive. The drives should be available in large quantities in mid-1986 for about $2500. Multi Solutions announced a licensing agreement with Computer Engineering & Consulting of Tokyo, under which CEC will translate Multi Solutions' SI operating system for Japanese computers. Currently, SI runs on several 68000-based computers and is being translated by MSI for the IBM PC AT. The agreement guarantees a minimum of $40 million in royalties, according to Multi Solutions. WATCOM Products Inc. has released two products developed at the University of Waterloo in Canada. WATFILE is a $295 data-management system for the IBM PC; JANET/2 is networking software for IBM's PC Cluster system. Alphacom announced a 193-character-per-second printer at $249 that it says is compatible with Epson's RX-80. Corvus and NEC have agreed to jointly develop a single-chip controller for Corvus's Omninet local-area network. Currently, an Omninet controller requires three chips developed by Corvus. Advanced Micro Devices now offers a 10-MHz version of the 80186 processor. Phoenix Software, Norwood, MA, has developed an IBM PC XT-compatible ROM BIOS and is developing software compatible with IBM's PC AT. Phoenix's earlier IBM PC-compatible ROM BIOS code has already been licensed by AT&T, Kaypro, Tandy/Radio Shack, Wyse Technology, and Zaisan. Rumors that Tandy would begin selling ACT computers in its Radio Shack stores are apparently false. Instead, the two companies announced a joint venture to operate a chain of computer stores in Europe, called TA ComputerWorld. The stores will sell both Tandy and ACT computer products. AST Research announced RamStak, a memory-expansion board for the Apple Lisa computer. The board can add up to 2 megabytes of memory to the Lisa; with 512K bytes, it's priced at $1395. Mosaic Electronics, Oregon City, OR, announced Access-M, an expansion card for the Commodore 64 adding up to 1 megabyte of memory. The standard $195 card includes 64K bytes of RAM and RAM-disk software; additional memory is plugged into the card. PortaAPL, a $275 APL interpreter for the Macintosh, was introduced by Portable Software, Cambridge, MA. PortaAPL adds a full-screen editor and access to many Macintosh ROM toolbox routines to the standard APL language but requires a 512K-byte Macintosh. C Line Inc., Chicago, IL, announced a dBASE II-to-cEnglish converter. The $795 program converts standard dBASE II source code into cEnglish, which is then translated by the $900 cEnglish program into C, which is in turn compiled into machine language by a C compiler.
The TI 855 is the only printer with letter quality, draft speed, graphics, plug-in font modules... all for under $1000. (suggested retail price)

Finally, the printer for all PC needs.

The TI 855 printer. The printer for all major PC's. See for yourself today. Call 1-800-527-3500 for the dealer nearest you.

TEXAS INSTRUMENTS
Creating useful products and services for you.
Slide Cat FROM KODAK INTRODUCES:
THE CAT-QUICK SLIDE-MAKERS
THAT WILL MAKE YOU GRIN.
"Now you can make presentation-quality instant slides from CRT screens, one at a time. Slides that integrate beautifully into the rest of your show. It’s like having your own instant slide department. And you don’t have to be an audiovisual professional to do it.

"Kodak's new catquick slide-makers are a versatile group of state-of-the-art products designed to convert computer-generated material into slides, fast!

"With our new imager, you can make instant slides (or prints) from just about any data that appears on your CRT screen...pie charts, bar charts, organization charts, etc. And you can use just about any size terminal—9-, 12-, 13-, even 19-inch screens. Direct conversion from CRT to slide can save you time, and money! For slides from hard copy use our sleek copy stand. Both methods are easy and affordable.

"Your options are many. You can buy one product, or the entire line. Make a single slide or an entire presentation. Prove a point, or wow an audience. Even use our camera back, module, and film to photograph images electronically transferred with many manufacturers’ video image recorders! And get results that make a grin begin.

"KODAK INSTAGRAPHIC Color Slide Film
Shoot just one slide or an entire presentation. One-at-a-time exposure means you waste no film, waste no money. If you need instant color prints of CRT displays, use KODAK INSTAGRAPHIC Color Print Film and substitute the KODAK INSTAGRAPHIC Print Module.

"To learn more about these new state-of-the-art products, call 1 800 4 4 KODAK, Ext 233 (1 800 4 45 6 325, Ext 233), or use the coupon below. Or contact your local dealer in Kodak audiovisual products, listed in the Yellow Pages under ‘AV equipment and supplies.’ "

Kodak
THEY'RE GONNA MAKE YOU GRIN.
CP/M PLUS FOR THE MODEL 4

Editor's note: In the following sequence of letters reader William F. Crowell addresses Tandy Corporation Chairman John Roach, BYTE (having received a copy of Crowell's letter) responds to Crowell, and David Krebbs of Tandy replies to Crowell.

Dear Mr. Roach,

I am a longtime computer customer of Tandy Corporation. I presently own two Model Is, a Model 4, and a Model 4P. For over 18 months now, since it was first announced, I have been waiting to receive a working version of Model 4 CP/M Plus.

First, I had to wait 13 months after Tandy announced the product before it was even released. (However, this didn't stop Tandy from advertising the product as available during this entire period of time, presumably to sell more Model 4s to customers who want to run CP/M Plus.) I immediately bought a copy. As you know, however, the original release was full of bugs.

I volunteered to beta-test the new preliminary version 1.1, which I did. Immediately discovered that random access failed miserably. Then I observed from the source code, RANDOM.ASM, that virtually nothing had been done to implement random access on the Model 4 hardware environment.

Tandy calls this an operating system? How could the company even release it in the first place without random access? Also, the BIOS is supposed to emulate a DEC VT-52 terminal, but it doesn't. Many of the VT-52 control codes don't work. During this entire period of time, presumably to sell more Model 4s... I trust, that it is not possible for us to design our products so that they are perfectly acceptable in every respect to every single member of the buying public.

Regarding your comments on the VT-52, please note that the first release of the Model 4 CP/M Plus manual did contain errors on the decimal values assigned to the VT-52 emulation codes. The correct codes have been sent to you by Mr. James Brown of this office, and a Publication Change Notice has been submitted for future editions of the manual. You will find that the VT-52 control codes will work correctly with the information that Mr. Brown sent to you.

(continued)

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.
Back Up All the Hard Drives in Your Office.
The MaynStream offers fully portable hard drive backup employing the latest software technology. It is compatible with IBM, Compaq, and NCR personal computers* and comes with an industry-leading 1-year warranty.

*IBM is a trademark of International Business Machines. Compaq is a trademark of Compaq Computer Corporation. NCR is a trademark of NCR Corporation.
LETTERS

Enclosed please find a/BASIC program that utilizes random-access procedures to retrieve and store data. At this time, we are not able to duplicate any inherent flaws with random-access procedures in CBASIC under CP/M Plus.

Let me advise you as well, by the way, that the catalog number for Model 4 CBASIC is 26-2217, and it is now available in our stores at a retail price of $99.95. In fact, it was released in June of this year.

I repeat my previous offer to you: if you wish to have a full refund on the Model 4 CP/M Plus package that you purchased, just send me the complete package (media and manual) together with a copy of your sales receipt. I shall then see that a check is cut and sent to you at once. I make this offer to you in an effort to retain your goodwill.

I do not pretend that our position, as I have stated it above, will be perfectly acceptable to you, but I trust that at least you now understand it clearly. We do appreciate your past business, and I hope that we shall be favored with more of it in the future.

DAVID KREBBS
Radio Shack Computer
Customer Services

A PIRATE CONFESSIONS

This is an open letter to software vendors and dealers. It has been prompted by various letters and articles that I have read recently concerning why otherwise ethical people would "pirate" software.

I do not advocate the piracy of software. It is nothing short of theft. However, I have been guilty of pirating a package or two for one reason: I refuse to spend my money on software that I cannot be sure will run on my machine. No vendor that I know of will offer you a money-back guarantee on its software package. I work on mainframe computers for a living, and very few vendors of mainframe software will not let you have a 30-day trial on one of their packages.

I understand that the volume of dollars spent on a mainframe package is considerably more than what personal computer users spend for their software packages; however, we personal computer users do not work with the same size budgets as mainframe users.

Some software vendors do in fact offer demonstration disks, but the disks that I've seen flash lots of colors and text describing the products but do not give you an opportunity to use the products and...
What every Apple owner should know about

WORD JUGGLER.

If you own an Apple Ile or Ilc—or you're planning to buy one—here are a few things you should know about Quark's Word Juggler word processor.

First of all, Word Juggler is the only word processor that gives you a powerful spelling checker and a built-in telecommunications feature. So you can create a document—check it for spelling errors—and then send it via electronic mail. All with just one program.

Plus, Word Juggler is the most easy-to-use, professional word processor you can buy for your Apple. Virtually every function—even complicated "cut-and-paste" tasks—can be accomplished with a single keystroke.

There's nothing to memorize, either. Because Word Juggler comes with replacement keycaps—and a special keyboard template—which identify principal editing and formatting commands. So you can focus your efforts on using the program, not learning it.

Fact is, no other word processor for your Apple Ilc or Ile gives you this unique combination of power, functionality and ease of use. And if all these advantages aren't compelling enough, check the price. Suggested retail is only $189.

So visit your favorite dealer today. Ask for a complete demonstration—and for a copy of our brochure, "What Every Apple Owner Should Know About Word Juggler." If you don't have a favorite dealer, but would like one, just call 1 (800) 543-7711. We'll fix you up.

Quark and Word Juggler are trademarks of Quark Incorporated. Apple is a registered trademark of Apple Computer, Inc.

Ask about our specially-priced educational version.

Copyright 1985, Quark Incorporated
Photography by Barbara Kassep
**Free UPS shipping on orders over $1,000.00**

**CALL FOR PRODUCTS YOU DON'T SEE HERE!**

**CALL FOR OUR FREE CATALOG**

TO ORDER CALL TOLL-FREE:

(800) 235-3020 (USA)

(800) 235-3021 (CA)

(415) 382-9085

**TERMS:**
- Call for shipping charges 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.

---

**FINALLY! MAIL ORDER SERVICE YOU CAN DEPEND ON!**

**EXPRESS BUSINESS SOFTWARE**

**PROFESSIONAL SUPPORT PLUS RELIABLE PERSONALIZED SERVICE**

AND WE'LL STILL BEAT MOST PRICES IN THIS MAGAZINE!

<table>
<thead>
<tr>
<th>WORDSTAR PROP</th>
<th>SYMPHONY</th>
<th>SIDEKICK (CP)</th>
<th>MULTIMATE</th>
<th>TURBO PASCAL (CP)</th>
<th>LOTUS 1-2-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>$243</td>
<td>$409</td>
<td>$39</td>
<td>$253</td>
<td>$39</td>
<td>$295</td>
</tr>
</tbody>
</table>

**AID**
- **Typequick** $85 $85

**ALPHA SOFTWARE**
- **Data Base Manager** $295 $179
- **ANDERSON-BELL** $235 $179
- **Abst** $395 $267

**ASHTON-TATE**
- **D Base II** $265
- **D Base III** $363
- **Framework** $383
- **Friday** $169

**ATI**
- **Training Word Star** $75 $45
- **Training Blase II** $75 $45

**BORGAL ANDERSON SOFTWARE**
- **Toolbox** $49 $40

**COEX**
- **Advanced Lotus 1-2-3** $70 $45

**CHANG LABS**
- **Rags to Riches Ledger** $99 $79

**CONDOR**
- **Commod** $650 $249

**CONTINENTAL SOFTWARE**
- **Home Accountant Plus** $150 $90

**DIGITAL MARKETING**
- **Writers Pak** $295 $199
- **Footnote** $99 $84
- **Datebook II** $295 $179
- **Notebook** $150 $98
- **Proofreader** $50 $30
- **Grammar** $75 $65

**ENERTRONICS**
- **Micrographics W/Plot Opt.** $450 $297
- **DX Graphic or Quickcode** $295 $159
- **dul** $99 $58

**FOX RESEARCH**
- **10 Base** $495 $399

**FUNK**
- **Sideways** $60 $45

---

**MONOGRAM**
- **Dolmar and Sense (IBM)** $179 $149
- **Dolmar and Sense (Mac)** $149 $119

**HERITAGE**
- **Lotus 1-2-3** $395 $240

**GOODS**
- **Easy System II** $395 $184
- **General Ledger** $595 $319
- **Accounts Payable** $595 $319
- **Excel Report Writer** $495 $239

**LIFEFREE**
- **Volkswriter Deluxe** $295 $158

**LIVING VIDEO TEXT INC.**
- **Talk Tank (IBM)** $150 $149
- **Talk Tank (Mac)** $150 $149

**MOB**
- **Managing Your Money** $199 $135
- **Micropro** $350 $195
- **SpellStar** $99 $79
- **CorrectStar** $145 $99
- **MailMerge** $99 $79

**INFOSTAR**
- **WordStar 2000** $495 $248

**MICROM**
- **R Base 4000** $425 $299
- **Extended Report Writer** $150 $119

**MICROSOFT**
- **MPLink** $250 $139
- **Word/Mouse** $475 $319
- **Chart (Mac)** $125 $99
- **Cash Plan (IBM)** $150 $99

**MICROSTUFF**
- **Crosslink** $195 $98

**Selene**
- **Extended Report Writer** $425 $299

**PRENTICE-HALL**
- **Execute** $395 $299

**SELECT INFORMATION SYSTEMS**
- **SelectWord Processor** $295 $199

**SOFTRIC**
- **SuperCalc 2** $295 $195
- **SuperCalc 3** $195 $199

**SOFTWARE PRODUCTS INT'L**
- **Open Access** $695 $349

**TYLOS**
- **eBase Window** $249 $155

**WARNER SOFTWARE INC.**
- **The Desk Organizer** $395 $248
- **WOLF SYSTEMS**
- **Move II** $150 $85

**PASCAL**
- **(CP)**

---

**FREE UPS shipping on orders over $1,000.00**

**CALL FOR PRODUCTS YOU DON'T SEE HERE!**

**CALL FOR OUR FREE CATALOG**

TO ORDER CALL TOLL-FREE:

(800) 235-3020 (USA)

(800) 235-3021 (CA)

(415) 382-9085

**TERMS:**
- Call for shipping charges 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.

---

**LETTERS**

**No Support from Apple**

---

I would like to confirm the lack of available Apple documentation noted in Dennis Dom's letter ("A Call for Better Apple Support," September 1984, page 14).

After purchasing an Apple IIc in May to complement my Iie while I was traveling, I was immediately confronted with a lack of technical details needed to connect my "non-Apple" peripherals to the IIc. What are the pin connections on the serial ports? What are the memory locations that control baud rate, characters per line, ACIA status, etc.?

Since I travel extensively, I thought I could pick up the Apple IIc Reference Manual in one of the many authorized Apple dealers I visit each week out of town. After visiting over 30 stores in New York, New Jersey, southern California, and Oregon, I have been unable to find the reference manual.

I hope that letters like Dennis's and mine will stir Apple into getting the publications I need to their dealers when I visit them. I obtain a copy (or the original) and attempt to find people who are using the product's documentation. I then try the product out for a month or so. If I like the product, I then purchase a "legitimate" version of it, or else I erase my copy or return it to the lender. In this respect I am probably more ethical than most in that I will buy a legitimate copy of any software that I intend to use on my machine for any length of time after I have already obtained a pirated version of it.

I seek only to protect my investment, and I will discontinue this practice when I can obtain a full-function demonstration disk of a package that I intend to purchase. I somehow expect that quite a number of software vendors would be opposed to a 30-day trial arrangement because their products wouldn't stand up to head-to-head competition.

NAME AND ADDRESS WITHHELD

---

I read with interest Dennis Dom's letter describing his problems obtaining Apple documentation.
Now you have a choice for bit-mapped graphics. Priced at $399—$100 less than what you'd expect—AST's Preview! brings high resolution bit-mapped graphics and clear, crisp text to your IBM® PC, XT or AT monochrome screen. And there's no standard like AST quality.

Preview! provides all the features and functions you'd expect, like bit-map addressing the maximum supported 720 horizontal pixels by 348 vertical lines for two pages of full-screen high resolution graphics, an IBM PC-compatible parallel printer port and Hercules™ bit-mapped graphics card compatibility.

It works with all kinds of software too, no other card offers more. New generation integrated business programs, bit-mapped text processing and advanced windowing applications are specialties.

Then there's the nonstandard features AST is famous for—consistent quality, reliability, comprehensive documentation, service, support and extra value. We include our SuperPak™ RAM disk simulator and printer spooler utility diskette. Judged by PC WORLD readers as a World Class Winner for the past two years, it's worth $45 by itself.

The leadership strength that makes our consistent quality so affordable is carried throughout our complete line of PC enhancement products. We offer a family of graphics products which provide a variety of features from serial ports to expansion memory, as well as multifunction boards, micro-to-mainframe communications, local area networks and disk subsystems.

So you can settle for the common, ordinary graphics card and hope for the best. Or you can pay $100 less and know you have the best—Preview! only from AST. For more information and dealer locations call our Customer Information Center (714) 863-1333, Ext. 5249. Or write, AST Research, Inc., 2121 Alton Avenue, Irvine, CA 92714 TWX: 753699AST UR.

<table>
<thead>
<tr>
<th>FEATURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>64K Screen Memory</td>
</tr>
<tr>
<td>Two Pages of High Resolution 720 Horizontal PELS by 348 Vertical Line Bit-Mapped Monochrome Graphics</td>
</tr>
<tr>
<td>80 Character by 25 Line IBM PC-Compatible Text Display</td>
</tr>
<tr>
<td>Standard IBM Character Set</td>
</tr>
<tr>
<td>Compatible With Popular Bit-Mapped Graphics, Text and Windowing Applications Software</td>
</tr>
<tr>
<td>Parallel Printer Port</td>
</tr>
<tr>
<td>SuperPak Utility Diskette</td>
</tr>
<tr>
<td>Hercules Compatible</td>
</tr>
</tbody>
</table>

Inquiry 5 for Dealers.
Inquiry 6 for End-Users.
Available for the IBM PC, AT, XT, jr.,* and true compatibles

CLEAR THE DESK, SIDEKICK'S HERE! The Super Organizer

ALWAYS JUST A KEystroke AWAY . . .
No matter what software you're running!
WHether yOu’re runniNg LOTUS, WORDSTAR,
dBASE or whatever . . .
JUST A KEystroke and a SIDEKICK WINDOW OPENS . . .
• a calcuLator
• AN APPOINTMENT CALENDAR
• AN AUTO DIALer
• A PHONE DIRECTORY
• AN ASCII TABLE

"IF YOU USE A PC, GET SIDEKICK. YOU'LL SOON BECOME DEPENDENT ON IT."
Jerry Pournelle, BYTE
Here's Sidekick in action. That's Lotus 1-2-3 running underneath. In the Sidekick Notepad you can see data that's been imported from the Lotus screen. On the upper right, that's the Sidekick Calculator.

NOW... Whether you're working in dBase, Lotus, Wordstar or whatever... you can unleash the full power of your computer... and make a lot of extra space on your desk at the same time.

Whenever you're using your computer... from start to finish of your session... Sidekick™ will be there... ready to serve. And it's as lightning-fast and compact as only Borland knows how to make it.

There's a notepad that has a full-screen editor that can time and date stamp your notes, and then save them to disk. You can even pull information into the notepad directly from the screen of your "underlying" software.

Suppose you're working in Lotus and the phone suddenly rings. Give your Sidekick a call and it pops right up over Lotus with the notepad you need. Or an appointment calendar... one you can never misplace.

What if you need to do a quick calculation? A keystroke instantly brings up the calculator. And the results of your calculations can even be transferred to your "underlying" software.

Need to make a phone call? Up pops your personal phone directory. Type in the name you want... and Sidekick jumps right to the phone number. Another keystroke, and the phone is automatically dialed 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. There's even an on-line help window for each of Sidekick's features.

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 need Sidekick, too.

†Only with Hayes smart modem and compatibles.

GOT YOUR SIDEKICK™ YET?
SIDEKICK IS AVAILABLE AT YOUR NEAREST SOFTWARE DEALER, OR DIRECT FROM BORLAND.

For VISA and MasterCard orders, call 1(800) 255-8008: in California call (800) 742-1133.

Lines are open 24 hours a day. 7 days a week.

Inquiry 33

Please be sure your system is an IBM PC, AT, XT Jr. or a true PC-compatible. PCjr. users must order noncopy-protected version.

NAME __________________________
ADDRESS _________________________
CITY/STATE/ZIP __________________
TELEPHONE _______________________

California residents add 6% sales tax. Outside USA add $10; payment must be by bank draft payable in the US and in US dollars. COD and purchase orders will not be accepted.

BoRlAnD
INTERNATIONAL
4113 Scotts Valley Drive
Scotts Valley, California 95066
TELEX: 172373

Check □ money order □
VISA □ MasterCard □
Card # __________________________
Expiration Date __________

Prices include $5 shipping and handling per order.

$54.95 SideKick
copy-protected
$84.95 SideKick
noncopy-protected

You may order SideKick and other Borland products by phone with your VISA or MasterCard.

Borland International
4113 Scotts Valley Drive
Scotts Valley, California 95066

GOT YOUR SIDEKICK™ YET?
After several years of CP/M experience, I purchased an Apple Iic in May. I have written and phoned Apple in Cupertino, the Apple distributor in Charlotte, and two Apple dealers. The response I have gotten is difficult to accept. Based on the information I have to date, the Apple Iic Technical Manual, ProDOS Technical Manual, ProDOS Users Kit, and Applesoft Technical Manual volumes 1 and 2 are unavailable and there is no official date for delivery.

My choice of the Iic was based on the promise of true portability by the end of 1984. The present availability of carrying cases and portable power supplies coupled with the continued assurance by Apple of the flat-screen display in 1984 will provide the hardware I expected when I chose the Iic. The total lack of technical information for the Iic and the operating system will make software development almost impossible.

**Don Overton**
Atlanta, GA

I found the letter by Dennis Dorns concerning the lack of technical support by Apple for its new ProDOS System very true. I am one of those newcomers to computers. It is indeed a nightmare trying to make sense out of Apple ProDOS from the scant instructions supplied with the Apple Iic.

For months I have been trying to buy several of Apple's manuals on ProDOS, especially BASIC Programming with ProDOS. The authorized Apple dealer has no idea when his shipment will come in.

In my opinion any machine, no matter how excellent it may be, is no better than the instructions that teach the operator how to use it. It seems a pity that a company that can split out machines at such a terrific rate cannot supply the basic tools the operator needs to operate that machine. Imagine that same company's concern if, when its new production line was ready to roll, it found it had few instructions on how to operate it.

**David D. Perry**
Ridgecrest, CA

**TAKE BACK YOUR MAC**

I am outraged. Apple's original descriptions of the Macintosh, as quoted in the press, made it clear that the Macintosh was a 512K system that was being released in a temporary 128K version due to failures on the part of Apple's suppliers. Now we are told (in defiance of the experience of any user of the machine) that the 128K Macintosh is a useful computer and will continue to be sold at the original price, while a 512K version will cost $1000 more. What's more, any purchaser of the earlier 128K machine who desires to upgrade to 512K must pay the $1000 difference in price. This policy is as blatantly unscrupulous a case of bait-and-switch as was ever practiced.

As a professional programmer, I was intrigued and excited by the concept of the Macintosh and eagerly awaited the release of the real 512K machine. As a consumer, I am disgusted by Apple's business practices and have no intention of throwing good money after bad. I am especially frustrated by this decision of Apple's, since I am sure that it will strangle the Macintosh in its cradle, and so my already substantial investment in the machine will have been for nothing.

**Kirk Rader**
Los Angeles, CA

I openly plead for a programmer or programming team somewhere to develop RAM-disk software to use the 512K RAM on the "Fat Mac" as a RAM disk as well as for memory.

A logical configuration to emulate the 128K Mac would be 128K memory with a 384K RAM disk. Later, variable options of more memory and less RAM would be nice, but they are not essential initially. Good programs like Microsoft Word can use disk I/O to make files larger than memory and would not be limited by the main-memory constraint, but rather only by the RAM-disk memory constraint.

Such a RAM disk must permit copying data to and from it, programs to and from it, and opening it. So designed, the system and major programs that use disk overlays could be loaded into RAM, with consequent lightning-speed operation. I believe such software is essential for the Mac to appeal to business. It would also make software development itself easier and faster.

I've checked, and apparently Apple's own programming philosophy is opposed to this concept. If someone does do this, I hope he or she sells it for a reasonable price ($50 or less) or else releases it accessibly into the public domain. Without such a development, my company will probably never buy a Mac and will probably never develop software for it.

**Don Slaughter**
MicroCost Software
Seattle, WA

Perhaps two of the most often used words throughout articles dealing with the Macintosh are "potential" and "wait." The Macintosh was introduced over nine months ago, and still there is a lack of varied and practical software available for the computer. On the day of its introduction Apple announced that "hundreds" of software companies had already had the Macintosh for up to two years. Software for the machine would be available in a torrential flood in a matter of weeks. Nine months later a real word processor (i.e., capable of handling more than eight or nine pages) is still not available, nor can I find a spelling checker, a true database manager, or a high-level language. If software companies have had over two years to work on their products and still have not fully developed what could be considered "standard" software products, just how long is the Macintosh software-development cycle? Is Apple truly supporting its software developers?

Added to the problem of third-party software is the lack of support software from Apple itself. Nine months after the computer was introduced, an assembler has not even been made available. Nor is a communication program like MacTerm available yet. Neither of these programs is particularly tricky to write. And, in fact, Apple must have had a 68000 assembler in house for quite a while (rehosting an assembler from the Lisa to the Macintosh takes over nine months?).

Many trade magazines and journals apparently wonder about these same problems. Often an attempt is made to rationalize Apple's tardiness and lack of support. The most common story is: "The Macintosh is a radically new computer requiring programmers to adapt to a completely different kind of style. And besides, 128K of memory makes for a tight squeeze on programs. When the 512K Macintosh is available, all kinds of fancy programs will appear and life will be wonderful again."

Well, the 512K Macintosh was recently announced. Now I can easily find several stores advertising the 128K Macintosh for $1600 and the 512K Macintosh for $2400. Yet Apple wants the people who already paid $2500 to fork over another $995 for the 512K upgrade. The entire computer obviously costs far less than $1000 to make, since that is the price the university consortium schools pay, and you can be certain that Apple is not so dedicated to education that it would pass up this additional source of profit.

If 128K is such a burden on software developers; why wasn't the computer released after the expanded memory was
available? This would have given developers more time to work on their software as well. If Apple felt it just had to be in the market with a machine like the 128K Macintosh, why was it priced so high? At least Apple could have promised all the early purchasers a fair price (or even no cost) on the upgrade.

I truly feel that Apple has treated its customers unfairly and with a certain amount of contempt. Prior to owning any Apple product I had a great deal of trust and respect for the company. In fact, it was that trust and respect that convinced me to buy a Macintosh even though I was aware of its limitations. I felt certain that Apple would take care of its customers. However, since buying a Macintosh, that trust and respect has gone. Even though I could recommend no alternative, I would not advise anybody to buy a Macintosh. Instead, I would recommend waiting until Apple straightens up or until another company recognizes the void and fills it.

R.S. LuebkeMan
Rancho Cucamonga, CA

CHOOSING A CAMPUS COMPUTER

We have recently undertaken a project to introduce the use of microcomputers in the junior/senior Physical Chemistry course at the University of Florida. Although the students are reasonably mature and mathematically sophisticated, they have shown a surprising reluctance to “get their feet wet” via hands-on work with the microcomputers available for the course (six Sanyo MBC 555 units, chosen for their low price, reasonably good graphics, and ability to use the 8087 math coprocessor).

There are several problems in introducing a microcomputer course as described above at a large state institution such as the University of Florida (35,000 students), where no requirement exists that students purchase a microcomputer (not to mention a specific brand of microcomputer). Even if money were available to fund purchase of sufficient machines to handle approximately 4000 technical students per year, along with space to house them, there remains the possible objection that the entire enterprise would be at least “type-specific.” Thus we might select MS-DOS, Microsoft BASIC, and WordStar, which would slant the situation toward IBM PCs and/or compatibles. This might lead to a loud chorus of objections from Macintosh supporters, for example.

(continued)
While some may disagree, I feel that the situation is more acceptable if reasonable alternate-brand selections do exist, such as the IBM PC, Seecua Chameleon, Eagle, Zenith 150, Tawa, Tandy 2000, etc. However, selection of a unique machine such as the Macintosh is virtually an endorsement of a specific brand rather than type, to the exclusion of all others.

I would be interested in hearing from others concerning this dilemma. Please write to me at the Chemistry Department, University of Florida, Gainesville, FL 32611.

ROBERT J. HANRAHAN
Gainesville, FL

ICONS ARE ARCANIE

Circa 5000 years ago, writing was invented in ancient Mesopotamia. This earliest known script, cuneiform, was derived from pictographic symbols that became stylized and standardized in form. Eventually it became mixed with phonetic elements until it was almost entirely phonetic. Our alphabet is most probably ultimately derived from ancient Egyptian—also originally a pictographic system. The point is this: Over thousands of years a phonetic and finally alphabetic system was developed. To anyone who has gone through the painful process of learning cuneiform or Egyptian, the superiority of the alphabet is readily apparent. A pictographic system (Apple’s "icons") requires that the user learn many, many symbols. My contention is that though users may find icons more “user friendly,” ultimately, as systems and software become more complex, the icon system will become more unwieldy and arcane than present systems.

As a humanist who uses computers extensively in my work, I would like to see user interfaces developed for micros that are faster, more streamlined (“elegant”), and smarter (“knowledge-based”) to aid in the learning process. It doesn’t take the uninitiated user long to grow impatient with the Mac.

ANN MARCHANT
Berkeley, CA

BRAVO, BORLAND!

This is the kind of letter I would like to be able to write more often. It’s about the people at Borland International, who distribute Turbo Pascal and, if we are lucky, a lot of other programs.

I’ve already spoken to Borland’s programmers about a problem, and with a completely satisfactory result. The latest event was my ordering of the Commodore 64 CP/M version of Turbo Pascal. When it arrived, it was an MS-DOS disk, which I couldn’t use. I scribbled a note on the invoice and mailed the whole package back the same day, the same way it arrived, at a cost of about a dollar in postage.

Today the United Parcel Service truck pulled up and delivered the correct replacement package—Second Day Air. It cost Borland $4. That is class.

WILLIAM T. POWERS
Northbrook, IL

SAGE DEFENDED

Introducing the Hercules™ Graphics Card for the technical user.

OK. We confess. The Hercules Graphics Card in the picture above isn't a special version for the technical user.

In fact, it's exactly the same as the standard Hercules Graphics Card running programs like 1-2-3™ and Symphony™ in more than 100,000 IBM® PCs.

We just wanted to make the point that the Hercules Graphics Card is not only big with business users—it's also the most popular high resolution graphics card for the technical user.

Why? We run more software than anyone else.

The Hercules Graphics Card is supported by more technical software than any other hi-res graphics card.

There are word processors that can produce publication quality documents with mathematical formulas.

There are programs that enable your PC to emulate a graphics terminal and run mainframe graphics software.

There are toolkits of graphics utilities that can be linked to popular programming languages.

There are CAD programs that can provide features normally associated with $50,000 systems.

And we supply free software with each card to do hi-res graphics with the PC's BASIC. No one else does.

Hardware that set the high performance standard.

When we introduced the Hercules Graphics Card in August, 1982, it set the standard for high resolution graphics on the PC.

But we didn't stop there. In the past two years, we've continually refined the original design.

Today's Graphics Card gives you two graphics pages, each with a resolution of 720h x 348v, and a parallel printer port—standard.

A 2K static RAM buffer elegantly eliminates scrolling flicker. And our exclusive safety switch helps prevent damage to your monitor.

Convinced? Good. Now, how about a little color?

Should you want IBM compatible color graphics for your system, then the new Hercules Color Card is the smart way to go.

It gives you a parallel printer port and a size small enough to fit in one of the XT's or Portable's short slots.

And both Hercules cards are compatible with the new AT™ and backed by our two year warranty.

Call 800 255-5550 Ext. 408 for the name of the Hercules dealer nearest you and we'll rush you a free info 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.
page 18) as lacking "many architectural features needed for multiuser, multitasking applications." This is a gross distortion of the facts, since, from the beginning, Sage has supplied an excellent multiuser BIOS capable of supporting not only multiple users but multiple operating systems running simultaneously. I know of no other supermicro that can make this claim. Even single-user operating systems such as Softech's UCSD p-System appear to be multiuser on the Sage as multiple copies are run in memory partitions isolated by the Sage MU BIOS. The BIOS allows easy configuration of each user's time slice and priority, flexible mapping of RAM disks (yes more than one!), memory and disk partitions, and serial ports and peripheral devices. Different operating systems may be allowed access to shared disk space.

At last count, at least 11 operating systems are supported, including CP/M 68K, Voltiton's Modula-2 system, HyperFORTH, and Whitesmith's UNIX-like multiuser Idris. The Idris implementation currently available was ported to the Sage by Rakon, an Australian company. Rakon's version reportedly runs 2.5 to 5 times faster on the same hardware as Logos Information Systems' (Dr. Peskin's firm). In this light, Dr. Peskin's opinion about Sage can hardly be characterized as "objective technical assessment."

The new products announced in September by Sage (now Stride Micro) will have a hardware memory-management option to support UNIX System V with Berkeley enhancements. They also run faster (10 MHz standard, 12 MHz optional), support hardware floating point, utilize the industry standard VME bus, come standard with Omninet networking hardware, and are even lower in cost.

JAI GOPAL SINGH KHALSA
Millis, MA

IMPROVING THE IBM KEYBOARD

Where I work we have IBM PCs and X's in abundance. People are always griping about the poorly designed keyboard, i.e., the long reach to the Return key and the dual-function 10-key pad/cursor controls that perform only one of their roles at a time. The complaints peaked around budget time, when data entry to spreadsheets became a paramount hassle. We found a partial remedy, however. Instead of switching between the 10-key pad and the cursor controls by using the Num Lock key, we found it easier to divide the labor between our two hands by locking in the 10-key pad for data entry and then to move to another cell, holding the left shift key down with our left hands and moving the cursor with the 10-key pad that then functions as a cursor control.

Granted, this is not a perfect solution, but the roar did quiet. Now we'd like to know how to solve the problem of the reach to the Return key.

W. TRAVIS GOOD
Summit, NJ

SOFTWARE SWAPPING

In response to "Dear Thieves" (August 1984, page 18), William Wright has expressed the opinion that it is entirely

(continued)
Apple Owners: Increase your Display up to 455% and Get The Big Picture!

You know the importance of "Bottom Line" and cash-flow management in your daily operations. Original 40-column spreadsheets were adequate, 80-column spreadsheets were better, but even with 80-columns you still waste valuable time scrolling your spreadsheet searching for data. The Videx UltraTerm will provide you the tool you need to reduce wasteful searching, and free up your time to make important business decisions.

Just look at the actual display photo above. The dark green portion of the spreadsheet represents the amount of information you get with a standard Apple display. The medium green area shows you what you get with ordinary 80-column displays. Nice. But not enough. With UltraTerm, your business "Big Picture" is exploded up to a full 128-columns by 32-lines (as shown by entire photo above), or ...% more data than you've previously had to work with.

In addition to the obvious benefits of using the UltraTerm with your spreadsheet, you can gain depth, breadth when using the new generation word processors that exploit the UltraTerm's vast array of capabilities. Word processors that currently support UltraTerm's expanded display formats include STAR, Word Juggler II, Letter Perfect, Executive Secretary, Apple Writer II (with Videx Preboot), and Write Away.

So, contact your local computer dealer today! If they are out of stock you can call Videx directly. Get THE BIG PICTURE today!

Suggested Retail Price—$379.00

UltraTerm is a trademark of Videx, Inc. Apple is a trademark of Apple Computer, Inc. Visicalc is a trademark of VisiCorp, Inc.

1. Except colors which were added for illustrative purposes only.
2. Assuming VisiCalc and Apple 40 x 24 display.

Inquiry 324

Videx INC. TM
1105 NE Circle Blvd., Corvallis, OR 97333
503-759-0521
NEW from BORLAND!
TURBO TOOLBOX & TURBO TUTOR

Offer extended by popular demand!


"TURBO is much better than the Pascal IBM sells."
Jerry Pournelle
Byte. July 1984

"TURBO PASCAL appears to violate the laws of thermodynamics. You won't find a comparable price/performance package anywhere. It is simply put, the best software deal to come along in a long time. If you have the slightest interest in Pascal... buy it."
Bruce Webster
Softtalk IBM: March 1984
BORLAND INTERNATIONAL GIFT PACK

ONLY $99.95
A SAVINGS OF $30!

What a gift for you and your friends! The extraordinary TURBO PASCAL compiler, together with the exciting new TURBO TOOLBOX and new TURBO TUTOR. All 3 manuals with disks for $99.95.

TURBO PASCAL Version 2.0 (reg. $49.95). The now classic program development environment still includes the FREE MICROCALC SPREAD SHEET. Commented source code on disk
• Optional 8087 support available for a small additional charge

NEW! TURBO TOOLBOX (reg. $49.95). A set of three fundamental utilities that work in conjunction with TURBO PASCAL. Includes:
• TURBO-ISAM FILES USING B + TREES. Commented source code on disk
• QUIKSORT ON DISK. Commented source code on disk
• GINST (General Installation Program)

Provides those programs written in TURBO PASCAL with a terminal installation module just like TURBO!
• NOW INCLUDES FREE SAMPLE DATABASE... right on the disk! Just compile it, and it's ready to go to work for you. It's a great example of how to use TURBO TOOLBOX and, at the same time, it's a working piece of software you can use right away!

NEW! TURBO TUTOR (reg. $29.95). Teaches step by step how to use the TURBO PASCAL development environment—an ideal introduction for basic programmers. Commented source code for all program examples on disk.

30 DAY MONEY BACK GUARANTEE Available at your nearest software dealer.

For VISA and MASTERCARD order call toll free: 1-(800)-255-8008 1-(800)-742-1133
(Lines open 24 hrs., 7 days a week) Dealer and Distributor inquiries welcome (408) 438-8400

CHOOSE ONE (please add $5.00 for handling and shipping U.S. orders)

<table>
<thead>
<tr>
<th>Package</th>
<th>Price</th>
<th>Handling Fee</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Three-Gift Pack</td>
<td>$99.95</td>
<td>$5.00</td>
<td>$104.95</td>
</tr>
<tr>
<td>Turbo Toolbox</td>
<td>$49.95</td>
<td>$5.00</td>
<td>$54.95</td>
</tr>
<tr>
<td>Turbo Tutor</td>
<td>$29.95</td>
<td>$5.00</td>
<td>$34.95</td>
</tr>
<tr>
<td>Turbo 8087</td>
<td>$89.95</td>
<td>$5.00</td>
<td>$94.95</td>
</tr>
</tbody>
</table>

Check__________Money Order__________VISA__________MasterCard__________
Card #:________________________Exp. date:____________________Shipped UPS
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.
We think Rel 3.0 of the Eco-C Compiler is the fastest full C available for the Z80 environment. Consider the evidence:

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Eco-C</th>
<th>Aztec</th>
<th>Q/C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve</td>
<td>29</td>
<td>33</td>
<td>40</td>
</tr>
<tr>
<td>Fib</td>
<td>75</td>
<td>125</td>
<td>99</td>
</tr>
<tr>
<td>Deref</td>
<td>19</td>
<td>CIC</td>
<td>31</td>
</tr>
<tr>
<td>Matmult</td>
<td>42</td>
<td>115</td>
<td>N/A</td>
</tr>
</tbody>
</table>

*Times courtesy of Dr. David Clark;
CNC - Could Not Compile;
N/A - Does not support floating point.

We've also expanded the library (120 functions), the user's manual and compile-time switches (including multiple non-fatal error messages). The price is still $250.00 and includes Microsoft's MACRO 80. As an option, we will supply Eco-C with the SLR Systems assembler - linker - librarian for $295.00 (up to six times faster than MACRO 80).

For additional information, call or write:

6413 N. College Ave. • Indianapolis, Indiana 46220

(317) 255-6476

We think Rel 3.0 of the Eco-C Compiler is the fastest full C available for the Z80 environment. Consider the evidence:

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Eco-C</th>
<th>Aztec</th>
<th>Q/C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve</td>
<td>29</td>
<td>33</td>
<td>40</td>
</tr>
<tr>
<td>Fib</td>
<td>75</td>
<td>125</td>
<td>99</td>
</tr>
<tr>
<td>Deref</td>
<td>19</td>
<td>CIC</td>
<td>31</td>
</tr>
<tr>
<td>Matmult</td>
<td>42</td>
<td>115</td>
<td>N/A</td>
</tr>
</tbody>
</table>

*Times courtesy of Dr. David Clark;
CNC - Could Not Compile;
N/A - Does not support floating point.

We've also expanded the library (120 functions), the user's manual and compile-time switches (including multiple non-fatal error messages). The price is still $250.00 and includes Microsoft's MACRO 80. As an option, we will supply Eco-C with the SLR Systems assembler - linker - librarian for $295.00 (up to six times faster than MACRO 80).

For additional information, call or write:

6413 N. College Ave. • Indianapolis, Indiana 46220

(317) 255-6476

wrong and dishonest to copy software, even for one's own use. He is absolutely right. But his statement is incomplete.

The software industry, in general, has shown a total disregard for honesty in its marketing. A large portion of the available software is sold without proper testing. It is tested by us, after we pay a ridiculous price for it. Customer support just does not exist, and the documentation is often a joke. According to the "rules" I must buy WordStar for each machine in the office. And I do not have backup protection with some software. Even after paying their price I am held ransom!

My complaint is not against all software publishers. Lotus, for example, has done a wonderful job of documentation and service.

Mr. Wright is right. But incomplete. Two wrongs don't make a right. But as long as the publishers are so blatant in their dishonesty, software swapping will be with us.

DAVE CHURCHER
Rye, NH

I really got a big laugh out of Paul Bernstein's letter ("Computers and Lawyers: August 1984, page 16) about the "argument" between him and his fellow lawyer Robert Wilkins over whether lawyers need to know "terms such as RAM, bps...and other foreign, often unnecessary technical terms." That from lawyers "...a Society [that] hath a peculiar Cant and largon of their own, that no other mortal can understand, and wherein all of their Laws are written, which they take special Care to multiply: whereby they have wholly confounded the very Essence of Truth and Falsehood, of Right and Wrong."

No comment could better be made on the subject than that by Jonathan Swift in Gulliver's Travels. Part 4: A Voyage to the Country of the Houyhnhnms. Chapter 5.

WILLIAM E. WHITE
Miami, FL

After reading all those pro Modula-2 and Ada articles in BYTE (August 1984), I at first feared I was the only one who harbors mixed feelings concerning these languages. I was relieved to find David V. Mof­fat's "UCSD Pascal vs. Modula-2: A Dissenting View" (page 428).

While I don't agree with all of Mr. Mof­fat's views (e.g., that the lack of publications on Modula-2 will become less
Absolutely first class. Our Keyboard Storage Drawer is tops—it can turn your narrow credenza or typewriter return into a perfect work station. From a reinforced platform on protective felt pads, the cantilever drawer extends on industrial strength ball bearing glides and locks into working position. The scratch resistant finish matches IBM colors. Optional locking device. Also available—an under-desktop suspension model—the bottom drawer. But still "top drawer!"

MicroComputer Accessories, Inc.

5721 Buckingham Parkway
P.O. Box 3725
Culver City, California 90231
Telephone 213/641-1800
Inquiry 355.

In Europe: Inquiry 356 for Dealers.
N.V. Microcomputer Accessories Europe S.A.
Rue de Florence 37
1050 Bruxelles, Belgique
Telephone 02/538.61.73

These and other fine products are available at Sears Business Systems Centers, Computerland, Businessland, IBM Product Centers and other computer/software retail locations.
distinct in the future). I’d like to point out a couple of items that have escaped mention so far.

The improved readability of Modula-2 source, achieved by the no-longer-needed BEGIN...END brackets that contain Pascal compound statements, is obviated because of the END statement that terminates all control structures apart from REPEAT. I would have preferred a specific end statement for each control statement, like ENDDO, ENDWHILE, ENDDO, ENDIF, etc.

Pascal’s lamented rigid order in which declarations have to be made shows its main advantage when it comes to software maintenance. I wouldn’t want to look for that doubly defined global variable that crept in when an existing program was extended, were it possible to declare said variable anywhere near the procedure that used it first, let alone in some external module.

I find Modula-2’s IF not much of an improvement over that of Pascal as far as nested IFs are concerned, the latter of which I tend to avoid and use logical expressions instead. Taking Robert J. Paul’s recipe example (“An Introduction to Modula-2,” August 1984, page 195), wouldn’t you agree that

```
IF (oregano IN recipe[1])
  AND
  (thyme IN recipe[1])
THEN
  WRITELN( ‘Use oregano & thyme’)
ELSE
  WRITELN( ‘Use only thyme’);
```

is easier to understand than what appeared on page 198?

Edmund Ramm 
Kaltenkirchen, West Germany

What a shame that you did not include the article “UCSD Pascal vs. Modula-2: A Dissenting View” by David V. Moffat in the theme section of your August issue: it would have provided some balance in what was an informative but rather biased section.

I write to support Mr. Moffat’s thesis that Modula-2 has yet to be proved a significant improvement over UCSD Pascal. Having used UCSD Pascal since 1980, I can link in assembly-language routines, build libraries, and write units with hardly a second thought. For programmers, the inequality of

Benefits of Modula-2  >  Cost of software + time to relearn + time to rewrite old routines

must be clearly shown to be true. I have yet to be convinced that the benefits outweigh the value of Pascal experience. Could it be that those software companies that have sold thousands of Pascal compilers in the past few years now fear that they are beginning to saturate the market and are promoting Modula-2 as a means of maintaining company profits?

One small point: Am I the only one who finds that dozens of ENDS, some for IFs, some for FORs, some for LOOPs, make Modula-2 programs less easy to read than Pascal programs?

Stuart A. Bell 
Sidmouth, Devon, England

(continued on page 416)
**C Listing Bug**

Bob Bonomo picked out a bug in the C source listing for the quicksort function in the October BYTE Japan. (See "Bits and Pieces" by William M. Raie, page 369.) In listing 1 on page 374, the third WHILE statement should read:

```c
while (j > i & & strcmp(baselil, pivot) >= 0)
```

Our thanks to Mr. Bonomo.

**A Case of Misidentification**

A caption in our product description of the Tandy 1000 incorrectly identifies a screen display. (See "The Tandy 1000" by G. Michael Vose. December, page 98.) On page 101, the caption identifies the screen display on the right as being produced by DeskMate. The photo actually depicts a screen from IBM's HomeWord, a word-processing program that also runs on the Tandy machine. HomeWord is produced by IBM's Entry Systems Division in Boca Raton, Florida.

**Penny Wise, Pound Foolish?**

A note arrived from Paul Hills of Launceston in Cornwall, England, telling us that we misstated the annual subscription fee for his club's newsletter. (See Clubs & Newsletters. August, page 68.) The 6809 User Group Newsletter is available for £3 annually. Overseas subscriptions are $4.70 in the U.S. and $6 in Canada.

**Weather Report Incorrect**

Charles S. Barnaby, vice president of the Berkeley Solar Group, sent us a clarification concerning the computer service that his company offers. In Matthew Lesko's article "Low-Cost On-Line Databases" (October, page 167), it was incorrectly stated that the Berkeley Solar Group offers "the latest weather." The Berkeley Solar Group has a large collection of weather data; however, this data is based on records at least several years old. The data is suitable for use with building-energy-analysis software. Portions of this information are available through interactive inquiry but the bulk of it serves as input for hour-by-hour building simulation programs.

The weather data is available for users of the Berkeley Solar Group's building energy-analysis software, which includes such programs as DOE-2, CALPAS3, and FCHART. The data can be used for other purposes, but its purchase must be negotiated on a case-by-case basis.

We thank Mr. Barnaby for clarifying this inaccuracy on our part. The Berkeley Solar Group can be reached at 3140 Martin Luther King Jr. Way, POB 3289, Berkeley, CA 94703, (415) 843-7600.

**Books Have American Distributor**

Jeffrey A. Blackman of the Computer Science Press in Rockville, Maryland, sent us some information about five books mentioned in the November Books Received section (page 495).

The books, *A First Course in Formal Language Theory, From Logic to Computers*, by Michael A. C. A. Blackman of the Computer Science Press. Microcomputers and Their Commercial Applications, and *UNIX for Users*, are all published by Blackwell Scientific; however, they are distributed in North America by the Computer Science Press. If you wish to order these books, contact Computer Science Press Inc., 11 Taft Court, Rockville, MD 20850, (301) 251-4050.

**Windy Day Bug**

Mark R. Parker of Seattle, Washington, saw an error in listing 1, the Module Windy-Day, in Eric Eldred's review "Volition Systems' Modula-2" (June, page 333). In the procedure OpenWindow (page 356), the line:

```c
Open (wind, 0, 1, 39); 
```

should read:

```c
Open (wind, 0, 0, 1, 39); 
```

because a call to open requires five parameters. The omitted second zero places the message at the upper left-hand corner of the screen.

Also, the comment "Phony" should be changed to "little busy bee."

**New Telephone Number**

Microserve in Tyler, Texas, which was mentioned in the October BYTE, has a new telephone number for its network. (See "Low-Cost On-Line Databases" by Matthew Lesko, page 167.) The new telephone number is (214) 581-3722.

**Photo Credits Due**

We inadvertently neglected to credit Lee Wright, a freelance photographer based in Medford, Massachusetts, for snapping the photos that accompanied Henry Brugsch's article in the *Guide to the Apple Personal Computers*, a special supplement to the December BYTE. (See "Apple's New Modem and Access II", page A58.) We apologize for this oversight.

**Address Change**

Sinclair Research, whose ZX Spectrum+ was featured in the December BYTE What's New, has relocated. (See page 435.) The new address is Sinclair Research, Berkeley Square House, London W1X 5LB, England: tel: 01-499 2666; Telex: 265212.

**Feedback**

More on POPLOG

In the October BYTE U.K., we inadvertently listed Aaron Sloman as the distributor for POP-11 and POPLOG, a pair of tools available to researchers in artificial intelligence. (See "Pop and Snap" by Dick Pountain, page 381.) Mr. Solman informs us that POPLOG is marketed in the US by Systems Designers Ltd. International, Suite 201, 5203 Leesburg Turnpike, Falls Church, VA 22041, (703) 820-2700. In the U.K., it's available from Systems Designers Ltd., Systems House, 1 Pembroke Broadway, Camberley.
Speaking of Least Squares

Steven A. Ruzinsky saw a number of doubtful statements in Marco Caccei and William Cacheris's article “Fitting Curves to Data” (May, page 340). He cites these remarks:

This is called the least-squares criterion. For random errors randomly generated (usually a reasonable assumption), this is the best criterion of all.

"This is simply untrue," says Ruzinsky. "In order for least squares to be the best criterion, the errors must have independent and identical normal (Gaussian) distributions. In situations meeting this requirement, least squares can be a maximum likelihood estimate of the parameters. For situations where the errors are not Gaussian, least squares is suboptimal. A good counter example to the authors' statement is the case where the errors have a binary distribution, e.g., a random sequence of 1's and -1's. In this case, I believe one will find a minimax fit (also called "Chebyshev" or "I oo") much more statistically efficient than least squares."

Mr. Cacheris notes that the first statement was intended to be broad and that least-squares analyses are often used under less than optimal conditions since the results can be checked by various methods, such as sensitivity analysis.

"Least-squares method is certainly best when the errors have identical distributions . . . [which we mentioned towards the end of our article when describing sensitivity analysis. We state that several synthetic data sets . . . are made by adding identical normal distributions to the error-less curve. Thus, the least-squares fits to these synthetic data sets are the best fit to these data sets and the values of the parameters obtained should approach the experimental data's values of the parameters if the error in the experimental data has identical normal distributions."
THE NCR PC IS COMPATIBLE WITH PEOPLE, TOO.

Getting along with all kinds of people is one of the most endearing qualities of the NCR PC.

It gets along with bosses, secretaries, accountants, engineers, lawyers, everybody.

Even first-timers take a liking to this computer the moment they take it out of the box.

Perhaps its good looks have a lot to do with this. But its beauty is more than skin deep.

Its smart, integrated cabinet takes up precious little space on your desk.

There are no complicated wires or clumsy boxes to set up. All you have to do is plug it in.

The keyboard is the same familiar layout your fingers know and love. Plus a couple of nice touches. Like separate cursor keys and a separate numeric keypad to make it easier to work with programs that have long lists and lots of numbers.

The NCR PC even comes with two special self-teaching programs that will have you computing in a matter of minutes. NCR PAL shows you how to use the computer itself. NCR TUTOR introduces you to word processing, spreadsheets and other popular business programs.

And if you get lost along the way, there's a built-in HELP command you type in to get you back on track.

Add all this up and you start to see why the NCR PC is so compatible with people.

Of course, it's also compatible with thousands of programs available at computer stores everywhere.

And it's compatible with industry standard hardware. Which means you can add on all sorts of helpful accessories. Like a printer, a modem for electronic mail, a mouse for even easier operation and all the memory you need—up to 640K.

If you'd like to meet this terrific computer, go to your nearest Authorized NCR Personal Computer Dealer.

Just ask for the computer everybody gets along with.

For the name of your nearest dealer, call toll-free: 1-800-544-3333. In Nebraska call: 1-800-343-4300.

NCR A BETTER PERSONAL COMPUTER. IT'S EXACTLY WHAT YOU'D EXPECT FROM NCR.
Great Ideas look even better on a Princeton monitor

Your Great Ideas deserve the best image you can give them. But, just as a music system's performance depends on the speakers, your computer system is limited by the quality of your monitor.

Monitor performance can be measured. That's something you should know about.

In other words, your Great Ideas should be seen, not blurred.
Things you should know about monitors

Resolution The quality of a color monitor's image is directly related to its resolution. The greater the number of dots available within a given area for displaying an image the greater the resolution.

- The PRINCETON SR-12 monitor features an extraordinary 640x480 [non-interlaced] resolution. The result is an extremely high quality, flickerless image with text that approaches monochrome quality. When used in conjunction with the PRINCETON Scan-Doubler card, the SR-12 runs from a standard IBM or equivalent color card, maintaining complete compatibility with all IBM software.

Dot pitch The image on an RGB color monitor is made up of a series of tiny dots. Dot pitch measures the distance between those dots. Anything finer than .38mm is considered high resolution.

- The PRINCETON HX-12 RGB color monitor, with a dot pitch of .31 mm, offers the finest resolution in its class. The HX-12 delivers 16 crisp, sharp colors including clean whites without color bleed—a not-so-easy accomplishment in an RGB monitor.

Price All Princeton monitors set the price/performance standard in their class. The SR-12 at $799 compares favorably with monitors costing hundreds more. The HX-12 is in a class by itself at $695.

- The PRINCETON MAX-12, with easy-on-the-eyes amber phosphor, sets the standard for monochrome monitors at $249. The MAX-12's dynamic focusing circuitry ensures sharpness not only in the center but also in the edges and corners. And it runs off the IBM PC monochrome card—no special card is required.

All three monitors feature a non-glare screen and an IBM compatible cable. A PCjr adapter cable is also available for the HX-12. And to see your Great Ideas from the best possible angle, you can put your Princeton monitor on the Princeton Undergraduate Tilt and Swivel Base for only $39.95. Or, while supplies last, get the Undergraduate FREE with the purchase of a MAX-12 monitor.

Image The ultimate test of any monitor is how the image looks to your own eyes. Compare the Princeton monitors side-by-side with the competition at Computerland, Entre or your local independent dealer.

Do it soon. You and your Great Ideas deserve the best.
FOR PEOPLE WHO THOUGHT THEY'D NEVER MEET THE PERFECT 10

We've got one to knock your socks off. The StarWriter™ Y10 from C. Itoh.

What sets this letter quality daisy wheel apart is its fabulous figure. Priced at only $595.

This little beauty prints 22 letter perfect characters per second. And like the rest of C. Itoh's fine printers, the StarWriter Y10 acts without acting up.

That's because it has been thoroughly tested and proven on the job to assure reliability. And it comes with a full year's warranty, backed by over 400 authorized service centers coast to coast.

The Y10 is an awful lot of printer for very little money. But that's not surprising when you consider that C. Itoh's been producing superior printers for over a decade. What's more, it has the strong backing of our 126-year-old parent company with over $60 billion in annual sales.

And the StarWriter Y10 is compatible with most of the popular PCs. It has a 256-byte buffer. And there is a full line of accessories available such as a cut sheet feeder and tractor feed.

Little wonder C. Itoh printers are No. 1 worldwide, with over 2.2 million sold annually. And with the StarWriter Y10 we're aiming to keep it that way.

To meet your own perfect 10, just see your local C. Itoh printer dealer. Or for more information call 1-800-423-0300.

Or write C. Itoh Digital Products, Inc. 19750 South Vermont Avenue, Suite 220, Torrance, CA 90502.
Radio Shack's battery-powered notebook-size Model 200 has a flip-up 16-line by 40-column LCD and a built-in 300-bps autodial modem. The Model 200 comes with 24K bytes of RAM and 72K bytes of ROM, and it includes word-processing, spreadsheet, telecommunications, and address-book programs.

Memory can be expanded with two 24K-byte banks of RAM, for a total of 72K, and a 32K-byte ROM chip. The system's keyboard has 60 full-travel sculptured keys, 12 special- and general-purpose function keys, and a power switch that is automatically depressed when the LCD/cover is closed. A cassette interface and parallel and serial ports are standard. The Model 200 weighs 4.5 pounds and measures 11 by 8.5 by 2.5 inches.

Although the Model 200 uses the same processor as the Model 100, changes in ROM will prevent Model 100 machine-language programs from running on the Model 200; BASIC programs will work on both. Other differences are a modified cursor key cluster, enhanced word-processing features, Microsoft's Multiplan spreadsheet in ROM, calculator function available from any program, and optional pulse or tone dialing. Normal battery life is 10-16 hours depending on RAM size, or you can install rechargeable nickel cadmium (nicad) batteries.

The Model 200 will retail for $999; 24K-byte add-on modules cost $249.95 each. Contact Tandy/Radio Shack, One Tandy Center, Fort Worth, TX 76102, or your local Radio Shack store. Inquiry 600.

Datavue Portable Includes Disk Drive, 80 by 25 Display

Quadram's Datavue 25 is a 14-pound portable computer with a 360K-byte 5¼-inch disk drive and a pivoting 80-character by 25-line LCD. It features an 83-key keyboard that communicates with the computer through infrared signals. The Datavue 25 has an 80C88 microprocessor, a real-time clock, 128K bytes of memory, and serial and parallel ports. It is powered either by an AC adapter/recharger or by built-in batteries that last up to four hours.

Monochrome graphics are available in either 640 by 200 resolution or 320 by 200 resolution with four levels of gray. An internal 300-bps modem is an option. Memory can be expanded to 256K bytes using 64K-byte chips or to 1 megabyte using 256K-byte chips. Quadram also plans to release an external IBM PC-compatible bus-expansion chassis and an external second floppy-disk drive.

The Datavue 25 should be available in March for $2195. Contact Quadram, 4355 International Blvd., Norcross, GA 30093, (404) 923-6666. Inquiry 601.

GRiD Systems' Model 1131 Compass is a portable computer with a 25-line by 128-column electro luminescent display (ELD). GRiD says that the durable 10-pound computer is built to stand a shock equal to 130 Gs. The Model 1131 features 256K bytes of RAM (expandable to 512K bytes), 384K bytes of nonvolatile bubble memory, a 300/1200-bps auto-dial/auto-answer modem, and the MS-DOS operating system in ROM.

The Compass Model 1131 costs $6795; with 512K bytes, it's $7995. The price of the original Model 1100 is now $4250. Contact GRiD Systems Corp., 2535 Garcia Ave., Mountain View, CA 94043, (415) 961-4800. Inquiry 602.

Model 1131 Compass Has 128-column LCD

(continued)
Visage Videodisc Software Development System

Visage has introduced a series of products for developing interactive videodisc software. Using an IBM PC or compatible personal computer, a standard videodisc player, and Visage's controller card and software, developers can create interactive programs for educational applications using images from videodiscs overlayed with computer-generated text and graphics.

Visage's V:Link 1000 includes an IBM PC expansion card and language-interface software, which together support NTSC graphics with 256 by 192 overlay capabilities. The V:Link 1500 adds the ability to switch between a 256 by 192 overlay and a 320 by 200 nonoverlay image, while the V:Link 1550 allows both 256 by 192 and 320 by 200 graphics to be overlayed on videodisc images. Prices range from $1150 to $2150.

The V:Station 2000 family all feature IBM PC-compatible computers with 256K bytes of RAM, one or two floppy disks, the V:Link 1500 graphics board, and a 13-inch RGB color monitor. Some of the V:Station configurations also include medium- or high-resolution touchscreens, 10-megabyte hard disks, and 512K bytes of memory. Prices range from $5995 to $10,850.

The V:Station 2000 family all feature IBM PC-compatible computers with 256K bytes of RAM, one or two floppy disks, the V:Link 1500 graphics board, and a 13-inch RGB color monitor. Some of the V:Station configurations also include medium- or high-resolution touchscreens, 10-megabyte hard disks, and 512K bytes of memory. Prices range from $5995 to $10,850.

Visage's products support the KoalaPad, Bit Pad, and Microsoft Mouse as graphics input devices. Optional support packages allowing the Visage software and hardware to be used with BASIC, Pascal, dBASE II, and 8088 assembly language cost $295 each, V:Paint I and II, $500 each, use the Microsoft Mouse ($125 extra) to create images. Cables are available to link the V:Link card to Sony, Pioneer, RCA, and Hitachi videodisc players.


NEC Introduces Four-Color Plotter

Britewriter is a four-pen color plotter that NEC says is compatible with Hewlett-Packard plotters. The Britewriter can plot at a speed of 60 millimeters per second (mm/s) in low-speed mode and 112 mm/s in high-speed mode. Characters can be drawn at 4.6 cps in one color or 2.6 cps in four colors. The plotter comes with black, blue, green, and red felt-tip pens. An optional set of colors includes violet, orange, brown, and pink pens. The plotter can be used with plain paper or transparencies up to 8¾ inches wide.

The Britewriter is available for RS-232C serial interfaces. It features a 256-byte character and instruction memory and supports the ASCII character set. Because it uses the same commands as Hewlett-Packard 7470 and 7550A plotters, it works with most graphics programs that support Hewlett-Packard plotters.


Commodore Announces 128K Computer

Commodore's B128 runs any program written for the Commodore 64 and has a number of additional capabilities. This system has 128K bytes of memory, expandable to 512K, and it can display 80 columns by 25 lines of text in color on an optional monitor. In addition to the 8500 processor, which is used to run Commodore software, the B128 includes a 2-MHz Z80 co-processor to run most CP/M-80 programs.

The 92-key keyboard has a numeric keypad, 4 cursor keys, 4 numbered shiftable function keys, and 4 special-purpose function keys. Like the 64, the B128 can display 16 colors and 8 independently movable sprites and can generate sound in three voices each with a range of eight octaves. The B128 comes with the same serial, expansion, user, and joystick ports as the 64: it also includes video interfaces for a standard television or an RGB or NTSC monitor.

Commodore also introduced a faster disk drive for the Commodore 64 and B128, which transfers data to the 64 at 320 cps, or to the B128 at 2000 cps, or, when running CP/M, 3200 cps.

The Commodore B128 will sell for less than $400. Contact Commodore, Computer Systems Division, 1200 Wilson Dr., West Chester, PA 19380, (215) 431-9100. Inquiry 605.
Systemaster II. Responding to market demand for speed and increased versatility, Teletek is proud to announce the availability of the next generation in 8-bit technology — the new Systemaster II! The Systemaster II will offer two CPU options, either a Z80B running at 6 MHz or a Z80H running at 8 MHz, 128K of parity checked RAM, two RS232 serial ports with on-board drivers (no paddle boards required), two parallel ports, or optional SCSI or IEEE-488 port. The WD floppy disk controller will simultaneously handle 8" and 5¼" drives. A Zilog Z-80 DMA controller will provide instant communications over the bus between master and slave. Add... SBC 86/87. As the name indicates, Teletek's new 16-bit slave board has an Intel 8086 CPU with an 8087 math co-processor option. This new board will provide either 128K or 512K of parity checked RAM. Two serial ports are provided with individually programmable baud rates. One Centronics-compatible parallel port is provided. When teamed up with Systemaster II under TurboDOS 1.3, this 5MHz or 8MHz multi-user, multi-processing, combination cannot be beat in speed or feature flexibility!

Teletek Z-150 MB. Teletek is the first to offer a RAM expansion board designed specifically for the Z-150/Z-160 from Zenith. The Teletek Z-150 MB is expandable from 64K to 384K. Bring your Z-150 up to its full potential by adding 320K of parity checked RAM (or your IBM PC, Columbia, Compaq, Corona, Eagle, or Seega to their full potential). The Teletek Z-150 MB optionally provides a game port for use when your portable goes home or a clock/calendar with battery backup!

Evaluate the Systemaster II, SBC 86/87 or Teletek Z-150 MB for 30 days under Teletek's Evaluation Program. A money-back guarantee is provided if not completely satisfied! All Teletek products carry a 3-year warranty. Specifications subject to change without notice.

TELETEK
4600 Pell Drive
Sacramento, CA 95838
(916) 920-4600
Telex #4991834
Answer back — Teletek Inquiry 310

Yes, I'm interested in information regarding:

☐ Systemaster II
☐ SBC 86/87
☐ Z-150 MB

Name: ____________________________
Company: _________________________
Address: __________________________
WHAT'S NEW

Computer Satellite Service

Satellite Broadcast Network has announced a satellite service that will transmit financial and news information to personal computer owners. SBN plans to have the service operational in May. You will need a 12-GHz satellite-receive antenna, a low-noise amplifier, a solid-state receiver, and SBN’s demodulator; all are available from SBN for $695. SBN will also charge a fee for access to each type of information, starting at about $25 per month. SBN will use multiple 9600-bps channels. Some channels will broadcast news and weather information, others will transmit stock and commodity prices. One channel might permit downloading of software sample programs, while another could include special-interest database information. A user could place a request for special database information with modems and telephone lines, but the response could be broadcast via satellite to avoid phone charges. A special header code would ensure that only one person could decode the information.

Modular Robot Kit

Cybot’s Tutor is a modular robot with a five-axis arm designed for educational and training uses. Because the robot can be dismantled and reassembled many times, it helps you understand how robotics work.

The package includes the robot arm, complete with five motors and a gripper, and the Controller module, which has one free S-100 card slot for custom applications, a standard RS-232C serial port, and an interface for an optional “teach pendant.” You can control the robot arm by sending ASCII commands from a personal computer through the RS-232C port or by directly manipulating the arm with the teach pendant.

Also available is an Optical Encoder Set. Since the set indicates the actual position of one of the motors (five are needed to monitor all five axis motors), a full feedback loop can be used to make sure the robot arm is precisely where it’s supposed to be.

The complete Cybot Tutor robotics kit costs $3395. The optional teach pendant is $129.95. Each Optical Encoder Set is $70. Parts of the robot kit can be purchased separately. Contact Cybot Inc., 12510 128th Ave. NE, B-5, Kirkland, WA 98034, (206) 823-4156.

Contact Satellite Business Network Inc., 212 West Superior St., Chicago, IL 60610, (312) 266-9844. Inquiry 606.

Sord Adds 80 by 25 Display to IS-11

Sord has released a version of its IS-11 Consultant computer with an 80-character by 25-line liquid-crystal display and a built-in 300-bps modem. The 6½-pound IS-11C has 80K bytes of RAM (expandable to 144K), 72K bytes of ROM, a 128K-byte microcassette tape drive, 62 full-travel sculptured keys plus 8 special function keys, and a CMOS 280A microprocessor running at a speed of 3.4 MHz. In addition to parallel and serial ports, the IS-11C can interface with a barcode reader, a separate numeric keypad, and optional 64K-byte ROM cartridges. Word-processing and communications software are standard in ROM.

The IS-11C should be available this month for $1495. For more information, contact Sord Computer of America Inc., 645 Fifth Ave., New York, NY 10022, (212) 759-0140.

Inquiry 608.

(continued)
PERSONALITY PROBLEM?
UNIX™ and DOS™ At the Same Time!

Looking at an IBM PC/AT? Happy with DOS but want UNIX? Happy with UNIX but want DOS? Want them working together?

**Get The Connector!™**

The Connector is a revolutionary product that allows DOS applications to run on the IBM PC/AT or XT under VENIX/86 (the first licensed AT&T UNIX operating system for the IBM PCs) or PC/IX. That means you can add one or more terminals to your AT which run programs using multi-user VENIX/86 to share the disk and printer. Switch between UNIX and DOS at the console with a single command. And run more than one task simultaneously. Like running a spelling check in the background while you print a report and run Lotus 1-2-3™ or dBaseII™.

Get yourself an AT and load it with VENIX. Collect your DOS and/or UNIX applications. We'll supply The Connector. The right solution to your software personality problems.

Call for complete details.
Unisource Software Corp., Department 4109, 71 Bent Street, Cambridge, MA 02141.
Telex 92-1401/COMPUMART CAM.
617-491-1264

Also available on the PC/XT and compatibles.

*UNIX is a trademark of AT&T Technologies, Inc. DOS is a trademark of Microsoft, Inc. PC/XT and PC/CT are trademarks of IBM.*
**Digital Filtering Chip for Speech Processing**

Kurzweil Applied Intelligence has introduced the KSC 2408 digital filter chip for use in sound-processing applications.

Each of the eight filters in the KSC 2408 processes 24 bits of information (with 48 bits accumulated at a time). Each of the filters processes information in a given frequency range; Kurzweil says that dozens of filters—or many 2408 chips—would be needed to divide up the frequency spectrum of the human voice enough to make speech recognition possible.

The 2408 can process sound up to a sampling frequency of 125 kHz (125,000 cycles per second) if only two filters are activated; if all eight filters are activated, the maximum sampling rate is 32 kHz. Since the chip is programmable, it can be used for other types of digital filtering, including high-pass, band-pass, or low-pass.

Kurzweil plans to market a

---

**Twelve Million Instructions per Second**

According to Cromemco, its Maximizer coprocessor subsystem executes an average of 12 million instructions per second. The Maximizer features a 2900-series ECL (emitter-coupled logic) bit-slice processor running at 48 MHz. It also has 16K bytes of 50-ns RAM, 16 dual-port registers, and 4,096 48-bit words for downloaded microcode instructions. Cromemco says the chip's speed is enhanced by the use of a 60-ns multiplier chip and a doubly pipelined instruction path. Most instructions execute in 62.5 ns, though some may take as long as 125 ns.

The Maximizer comes on two S-100 (IEEE-696) bus boards that plug into Cromemco's microcomputers. The system runs under the company's Cromix operating system, and it will soon run under UNIX System V as well.

The Maximizer supports FORTRAN, Pascal, and C. Also available is MAXASM, a microcode assembler used to write custom microcode for applications where execution speed is critical.

The Maximizer retail for $3,495; the MAXASM Microcode Assembler costs $2,995. Contact Cromemco Inc., 280 Bernardo Ave., POB 7400, Mountain View, CA 94039, (415) 964-7400. Inquiry 610.

---

**Data Access Enhances Database Program**

Data Access Corporation's DataFlex 2.1 is a 16-bit version of the company's multiuser relational database programming system. It permits over 16 million records per file, up to 250 files, each as large as the operating system will handle (up to 2 gigabytes, 32 megabytes in MS-DOS), and use of unlimited RAM.

The package includes a relational database command language, a custom menu system, and an application generator. Versions of the program are available for such operating systems as MS-DOS/PC-DOS 1.1 through 3.1, CP/M, CP/M-86, Concurrent CP/M-86, MP/M, MP/M-86, and 'TurboDOS. DataFlex also operates under a number of networking systems.

Pricing depends on the computer, operating system, and number of users; a single-user IBM PC version is $995. A separate run-time version is available. For details, contact Data Access, 8525 Southwest 129 Terrace, Miami, FL 33156-6565, (305) 238-0012. Inquiry 611.

(continued on page 421)
Need RGB color and TTL monochrome support from a single board?

There's only one INTELLIGENT decision!

INTELLIGENT B-450
Mono/Color Display Card

Look no further, the INTELLIGENT B-450 has it all. Designed to work with the IBM PC, PC XT, and PC AT, the INTELLIGENT B-450 is also suitable for IBM PC look-alikes. In addition to a parallel printer port, the B-450 has fourteen different screen modes which cover everything from medium-resolution monochrome text to high-resolution color graphics with interlace.

Everyone from the ordinary user to the CAD/CAM specialist will find the B-450 is just right. Sound good? With a suggested retail price of only $294, it's nothing less than great!

IBM and IBM PC are registered trademarks of International Business Machines Corporation.

INTELLIGENT DATA SYSTEM

Intelligent Data System, Inc.
14932 Gwencris Ct., Paramount, CA 90723
Toll Free Tel: (800)325-2455 Calif. Tel: (213)633-5504 Telex: 509098
Components are the essence of your computer. Without the right components, you're restricting your system's potential for maximum productivity.

CompuPro components enable you to make the most of your computer's capabilities. Choose from more than 25 boards to build or expand your system—to any of our ten fully integrated models. You can add more users to your CompuPro system, increase its memory, add a hard disk drive—all with modular components that mesh perfectly with your existing system.

Since 1973, our design team has been recognized for creating the highest performing, most reliable products at the lowest possible price. For the toughest business, scientific and industrial computing environments—across the country and around the world—make CompuPro IEEE 696/S-100 components the essence of your system.

**CPU Boards**

**CPU 68K**
- 68000-based board with sockets for memory management unit and up to 8K×16 (16 Kb) of EPROM.

**CPU 86/87**
- 8086-based board with sockets for 8087 math processor and 80130 firmware chips. Compatible with 8- and 16-bit memory.

**CPU 8085/88**
- The original, much imitated dual processor board delivers 8-bit, 16-bit, or 8- and 16-bit computing capability.

**CPU-Z**
- Includes all standard Z80B features. Downward compatibility with the vast library of 8080 software.

**CPU 32016**
- A true 32-bit processor for the desktop microcomputer. Compatible with 8- and 16-bit memory.

**CPU 286**
- Based on the high-performance iAPX 80286/10 16-bit processor. 100% software compatible with 8086 and 8088 processors for unprecedented speed and power.

**CMOS Static 12 MHz Memory Boards**

**RAM 22**
- 256K×8 or 128K×16—works automatically with 8- or 16-bit processors. A low-power, high-density RAM board.

**RAM 23**
- 128K×8 or 64K×16—works automatically with 8- or 16-bit processors. A low-power, high-density RAM board.

**MDrive®/H**
- 512K or 2 Mb disk memory board. Emulates disk drive operation and runs under CP/M® or MP/M™. Can increase operating speeds up to 3500%. Expandable up to 4 Mb for even more storage.

**Dual Floppy Disk Subsystem**

Two 8” floppy drives provide up to 2.4 Mb of formatted storage. With all-metal enclosure, Disk 1A™ controller, rugged power supply, cables, and software: Digital Research's CP/M-80™ and CP/M-86™.

**8” Floppy Hard Disk Subsystem**

One or two 8” floppy disk drives and one 20 Mb, 40 Mb or 80 Mb hard disk drive in all-metal enclosure with controller, rugged power supply, cables and software. CP/M-80 and CP/M-86.

**Disk Controller Boards**

Disk 1A™ High-performance, high-speed floppy disk controller for 8” and 5½” drives; reads and writes most popular formats.

Disk 2™/Selector Channel™ A high-performance 8” Winchester disk controller with high operating speed and flawless DMA.
Disk 3™ A high-performance Winchester disk controller for 5¼" hard-disk drives. High speed "burst mode" DMA transfers each disk sector in a block.

**INTERFACE BOARDS**

**Interfacer 3™** Eight RS-232C serial ports (2 synchronous/async, 6 asynchronous).

**Interfacer 4™** Three RS-232C serial ports, one parallel port, one Centronics parallel port.

**MPX 1™**
Multi-user system front-end processor with 16K on-board RAM. Intended for OEM applications only.

**HIGH-PERFORMANCE MOTHERBOARDS**
Quiet, fast and reliable. Shielded with active termination. A variety of formats (6, 12 or 21 slots) offers maximum flexibility.

**SYSTEM SUPPORT 1™**
Clock/calendar; math processor option; RS-232C serial port; interval timers and interrupt controllers; plus many more useful features.

**SYSTEMS**
CompuPro's extensive System 816 series of fully integrated single- and multi-user microcomputers includes eleven IEEE 696/S-100 bus models offering 8-, 16- or 32-bit operation, and our CompuPro 10 and CompuPro 286 business computers. All are CP/M or MP/M based, enabling users to access more than 3,000 industry standard application programs.

**DESKTOP ENCLOSURE 2**
With shielded/terminated 21-slot motherboard, power supply, fan, dust filter, rugged all-metal construction.

**DOCUMENTATION**
"Bits, Bytes and Buzzwords" is a primer for those who want to get started right in business computing. 25 pages.


Individual technical manuals also available.

**WARRANTY**
All CompuPro products are backed by a one year limited warranty with a two year option. We also offer nationwide on-site service by Xerox Americare™-free with the purchase of designated systems.

**The Essential Computer™**
3506 Breakwater Court, Hayward, CA 94545

For further information and the location of the participating Full Service CompuPro System Center nearest you, call 1-800-367-7816. In California call (415) 786-0909 ext. 206.
ASK BYTE

Conducted by Steve Ciarcia

CORONA COMPATIBILITY

Dear Steve,

I've had my Corona PC for about a year now, and for the first time I've run into an incompatibility with the IBM PC. The problem is that the IBM PC has an extra open socket built into it to add a ROM or EPROM, and the Corona doesn't. A few programs on the market make use of this socket, including a genetics program I am interested in. Is there a fairly simple way to add an extra ROM chip?

Another problem is that my BIOS is written on a 28-pin 2764, while the chip for the genetics program is on a 24-pin 2732A. How can I use the 2732 in my Corona, and what is the difference between a 2732 and 2732A anyway?

Yet another problem is the Corona's incompatibility with IBM graphics. To get graphics on the IBM, you must buy a graphics color card, which uses memory locations B800 to BC00 hexadecimal. On the Corona, different RAM locations are used for graphics. Is there a way to modify programs that need the color card (e.g., Flight Simulator) so that they will work on the Corona? It may not be that difficult because there is a graphics driver by HST which, if loaded before Lotus 1-2-3, enables 1-2-3 to draw graphs perfectly on my screen.

RICHARD BERMAN
King of Prussia, PA

You should be able to add a ROM to the Corona by installing it on an expansion board with the proper interfacing circuitry. This could be built on a PC prototyping board, such as those produced by Vector Electronic Co., POB 4336, 12460 Gladstone Ave., Sylmar, CA 91342, (818) 365-9661. Since all 20 address lines are available in the I/O channel (expansion slots), you can set up the addressing as required for the ROMs with your genetics program. There could be interference between the Corona's BIOS ROM and the add-on ROM. IBM uses 40K bytes out of the 48K bytes of reserved ROM space, and I suspect that the Corona uses the same space to preserve compatibility with IBM.

The 2732s are programmed at +25 V, while the 2732As require only 21 V. A possibility exists that the HST graphics-driver program you mention may allow you to run the new Microsoft Flight Simulator on your Corona but not the original version. The new version can be loaded from DOS with the command FS, so a driver can be loaded ahead of the program. The original version could be loaded only by rebooting, which of course wipes out the graphics driver. See your dealer for a demonstration before you buy because there may be other incompatibilities not fixed by the HST driver.—Steve

SOURCE BOOK NEEDED

Dear Steve,

As a computer counselor, I help clients with hardware and software purchases, checking sources and buffering clients from high-pressure salespeople. Since I am not affiliated with any computer manufacturer or outlet, I do not limit clients to the selections of a particular store. However, this lack of affiliation means that I do not receive promotional materials, which limits my effectiveness. Can you recommend any source book that lists computer manufacturers and gives at least minimal specifications on their products?

PATRICIA SELK
Stafford, VA

Many sources of information of the type you need are available. First, most computer magazines, including BYTE, publish reviews of microcomputers, peripherals, and accessories. These are a good source of unbiased information.

Second, you can get promotional information from manufacturers by writing to them on your letterhead, explaining your needs. Their addresses are available in ads in BYTE and other magazines and are frequently published in buyers guides and directories available at most computer stores and many bookstores.

A third source is companies that specialize in publishing survey reports on this type of equipment. One of these is Data pro Research Corporation, 1805 Underwood Blvd., Delran, NJ 08075, (800) 257-9406.—Steve

DRIVE-HEAD PROBLEM

Dear Steve,

I bought an Atari 800 and two Atari 810 disk drives three years ago. Some time ago, one of the drives began to have problems. Before realizing that it was only a burned-out IC, I measured the head's resistance with a digital tester. Since then, the drive seems to be able to write but does not read. I think I've magnetized the head. I tried to demagnetize it with various methods (including the use of a commercial head demagnetizer for cassette recorders), but I haven't had any success. If you think I must replace the head, could you tell me where I could buy it?

ODINO CIAI
Buenos Aires, Argentina

Digital testers normally do not supply enough current to damage a disk-drive read/write head. You did not say whether you could write to a disk and read it from the other drive. It is possible that the alignment of the head was disturbed when you were making your tests. Try some cross-checks to see if that is the case. Also, check the obvious things, such as dirt on the head and a worn head-load pad. The head-load pad is a little felt pad that keeps the disk in contact with the head. If it is worn, data may not be properly read or written. Check the continuity of the read head with an ohmmeter or your digital tester. If the head coil is open, see if there is a mechanical break in the wiring.

If you are convinced that the head is defective, a replacement can be obtained from Micro Peripherals Inc., 9754 Deer Ave., Chatsworth, CA 91311, (213) 709-4202.—Steve

SHARING FILES

Dear Steve,

We have several Eagle PCs in our analytical laboratory, all of which use two pieces of software: pfs:file and Lotus (continued)
Ah, the great ones . . .
They organized their ideas, their intuitions, their idioms. They set them down, sorted them out, arranged them and re-arranged them till they came out right. They used small scraps of paper to record huge hunks of Truth; primitive tools to produce profound prose. But when the words finally went forth, they made indelible marks on all who read them.

The amazing thing is that these monumental processors of words, did it without the benefit of monumental help. Like Leading Edge Word Processing: the easiest to use, yet most potent piece of software ever created to take full advantage of all the power inherent, but until now un-tapped, in today's most sophisticated personal computer. (Like the IBM® PC and the even faster and more powerful Leading Edge™ & AT&T.)

The heart and soul of it is a 5½ Floppy disk, elegantly logical instruction manual and documentation . . . everything. And what you end up with is word processing at the leading edge.

LEADING EDGE™ WORD PROCESSING FROM $100

IBM IS A REGISTERED TRADEMARK OF INTERNATIONAL BUSINESS MACHINES CORPORATION
LEADING EDGE IS A TRADEMARK OF LEADING EDGE PRODUCTS, INCORPORATED
Dear Steve,

I use my Z-100 almost exclusively for word processing and other nonnumerical data-manipulation tasks. I find the number pad to the right of the keyboard useless except for the cursor-control keys, which I think are tedious and clumsy.

What about this: replace the number pad with a track ball for cursor control. Or even better, an upside-down mouse (I never could understand why they had to run around on a tabletop—mine is always too cluttered) with one or two appropriate function buttons.

Is this possible? Am I the only one who would use such a gizmo? Where can I go for information on how this might be done?

MICHAEL R. THOMAS
Port Arthur, TX

Some people who use track balls and mice claim that they would never go back to using cursor-control keys again. That is why several companies are making these devices for micros. Your idea to incorporate such a device into a keyboard is a good one, but it will have to be done by keyboard manufacturers. There is no easy or economical way to modify your Z-100 keyboard, due to the different nature of keyboards and mice and their interaction with a particular program. A keyboard sends a unique code to the computer for each key as it is pressed. A mouse or track ball does not generate the same code when it is used, and the information it does generate usually enters the computer through a different port.

Add-on mice are sold with utility software that translates the signals from the mouse into usable information. A word processor, for example, has been written to accept the control codes generated by certain keys (the cursor keys) and always expects those codes to come from the keyboard. Most current software is not written to take advantage of mice or track balls and would have to be modified to use these devices. Of course, Microsoft's Word program was written specifically for a mouse. Other programs are appearing that also use mice.—Steve

POWER-LINE POLLUTION

Dear Steve,


To protect my IBM PC, I am using the Radio Shack filter strip (cat. #26-1451).

Judith Thomas
Port Washington, NY

(continued)
With PC Paintbrush, you'll now be able to do things that you once only dreamed about.

Because, like your dreams, you'll be working with a palette of up to 256 vibrant colors and shades, depending on your color card.

And, as you'll notice, you'll also have drawing tools, drop-down menus, and a range of brush widths and shapes. Plus your choice of mouse or joystick.

In addition to freeform drawing, you'll be able to draw precise triangles, rectangles, boxes, circles and ellipses.

You'll be able to cut, paste, and move things around. Even enhance graphs, text, and images from other programs like Lotus 1-2-3, Microsoft Word, and SuperCalc 3.

But don't stop with painting. PC Paintbrush also gives you an electronic type shop to work with. Several fonts, from Olde English to Computer. Each in seven styles (boldface, italics, underline, etc.) and seven sizes.

All of which makes it great for designing everything from flyers and report covers to greeting cards and birthday banners. (For a wall-sized work of art, just print sideways.)

The possibilities are endless. But the best way to see for yourself is to see for yourself. Get a demonstration at your nearest computer store.

Then, draw your own conclusions.
Would you please answer the following questions?

Is it necessary to connect my IBM PC Color Display Monitor to the 0.5-A monitor outlet on the filter, as recommended for Radio Shack monitors?

My PC is connected to the 1.25-A processor outlet. Is this all right?

I could not determine from your article where the MOVs are to be soldered on this unit. Could you tell me where they go?

Is it advisable to remove disks from drives before turning the main power switch on?

I also need your help on a different problem. We have often found that our telephone bills contain calls we did not make. The telephone company doesn't charge us for these calls, but this involves an examination of each bill and checking with Ma Bell to determine whether we made suspect calls.

The computerized telephones being introduced are becoming more sophisticated, but none, as yet, keeps a record of outgoing calls. Is it possible to modify such a unit or to inexpensively build a device that would do this?

I have one Touch-Tone and two rotary-dial telephones, and I would like the new unit to be attached to one of them that would record outgoing calls on all three.

SIDNEY BELMAN
Teaneck, NJ

The Radio Shack filter strip was originally designed for the TRS-80 Model I computer, and the filters for each outlet were designed to handle different types of noise. The outlets have current limitations because the filters have current limitations. As long as the current ratings are not exceeded, any socket can be used.

The IBM PC is rated at 200 W at 120 V AC. This works out to 1.66 A, which is in excess of the 1.25-A rating of the filter. It is not necessary to remove disks from the drives before turning on the PC. It was a problem on the TRS-80 Model I, but the PC has an autoboot feature that allows the disk to be inserted prior to it being turned on.

Recording outgoing telephone calls can be accomplished by a simple pulse-counter circuit connected to a computer. The computer would pulse the line to see if a call were being made and then read and store the output of the pulse counter. A suitable pulse-counter circuit can be found in Telephone Accessories You Can Build by Jules H. Gilder (Hayden, 1976).
C COMPILERS FOR
PC DOS MS DOS CP/M-86 CP/M-80 APPLE II, llc, IIe 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

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

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

AZTEC C65
"C" compiler for APPLE DOS 3.3, ProDOS or COMMODORE 64
VED editor, SHELL, UNIX & math libraries
/PRO — library source, ROM, overlays

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

PRICES

AZTEC C86 C COMPILER
PC DOS MSDOS 249
CP/M-86 249
BOTH 399
CP/M-86/PRO 499
/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
/ZI/PRO 349
/Z 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 2000
CP/M-86 750
CP/M-80 750
APPLE 750
VAX HOST 750
MACINTOSH CALL
COMMODORE 64 CALL

TARGETS

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 Blakey St. — Chatswood NSW 2067 — Australia 61-2449-5579
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 $5, 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

FEBRUARY 1985 • BYTE 53
Achieve laboratory automation at low cost—connect a DAISI™ (Data Acquisition and Instrument Systems Interface) to your Apple® II or IIe Computer.

DAISI peripheral devices...

- Interface with Apple II and Apple IIe Computers and their lookalikes
- Work with all popular language systems
- Come with cable, instructional diskette and comprehensive manual

DAISI and Apple work together as a single system to measure, monitor, time, analyze, control and record a wide variety of research and testing functions.

DAISI peripherals plug easily into any Apple expansion slot, ready to be used in chromatography, environmental data collection, evoked response, gas analysis, spectroscopy, signal processing, solar heating, mechanical measurement, structural testing, and many more functional applications.

The Al13 analog-to-digital converter reads instruments and sensors and has its own external unit for easy cable access.

DISCOVER NEW HORIZONS IN LABORATORY AUTOMATION AND KEEP YOUR COSTS DOWN TO EARTH

Here’s a rundown on the DAISI Peripherals:

Al13 12-Bit Analog Input Interface .................. $550
  - 16 input channels
  - 20 microseconds conversion time
Di09 Digital Interface with Timers .................. $330
  - timing and interrupt capability
  - direct connection to BCD digits, switches, relays
AO03 8-Bit Analog Output Interface .......... $195-$437
  - up to 8 independent channels
  - range and offset adjustable
AI02 8-Bit Analog Input Interface ............... $299
  - 16 input channels
  - 70 microseconds conversion time

Plus the SC14 system for front-end signal conditioning and amplification, the UI16 isolation system for AC or DC power input or output, and more...

AND NOW ... AMPRIS™

An easy add-on to Applesoft® BASIC.

With AMPRIS you can:
- Read and store analog and digital inputs
- Send out analog and digital outputs
- Set, read and control the DI09 counters
- Set, read and control the DI09 shift registers
- Make full use of the DI09 interrupt capability

Using AMPRIS is as easy as inserting an ampersand (&) command where you would normally insert an Applesoft command. For more information about the complete line of DAISI peripheral devices and the full spectrum of their applications, write or phone:

Interactive Structures, Inc.
146 Montgomery Avenue
Bala Cynwyd, PA 19004
Phone: (215) 667-1713

ASK BYTE

A simpler circuit, not requiring a computer, would consist of a tape recorder to record the pulses. The tape could then be played back through the pulse counter to see what numbers were dialed. The tape recorder could be controlled by the pulse detector.—Steve

COMPUTERIZED HOME

Dear Steve,

I am planning to build a house and would like to provide for computer control in my home. Can you offer any suggestions?

PAUL W. MARSH
Urbana, IL

With the almost daily announcement of some computerized device, it makes sense to provide a means for installation in the home. However, it is difficult to know what devices will ultimately be required.

I will be presenting a series of three articles, beginning in April, covering the construction of the Circuit Cellar home-control system.—Steve

Between Circuit Cellar Feedback, personal questions, and Ask BYTE, I receive hundreds of letters each month. As you might have noticed, at the end of Ask BYTE I have listed my own paid staff. We answer many more letters than you see published, and it often takes a lot of research.

If you would like to share the knowledge you have on microcomputer hardware with other BYTE readers, joining the Circuit Cellar/Ask BYTE staff would give you the opportunity. We’re looking for additional researchers to answer letters and gather Circuit Cellar project material.

If you’re interested, let us hear from you. Send a short letter describing your area of interest and qualifications to Steve Ciarcia, POB 582, Glastonbury, CT 06033.
OVAL 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

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

12-BIT A-D-A CONVERTER BOARD
8 Channel A-D: 12 microsec Conversion, 50KHz Sample Rate, Programmable Gains, Offset and Diff./Single Modes. 8 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

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, P/N 52748-500-101 Without Wand
A&T, P/N 52748-600-201 With Wand

PERIPHERAL SUPPORT BOARD
Two Serial SYNC/ASYNC Ports with RS-232, TTL or Current Loop Outputs, three 8-Bit Parallel Ports, three Timers. Real Time Clock/Calendar and Programmable Interrupt Controller. Small Proto Area with +5 and ±12v.
A&T, P/N 52748-150-101

MULTI-PURPOSE PROTOTYPING KIT
Industrial Quality with Plated-Thru holes for Wire-Wrap or Solder projects. Complete with +5, ±12v Regulators, Bus Bar, Filter Capacitors, and Manual.
P/N 52748-450 Inquiry 148

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

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

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
AND NOW FOR SOMETHING INCOMPLETELY DIFFERENT!

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. You see, as hard as we work at possessing 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.
Master Piece puts the power at your fingertips.

Master Piece is the most versatile accessory ever made for IBM Personal Computers. Master Piece combines the four most popular IBM® accessories into one elegant accessory offering the most convenience and best value available.

A SWIVEL BASE
The Master Piece has a swivel so you can adjust the viewing angle of your monitor with just the touch of a finger. Since the Master Piece swivels with your monitor, its switches and static control are in front of you at all times.

FIVE SWITCHED OUTLETS
Stop searching for outlets to plug in your peripherals. Master Piece's five outlets put your entire system at your fingertips. Power up with the "Master" switch, then use the individual switches to control your peripherals. Touch the "Master" switch to shut down and you'll never accidentally leave your peripherals running overnight.

SURGE SUPPRESSION CIRCUITRY
Power surges, spikes and line noise are responsible for 70-90% of all PC malfunctions. They can wipe out memory in your PC, taking hours of hard work with them. They can zap your delicate chips, sending your PC in for costly repairs. Master Piece clips surges and spikes at a safe level. You end up with an IBM that’s more accurate and reliable.

STATIC PROTECTION
Even you are a threat to your IBM. During the day you build up static charges—as much a threat to your PC as surges and spikes. Master Piece offers an elegant alternative to expensive and unsightly static mats. Just touch its nameplate before you begin work and static charges are grounded.

If you bought these accessories separately, you could spend more than $200. Master Piece's recommended retail price is under $150. Available now from IBM dealers everywhere.
VISIT WITH APPLE

USERS—Ideas, information, and the latest computer news are available to members of the Arkon Info-system, a 24-hour 300-bps bulletin-board system operating in Toronto, Canada. Upload, download, electronic mail, and public messages are a few of its features. Also included are 20 conferences. 10 megabytes of storage, and on-line help. The annual fee for using the system is $19.95, but inquirers can log on under the "Guest" user function. Questions about the system can be sent through the (Feedback-to-sysop) function of the Arkon Info-system at (416) 593-7460. Other details are available from David Fingold, Arkon Info-system, 409 Queen St. W. Toronto, Ontario M5V 2A5, Canada. (416) 593-9653.

CHAMELEON ADVOCATE

The National Chameleon Users Group (NACHUG) produces a newsletter, The 80/88 National Newsletter, that contains hardware and software reviews, updates, and a users forum. Member discounts are provided on peripherals and accessories. Membership is $12 a year. Contact Steven Bender, NACHUG, POB 28360, Queens Village, NY 11428.

SIG, NEWS FOR PUBLIC-DOMAIN SOFTWARE

PC-SIG News, a newsletter from the PC Software Interest Group (PC-SIG), is devoted to public-domain or user-supported software for the IBM PC and compatible computers. It lists the disks in the library, updates recent disk arrivals, and encourages patches and feedback from users. The members have compiled a directory with a subject index and listings. Contact the PC Software Interest Group, Suite 130, 1556 Halford Ave., Santa Clara, CA 95051.

C-CLUB IN RIVER CITY

The River City Commodore Club is a nonprofit organization that meets twice a month to promote interest in all Commodore computers. The group features a large club library, help groups, and basic and advanced tutorials. For details, write River City Commodore Club, POB 4298, North Little Rock, AR 72116.

COMPUTER AND SOFTWARE LAW—The Center for Computer/Law, a nonprofit educational institution, provides research and educational services in computer law. The Center produces Computer/Law Journal, an international journal on the legal issues of computers, telecommunications, and the information industries. It also publishes a quarterly law review, Software Law Journal, that contains scholarly articles from computer law experts, as well as a bibliography of software law and a directory of recent cases. Contact the Center for Computer/Law, POB 3549, Manhattan Beach, CA 90266.

MANY SHARED BENEFITS—The First Attaché/2001 User Group (FAUG) produces a monthly newsletter titled Where It's At. Members meet quarterly, have access to public-domain library disks, and receive support by telephone and networking. The club can be reached on Compuserve at 70346,63. Annual dues are $25. Contact Charles Raisch, FAUG, 1827 Haight, San Francisco, CA 94117-2791, (415) 221-3415.

NO TIME LIMITS SET YET—In northern Idaho a 24-hour bulletin-board system called SPACE features Atari downloads. Passwords are not required, no time limits are set, and people add to it frequently. The BBS number is (208) 772-9421. Contact Robert Marshall, POB 5123, Coeur D'Alene, ID 83814, (208) 772-5922.

CHRISTIAN COMPUTERISTS—Christian programs, a member's exchange, a monthly newsletter, and discounts on computer supplies are available from the Elect Christian Computer Club. For details and a free issue of the newsletter, Electletter, write to the Elect Christian Computer Club, Department LAI, POB 30122, Chicago, IL 60631-0022.

TRIANGLE dBASE USERS GROUP—Members of a users group for dBASE II and III meet at 7:30 p.m. on the second Wednesday of each month in the Dreyfus Auditorium of the Research Triangle Institute in Research Triangle Park, North Carolina. A bimonthly newsletter is available on Compuserve (701) 56,404, and a public-domain library of application disks is planned. Annual dues are $10. Send a self-addressed, stamped envelope for a sample newsletter to Rich Slattra, Triangle dBASE Users Group, 2618 Davis St., Raleigh, NC 27608, (919) 782-8926.

NEWSLETTER WITH FOCUS—Users of Lotus 1-2-3 and Symphony can focus on applications with Learn Mode, a monthly newsletter from Systems Consulting. Among its features are book reviews, solutions to problems, questions and answers, and updates on Lotus products. Article contributions are welcome. Learn Mode is $30 for 12 issues. Request a complimentary copy of the first issue from Systems Consulting, POB 932, Palo Alto, CA 94302, (415) 326-8605.

FRIENDLY USERS

Business computer users in the Chicago metropolitan area form the Tandy Business Users Group, which meets on the third Wednesday of each month. The monthly newsletter, T-BUG, contains a schedule of coming events, workshops, and forums, profiles, meeting notes, news releases, and product announcements. An-
BANC ON US

GET SERIOUS. STOP PAYING HIGH PRICES NOW!
THOUSANDS OF AVAILABLE ITEMS. CALL FOR COMPLETE PRICING.

SYSTEMS

IBM PC

LOTUS 1-2-3 .......................... 349.00
LOTUS 1-2-3 II .......................... 449.00
MICROPRO Wordstar .................. 249.00
ASCIIFax Express for IBM .......... 125.00
Wordstar Professional ............... 359.00
Infoprint .............................. 249.00
Multimate make ...................... 269.00
MICROSOFT Word ..................... 220.00
Word Star Professional .............. 200.00
Multiplan .............................. 139.00
ojecte make ......................... 156.00
ASCON TAT ..... \ .................................. 278.00
Dbase II .................. ........................ 280.00
Dbase IV (Macintosh) ............... 266.00
LIFETREE SOFTWARE Velosoftware 119.00
Velosoftware Deluxe ................. 160.00
IBM UTILITIES ....................... 59.00

IBM HARDWARE

AST 6 Fusion Plus 64K ................. 258.00
Microfiche II .......................... 258.00
PC 1125 Starter Kit ................. 630.00
QUADRA QuadeBoard II .............. 219.00
Quadra t (Quadra) ................. 205.00
Quadra t (Quadra) ................. 205.00
Micros .................. .......................... 476.00

MICROCOMICS .......................... 790.00
HERCULES Mono Graphics .......... 329.00
Color Card .................................. 329.00
PLANTONICS Colopaint ............... 389.00
Scientific WordPerfect .............. 218.00
Super Rb .......................... 259.00
Graphics 8 NEW ...................... 300.00
TEAC HID/8PC ......................... 70.00
TANDON T2420 ......................... 180.00
IBM Power X Mag ...................... CALL
TEx COM OLS 12M / 12M Upgrade ... 35.00
RAM 64K Upgrade ..................... 25.00
MODeS SYSTEMS OCC/OPE ........... 180.00

PRINTERS LETTER QUALITY

BRUGES 800 .......................... 375.00
HDC 85 .................................. 629.00
HDC 60 .................................. 629.00
HYD 60 .................................. 629.00
NDC 3000 .............................. 659.00
2500 .......................... 799.00
3300 .................................. 1228.00
3500 .................................. 1539.00

PRINTERS DOT MATRIX

STAR MICRONICS Gemini 10X ........ 239.00
Gemini 13X ................................ 389.00
EPSON 80/60P/T ........................ 329.00
FX 20 .................................. 649.00
FX 100 .................................. 649.00
LX 300 .................................. 139.00
ORDATA 92A .......................... 389.00
SAP .................................. 649.00
PANASONIC (EG) ........................ 219.00
TOSHIBA (LF) ......................... 139.00

MONITORS

AMDTEK 300 ......................... 129.00
300A .................................. 145.00
145A .................................. 155.00
Color X .................................. 269.00
Color II .................................. 269.00
TAXAN Composite Amber .......... 119.00
121/122 .................................. 169.00
620 (Used) (301) ...................... 145.00
41A (50Hz) .......................... 489.00

PRINCIPLES (MICRO) 150C ........ 450.00
SR-152 .................................. 625.00
MS 12 .......................... 139.00
ZENITH ZM-112 Amber ............. 95.00
ZM-112 Green .......................... 95.00
NEC 1201 12 Res Amber ............ 125.00
1201 12 Res Green ................... 85.00
ICICI12 Composite Color w/audio ... 215.00
ICICI12 Color RGB ................... 334.00

MODEMS

HARRIS 1200 ......................... 469.00
120K .................................. 389.00
120K Euro .................................. 389.00
Mimicmodem ......................... 119.00
ANCHOR Mark X ...................... 105.00
MicroCommod ......................... 219.00
Voldermodem ......................... 59.00
NOVA Mity .................................. 329.00
Access 1-2-3 ......................... 419.00
AppleCat II .................................. 419.00
U.S. ROBOTICS PC Modem .......... 369.00
Prometheus Promodem 1200 ...... 329.00

APPLE PRODUCTS

MICRO SQ. AZ 42 drives .............. 179.00
RANA EDL II .................................. 179.00
TEAC gene .......................... 189.00
Applo Compatible drive ............. 189.00
WASP Hip .................. .......................... 69.00
2-30 TF .................................. 179.00
SYSTEMS 256 K .................................. 179.00
Mikrosoft Peripherals ................ 275.00
MULTIPRINT .................................. 128.00
Multiplan .......................... 128.00
MacMultiplan (Macintosh) ........ 128.00
Basic (Unidisk) .......................... 159.00
MAXI MK 5/6 .......................... 159.00
D-5 .................................. 27.00
RODOM Touch Table .................. 39.00
BATES Mach II JoyStck .............. 39.00
MACHINES LOCKED ................... 27.00
COMMODORE II ....................... 27.00
APPLIANCE BOARD ................... 27.00
APPLE COMMODORE II ............ 129.00
80 COLUMN/64K (interface only) ... 99.00
80 COLUMN Card only ................ 49.00

WRITERS SUPPORT THESE PENS SYSTEMS: Appli, Compac, IBM, Sony and many more.

MORE FOR ENCORE

Encore 100 and 200, two software-based portable net­

CLUBS & NEWSLETTERS

COMMODORE IN SILVER

The Silver State Commodore Users Group of Las Vegas,
Nevada, meets at 7:30 p.m. Wednesday nights at the
local YMCA. The $4 per month dues entitle members
to vote and to copy any of

FOR NEW VENTURES

A monthly newsletter, CompuVenture, contains so­

FOR THE FORTUNE

Users of the multisher

Most diskettes are pretty good. And some of the time that’s good enough. But next time you throw away one that won’t format or you lose the cash flow analysis you’ve been working on for weeks, make a mental note to try a box of Dysan diskettes. They’re better. So much better, in fact, that major computer manufacturers put their names on our diskettes and sell them as their own. Without fear of failure, you see, we make our diskettes better with advanced manufacturing processes that our competitors have yet to figure out. And we test them. Almost to the point of absurdity. Dysan diskettes are inspected almost a hundred times as they come down the line. They’re tested to performance levels way beyond industry standards. And each one is certified to be 100 percent error free. Then our corporate quality assurance fanatics come along and check them all over again. For all the same things. Plus some things only they understand.

When we’re done, you get exactly what you wanted in the first place. Diskettes that will record and retain all your data all the time. We don’t expect you to keep all that in your mental note, but we would like you to remember your last diskette failure. And when your computer products dealer offers you another box of pretty good diskettes, tell him you’re ready for something better. Dysan.

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.
Sooner or later, you'll have to face this computer problem.

Do your eyes itch, burn, or tear? Are they tired and sore? Do you get headaches, occasional dizziness, or blurred or double vision? If you have any of these symptoms, you're probably suffering from eyestrain and fatigue, and it may be from using your PC.

Eye fatigue and other vision problems are common for regular users of PCs and other kinds of video computer displays. This visual stress can also contribute to general tension and tiredness. Fortunately, the vision problems experienced by video display users have...
Better Sooner.
Computers don't ever get headaches.
But the people who use computers do.
Quite clearly, as PC Magazine spells out, that's not the only trouble they're having.
In case you're tempted to dismiss this as trivial, there are two things you should be aware of:
First, more than twenty states are already preparing legislation to force some improvements.
Second, if computer users suffer, so does business.
Because computers are only as fast and accurate as the people who operate them.

You are not a machine.
Computers are designed by engineers.
They usually know a lot about technology but very little about people.
Which is why so many computers are technically impressive but strangely unnatural to use.

Better Sooner.
The Ericsson PC.
It's Ergo-Intelligent.™ Ericsson has spent $300 million finding ways to make people and computers work better together.
Here are some of the results.

The Ericsson PC monitor has a non-glare screen.
With restful amber characters on a specially developed, low-fatigue background color.
Even the shape of the actual characters was specially developed to allow easier recognition of difficult to distinguish letters like O and Q.
On the monochrome monitor, the resolution is double that of IBM's, so clarity is remarkable.
You can even have characters and graphics on the same screen.

Ergo-Arm.™ Thousands of people get neck and muscle pain from inadequate height and angle adjustment.
The Ericsson Ergo-Arm lets you move your screen exactly where you want it.
Better than back pain, wouldn't you agree?

Ergo-Touch.™ The keys are full-size and the layout is ergonomically planned for greater accuracy and speed.
Yet the keyboard is 20% more compact and less than half the weight of IBM's.
Even the cord is adjustable to suit left- or right-handers.

Ergo-Color.™ Even the color of the case is ergonomically selected to be restful to the eye over many hours.

IBM Compatible.
Many companies claim to be compatible.
Some are. Some are stretching the truth.
The Ericsson PC boasts the highest compatibility rating there is.
It's operationally compatible.
You can take advantage of thousands of PC-compatible programs already available.
In fact, with the best-selling software, the program and data disks are interchangeable with those of the IBM PC.

Service. Not Excuses.
Ericsson wouldn't give you anything less than on-site or carry-in service. The choice is yours.

3 Free Offers.
Ericsson will send you revealing literature on ergonomics.
Also a detailed brochure on the Ericsson PC.
And arrange a hands-on test if you ask for it.
Call toll-free 1-800-FOR-ERGO.

IBM is a trademark of International Business Machines Corp.
Sanyo 555-2’s
Now 51 Dollars Less

To months a competitor has been selling Sanyo 555-2’s for a bit less than Scottsdale Systems no more. Of course, we still include more free software like (1) Sketch, (2) 15 Games, (3) Doremare (4) Diagnostics and Utilities, (5) PC Flex and (6)13 Manager. And now we have the best price for the 555-2 as well as the other models.

Plus if you mention this ad when you buy your Sanyo from Scottsdale you can buy on $5 232 or an extra $256 of RAM or the same time for a mere $69.

To paraphrase Bagley, if you don’t buy your Sanyo from Scottsdale Systems you’ll regret it. Maybe not today, maybe not tomorrow, but soon and for the rest of your life.

Columbia’s
If you’re looking for maximum compatibility, minimum price, nationwide service you should consider buying a Columbia from Scottsdale Systems. Each system comes with MS-DOS 2.1, Basic, 2.0 Perfect Writer, Col. Speaker, IBM Fax, Graphs. Home Accountant Plus, Space Commanders. All tutorials and IBM/XT disk base managers.

We have the best prices on all Colombias including the new 1600V Plus or V Plus with 256K, keyboard, and video card for:

$1717

Closeout
Sanyo 1100’s

Sanyoo 1100 Computers with two built in 3.5K drives, 12” green phosphor monitor. 80 column/dual-line display, plus over 12000 of the best-selling Micropro software including WordStar, Col. Graphs, Multiskip, Spreadsheets. Reports, Data bases, OPM and BASIC. Not a cupcake Commodore or a parrot with unknown software, but a powerful combination of hardware and software for professional use.

If you didn’t think your
$1397 could buy you this much computer, give us a call and we’ll rush you a brochure that will tell you how it can.

ColorFox

Sotctsdale Systems Ltd.
617 N. Scottsdale Road, Suite B, Scottsdale, Arizona 85257
(602) 941-5856

The Silver Fox ™ Trots
Through Lotus like 1,2,3

The Silver Fox has always run hundreds of programs originally written for the IBM PC. Now with its new compatible video board and GW BASIC it runs the most popular and powerful software in microwriting, including Lotus 1-2-3, VisiCalc II, Multiplex the PI3 series and even Flight Simulator. Yet you still get an incomparable combination of hardware and software at a price that invites comparison.

MORE HARDWARE

Each Silver Fox comes with an 8866 CPU (256K of RAM) monochrome and color video and a printer port all on a single board. Plus you get more than twice the storage of a standard PC (1.6 Megabytes on dual 3 1/2” floppy’s and the Fox will read and write to all popular PC formats.

Standard equipment also includes a better keyboard, and a 12” high-resolution greentube monitor, with a full 256K column display. And although the Silver Fox doesn’t have “compatible” expansion slots you can add serial ports, communications, joysticks, and 8087 co-processors, and/or a hard disk.

Because the Silver Fox is born on a natively automated line in Japan it is simply more reliable than PCs that are assembled by hand. So we back each Silver Fox with a one year limited warranty, four times the industry standard.

FREE SOFTWARE

Were not enough, each Fox comes with the best free software bundle in the business including:

Fortune 1200 components and universes. No C.O.D.’s, or A.P.O.’s. P.O. added 2%.

Diablo Low Sale

Diablo 630 API ... $1499
Diablo 620 ... $715

Gemini 10X ... $244
Power Type ... $299
Radix 15 ... $589

DIABLO LOW SALE

TERMINALS

Ampeo 210 w/16 emulations ..... $434
Wyse 50 ..... $499
Also great prices on other Ampeos and Wyse terminals, as well as ADDS and a Qume and Zenith.

PLOTTERS

HI DMP-29 ... $1795
HI DMP-40 ... $745
HI DMP-41 ... $2340

MODEMS

Password 2000 . . . . . . . $208
Prometheus . . . . . . . . . $209
Compatible Drives
Teac SlimLine
FD6S4A (160K) . . . . . $69
FD6S50 (260K) . . . . . $129
FD6S55 (720K) . . . . . $159

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 Net 30 basis to Fortune 1200 companies and universities. No C.O.D.’s, or A.P.O.’s, P.O. added 2%.

Visi, 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 are new with manufacturers warranty. 30% 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.; Silver Fox ™, HAGEN-DOS Scottsdale Systems Ltd; Commuter-Visual Computer Incorporated.

STAR MICRONICS SALE

EpsonFX 80T ... $1668
Epson RX-80T ... $1600
Tolly Spirit 80 ... $254
Tolly 160L ... $589
Panasonic 1200T ... $298
Toshiba 1340 ... $707
Okidata 400 ... $249
Okidata 8050 “loaded” ... $1344
Toshiba 1351 ... $1222

LETTER QUALITY

Juki 6100 ... $191
Juki 6300 ... $719
Silver Reed 300 ... $299
Silver Reed 500 ... $409
Silver Reed 770 ... $724
Call to order

TELETAB E X 2000 ... $824
Diablowriter 2000 ... $824

WE have printed material for business and customers through the Desert Business Bureau of Maricopa County.
ALAN TURING: 
THE ENIGMA
Andrew Hodges
Simon & Schuster
New York: 1983
600 pages. $24.95

COMPUTER GRAPHICS 
PROGRAMMING
Günter Enderle, Klaus 
Kansy, and Günther Pfaff
Springer-Verlag
New York: 1984
560 pages. $39

DATA STRUCTURES AND 
PROGRAM DESIGN
Robert L. Kruse
Prentice-Hall
Englewood Cliffs, NJ: 1984
486 pages. $29.95

ALAN TURING: 
THE ENIGMA
Reviewed by
G. Michael Vose

A
nd thus it was that . . . thinking in his spare time, an English homo-
sexual atheist mathematician . . . conceived of the com-
puter: "This startling claim is at the heart of the first ma-
ajor biography of Alan Mathison Turing (1912-1954), a man
whose legacies include the Turing machine and the Turing
test. Andrew Hodges has uncovered the genius of this
complicated man and recorded the evolution of his ideas
within the unique context of the tumultuous times in which
he lived. Hodges's fascinating study adds new informa-
tion to the history of computer science, counters its all-
American bias, and claims a rightful place for the eccen-
tric Alan Turing.

Revising history is a risky endeavor. The task demands
rigorous scholarship and the courage to successfully
challenge the assumptions of the past. Hodges's Alan
Turing: The Enigma brims with painstaking research and em-
phatic interpretation. No less an authority than the New
York Times (December 4, 1983, section 7, page 80) has labeled this volume a
work of major literary importance.

This praise derives from the wealth of ideas ex-
posed and illuminated in the book, from lucid discus-
sions of complex mathemat-
ics to revelations about the secret cryptography work accomplished by Tur-
ing and others during World War II. Through this work, the fortunes of war con-
tributed significantly to the creation of the British
computer.

In Bletchley Park, a London suburb, the cryp-
tography group worked to
decipher codes generated
by the German army's
Enigma machine. While
Turing's inventiveness was
instrumental in breaking
these codes, his life was full
of naive contradictions,
similar in nature to the
Nazis' refusal to believe
that the codes of their
cipher machine could ever be broken.

Hodges is sympathetic to the idea that the Allied vic-
tory in WWII hinged on the battle in the Atlantic in which
Hitler's U-boats tried to isolate Britain by cutting off her
sea supply routes to the West. Here, the breaking of the
Enigma codes made the difference between victory and
defeat because deciphering German naval messages
helped transatlantic convoys avoid the U-boat wolfpacks.
But it is Hodges's contention that Turing came up with the
major formulations of modern computer science that
makes this biography so significant.

Of course, the Universal machine (now known as the 'Tur-
ing machine) that Turing conceived in 1935 and described
in a 1936 paper called "On Computable Numbers, with
an Application to the Entscheidungsproblem" has rightfu-

(continued)
ly taken its place as a seminal computer science idea. It was central to Turing's lifelong inquiry into the idea that machines could be intelligent. However, his later, little-publicized ideas about how computing machines might work form the bulk of the biographer's most interesting revisions to the historical record.

During his Enigma-deciphering work, Turing designed and helped construct a machine called the Bombe, an electromechanical device that calculated the permutations of the Enigma's enciphering rotors. It used relays as switches and was a specialized, high-speed calculating machine. Turing's work on the Bombe enabled others in the Bletchley Park group to develop the Colossus, the machine that some historians consider the first computer. The Colossus began service in December of 1943, but Turing played no part in its design or construction. In conceiving and building the Bombe, however, and later machines like the Delilah (a telephone-voice enciphering device), Turing began fermenting the ideas that he would later develop to construct a version of his Universal machine.

The distillation of these ideas appeared in "Proposed Electronic Calculator," a late-1945 report prepared in conjunction with his new responsibilities as senior scientific officer with the Mathematics Division of the National Physical Laboratory (NPL) in Bushy Park, Teddington. In this report, Turing laid out plans to construct a machine later named the ACE (automatic computing engine), a project in response to the American scientific community's efforts to build a digital computing machine. The plan outlined the construction of a true automatic electronic digital computer with internal program storage, a fully developed scheme broader in scope than those conceived by John von Neumann and others. But to Turing it was an old idea.

**AN INNOVATOR**

The stored-program concept was a natural one to Turing because it was essentially the same idea that he developed in connection with the "instructions on paper tape" idea that was central to his Universal machine. The ACE report described how the stored-program concept would apply to a computer. The report's discussion of how the machine's instruction tables would be created leads to Hodges's claim that Turing "...invented the art of computer programming." This art, in Turing's words, would find that "Instruction tables will have to be made up by mathematicians with computing experience and perhaps a certain puzzle-solving ability." Turing later wrote routines, in conjunction with J. H. Wilkinson (see the interview on page 177), to perform floating-point arithmetic that enabled programmers to multiply two numbers without knowing what was really happening inside the machine, thus presaging the development of high-level languages. His notes for the ACE report talk about "subsidiary" routines and about "burying" and "unburying" an area of memory containing information vital to a program returning from a sub-
sideway routine. (This is known today as "pushing" and "popping" the stack.) He even envisioned the use of remote terminals, claiming that "it would be quite possible to arrange to control a distant computer by means of a telephone line."

Although he left the NPL before the ACE machine was built because he was unable to deal with the politics of bureaucracy, Turing nonetheless walked through the front door of British computing. Taking up the post of Deputy Director, Royal Society Computing Laboratory at Manchester University, he arrived in time to witness the fruition of the other English attempt to build a computer. Driven by the efforts of M.H.A. Newman (a former professor of Turing's and the first reader of "Computable Numbers") and Cambridge mathematician M.V. Wilkes, the university assembled a team of wartime electronics engineers and Bletchley Park mathematicians to work on developing a computing machine. The major difference between the Manchester machine and Turing's ACE was the type of memory used. The ACE used acoustic delay lines made of thin tubes filled with mercury, capped on each end by piezoelectric crystals. A signal traveling between crystals through the mercury was "stored" for a microsecond. The Manchester machine used electrostatic tubes, primarily cathode-ray tubes that stored information as a charged phosphor, refreshed every millisecond, on the tube's screen.

Less encumbered by bureaucratic entanglements than the NPL, the university's computer, later called the Mark 1, executed its first program on June 21, 1948. Turing became a programmer of the Mark 1, for the rest of his life, which presumably ended by his own hand a scant six years later, he worked on research that interested him but led to no significant discoveries. But during this time he exchanged ideas with other Manchester faculty members, including Michael Polanyi, whose disdain for the idea of intelligent machines gave rise to the debate that spurred Turing's creation of the test that later carried his name. The Turing test was put forth in an article called "Computing Machinery and Intelligence" in the October 1950 issue of Mind. Its now-famous central thesis was that if a machine's response to interrogation was indistinguishable from a human's, then the machine exhibited intelligent behavior.

Hodges's treatment of the intellectual accomplishments of Turing's life is a major contribution. The book is a fountainhead of stimulating thought—discussing Turing's ideas on the determinism/free-will dialectic, for example—and historical minutiae. Hodges reveals, for example, that Mark 1 program code was written in base 32 arithmetic notation, a modification of Baudot teleprinter conventions. Turing found it easy to think in this notation and confuted his colleagues by writing base 32 numbers on the blackboard when explaining an idea. A slash (/) was the symbol that represented the number 0 in this notation and is the likely origin of today's convention of writing 0s with
a slash through them (also a good way to differentiate 0 from the letter “O”). Turing was also fascinated throughout his life by the natural occurrences of flower petals, fir-cone florets, and sunflower seeds in a Fibonacci number sequence.

Aside from its contributions to the historical record, this book is a fascinating human story. Turing’s disdain of social conventions, his lack of social graces, and his individuality brought him both pleasure and pain. Though not a psychological history, Alan Turing: The Enigma explores the human side of the man who gave life to some remarkable ideas. Equally important, the study remains aware of the role played by the circumstances of a man’s life in the development of his thought. Turing’s ideas could have taken a much different turn were it not for a world war and a German cipher machine.

The major unanswered question about Alan Turing is why he took his life. There was a homosexual scandal, resulting in a conviction for violation of sexual decency laws, and a subsequent agonizing year of drug treatment with female hormones. But his suicide came a full year after the end of the treatments and probation for his offense. Hodges closes his book with a 15-page discussion of government debates about excluding homosexuals from sensitive scientific and research posts for fear of their susceptibility to blackmail and coercion. But he never satisfactorily answers the question. Why suicide? Turing’s mother never accepted this verdict, claiming that Alan’s death was accidental. If Hodges explored the other possibilities, he doesn’t reveal his findings.

Though minor, there is one flaw in this book: it is plagued with editing and typographical errors, no doubt a result of the complexity of the manuscript. Anyone interested in the idea of intelligent machines should have no problem overlooking these errors. The book is nevertheless a major work in the history of computer science. Well indexed and containing 28 pages of bibliographic notes, it is a valuable resource for information about the people who created the technology and the papers they wrote describing their ideas.

G. Michael Vose is BYTE’s senior technical editor for theme articles. He can be contacted at POB 372, Hancock, NH 03449.

---

**COMPUTER GRAPHICS PROGR**

Reviewed by Judith L. Maggiore

The Graphical Kernel System (GKS) is the international standard for computer-graphics software. *Computer Graphics Programming* is an important addition to the standard document defining GKS because it explains concepts, examples, and figures that could not be included in the standard document. Günter Enderle, Klaus Kansy, and Günther Pfaff are in a good position to write about that (continued)
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 control 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.


### BOOK REVIEWS

**Computer Graphics Programming**

Macintosh meets Epson.

For under $130, HanZon can enhance any Epson printer to Apple® standards. The HanZon Universal Interface Card plugs into your Epson MX, FX or RX. This combination delivers total compatibility with any software—even MacPaint™ and AppleWorks—that you run on the Macintosh™ or Apple IIc. Ask your Epson dealer or call (206) 487-1717.

Macintosh meets Epson.

For under $130, HanZon can enhance any Epson printer to Apple® standards. The HanZon Universal Interface Card plugs into your Epson MX, FX or RX. This combination delivers total compatibility with any software—even MacPaint™ and AppleWorks—that you run on the Macintosh™ or Apple IIc. Ask your Epson dealer or call (206) 487-1717.

The history of computer graphics has been one of fragmentation and separation. The subject is broad, covering areas including computer-aided design (CAD), business graphics, mapping, video games, and more. Each area had its own preferred hardware for displaying pictures. CAD applications used vector-refresh devices, while business graphics used storage tubes and pen plotters. The introduction of raster devices led to even more diversity. Software was tailored to take advantage of the capabilities of a particular device. As well as being device-dependent, computer-graphics software was also application- and system-dependent. There was little relation between the software used to design circuits and the software used to draw histograms. This situation meant that graphics programs were useful only for the application, operating system, and device for which they were specifically designed.

As graphics devices became less expensive, more people discovered computer graphics. The advantages of being able to display data as pictures are obvious. Once the prohibitive cost was removed, computer-graphics users proliferated. These new users of computer graphics were not interested in designing whole new systems—they were interested in using computers to draw pictures.

At this point, the field was ripe for a standard. The development of this standard began in the mid 1970s, with many organizations participating. In the United States, standardization was initiated in 1974 by the Association for Computing Machinery's Graphics Standards Planning Committee, part of the special-interest group on computer graphics. This work was taken over by ANSI (American National Standards Institute) committee X3H3, one of the major contributors to the review of GKS. The work of all the committees in various countries was consolidated under the auspices of the International Standards Organization (ISO) and eventually led to the development of GKS. The authors estimate that there were 50 man-years of effort devoted to the development of the graphics standard.

Computer Graphics Programming has something for everyone. The novice to computer graphics will find the definitions of graphical terms and concepts very valuable. Experienced graphics users and experts will find the book the best help available for understanding GKS. Application programmers who plan to use an implementation of GKS will probably use this text daily as a reference. Implementors of GKS will find the sections on device and language interfaces and implementation styles invaluable. Students and teachers on either the undergraduate or graduate level can use Computer Graphics Programming as a text or reference for a course in computer graphics.

**WELL ORGANIZED**

The authors have organized this book very well. Section 1 contains an overview of the standard's general concepts (continued)
The first 3-in-One printer with a good head for graphics. The Toshiba P1351.

The Toshiba P1351 is the ultimate 3-in-One printer. Other printers try to approach our level of graphics sophistication. Other dot matrix printers can come close to us on speed. And there are even a couple of printers with a 24-pin dot matrix print head similar to ours. But our combination of graphics, speed and letter quality makes the Toshiba P1351 stand alone.

Intelligence with an eye for detail. The Toshiba P1351 comes with one of the most advanced print heads in the industry. A unique high-density 24-pin dot matrix print head that produces amazingly sharp 180 x 180 dot-per-square inch, fully dot-addressable graphics. So you get unbeatable high-resolution charts, graphs and illustrations no one can duplicate. And it's supported on popular graphics software like Lotus 1-2-3.

Intelligence that's unlimited. The Toshiba P1351 does more than give you access to three resident typefaces for word processing. It also gives you the ability to download an unlimited variety from a growing library of IBM-compatible software typefaces. They're all stored on floppy disk. And you get programming access to five typefaces at any time.

Intelligence that's letter-perfect. Our unique print head gives you letter-quality results from any typeface you choose. And with Qume SPRINT 5™ emulation, the Toshiba P1351 can give you those results from almost every popular word processing program. Of course, it's fully IBM-compatible. And there's even an optional forms tractor or sheet feeder for paper handling versatility.

Intelligence and speed. You won't have to sacrifice speed for letter-quality printing. Because the Toshiba P1351 gives you the best of both. Sharp, clean letter copy at 100 cps. And even faster draft copy at 192 cps.

Intelligent and dependable. The Toshiba P1351 3-in-One™ printer is also engineered and built with a very intelligent attitude toward dependability. And optional third party 24-hour service is also available. That's why, over the past four years, more than 200,000 intelligent buyers have depended on Toshiba 24-pin printers.

So make the intelligent move. To the Toshiba P1351, the first 3-in-One printer with a good head for graphics. And everything else.

For more information, call 1-800-457-7777, Operator 32.
When you can't stop by your local Micro Mart Store, call us direct.
ORDERS ONLY
1-800-241-8149

At Micro Mart, we've got our finger on the pulse of the microcomputer industry. And, from our retail stores to our telemarketing divisions, we're in touch with the very latest developments, the newest products and the cutting edge of expert advice.

When you need the right product at the right price, remember the sales, service and support our local store experts and national distribution center can give you.

So if you can't drop by your local Micro Mart Store, let us point you in the right direction. Ask for your best price and expert advice.

AT&T Personal Computer: Innovative hardware for a wide range of business applications.

128K expandable to 640K, 2 360K, DS/DD Disk Drives, Monochrome Display, IBM Compatible Special introductory price.

LEADING EDGE Color PC, 256K, 2-360K DS/DD Disk Drives, Amdek Color 600 __ $1995
MINDSET Personal Computer, 256K, 2-360K DS/DD Disk Drives, W/ Mindset Mouse __ $1795

Networking/Protocol Conversion

SNA & BISYNC 3780, 5251, 3274, 3278
PC TURBO 186 by ORCHID, 80186 coprocessor board __ $829
IRMA/w/PC's __ $899/$1099

FORTEGRAPH for IRMA, upgrad IRMA to 3278 graphics capability __ IRMAPRINT Enhances IRMA graphics.
PCnet by ORCHID, complete line __ Start @ $299
BLUE LYNX 3271 Mod 12 & 3276 Emulators by TECHLAND
SANTA CLARA PC Terminal

Printers & Plotters

Thousands in stock.
HOUSTON INSTRUMENTS Plotters and Digitizers.

Maynard Complete line

Graphical Cards

STB Graphics Plus II, color & mono, w/par. port & software __ $369
HERCULES Mono & color graphics cards support Lotus __ $499
PLANTRONICS Color Plus, HiRes color bd., par. port w/software
TECMAIR Graphics Master, HiRes color & mono supports Lotus __ $499
QUADRUM QUADCOLOR II & III, color cards
PARADISE SYSTEM Multi-display or Modular Graphics Cards, color & mono, par. port

Software

Accounting
SORCIM/SUS Complete line including windows
BPI ACCOUNTING Complete line

Spreadsheets & Integrated Packages
ASHTON TATE Framework __ $345
LOTUS Symphony and Lotus __
MICROSOFT MultiPlan, w/templates __
MDBS Knowledge Man__
SORCIM SuperCalc 3, Vers. 2.0 __
SPL OPEN ACCESS __
Enhancements & Utilities
SOFTCRAFT Fancy Font __
FOX & GELLER Complete line of enhancements for DBase II, III & Rhube 4000.
NORTON Utilities __ $65
ROSESOF ProKey 3.0 __ $89

Atlanta, New Orleans, Nashville, Miami, Tampa, Orlando
Micro Mart has financing options available. Ask for a Micro Mart Blue Chip Credit Card application today.

For information or the store location nearest you call (404) 449-8089
and vocabulary. The precise and clear definitions of graphical terms and concepts presented in this section should go a long way toward clarifying the vocabulary we need to talk about computer graphics. These basic terms and concepts form the basis of the more formal description of GKS found later in the book. Included in this section are chapters on the principles and goals used in the design of GKS and the interfaces to GKS. Since GKS is designed to be device- and system-independent, it must be interfaced on one side to a specific language and on the other to the graphical hardware. Chapter 6 is especially useful because here the authors provide concise definitions of all the main ideas used in GKS. These definitions are followed by chapters that supply additional detail and amplification about each concept.

The second section describes the process of the development of the GKS standard. The authors sketch briefly the history of computer graphics and the events that led up to the final GKS document. The most interesting part of this section is chapter 3, which presents some of the issues the developers of GKS had to resolve. Arguments pro and con on each issue and the ultimate decision of the committee are discussed.

Section III, the largest part of the book, is a detailed description of the functional capabilities of GKS. Enderle, Kansy, and Pfaff explain all the functions and data structures relevant to GKS. The definitions of the functions are presented in two parts. First is the language-independent version, taken directly from the GKS standard document. Next is the FORTRAN definition. Following the function definitions are examples of programs or program fragments using GKS. These examples are presented in both Pascal and FORTRAN and very clearly show typical uses of GKS by applications programmers. The book also includes some exercises intended to help students and teachers.

Section IV will be most useful to the implementors of GKS, those people who will write the subroutine package that makes GKS available to applications programmers. This section covers methods of implementation, implementation styles, interfaces to devices, and interfaces to specific languages. A mapping of the abstract data structures of GKS to FORTRAN data structures is included. Other topics in this section are graphics metafiles, validation of GKS implementations, and three-dimensional extensions to GKS.

**Evaluation**

This book clarifies an area that is often confusing and obscure. Terms and concepts are excellently presented. Anyone seriously involved in the use of GKS will find this book invaluable. More pictures and illustrations should have been included. A book on computer graphics needs lots of pictures. The second problem is minor. The use of the English language seems awkward at times.

(continued)
The C Programming System from Mark Williams

MWC86 gets your C programs running faster and uses less memory space than any other compiler on the market. Then csd, Mark Williams' revolutionary C Source Debugger, helps you debug faster. That's The C Programming System from Mark Williams Company.

MWC86

MWC86 is the most highly optimized C compiler available anywhere for the DOS and 8086 environment. The benchmarks prove it! They show MWC86 is unmatched in speed and code density. MWC86 supports large and small models of compilation, the 8087 math coprocessor and DOS 2.0 pathnames. The compiler features common code elimination, peephole optimization and register variables. It includes the most complete libraries. Unlike its competition, MWC86 supports the full C language including recent extensions such as the Berkeley structure rules, voids, enumerated data types, UNIX* I/O calls and structure assignments.

Quality is why Intel, DEC and Wang chose to distribute MWC86. These industry leaders looked and compared and found Mark Williams to be best.

User Friendly

MWC86 is the easiest to use of all compilers. One command runs all phases from pre-processor to assembler and linker. MWC86 eliminates the need to search for error messages in the back of a manual. All error messages appear on the screen in English.

A recent review of MWC86 in PC World, June, 1984, summed it up:

"Of all the compilers reviewed, MWC86 would be my first choice for product development. It compiles quickly, produces superior error messages, and generates quick, compact object code. The library is small and fast and closely follows the industry standard for C libraries."

csd C Source Debugger

Mark Williams was not content to write the best C compiler on the market. To advance the state of the art in software development, Mark Williams wrote csd.

csd C Source Debugger serves as a microscope on the program. Any C expression can be entered and evaluated. With csd a programmer can set tracepoints on variables and expressions with full history capability and can single step a program to find bugs. The debugger does not affect either code size or execution time. csd features online help instructions; the ability to walk through the stack; the debugging of graphics programs without disturbing the program under test; and evaluation, source, program and history windows.

csd eases the most difficult part of development — debugging. Because csd debugs in C, not assembler, a programmer no longer has to rely on old-fashioned assembler tools, but can work as if using a C interpreter — in real time.

The C Programming System from Mark Williams now supports the following libraries:

<table>
<thead>
<tr>
<th>Library</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows for C</td>
<td>Creative Solutions</td>
</tr>
<tr>
<td>Halo</td>
<td>Media Cybernetics</td>
</tr>
<tr>
<td>PHACT</td>
<td>PHACT Associates</td>
</tr>
<tr>
<td>The Greenleaf Functions</td>
<td>Greenleaf Software</td>
</tr>
<tr>
<td>Btrieve</td>
<td>SoftCraft</td>
</tr>
</tbody>
</table>

The C Programming System from Mark Williams

The C Programming System from Mark Williams delivers not only the best C compiler for the 8086 but also the only C source level debugger. That's why it does for C programming what C did for programming. The Mark Williams C Programming System gives the programmer the MWC86 C compiler and the csd C Source Debugger for only $495. Order today by calling 1-800-MWC-1700. Major credit cards accepted.

Technical support for The Mark Williams C Programming System is provided free of charge by the team that developed it.

Mark Williams Company
1430 W. Wrightwood Ave.
Chicago, IL 60614

*Unix is a Trademark of Bell Laboratories.
Inquiry 349 for Dealers. Inquiry 350 for End-Users.

I Request your FREE catalog today!
I Mail this coupon to:

Moore Computer Supplies Catalog
P.C. Box 20, Wheeling, 11. 60090

[ ] COMPUTER MAKE AND MODEL

[ ] CITY  [ ] STATE

[ ] ADDRESS

[ ] NO. OF EMPLOYEES

[ ] TYPE OF BUSINESS

---

BOOK REVIEWS

It's too early to tell what effect GKS will have on the computer-graphics industry. It will be interesting to see how GKS stands up in light of recent developments. Whatever the future of GKS, it is a very important development now, and Computer Graphics Programming is indispensable to anyone wishing to understand and use GKS.

Judith L. Maggiore programmed graphics for three years prior to teaching computer science classes and computer graphics seminars at Keene State College (Mathematics Dept., Keene, NH 03431).

DATA STRUCTURES

AND PROGRAM DESIGN

Reviewed by Edward Brent

The boundary between writing programs that merely get by and designing programs that perform complex tasks efficiently is one that many programmers never cross. Yet it is a boundary that is fundamental to the development of programming as a discipline. People who program by the seat of their pants and hold their programs together with the electronic equivalent of spit and baling wire must give way to trained programmers who develop finely crafted, efficient, and maintainable programming solutions to difficult problems. The selection and design of appropriate data structures and algorithms is a crucial element of professional-quality programming. The central role of data structures in professional programming is insightfully examined by Robert L. Kruse in Data Structures and Program Design.

AUDIENCE

In the preface Kruse indicates this book includes all the topics of specific courses recommended and offered by ACM (Association for Computing Machinery) Curriculum '78. The prerequisite for the book is a first course in programming, or equivalent experience, and elementary experience with Pascal.

I find the book suitable for a second course in computer programming. However, it could also be of value to programmers not enrolled in a computer science course but interested in upgrading their programming skills.

But the issues of selecting appropriate data structures should not be relegated to a second course on computing. Because the selection of data structures is such an important aspect of quality programming, it should not be left for more advanced books.

Kruse consistently highlights the distinction between abstract structures and their implementations. He begins by addressing the programming principles of top-down refinement, program design, and review and testing: he illustrates these principles with extended examples.

In chapters 2 and 3, Kruse discusses the more important structures: stacks, queues, and other lists in both contiguous and linked representations and binary trees. He (continued)
**Computers**

- **IBM System Specials**
  - 25K2 Drives: $39
  - 28K, 2 colors, graphics, printer $89
  - 30K, 2 colors, graphics, printer $109
  - 28K, 2 colors, graphics, printer $89

- **Two User System (incl. 2 MB, Advanced Digital PC, 6 terminal)**
  - $189

- **MPC 4202**
  - $299
  - For 28K, 2 colors, graphics, printer $99

- **Profession (10 MB, w/ tape backup)**
  - $299

- **CompuPro 10**
  - $299
  - Multi-user

- **Hard Disk**
  - Apple Macintosh Hard disks now available!
  - *$Call*

- ** Towerships Graphix Plus**
  - $149

- **Quadram**
  - 64K $259
  - 32K $229

- **SIX PACK PLUS (64K, Ser/Par, Clk)**
  - $259

- **Advantage**
  - Multi-Fin Board for AT
  - *$Call*

- **MPC 4202**
  - $299:
    - 28K, 2 colors, graphics, printer $99

- **For IBM PC/XT & AT/COMPACT**
  - Advanced Digital Multi User (2 MB, Advanced Digital PC, 6 terminal)**
  - $189

- **Dot Matrix Printers**
  - C-10W Printer: $169
  - DDA Printers All Models: $129

- **Letter Quality Printers**
  - ABATI LD-23 (10 IPS, 15" carriage)
  - *$Call*

- **Plotters**
  - New Polioidal Palettes
  - *$Call*

- **Software**
  - Asymet 3D, 3D Card
  - Prestige Hall VCN ExecuVisi
  - Real World ASCII Accounting
  - Satellite Software WordPerfect
  - Centrepoint Copy II PCIPCLIP, 29

- **Magnatone**
  - Multi I/O Card
  - *$Call*

- **Apple Macintosh/II Systems**
  - ALS CP/M Card
  - Panasonic KX-P1091/1093
  - $299

- **Ram Chips**
  - 64K Set
  - *$Call*

- **Double-Sided Diskettes**
  - “SKC” (100 MB), $19

- **Print Buffers**
  - Bumpered Grappler $169

- **Communications for IBM**
  - BLUE LYNX 3270
  - DCA lms/finalizer/$1

- **Apple Macintosh II Systems**
  - ALS CP/M Card
  - Panasonic KX-P1091/1093
  - $299

- **RK**
  - 23 MB External (w/ Controller)
  - *$Call*

- **Micros**
  - Micromodem lie w/SmartCom $149

- **Surge Protectors**
  - HP 120/200, 100MB, 10MB

- **Centennial Power Systems**
  - Triscan 3200-5 (Battery incl.)
  - Triscan 3245-FC (425 Watts)

- **Customer Service**
  - 401-781-0020
  - 150 Broadway, Suite 212, NY, 10038

**IBM System Specials**

- **25K2 Drives**: $39
- **28K, 2 colors, graphics, printer adapter & PSS-HX-2 monitor**: $259
- **25K, 2 colors, graphics, printer adapter**: $259
- **McB 4202**
  - $299
  - For 28K, 2 colors, graphics, printer $99

**Profession (10 MB, w/ tape backup)**

- $299

**CompuPro 10**

- $299
  - Multi-user
BOOK REVIEWS

Edward Brent, an associate professor of sociology and family and community medicine (108 Sociology, University of Missouri, Columbia, MO 65211), has recently completed a post-doctorate fellowship in which he studied the role of data structures in artificial-intelligence programming.
Now you can open up a whole new dimension in data base applications by merging real-life pictures with popular data base management systems. Pictures of people, products, diagrams, maps, company logos — whatever you want to photograph — can be integrated with your data base. Consider these typical applications:

**Security** — verify those employees who have authorized clearance to limited access areas. A data base containing employee pictures and personnel records can be searched and displayed for visual verification.

**Signature Verification** — increase the efficiency of credit checks by adding pictures of customer signatures to your financial data base records.

**Real Estate** — add pictures of houses to on-line real estate listings for faster property identification and improved sales presentations.

**Electronic Cataloging** — pictures of products can be combined with a data base system containing product specifications, pricing, availability and much more.

Customers, distributors and sales personnel can quickly search data and view the resulting product/picture information on one screen. Files can be updated easily, quickly.

It's Easy
With a simple keystroke, pop-out of your data base system and into the PHOTOBASE menu. Capture images of text, photos, artwork and 3-dimensional objects with an ordinary video camera and our high resolution PC-EYE™ video digitizer. Pop back into your data base system and add the picture name to your data base like you would any other piece of information. The full functionality of the data base system is preserved, but the resulting display is text and picture information on one screen.

Pictures are displayed in the upper right quadrant of the screen at a resolution of 320 x 200 with 16 colors or levels of gray. Text information from data base records fills the rest of the screen. Pictures can also be exploded to full screen.

Call or write and we will send you information on PHOTOBASE, PC-EYE, compatible cameras and other imaging equipment in the Chorus Family of products.

(603) 424-2900 or 1-800-CHORUS.

T.M. PHOTOBASE and PC-EYE are trademarks of CHORUS Data Systems.

*dBase II is a trademark of Ashton-Tate; R:Base 4000 is a trademark of Micronix, Inc.; IBM Filing Assistant is a trademark of International Business Machines Corporation.

Inquiry 49
SHE'S TEMPORARY.
THE DAMAGE IS PERMANENT.

One wrong key.
The slightest slip.
And your accounts receivable
are accounts irretrievable.
It can happen to you—because
a leading cause of data loss is
human error. If you employ people
and computers, you're vulnerable.
Unless you backup your data.
Every day.
No matter what.

The smartest way to do that
is with a Tallgrass HardFile™
Mass Storage System.

TALLGRASS SELLS MORE
HARD DISK STORAGE WITH
CARTRIDGE TAPE BACKUP
THAN ANYONE IN THE WORLD.

Tallgrass took the industry's
most reliable medium—magnetic
tape—and perfected a format
that's become the standard for
personal computers.
We used a removable tape
cartridge to store data out of
harm's way. And made two versions. Our 3000 Series HardFiles combine tape's accuracy with the enormous capacities of hard disk, providing 12, 20, 35 or 70 megabytes storage with a removable cartridge tape for backup. Our 4060 tape storage system, for personal computers with hard disks built in, supplies 60 megabytes of backup capacity.

Result: the world's best selling mass storage systems with the most reliable data protection. The only kind to have when facing a permanent problem.

For a free brochure, your nearest dealer, and more good reasons to backup, call 1-800-228-DISK. And solve your problems permanently.

TALLGRASS TECHNOLOGIES
COMMITTED TO MEMORY

Inquiry 307

Harm's File and Tallgrass are trademarks of Tallgrass Technologies Corporation. © 1984 Tallgrass Technologies.
## Software

### Word Processing Editors
- EASYWRITER II $219
- FANCY FONT $129
- FINAL WORD $199
- MICROSOFT WORD $339
- WIMOWRE $229
- MULTIMATE $229
- SAMNA WORD III $319

### Database Systems
- ALPHA DATA BASE MANAGER $179
- CLOUT V.2.0 $199
- CONDOM III $229
- DBASE II $229
- DBASE III $239
- INFOSTAR KNOWLEDGEMAN $219
- PFS: FILE/FS: REPORT $199
- QUICKCODE III $189
- R BASE 4000 $259

### Languages/Utilities
- CONCERNENT DOS CM.COMPLER $189
- DIGITAL RESEARCH C.COMPLER $199
- DR FORTRAN 77 $199
- ATTICE C.COMPLER $200

### Project Management
- HARVARD PROJECT MANAGER $219
- HARVARD PROJECT MANAGER MICROSOFT C.COMPLER $159

### Graphics/Statistics
- AUTOCAD $279
- LAND BUSINESSGRAPHICS $329
- HERCULES GRAPHICS CHARTMASTER $299
- HERCULES COLOR CARD $179
- PARADISE MODULAR GRAPHICS CARD $249

### Display Boards
- AST MONOGRAPH PLUS $Scall
- EVEREX GRAPHICS $419
- HERCULES GRAPHICS $329
- HERCULES COLOR CARD $179
- PARADISE MODULAR GRAPHICS CARD $249

### Hardware
- MULTIBOARD $1200 $299
- MULTIPRINT PLUS (64K) $489
- MULTIPRINT PLUS $529
- MULTIPRINT PLUS EXP. $599
- MULTIPRINT PLUS 1200B $599

### Communications/Productivity Tools
- CROSSSTALK $105
- PROKEY $89
- REEL I $39
- SMARTCOM II $105

---

### Lowest Price Guarantee!!

We will match current nationally advertised prices on most products. Call and compare.

**1-800-221-1260**
In New York State call (718) 438-6057

---

**FREE SHIPPING**
on all credit card or pre-paid orders and all orders over $100.

**Free!**
Diskette Library Case with your order.

**Lowest Price Guarantee!!**
We will match current nationally advertised prices on most products. Call and compare.

**in New York State call (718) 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 $6.00 per item). NY State Residents—add applicable sales tax. All prices subject to change.

---

**Softline Corporation**
P.O. Box 729, Brooklyn, N.Y. 11230
TELEX: 421047 ATLN UI

---

**Shipping:**
MON.-THURS. 9:00AM-8:00PM
SUN. & FRI. 9:00AM-4:00PM

---

**Inquiry:** 283
February 1985

- **AI, EXPERT SYSTEM BRIEFING—**Artificial Intelligence and Expert Systems: What Business Must Know Today to Reap the Benefits Tomorrow. Marriott Copley Place, Boston, MA. A one-day executive briefing. The fee is $5790. Contact Lee Burgess, Professional Development Programs, Rensselaer Polytechnic Institute, Troy Building, New York, NY 12180-3590, (518) 266-6589. February 11


- **NETWORK COMPONENTS EXPLAINED—**Data Communications Network Components. Atlanta, GA. A thorough overview of the use, operation, applications, and acquisition procedures of 25 major communications components. The fee is $5795. Contact Elaine Hadden Nicholas, Department of Continuing Education, Georgia Institute of Technology, Atlanta, GA 30332-0385, (404) 894-2547. February 12–14

- **INTERACTIVE INSTRUCTION—**The Third Conference on Interactive Instruction Delivery. Sheraton Towers Hotel, Orlando, FL. Contact the Society for Applied Learning Technology, 50 Culpeper St., Warrenton, VA 22186, (703) 347-0055. February 13–15

- **COMPUTERS FILL EDUCATORS' TALL ORDER**
  The Fifth Annual Conference of the Texas Computer Education Association, Hyatt Regency Hotel, Austin, TX. The theme is “New Directions for Education Using Modern Day Technology.” Contact TCEA Conference, POB 2573, Austin, TX 78768. February 13–16

- **PC SYMPOSIUM**
  The 1984 UNM Personal Computer Symposium, University of New Mexico, Albuquerque. Exhibits, seminars, and demonstrations of personal computer systems for business, education, and professional offices. Contact the “Tau Beta Pi Honor Society, c/o Dr. Randy Truman, Department of Mechanical Engineering, University of New Mexico, Albuquerque, NM 87131, (505) 277-6296. February 15–16

- **COCO CONVOCATION**

- **MICROS FOR EDUCATORS—**Association of Teacher Educators National Conference, Riviera Convention and Resort Hotel, Las Vegas, NV. Exhibits and demonstrations of microcomputers, microcomputer products, and communications equipment will be featured. Contact Peter C. West, Learning Center, Colorado College of Education, Gable Hall 8, Northern Illinois University, DeKalb, IL 60115, (815) 753-1241. February 18–19

- **MANAGE YOUR COMPUTER—**Managing Computer Resources, Wintergreen Learning Institute, Wintergreen, VA. Focuses on networking, system design, performance evaluation, and operational difficulties encountered by managers and executives. Rates vary from $570 to $769, depending on accommodations. Contact Dr. M. D. Corcoran, Wintergreen Learning Institute, POB 7, Wintergreen, VA 22958, (800) 325-2200, in Virginia, (804) 325-1107. February 18–22

- **COMMUNICATIONS FOR EXECUTORS—**InfoCentral, O'Hare Exposition Center, Chicago, IL. A computer and communications show and conference for executives and data-processing managers. Topics: mainframes, microcomputers, telecommunications systems, and micrographics. Contact the Show Manager, InfoCentral, 999 Summer St., Stamford, CT 06905, (203) 964-8287. February 20–22

- **MEXCOM '85—**The First International Computer and Communications Exposition and Conference: Mexico City, Mexico. Contact E·V·E·N·T Q·U·E·U·E your organization's public activities listed in BYTE's Event Queue, we need to know about them at least four months in advance. Send information about computer conferences, seminars, workshops, and courses to BYTE, Event Queue, POB 372, Hancock, NH 03449.

- **MODULA-2 ENGINEERING—**Software Engineering with Modula-2. Atlanta, GA. A course emphasizing methods for building large-scale software systems in Modula-2. Prerequisite: knowledge of Ada or Pascal. The fee is $495. Contact Elaine Hadden Nicholas, Department of Continuing Education, Georgia Institute of Technology, Atlanta, GA 30332-0385, (404) 894-2547. February 20–22

- **BUSINESS GRAPHICS**

- **MAC IN SPOTLIGHT**

- **COMPUTER FAIRE**
  The Fourth Annual IEEE Computer Faire, Huntsville, AL. Sponsored by the Institute of Electrical and Electronics Engineers. Contact Terry Mizell, POB 5188, Huntsville, AL 35805, (205) 532-2036. February 22–23

- **COMPUTERS IN MEXICO**
  The First International Computer and Communications Exposition and Conference: Mexico City. (continued)
**Special Offer**

**ERGO® 4000**

A 66-Line Processing Terminal

**$595**

ERGO® 4000 is the ASCII Terminal featuring 80-column by 66-line format for full-page display capability. Features include: 15 downloadable function keys, four video attributes, pass-through printer port, screen saver, alternate character generator, settable tabs, 24-line display, and user-definable custom mode. (Compatible with VT100 codes.) Most popular word processing packages are already modified to run on the ERGO® 4000.

**P.O. Box 556 • Plymouth, MI 48170 • (313) 451-0665**

**THUNDER 186™ SYSTEM $1995.**

Includes 256K RAM, 2-5" Floppys and concurrent DOS® expandable to 10 or 40 MB hard disk & up to 4 users.

**TELETEK SYSTEMASTER II® SYSTEM $5895.**

With 2 Hi-speed 128K banked slaves, 10MB hard disk and two Qume 102 terminals.

**Teletek**

**Sample Component Prices**

- CPU z™ $215
- RAM 22 $995
- LDP 286 $996
- Color Magic™ $496
- Thunder 186™ $1195
- Teletek Systemaster II® $899
- Teletek HDCTC® Hard Disk Controller $525
- Qume 102 GR $450
- C. ITOH 8510 PTR $350
- DRIFORTAN $250
- COMP. Innovation C $299

All prices subject to change and stock on hand shipping extra min. $3.

**COMPETITIVE EDGE**

P.O. Box 556 • Plymouth, MI 48170 • (313) 451-0665

**THUNDER 186™ SYSTEM $1995.**

Includes 256K RAM, 2-5" Floppys and concurrent DOS® expandable to 10 or 40 MB hard disk & up to 4 users.

**TELETEK SYSTEMASTER II® SYSTEM $5895.**

With 2 Hi-speed 128K banked slaves, 10MB hard disk and two Qume 102 terminals.

**We Integrate Systems with the Following Components**

**CompuPro®**

Lomas Data Products

**Teletek**

Sample Component Prices

- CompuPro 286 with 287 chip CPU $1199
- RAM 22 $995
- LDP 286 $996
- Thunder 186™ $1195
- Teletek Systemaster II® $899
- Teletek HDCTC® Hard Disk Controller $525

All prices subject to change and stock on hand shipping extra min. $3.

**EVENT QUEUE**

**March 1985**

- **DISCOVER UNIX**
  Discover UNIX, various sites throughout the US. A two-day seminar exploring such topics as the UNIX file system, shell interpreter, text editors, programming languages, and system tools. The fee is $595. Contact Data/tech Institute, 37 Lakeview Plaza, POB 2429, Clifton, NJ 07015, (201) 478-5400. March 2–3

- **COMPUTERS FOR SALE**

- **FOSE SOFTWARE SHOW**

- **MINI/MICRO**
  Mini/Micro Southeast-85, Georgia World Congress Center, Atlanta, GA. A conference and exposition. Contact Electronic Conventions Management, 8110 Airport Blvd., Los Angeles, CA 90045, (213) 772-2965. March 5–7

- **DESIGN SHOW**
  The 1985 National Design Engineering Show, McCormick Place, Chicago, IL. More than 600 CAD/CAM system and electronic component companies will exhibit. Contact the Show Manager, National Design
Engineering Show. 999 Summer St., Stamford, CT 06905. (203) 964-0000. March 11-14


- ACM COMPUTER CONFERENCE—The Thirteenth Annual ACM Computer Science Conference: CSC '85, New Orleans Marriott, LA. An employment register, social events, technical programs, award presentations, and exhibits are highlights of this show. Contact Della T. Bonnette, Conference Chair, Computing and Information Services, University of Southwestern Louisiana, Lafayette, LA 70504, (318) 231-6306. March 12-14

- EDUCATIONAL CONFERENCE—The 1985 Microcomputers in Education Conference, Arizona State University, Tempe. The theme for this conference is "Tomorrow's Technology." Emphasis will be placed on integrating computer technology and languages into the educational environment. Exhibits will be featured. Contact Donna Craighead, Payne B47, Arizona State University, College of Education, Tempe, AZ 85287. (602) 965-7363. March 13-15

- SIMULATION IN SUNSHINE—The Eighteenth Annual Simulation Symposium, Tampa, FL. A forum for the interchange of ideas, techniques, and applications among those working in simulation. Contact Alexander Kran, IBM Corp., East Fishkill Facility, Hopewell Junction, NY 12533. March 13-15

- INTERFACING WORKSHOP—Personal Computer and STD Computer Interfacing for Scientific Instrument Automation, Virginia Tech, Blacksburg. A hands-on workshop with participants wiring and testing interfaces. The fee is $450. Contact Dr. Linda Leffel, C.E.C., Virginia Polytechnic Institute and State University, Blacksburg, VA 24061, (703) 961-4848. March 14–16

- SHOW IN DELAWARE The Seventh Annual Delaware Computer Faire, Delaware State College, Dover. Current technology for use in the classroom, office, and home will be displayed. Workshops, demonstrations, and sessions on the use of computers in the classroom are planned. Contact Dr. William J. Geppert, State Supervisor, Mathematics, Department of Public Instruction, Townsend Building, POB 1402, Dover, DE 19903, (302) 736-4885. March 16

- CLASSROOM COMPUTING TECHNIQUES Instructional Strategies for Integrating the Microcomputer into the Classroom, University of Wisconsin, Madison. A special emphasis is placed on strategies that have already proved successful. Hands-on sessions will be offered. Contact Dr. Judith Rodenstein or Dr. Roger Lambert, University of Wisconsin, 964 Educational Sciences Building, 1025 West Johnson St., Madison, WI 53706, (608) 263-4367 or 263-2704. March 18-19

(continued)
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 VERSALEGGER 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 payable 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 VERSALEGGER 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.

VERSALEGGER II™ $149.95
VERSALEGGER II™ is a complete accounting system that grows as your business grows. VERSALEGGER 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. VERSALEGGER 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 check registers, handles multiple checkbooks and general ledgers, prints 17 customized accounting reports including check registers, balance sheets, income statements, transaction reports, account listings, etc. VERSALEGGER II™ comes with a professionally-written 160 page manual designed for first-time users. The VERSALEGGER II™ manual will help you become quickly familiar with VERSALEGGER 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 $6 for C.O.D. or non-UPS areas
Inquiry 127
DEALER INQUIRIES WELCOME
All prices and specifications subject to change / Delivery subject to availability.

* 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.
A black border may appear around the Palette slide image, which will be imperceptible when projected.
Now last minute presentations can be made from your personal computer. In color. In house. In minutes.

Introducing Polaroid Palette.

Whether your presentation is in 30 minutes or 30 days, the new Polaroid Palette Computer Image Recorder will make it easier. Priced at under $1800, it lets you make Polaroid instant 35mm slides or prints from personal computer-generated data. Right at your desk. So now you can create a presentation in minutes. Without sending out for processing, paying premiums for rush service or risking the security of your confidential information.

Works with the graphics packages of the IBM PC or XT, DEC Rainbow or PRO, Apple IIe or II+ and AT&T 6300.

The Polaroid Palette is designed to work with many graphics software packages. In fact, when using such popular programs as Graphwriter, Chart-Master, Sign-Master, DR Draw and DR Graph, Palette can virtually double both the horizontal and vertical resolution of your monitor. Plus, a "backfill" feature reduces raster lines for a smoother, more finished appearance. The result—presentation quality slides. On-the-spot.

Color 35mm slides, even from a black and white CRT

Think of it as an artist's palette. Because Palette "paints" your graphs, charts and text. You're choosing from up to 72 colors. If you don't want red, press a few keys—it's green. And if you're not the artistic-type, Polaroid has developed a menu of color sets, combinations of colors that have been specially coordinated to complement your presentations. And all of this is yours, even if you have a black and white monitor.

Lets you make last minute changes or add up-to-the-minute information.

The Polaroid Palette is the fast, convenient, low-cost way to prepare slides for your presentation. And perhaps even more important, Palette allows you to keep confidential information confidential. You won't have to send your work out to anyone again.

So why wait until the last minute to find out about Polaroid Palette? Call this toll-free number or return this coupon. Because with Palette you'll make your deadlines, in no time.

For a demonstration, call toll-free, or mail the coupon to Polaroid Corp., E.I. Marketing, Dept. 604, 575 Technology Sq., Cambridge, MA 02139.

CALL 1-800-225-1618

D Send information. D Have representative call.

Name ____________________________ Title ____________________________
Company ____________________________
Address ____________________________
City ____________________________ State _______ Zip
Telephone ( )

PC make and model: ____________________________

Inquiry 254
the universal printer interface

apple II, III, and Apple compatible.
- Universal for virtually all standard parallel printers.
- Famous for graphics (LoRes, HiRes, SuperRes) (Logo compatible)
- Terrific for text (even rotates spreadsheets to print sideways)

One set of commands for all printers. One command changes character sizes. Create your own printing fonts, alphabets and symbols...bold face, underline, italics, subscript and superscript, HiRes zooming.

PLUS:
- FREE utility and demonstration software disk. CLEAR, comprehensive user documentation. PKASO/U...for all the reasons you need an interface.

Contact us for a list of authorized dealers near you.

Interactive Structures, Inc.
146 Montgomery Avenue
Bala Cynwyd, PA 19004
Telephone: (215) 667-1713

systems. Contact David Maier, Department of Computer Science. Oregon Grad Center, 19600 Northwes Walker Rd. Beaverton, OR 97006. March 25-27


CAI INVESTIGATED
The Twenty-Sixth International Conference of the Association for the Development of Computer-based Instructional Systems, Philadelphia, PA. Presentations and panel discussions will explore the research and use of computers for direct instruction. Interest groups for educators. Contact ADCIS International Headquarters. Miller Hall 409, Western Washington University, Bellingham, WA 98225. March 25-28

INTEGRATION, COMMUNICATIONS, COMPUTERS
IEEE INFOCOM '85, Washington, DC. Papers will address such issues as architecture, protocols, gateways, and support. Contact Tom Stack. IEEE INFOCOM '85, POB 639, Silver Spring, MD 20901. (301) 589-6142. March 25-28

MACHINE VISION EYED

JOINT CONFERENCE IN MINNESOTA—Update '85: The Seventh Annual Minnesota Joint Computer Conference, Radisson South Hotel, Bloomington, MN. A conference for data-processing professionals. The theme is "Meeting Tomorrow's Challenge Today!" Contact Mick Williams, Standard Iron, 4990 North County Rd. 18, New Hope, MN 55428. (612) 533-1110. March 25-27

WESTERN EDUCATORS MEET—Western Educational Computing Workshops, University of California, Santa Cruz. A series of workshops and demonstrations that give educators hands-on experience with computer application packages and computer hardware. Contact Hal Roach, Computer Services, Mount San Antonio College, 1100 North Grand Ave., Walnut, CA 94542. March 28-29

WEST COAST FAIRE
The Tenth Annual West Coast Computer Faire, Moscone Center, San Francisco, CA. This is one of the largest computer shows. Contact Computer Faire Inc., Suite 201, 181 Wells Ave., Newton Falls, MA 02159. (800) 826-2680; in Massachusetts, (617) 965-8350. March 30-April 2

COMPUTERFEST
The 1985 Greater Baltimore Hamboree and Computerfest. Maryland State Fairgrounds, Timonium. Exhibits, flea market, and forums highlight this annual event. Admission is $4, and the gates open at 8 a.m. Contact Baltimore Amateur Radio Club Inc. POB 95, Timonium, MD 21093-0095. (301) 561-1282. March 31
workshops are planned. Registration is $35 for exhibits-only admission or $195 for a four-day conference and exhibits badge. Contact Softcon, Northeast Expositions, 822 Boylston St., Chestnut Hill, MA 02167. (617) 739-2000. March 31–April 3

- TELECONFERENCING SEMINAR—Teleconferencing in the Marketplace. International Congress Centre RAI, Amsterdam, The Netherlands. A seminar for users and suppliers of teleconferencing services and facilities. For further information, contact International Congress and Convention Association, POB 5343, 1007 AH Amsterdam, The Netherlands. March 31–April 3

- MICROPROCESSOR IDEA EXCHANGE—The 1985 Microprocessor Forum, Bally’s Park Place Casino Hotel. Atlantic City, NJ. Tutorials, forums, and exhibits will be held. A robotic maze contest will be held. On April 1 and 2, the 1985 IEEE VLSI Test Workshop will be held. Contact IEEE Computer Society, Suite 300, 1109 Spring St., Silver Spring, MD 20910. (301) 589-8142. March 31–April 4

April 1985


- MEET SOME NETWORKS Introduction to Network Architectures. Atlanta, GA. This course provides an understanding of the role of network architectures and explains their many forms. The fee is $795. Contact Elaine Hadden Nicholas, Department of Continuing Education, Georgia Institute of Technology, Atlanta, GA 30332-0385. (404) 894-2547. April 2–4

- ENGINEERING WITH MODULA-2—Software Engineering with Modula-2, Atlanta, GA. See February 20–22 for details. April 3–5

- COMMUNICATIONS TECHNOLOGY FOR THE NONVERBAL—The Fourth Annual Conference on Communication Technology and Nonspeaking Children. Joseph Stokes Auditorium, Children’s Hospital of Philadelphia, PA. Up-to-the-minute information on the use of technology with nonverbal children will be presented. Concurrent sessions will address ongoing research, computers, and treatment strategies. The registration fee is $95. Contact Joan Bruno, Children’s Seashore House, 4100 Atlantic Ave., POB 4111, Atlantic City, NJ 08404. (609) 345-5191. Ext. 278. April 12–13


- OPTICAL STORAGE INVESTIGATED—The 1985 Materials Research Society: Symposium D, Golden Gate Holiday Inn, San Francisco, CA. A mass-storage technologies symposium in

(continued)
EVENT QUEUE

- INDUSTRIAL SOFTWARE EXPO—The Second
  CIMCOM: Industrial Software Conference & Exhibition,
  Disneyland Hotel, Anaheim, CA. Contact Computer
  and Automated Systems Association of the Society of
  Manufacturing Engineers, One SME Dr., POB 930,
  Dearborn, MI 48121. (313) 271-1500. April 16-18

- TRAINING AND TECHNOLOGY—The Third
  Annual Technology in Training and Education (TITE)
  Conference, Antler's Hotel, Colorado Springs, CO. A
  conference designed to facilitate the interchange of
  ideas and to explore ways
  that computers and technology can be applied to
  education and training. Contact Lt. Colonel McCann,
  1985 TITE Conference. USAFA/DFSR, USAF
  Academy, Colorado Springs, CO 80940-5751. (303)
  472-4195. April 16-19

- NETWORK CONTROL AND
  MANAGEMENT—Network Management/Technical
  Control, Marriott Copley
  Place, Boston, MA. Diagnostic and test instruments
  will be among the products
  displayed. Contact Louise
  Myrow, CW/Conference
  Management Group, 375
  Cochituate Rd., POB 880,
  Framingham, MA 01701.
  (800) 225-4698; in
  Massachusetts, (617) 879-0700. April 18-19

- PATIENT CARE AND
  COMPUTERS—The Second
  Annual Physicians and Computers: Applications in
  Patient Care, Las Vegas Hilton,
  NV. This conference addresses the concerns of
  doctors, nurses, dietitians,
  pharmacists, administrators,
  and medical record adminis-
  trators. Contact Beverly J.
  Johnson, University of
  Southern California School of
  Medicine, Postgraduate
  Division, 2025 Zonal Ave.
  KAM 318, Los Angeles, CA
  90033. (213) 224-7051.
  April 19-21

- COMPUTER FESTIVAL
  The Tenth Annual Trenton
  Computer Festival, Trenton
  State College, Trenton, NJ.
  Highlights talks, tutorials,
  user-group activities, ex-
  hibits, computer-graphics
  theater, games, and a
  50-acre outdoor electronics
  flea market. Contact Ms.
  Marilyn Hughes, Trenton
  State College, Hillwood
  Lakes CN 550, Trenton, NJ
  08625, (609) 771-2487.
  April 20-21

- AIDS FOR EDUCATORS
  AEDS/ECOO '85: The
  Twenty-Third Annual Con-
  vention of the Association
  for Educational Data Sys-
  tems (AEDS), Hilton Har-
  bour Castle, Toronto,
  Ontario. The theme is
  "Computing Knows No
  Borders." Contact AEDS/
  ECOO '85, c/o OISE, 252
  Bloor St. W, Toronto,
  Ontario M3S 1V6, Canada.
  In the U.S., AEDS/ECOO
  '85, 1201 16th St. NW,
  Washington, DC 20036.
  April 21-27

- SPEECH IN FOCUS
  Speech Tech '85, Vista
  International Hotel, World
  Trade Center, New York
  City. Speakers and ex-
  hibitors will focus on voice
  synthesis and recognition.
  Registration is $195. Contact
  Media Dimensions Inc., POB
  1121 Gracie Station, New
  York, NY 10028, (212)
  772-7068 or 680-6451.
  April 22-24

- PUBLIC NETWORK
  OPERATIONS—X.25 and
NEVADA FORTRAN™ DISKETTE & MANUAL
$29.95

NEVADA COBOL™ DISKETTE & MANUAL
$29.95

NEVADA BASIC™ DISKETTE & MANUAL
$29.95

NEVADA PASCAL™ DISKETTE & MANUAL
$29.95

NEVADA PILOT™ DISKETTE & MANUAL
$29.95

NEVADA EDIT™ DISKETTE & MANUAL
$29.95

NEVADA BASIC, based upon the ANSI-74 standards, has all the popular features. Advanced level 2 features include: compound conditionals and full CALL CANCEL. This software package includes a diskette, 165-page manual, plenty of examples and 16 complete COBOL source code programs.

With the built-in, full-screen text editor, you can easily develop programs for 1/10 the cost of a comparable BASIC interpreter. What's more, Nevada BASIC has full Matrix operations, Single- and Multi-Line functions, and BCD math (no round-off errors). You get a diskette and a 220-page manual. Requires 48K RAM.

Advanced features include:
14-Digit precision; BCD math (no round-off errors); Floating point + 63 -64; TRACE debugging; Arrays up to 6 dimensions; 64K strings; External procedures; and Dynamic Module loading. You get a diskette and a 184-page manual. Requires 60K RAM and one disk drive with at least 90K storage.

NEVADA FORTRAN is based upon the ANSI-86 standards (FORTRAN IV) with some 1977 level features. Advanced features include: IF...THEN...ELSE statement; COPY (include); CHAINing with COMMON; and TRACE debugging. Package includes a diskette, 214-page manual and 5 sample programs. Included also is an 8080 assembler. Requires 48K RAM.

Nevada PILOT, written by Prof. John Starkweather, the language's creator, meets and exceeds all PILOT-73 standards. See the review in January 1983 MICROCOMPUTING. This package includes a diskette, 131-page manual, and 10 useful sample programs.

Nevada FORTRAN is based upon the ANSI-86 standards (FORTRAN IV) with some 1977 level features. Advanced features include: IF...THEN...ELSE statement; COPY (include); CHAINing with COMMON; and TRACE debugging. Package includes a diskette, 214-page manual and 5 sample programs. Included also is an 8080 assembler. Requires 48K RAM.

NEVADA EDIT, a full-screen, video-display text editor, is designed specifically for computer program text preparation. Nevada EDIT is completely user-changeable, can be configured to almost any terminal and takes up only 12K of disk space. This package includes a diskette and a 59-page manual.

WHEN YOU ORDER, PLEASE SPECIFY ONE OF THE FOLLOWING DISKETTE FORMATS:

- 8" SSSD (Standard CP/M IBM 3740)
- 5¼" "Diskettes for:
  - Access/Actrix
  - Apple CP/M
  - DEC VT 180
  - DEC Rainbow
  - Epson QX-10
  - Heath Hard Sector (Z-89)
  - Heath Soft Sector (Z-80, Z-100)
  - IBM-PC (Requires Z-80, Baby Blue II Card)
  - Kaypro Double Density (NCR)
  - Micropolis Mod II
  - NEC PC 8201
  - North Star Double Density
  - North Star Single Density
  - Osborne Single Density
  - Sony 1000, 1050
  - Superbrain DD DOS 3.5X
  - (512 byte sec)
  - Televideo
  - TRS-80 Model 1 (Base O Mapper)
  - Xerox 820 Single Density

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 is a registered 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. 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.
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. The unique P.D.T. technique, introduced by DATA SPEC™ and employed beneath the hood shield, insures maximum integrity under the most adverse conditions. DATA SPEC™ has interface cables for all your requirements: Printers, Modems, Monitors, Disk Drives, and much more. And all DATA SPEC™ cable assemblies carry a lifetime warranty. 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
20120 Plummer Street • Chatsworth, CA 91311 • (818) 993-1202

---

**dBASE II**

with 65,000 memory variables, arrays, 8087 support, high-speed math functions, windows, animation, full syntax checking!

Impossible?

Not anymore!

... with GRYPHON Microproducts' dBASE II "add-ins". For PC/MS-DOS. Write or call for details.

---

**EVENT QUEUE**

Packet Switching Networks, Atlanta, GA. This course covers the internal operations of a packet-switching network and its implementation. The fee is $795. Contact Elaine Hadden Nicholas, Department of Continuing Education, Georgia Institute of Technology, Atlanta, GA 30332-0335, (404) 894-2547. April 23-25


COMPUTER APPLICATIONS EXPLORED Perscomp '85, Sofia, Bulgaria. An international conference on the applications of personal computers and the problems encountered in using them. Contact Dr. Marcel Israel, Bulgarian Academy of Sciences, Institute of Industrial Cybernetics and Robotics, 1113 Sofia, Acad. G. Bonchev St., Bl. 12, Bulgaria; tel: 72-46-98; Telex: 22836 ITKR BG. April 23-25

MICROS IN EMPIRE STATE—The Fourth Annual New York Computer Show and Software Exposition, Nassau County Coliseum, Uniondale, NY. Contact Ann Katchef, CompuShows, POB 3315, Annapolis, MD 21403, (800) 368-2066; in Annapolis, (301) 263-8044; in Baltimore, (301) 269-7694; in the District of Columbia, (202) 261-1047. April 25-28


C FOR ENGINEERS C Programming for Engineers, University of Michigan, Dearborn. A short course and workshop. Contact Professor R. E. Little, University of Michigan, 4901 Evergreen Rd., Dearborn, MI 48128, (313) 593-5241. April 29-May 3

COMMERCIAL AI, HIGHTECH CONFERENCE AI '85: Artificial Intelligence and Advanced Computer Technology Conference/Exhibition, Convention Center, Long Beach, CA. Technical sessions, panel discussions, and product displays are planned. Contact Tower Conference Management Co., 331 West Wesley St., Wheaton, IL 60187, (312) 666-8100. April 30-May 2

MEETING ON LINE National Online Meeting. Sheraton Centre Hotel, New York City. Formal paper presentations, product review sessions, exhibits, and special workshops and seminars transmitted via satellite. Contact Thomas Hogan, National Online Meeting, Learned Information Inc., 143 Old Marlton Pike, Medford, NJ 08055, (609) 654-6265. April 30-May 2
WITH STANDARD MICROSYSTEMS' NEW ARCNET-PC, ARCNET-S100 OR ARCNET-LINK, YOU CAN CREATE YOUR OWN LOCAL AREA NETWORK.

The world's first single-chip local area network controller established Standard Microsystems as a leader in networking technology. Now we're devoting our technical expertise to bring you revolutionary LAN board products, too.

Our ARCNET-PC board interconnects up to 255 IBM*-type personal computers, permitting them to share disk files and printer resources at an extremely efficient 2.5 Megabit data rate.

The ARCNET-S100 board links up to 255 S100 computer systems, providing the S100 computer user with a high performance local area network.

The ARCNET-LINK is a self-contained unit that provides a simplified interface between equipment with a programmable asynchronous RS-232 port and an ARCNET* local area network.

All three products incorporate SMC's industry-standard MOS/VLSI local area network chip set to give you a totally integrated and cost-effective LAN solution. Software available from Standard Microsystems and others provides increased capability for your networking applications. Standard Microsystems Corporation, 35 Marcus Boulevard, Hauppauge, NY 11788. (516) 273-3100.

IBM* is a trademark of the International Business Machines Corporation. ARCNET* is a trademark of the Datapoint Corporation.
THIS MONTH BYTE presents a variety of features including two product previews.

Developed under the name "Pisces," Hewlett-Packard's Integral Personal Computer includes UNIX System III in a transportable package. This product preview by Phillip Robinson, technical editor on our West Coast staff, takes an introductory look at the Integral, its major subassemblies, and its capabilities and limitations. The Integral uses a built-in electroluminescent flat screen and ink-jet printer, but the big news is its incorporation of UNIX in ROM.

The Macintosh continues to provoke lots of love/hate feelings. To bolster its attractiveness to business environments, Apple introduced AppleTalk, a local-area network, and the first two in a series of peripherals designed to be networked. AppleTalk, previewed this month by John Markoff and Phillip Robinson, is a departure from what we often consider fundamental to a local-area network concept. With only a printer and file server currently available, AppleTalk is an interesting approach.

If you are ready to commit your code to EPROM but don't have access to an EPROM programmer, or if you would like to learn more about the process, read Ciarcia's Circuit Cellar. This month, Steve shows us how to build an EPROM programmer inexpensively. This unit attaches to your computer's serial port and uses your computer's intelligence. It is also fully documented and is easily expandable to work with future EPROM designs.

Translating programs among various languages (or even between two languages) is a wonderful concept but generally difficult to implement. In "C to Pascal," Ted Carnevale describes some of the conventional approaches and problems he discovered while trying to move a graphics subroutine library in C to a Pascal environment. He also provides us with a program that makes the process less tedious.

The theme of the March 1984 BYTE was simulation, an intriguing topic once relegated only to rooms full of computers. While microcomputers really can't compete with the fast, large-scale simulations that run on the CRAY-1 and other supercomputers, Don Stauffer uses a microcomputer to "Simulate a Servo System," using an electronic weighing scale as an example of servo-system simulation.

Jeffrey L. Star also capitalizes on the power of the microcomputer in his article "Introduction to Image Processing." While commercial broadcast television limits gray-scale reproduction to about 12 levels and human vision covers a restricted spectrum, image-processing systems usually can deal with at least 32 gray levels and over 16 million unique colors. And, interestingly, there are a couple of image-processing programs available for microcomputers.

—Gene Smarte, Managing Editor
The Hewlett-Packard Integral Personal Computer is a complete, transportable computer system designed around UNIX (System III). (See photo 1.) With the UNIX kernel in ROM (read-only memory), an electroluminescent (EL) flat screen, a 3½-inch floppy-disk drive, a built-in ink-jet printer, and Hewlett-Packard’s Personal Applications Manager (PAM), the Integral is a marvel of advanced personal computing technology.

**HISTORY**
A big team worked on the Integral, which, during development, was known by the name “Pisces.” Some of the team’s members I met were Jon Brewster (user interface), Ray Pajardo (software), Tim Williams (section manager), Doug Collins (hardware manager), and Andy Rood (operating system).

While the hardware development of the Integral began in the fall of 1982, the software development had begun a year earlier. In fact, several projects were merged to come up with the Integral. The original design called for desktop functions in a transportable box: 80 characters by 25 lines on the display, a full-size printer (not thermal), and a real keyboard. When the project began, many of the elements that would meet those requirements didn’t exist. To assure that those devices would be ready in time, Hewlett-Packard (HP) had to get intimately involved in the particular technologies. For example, HP decided early on to use an EL screen and an ink-jet printer. At the time. EL technology was in its infancy and HP had to become a major factor in the EL marketplace.

**BRASS TACKS**
The Integral’s logic board is a generic 68000 8-MHz system supplemented by a few special fillips: a memory mapper for UNIX and a proprietary graphics chip. The 68451 MMU (memory-management unit) chip wasn’t used for memory mapping because it slows the memory cycle quite a bit—it would reside between the processor and RAM (random-access read/write memory). Instead, only the top address bits are mapped, and while that mapping is going on, the lower-half addressing of the RAM also is proceeding. This leaves the RAM’s speed unaffected while still giving reasonable page sizes.

The RAM comes as a standard 512K bytes (with 32K more for the display) made up of 256K by 1 bit DRAMs (dynamic RAMs) with no parity chips. You can purchase 256K and 512K RAM boards separately and insert them into the Integral’s two internal slots. By using extender boxes (which plug into one of the slots, sit underneath the Integral, and provide five slots) you can have up to 5,5 megabytes of RAM. When the 1-megabyte RAM cards become available (soon after introduction) you’ll be able to use the full logical RAM space of 7.5 megabytes. The Integral also has 256K bytes of ROM, which holds the operating system. I’ll discuss the Integral’s ROM a little more in the UNIX section, that follows.

The custom graphics processing unit (GPU) chip was designed and made by HP in Corvallis, Oregon. According to Jon Brewster, a lot of effort went into the chip, which handles window scrolling, window moves, line drawing, and soft character fonts. The GPU is a big chip: it has a 16-bit ALU (arithmetic logic unit), a 16-bit data path, and a barrel shifter.

The engineering and a nearly silent fan enable the Integral to work in some severe environments—up to 40 degrees centigrade and 80 percent humidity. (The humidity limit is 95 percent without the disks, which are the most susceptible to moisture problems.) According to HP, some of the humidity testing involved just taking the machine outside—remember...

Editor’s note: The following is a BYTE product preview. It is not a review. We provide an advance look at this new product because we feel it is significant. A complete review will follow in a subsequent issue.

Phillip Robinson is a senior technical editor at BYTE. He may be contact at 1000 Elwell Court, Palo Alto, CA 94303.
In one test, HP dropped the Integral from a meter up. It still ran.

Photo 2: HP's Personal Applications Manager (PAM) and Calculator.

this was all done in moist Oregon.

NO FEATHERWEIGHT
HP says that the Integral is the only complete product around (i.e., with both a full screen and a printer) that you can really carry and that will fit under airline seats or in overhead racks. Regardless, this machine definitely remains in the transportable category. It is smaller than other transportables—such as the Kaypro—but still weighs 27 pounds.

RELIABILITY
I asked what sort of reliability the Integral will have when it is actually carted around. “You’d be amazed,” replied an HP spokesperson, who recited numerous tests with glee. For instance, in one test they dropped the system from a meter up: it sustained some cosmetic damage but still ran (although that isn’t guaranteed). When something did break during testing, HP made the necessary changes to the components or case. Further testing included vibrating the system, checking for condensation, and giving prototypes to marketing people.

Another ramification of this reliability obsession is that HP won’t soon introduce a hard-disk version of the Integral. Though HP engineers admittedly had considered the possibility, it seems they don’t trust the ruggedness of the hard disks they’ve seen. Beyond that, the design team believes that RAM disks and ROM-based operating systems give hard-disk performance without the problems.

SERVICE
Service for the Integral will be available through dealers or HP, with the standard 90-day warranty offered in the U.S. Because of different legal requirements, the warranty period will be one year in Europe. You will also be able to purchase extended service agreements.

I/O CAPABILITIES
The Integral has only a single port on the back, an HPIB (Hewlett-Packard Interface Bus) socket. If you need more I/O (input/output) capabilities you have to put I/O boards in the slots (for example, an RS-232C card, which should be immediately available).

Another form of I/O is provided by the keyboard and mouse sockets. These sockets are called Human Interface Loop (HIL) ports and can handle other devices, such as graphics tablets. Hewlett-Packard has standardized the protocol for these ports throughout many of its wide range of products.

DISPLAY
The Integral’s electroluminescent, flat-screen display is a centerpiece. Although the display isn’t manufactured at HP, the HP engineers worked closely with the vendor to assure readability and reliability. In fact, each time I talked to an HP engineer I was assured that the “slight shadowing” on the prototype screen had been corrected. Unfortunately, I never saw the shadow. Maybe eyes trained on LCDs (liquid-crystal displays) aren’t yet ready to analyze an EL flat-screen critically. The screen is also fast—with no phosphors to fade, it could be faster than a CRT (cathode-ray tube). The only color choice is amber.

With 512 by 255 pixels in an area 8 inches wide and 4 inches tall, the Integral screen is twice the size of the Grid Compass screen—the only other well-known example of an EL on a microcomputer. Because the screen is so thin, the Integral could probably be the shallowest system you have ever put on a desk. While transportables of the Osborne and Kaypro variety have to be unbuttoned and then tilted over, taking up much of the depth of a desk, the Integral retains its standing position, with only the keyboard folding down to occupy writing space.

An EL display is clearer than a CRT because there’s no focus problem. As project manager Tim Williams noted dryly, “If a dot lights up, a dot lights up.” The Integral has a variety of fonts and a font editor that lets you create your own. An antireflective coating and a circular polarizer for glare reduction combine to improve your...
The Integral PC's electroluminescent, flat-screen display is its centerpiece.

“One disk is cheaper than two,” says HP's Andy Rood. “So the question is: Why two?”

Normally manufacturers include two disk drives to provide enough total storage, separate storage devices for programs and data, and backup capability.

According to HP, the Integral's single floppy-disk drive, RAM, and ROM meet these needs: the very high density of the floppy-disk drive provides enough total storage; the separation of programs and data is accomplished partly by the ROM and partly by the RAM disk; and because the operating system is in ROM instead of on a disk and the RAM of the Integral automatically includes a RAM-disk function, you can put programs on the RAM disk and data files on the floppy. As an added benefit, RAM-disk programs run faster than those on a floppy disk. Finally, the development team felt that the high-density floppy and the RAM disk made up a perfectly capable pair of devices for backing up files. For those reasons, and to save on space and power, the team decided to leave out a second disk drive.

The use of ROM for the operating system was a big challenge: UNIX likes to have a disk drive at its disposal. The HP team had to "tune" their UNIX so that it didn't do that. The ROM solution provides that the root file is on the RAM disk, so when UNIX comes up, the only file system it presumes to exist is the RAM disk.

You can have more mass storage (externally) if you want it. Through the Integral's I/O interface you can use any of HP's many storage peripherals. All of the software drivers—such as for a hard disk—are already built in.

**ThinkJet Printer**

One of the features that makes the Integral unusually "integrated" is the built-in ink-jet printer (see "The Hewlett-Packard ThinkJet Printer" by Mark Haas in the January BYTE, page 337). The ThinkJet is also a product of the Corvallis division of Hewlett-Packard and the Integral team was intimately asso-
Although the Integral is compatible with UNIX System III, it emulates other versions.

associated with its development.

As an ink-jet printer, the ThinkJet is quiet and fast. The characters it produces are near letter quality. The ThinkJet can print in a number of different fonts and can also handle black-and-white graphics. The Integral’s keyboard has a Print key that immediately cues a dump of the screen’s contents to the ThinkJet.

One small drawback of the printer’s placement is that there is no good place to put the paper—that is, if you put the pile of blank paper just behind the computer, the system takes up a lot more room.

The ThinkJet is generally simple to load and use but doesn’t have a platen knob. Therefore, you have to be careful not to overrun when using the line-feed and form-feed buttons.

**Mouse**

The Integral’s optional mouse is HP’s standard two-button, mechanical contraption that uses a steel ball beneath a circular palm grip. The plug-in position (on the left side of the unit) is slightly awkward for a right-handed user because the cable must run behind the keyboard. The mouse’s left button is called the “clicking” button (for selection) and the right is called the “right” button (for mode changing).

**Software**

The Integral runs HP-UX 2.1, which HP calls a “vanilla” UNIX environment, and the Personal Applications Manager (photos 2 and 3). HP’s operating-environment shell (see “The HP 150” by Phil Lemmons and Barbara Robertson in the October 1983 BYTE, page 36, and “The HP 110” in the June 1984 BYTE, page-111). The Integral’s windows emulate terminals that report back at 9600 bits per second, have 80 characters by 24 lines, and use normal escape sequences. As Tim Williams puts it, “We think the UNIX wave is just beginning. And as the UNIX wave rolls along we want to roll with it and help it to grow.” Ray Fajardo noted that a lot of development time was devoted to making the Integral run most UNIX software without modification. The primary goal was System III compatibility; a secondary goal was flexibility. The system can dynamically configure drivers and make operating-system patches on the fly, so the environment is standard yet can be specialized by independent software vendors. According to HP, HP-UX’s flexibility enables it to emulate Venix, System V, and other UNIX derivatives. Over 50 utilities, commands, and standard applications are included with the system.

**User Interface**

The Integral’s user interface (windows, graphics, function keys, and optional mouse) were Jon Brewster’s responsibility. He explained that the original reason for windows was to provide users with more than one interface to the product. HP had discovered that even novice users use multitasking...
and keep multiple programs on the display. The windowing system, then, had to allow novices to do multitasking without worrying about foreground, background, priorities, and scheduling. Because the mouse was to be (and is) optional, the windows had to work well with and without it.

Also, unlike the Macintosh, the Integral allows you to move windows while they are being updated: windows are moved by animating a sprite (which resembles a corner of the window) and positioning it—rather than moving the entire window. Thus, you can hide windows (they appear as title lines in the lower left of the display), stretch them (by choosing a new bottom right corner with a sprite), move them (by choosing a new top left corner with a sprite), and shuffle them (the top window being the only one with which you can interface directly, although the others can still be active).

**APPLICATIONS**

According to HP, a variety of software packages will be available within 60 days of the Integral's introduction. These include Microsoft's Multiplan, Officeware's Script and Plan, Ashton Tate's dBASE III, HP's MemoMaker, Data and Calculator, HP-UX software development tools, and others.

More software is being developed both at HP's personal software division and by independent vendors who have already been alerted to the Integral's introduction. Also, because of the compatibility of HP Technical BASIC, many programs for other HP systems, such as Series 200 and 500 products, will immediately run on the Integral.

**DOCUMENTATION**

Although the documentation I viewed was only in the draft stage, HP has given plenty of attention to the literature explaining its system. The documentation is clear and thorough. Beginners will spend the most time with the *Personal Tutor* disk and booklet, a tutorial that takes an estimated eight hours to fully absorb. Lessons include use of the mouse, windows, and the organization, viewing, printing, and creating of files. The integral's documentation also includes a cartoon booklet that explains how to set up and start up the system, and a reference guide. HP claims that the documentation, user interface, and PAM will have novices working on the system within 30 minutes.

**PRICE AND CONCLUSIONS**

The Integral Personal Computer is priced at $4990 (with HP-UX, PAM, and HP Windows). Although the price is high for a single-disk-drive system, the perceived price/value ratio depends on what class of computer you compare the Integral to. HP would like it to be compared to the higher-performance (and higher-priced) UNIX machines, rather than MS-DOS transportables such as the Compaq.

The big question is, who will buy the Integral? Perhaps business and technical professionals whose requirements push the limitations of today's 16-bit MS-DOS machines. Certainly computer science students and engineers will see many advantages to a complete UNIX system they can take home. And with the benefits of multitasking, HP may pull in more people: imagine having several data-communications cards, each hooked to a different electronic information service, and all communicating while you work on a spreadsheet and a word processor.

The HP Integral Personal Computer's advantages include: state-of-the-art technology; the "everything you need in one box" design; engineering that looks absolutely solid, and a multitasking environment—all from a company with a great engineering track record. On the minus side: the list of software available for the Integral PC is short, and the price may be too high. But for those who need advanced computing power and who want to cast their votes against the IBM PC and its various compatibles, the HP Integral Personal Computer may be the best argument yet for biting the bullet and switching to UNIX.
Over the years, many articles have been published on programming EPROMs (erasable programmable read-only memories). The number of articles alone indicates the value of an EPROM programmer and the interest expressed in the subject. True-blooded computer experimenters consider an EPROM programmer as essential a tool as a soldering iron and a DVM (digital voltmeter).

Most EPROM programmers designed for personal computers are implemented as bus-dependent I/O (input/output) peripheral cards that use computer-specific, machine-language driver programs. By eliminating the need for an enclosure and using the system power supply, a relatively cost-effective unit can be produced. Unfortunately, if I designed such a unit, it probably wouldn't be for the computer you own.

For computer users who don't have expansion buses or who want their EPROM programmer to be transportable between systems, the only alternative is a stand-alone EPROM programmer attached to a serial port (much like a modem). Making it a separate peripheral device, however, necessarily increases its cost. In fact, external serial-port EPROM programmers are frequently two or three times the cost of board-level units.

A certain portion of the cost is due to its separate power supply and enclosure, but most of the expense is attributed to the features that manufacturers generally incorporate in the devices. The majority of stand-alone serial-connected programmers are, in fact, designed as intelligent EPROM programmers that have the basic processing power and memory of whole computers. I have taken this approach on previous designs. Such devices perform well and require little assistance from the host system beyond the data to be programmed.

This time I'm approaching the problem differently. I've decided to keep it simple and design the most universally applicable and cost-effective programmer that I can.

The latest Circuit Cellar EPROM programmer is a serial-port programmer that has the speed of a turtle, the intelligence of the mightiest computer (that is, it has absolutely no smarts of its own), and is as functional as a doorstop between uses. On the positive side, it's fully documented, universally applicable, and easily expandable to ac-

(continued)
commodate future EPROM types.

The serial-port programmer can be operated from almost any system with a serial port. The driver software is written completely in BASIC with no machine-language routines. The serial-port programmer offers all the hardware features to program 2716, 2732, 2732A, 2764, and 27128 EPROMS through a serial port, including: RS-232C compatibility, no handshaking necessary, internal power supplies, jumper-selectable EPROM types, and jumper-selectable data rates.

The BASIC-language driver program included offers features such as:
- menu-driven operation using single keystrokes
- a help routine that can be called at any time
- single-byte or burst-write modes
- read or copy EPROM
- optional programming from a disk file
- verify after write
- verify EPROM erasure
- screen-dump routines by page or byte
- single-stepping mode
- software-controlled read/write mode select
- BASIC driver that can be user-modified

REVIEWING EPROM BASICS

A personal computer, even in its minimum configuration, always contains some user-programmable memory or RAM (random-access read/write memory), usually in the form of semiconductor-memory integrated circuits. This memory can contain both programs and data and can be read or modified as needed.

Any of several kinds of electronic components can function as bit-storage elements in this kind of memory. TTL (transistor-transistor logic) type-7474 flip-flops, bistable relays, or tiny ferrite toroids (memory cores) are suitable, but they all cost too much, are hard to use, and have other disadvantages.

In personal computer and other microprocessor-based applications, the most cost-effective memory is made from MOS (metal-oxide semiconductor) ICs (integrated circuits). Unfortunately, data stored in these semiconductor RAMs is volatile. When the power is turned off, the data is lost. Many ways of dealing with this problem have been devised, with essential programs and data usually stored in some nonvolatile medium.

In most computer systems, some data or programs are stored in nonvolatile ROM (read-only memory). A semiconductor ROM can be randomly accessed for reading in the same manner as the volatile memory, but the data in the ROM is permanent. In a mask-programmed ROM, the data that can be read is determined during the manufacturing process. Whenever power is supplied to the ROM, this permanent data (or program) is available. In small computer systems, ROM is chiefly used to contain operating systems and/or BASIC interpreters—programs that don't need to be changed.

Another type of ROM is the PROM (programmable read-only memory). A PROM component is delivered containing no data. The user decides what data it should contain and permanently programs it with a special programming device. Once initially programmed, PROMs exhibit the characteristics of mask-programmed ROMs. You might label such PROMs as write-once memories.

The EPROM, which is ultraviolet-light-erasable, is a compromise between the write-once kind of PROM and the volatile memory. You can think of the EPROM as a read-mostly memory, used in read-only mode most of the time but occasionally erased and reprogrammed as necessary. The EPROM is erased by exposing the silicon chip to ultraviolet light at a wavelength of 2537 angstroms. Conveniently, most EPROM chips are packaged in an enclosure with a transparent quartz window.

HOW AN EPROM WORKS

EPROMs store data bits in cells formed from stored-charge FAMOS (floating-gate avalanche-injection metal-oxide semiconductor) transistors. Such transistors are similar to positive-channel silicon-gate field-effect transistors, but they have two gates. The lower or floating gate is completely surrounded by an insulator layer of silicon dioxide; the upper control or select gate is connected to external circuitry.

The amount of electric charge stored on the floating gate determines whether the bit cell contains a 1 or a 0. Charged cells are read as Os; uncharged cells are read as Is. When the EPROM chip comes from the factory, all bit locations are cleared of charge and are read as logic Is; each byte contains hexadecimal FF.

When a given bit cell is to be burned from a 1 to a 0, a current is passed through the transistor's channel from the source to the gate. (The electrons, of course, move the opposite way.) At the same time, a relatively high voltage potential is placed on the transistor's upper select gate, creating a strong electric field within the layers of semiconductor

(continued)
Figure 2: The serial-port PROM programmer.
material. (This is the function of the +21- or +25-volt [V_{pp}] charging potential applied to the EPROM.) In the presence of this strong electric field, some of the electrons passing through the source-drain channel gain enough energy to tunnel through the insulating layer that normally isolates the floating gate. As the tunneling electrons accumulate on the floating gate, the gate takes on a negative charge, which makes the cell contain a 0.

When data is to be erased from the chip, it is exposed to ultraviolet light, which contains photons of relatively high energy. The incident photons excite the electrons on the floating gate to sufficiently high energy states that they can tunnel back through the insulating layer, removing the charge from the gate and returning the cell to the 1 state.

The 2700 family of EPROMs contains bit-storage cells configured as individually addressable bytes. This organization is often called "2K by 8" for a 2716 or "8K by 8" for a 2764. Figure 1 shows the 2716 and 2764. The completely static operation of these devices requires no clock signals. The primary operating modes include read, standby, and program (program-inhibit and program-verify modes are important primarily in high-volume applications).

Control inputs are used to select the chip and configure it for one of these operating modes. In the program mode, particular bit cells are induced to contain 0 values. Both 1s and 0s are present in the data word presented on the data lines, but only the presence of a 0 causes action to take place. To program the 2716 EPROM, the V_{pp} input is made +25 V and the OE input is at a high TTL level. Then, the TTL-level data to be programmed for a specific address is set up on the 2716's data lines, and the address is set up on address lines A0 through A10. After a setup time of at least 2 microseconds (µs), a high TTL-level programming pulse 50 milliseconds (ms) long is applied to the CE/PGM input. Addresses to be programmed may be specified in any order.

The 50-ms programming pulse must be applied once for each location to be programmed (under no circumstances should a constant high level be applied to the CE/PGM input in the program mode). Repeated 50-ms pulses to the same location are acceptable, but any pulse width greater than 55 ms might destroy the chip. The minimum pulse width is 45 ms.

### Table 1: Power supply and ground pin numbers for figures 2 and 3.

<table>
<thead>
<tr>
<th>IC Number</th>
<th>Type</th>
<th>Ground</th>
<th>5 V</th>
<th>12 V</th>
<th>-12 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC1</td>
<td>AY3-1015</td>
<td>pin 3</td>
<td>pin 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IC2</td>
<td>74LS75</td>
<td>pin 8</td>
<td>pin 16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IC3,4,5</td>
<td>74LS374</td>
<td>pin 10</td>
<td>pin 20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IC6</td>
<td>74LS00</td>
<td>pin 7</td>
<td>pin 14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IC7</td>
<td>74LS14</td>
<td>pin 7</td>
<td>pin 14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IC8</td>
<td>NE555</td>
<td>pin 7</td>
<td>pin 14</td>
<td></td>
<td>pin 14</td>
</tr>
<tr>
<td>IC9</td>
<td>74LS02</td>
<td>pin 7</td>
<td>pin 14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IC10</td>
<td>MC1488</td>
<td>pin 7</td>
<td>pin 14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IC11</td>
<td>MC1489</td>
<td>pin 7</td>
<td>pin 14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IC12</td>
<td>74LS44</td>
<td>pin 7</td>
<td>pin 14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IC13</td>
<td>CD74HC4040</td>
<td>pin 7</td>
<td>pin 14</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Figure 3: Serial interface and data-rate generator.

Circuit Description

Figures 2, 3, and 4 show the schematic drawings for the serial-port EPROM programmer, the RS-232C interface, and the four-voltage power supply. Table 1 shows the powersupply connections for the schematics. The main element in figure 2 is the AY3-1015 UART (universal asynchronous receiver/transmitter). The UART converts serial information sent from the computer into parallel information used in the programmer. This parallel data appears on pins 5 through 12 of the UART receiver bus. The UART can also pass information back to the computer by converting any parallel information present on pins 26 through 33 of the transmitter bus into serial information. The serial information is received from the computer on pin 20 and transmitted to the computer on pin 25.

A logic high level on pin 21 resets and initializes the UART. This level is generated as a power-on reset (PWR) every time the power to the programmer is turned on or the manual reset button pressed. This PWR also clears
the receiver character counter, IC2.

The format of the serial transmission between the computer and the programmer. (I chose to hard-wire these options rather than provide option switches that are rarely used.) As shown, the UART is configured for an 8-bit character length with 1 stop bit and parity checking inhibited. If your computer requires 2 stop bits, connect pin 36 to +5 V instead of ground. The programmer will operate at any location read from or written to in the EPROM. This 4-byte protocol eliminates the need for incremental counters and sophisticated decision logic in the programmer. It does, however, reduce the speed of read and erase-verification operations.

The first 3 bytes received are latched a byte at a time into latches IC3, IC4, and IC5. The latching pulses are generated by IC2, which is configured as a 4-bit byte counter. Each time a byte is received by the UART, an RDA (received data available) pulse is generated at pin 19 of the UART. This pulse is used to clock IC2 and is gated back to the RDAV (reset data available) line, pin 18, to clear the receiver section of the UART. As the counter clocks, the leading edges of its output latch the data from the UART into IC3, IC4, or IC5. The counter is reset by the PWR line or when the fourth byte is received.

The first byte received by the programmer contains the most significant 3 to 6 bits of the EPROM address (depending upon the EPROM type) and 1 bit to select either the read or write mode of operation. A logic 1 in bit 7 sets the write mode; a logic 0 sets the read mode.

The second byte contains the lower 8 bits of the EPROM address.

The third byte contains the data to be programmed into the addressed location when it is in the write mode or a dummy character when in the read mode.

The fourth byte contains dummy data in both the read and write modes. When the counter increments with the reception of the fourth byte, it causes IC2 to reset. The time between setting this output bit and clearing the counter is about 100 nanoseconds (ns). This short pulse concluding the setup of the address and data is used to trigger the actual programming pulse to the EPROM.

The programming pulse to the EPROM is generated by IC8, which is configured as a 50-ms one-shot (triggered by the reception of the fourth byte). The programming pulse is fed to the EPROM at several different locations, depending on which EPROM is being programmed and how the EPROM selection jumper block (see figure 5) is configured.

The one-shot is functional only when the mode select line (R/W, read/not write) IC3 pin 2 is a logic 0, setting the write mode. The mode select line is also used to select the programming voltage ranges of the various EPROMs. When configured for a 2732 or a 2716 EPROM, a low on the mode select line sets the Vpp supply to a 25-V level. For all other EPROM types, the Vpp supply is set to a 21-V level.

Depending on the configuration of the jumper block, the mode select line sets the proper TTL levels at the CE and OE pins to place the various EPROMs in the read or write mode. A logic high on the mode select line causes the Vpp supply to drop to 0 V for the 2732 and 2732A EPROMs and to 5 V for the other types.

The mode select line also functions as the output enable line of data latch IC5. When the programmer is in the write mode, data from the UART is latched and directed to the EPROM data bus for programming. When the programmer is in the read mode, IC5's output is disabled, and the EPROM data-bus contents are transmitted back to the computer.

LEDs (light-emitting diodes) 1, 2, and 3 indicate when power is on and when read and write pulses occur. They are not necessary to the operation of the programmer and are merely included as visual aids.

Figure 3 shows the serial-interface connections and the data-rate generator. IC10 and IC11 are standard RS-232C transmitter and receiver chips that conform to the EIA (Electronic Industries Association) standard for RS-232C transmission. (If your computer needs a handshaking signal, the 50-ms write pulse can be connected to the clear-to-send line. It is not used with the software presented in this article.) The serial-communication rate between the programmer and the computer is jumper-selectable. A 4.9152-MHz oscillator is divided down through a CD74HC4040 (it must include the HC designation to accommodate the high frequency) to produce the appropriate clock rate for the UART.

Figure 4 shows the power supply used with the programmer. The power transformer I chose was 22 V CT (center tap), but any transformer from
22 to 25.6 V CT is adequate. The secondary output of the transformer is full-wave rectified, filtered, and then regulated to +12 V, +5 V, and -12 V. Only the +5 V supply needs an actual IC regulator; less stringent zener regulation is adequate for the 12-V supplies to the RS-232C drivers.

The 35-V output consists of components C4, C5, D3, and D4 connected as a cascade voltage doubler with half-wave rectification. This configuration produces an input of approximately 32 to 34 V to the LM317/338 regulator. The minimum acceptable voltage at the input is 28.5 V (for a 25-V output). If you use a higher-output transformer than 22 V CT, be careful that the input to the V_{pp} regulator doesn't exceed 35 V. If it does, additional preregulation may be necessary to use this circuit.

Figure 6 shows the programmable V_{pp} supply. The 2732A EPROM requires the programming voltage to be pulsed between 0 and 21 V, while a 2716 requires a pulse between 5 and 25 V. The supply is controlled by the jumper connections and the mode select line. With jumper #1 across R6, the supply is configured for a maximum V_{pp} level of 21 V. When it is removed, the supply has a maximum voltage of 25 V.

The minimum V_{pp} level is set by two jumper-selectable programming circuits, which are also connected to the regulator's output set point-adjust line. When jumper #2 is installed, a two-transistor circuit is enabled, which applies -1.2 V to the adjust line. The result is a 0-V output from the regulator. When jumper #3 is installed, the reference-adjust line is set to allow a +5-V regulator output.

INTERACTING WITH HARDWARE

The operation of the serial programmer should become clear by following an example of a write operation followed by a read operation. This is the sequence that would necessarily occur during a standard write-and-verify cycle.

First, the EPROM programmer is cleared and set to the read mode by the power-on reset pulse (which can be generated by pressing a button or by turning the programmer on) so that it is ready to receive the first character. If we plan a write cycle, the first character must contain a logic 1 in bit 8 to activate the write mode. The upper 3 to 6 bits of the EPROM address (the page address that depends on the size of the EPROM) must also appear in the first 3 to 6 bits (bit 0 through bit 5) of this first character. Each character of data to be programmed into the EPROM is sent to the programmer as a 4-byte transmission with the programming address specified each time.

Table 2 indicates the allowable bit patterns for this first character received by the programmer.

For our example, assume that the
data byte C3 (hexadecimal) is to be written into the first byte of page 4 in the EPROM. In this case, the first character received by the programmer should be 1x000100. The receipt of this character pulses IC2 and latches the page address and mode select bit into the page/mode latch, IC3. The mode select bit selects the EPROM for a write cycle, turns on the \( V_{pp} \) supply to the EPROM, releases the reset line on the timer, activates the output enable line of the data latch, and shuts off the transmission gate of the UART.

The second character sent contains the lower 8 address bits for the EPROM. To program the first location in page 4, the rest of the address must then be 00000000. This character sets the second stage of the counter and latches the lower address location into the lower address latch, IC4.

The third character, 11000011 (C3 hexadecimal), contains data to be programmed into the EPROM. When this character is received, the counter latches the data into the data latch, IC5.

The fourth character sent is a dummy character that may contain any value. This fourth and last character simply clocks IC2 and triggers the 50-ms programming pulse. When the one-shot times out, the programmer is still in the write mode. It has to be set to the read mode by initiating a read cycle.

The four characters sent in our present example of a write sequence are 1x000100, which sets the write mode and upper address; 00000000, which sets the lower address; 11000011, which sets the data byte (C3 hexadecimal); and xxxxxxxx, dummy data.

The read sequence is similar to the write sequence. The first character

<table>
<thead>
<tr>
<th>Page</th>
<th>Write Mode</th>
<th>Read Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1x000000</td>
<td>0x000000</td>
</tr>
<tr>
<td>1</td>
<td>1x000001</td>
<td>0x000001</td>
</tr>
<tr>
<td>2</td>
<td>1x000010</td>
<td>0x000010</td>
</tr>
<tr>
<td>3</td>
<td>1x000011</td>
<td>0x000011</td>
</tr>
<tr>
<td>4</td>
<td>1x000100</td>
<td>0x000100</td>
</tr>
<tr>
<td>5</td>
<td>1x000101</td>
<td>0x000101</td>
</tr>
<tr>
<td>6</td>
<td>1x000110</td>
<td>0x000110</td>
</tr>
<tr>
<td>7</td>
<td>1x000111</td>
<td>0x000111</td>
</tr>
<tr>
<td>64</td>
<td>1x111111</td>
<td>0x111111</td>
</tr>
</tbody>
</table>

Table 2: Allowable bit patterns.

Figure 6: Close-up of the programmable \( V_{pp} \) supply.
sent again contains the upper bits of the address, but bit 8 is now set to logic 0 to put the mode select line high (read mode). A logic 1 on the read/write line deactivates the programming one-shot and tristates the data latch, IC5.

Again, the first character is latched into the page/mode latch, and the second character is latched into the lower address latch. With IC5 tristated, the EPROM's data output is placed on the UART transmitter bus. The third character is a dummy character that is used to clock IC2. This signal causes the UART to transmit the data on the transmitter bus to the computer. The fourth character is then sent to the programmer to reset the counter.

The four characters that must be sent in the verify sequence of our example are 0x000100, which sets the read mode and upper page address; 00000000, which sets the lower address; xxxxxxxx, which gets the data byte from the EPROM (C3 hexadecimal); and xxxxxxxx, which resets the programmer.

**Programmer Software**

The driver program shown in listing 1 could have been written in any language that supports input and output ports. [This program is available for downloading from BYTEnet Listings at (603) 924-9820. You can also receive it by sending an IBM PC-formatted disk to Steve Ciarcia.] BASIC was chosen because it has wide appeal in the personal computer field and because most systems with serial I/O ports support BASIC. The software (flow-diagramed in figure 7) was written specifically for the IBM PC but can be easily modified to conform to most other systems that also support Microsoft BASIC. The program was written with a short MAIN program module that calls a number of subroutine modules. This modular approach makes modifying, debugging, or ex-

---

**Figure 7: A flowchart of the driver program.**

112 BYTE • FEBRUARY 1985
panding the software a much easier task. Examining the driver software should provide enough understanding so that any additions or changes desired can be easily implemented.

The program modules that access the serial port are labeled READ A BYTE and WRITE A BYTE in listing 1. These sections contain the only software modules that are hardware-dependent and that need to be configured to your particular system.

The WRITE module performs the actual program burn of the data into the EPROM. The first statement sends the page address to the serial port with the value of bit 8 set to 1. This is accomplished by combining the page address with the value 128 (10000000 binary). The page address is calculated elsewhere in the program before entering this module. The next statement sends the lower address contained in the variable BYTE to the serial port. This value is also calculated by the program prior to entering the WRITE module.

The statement “PRINT #3,DATUM” sends the data to be written into the EPROM to the serial port. The last statement in the WRITE module is a timing loop that causes the program to pause while the 50-ms timer in the serial-port programmer times out.

The READ module requests a data byte from the programmer and receives the byte from the serial port. It accomplishes this by sending a page address and byte address to the serial port as in the WRITE module. In this case, bit 8 of the page address is set to 0 to inform the programmer that a read cycle is being performed. The next two lines send a dummy data value and a strobe to the serial port to complete the read sequence. The values of DUMMY and STROBE are set in the initialization module. The data sent by the serial-port programmer is received in the variable RDATA.

Once these modules have been configured to your system, it is a simple matter to write and read data from the programmer. Simply define the PAGE and BYTE address variables along with the DATUM value and send them to your serial port by calling the appropriate module. The rest of the program in listing 1 shows methods for doing this.

The approach used in the program is to place any data to be programmed into the EPROM in an array so that it can be reviewed and edited prior to burning it permanently into the EPROM. The array name is appropriately called ARRAY(). The high-order byte of every element in ARRAY() stores a flag bit indicating that the lower-order byte of the element is data to be programmed. This method allows the program to write to only those locations in the EPROM where a valid data value has been entered in ARRAY().

Each time a data value is put into ARRAY(), the value is combined with 2^6 to set the flag. When it is time to send all the data to the EPROM, the flag is checked in each element, and only those elements with the flag bit set are sent to the EPROM. This process is repeated until all the flagged elements have been programmed. The initial values for ARRAY() are taken directly from the EPROM by reading each location and storing the values in ARRAY().

Several methods of entering data into ARRAY() are used in the program. One method is to enter each data value directly from the keyboard; another method is to fill ARRAY() by reading an already-programmed EPROM. Finally, a disk file previously (continued)
Listing 1: EPROM programmer routines.

1000 REM = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
1010 REM SERIAL EPROM PROGRAMMER
1020 REM written in MICROSOFT BASIC for the IBM PC
1030 REM = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
1040 REM INITIALIZATION ROUTINE
1050 KEY OFF
1060 LINE25$="BAUD RATE = \ EPROM = \ BASE PAGE = \"
1070 BR$= "OOOO":EP$ = BR$:BP$ = BR$
1080 DEFINT A-Z:ON ERROR GOTO 4600
1090 STROBE= 255:DUMMY = 255:PAGE = O:BYTE = O:DATA = 255
1100 K$="VPNEOWHDIBSL":FORMAT$="PAGE = \ BYTE = \ DATA = \"
1110 MIMAGE=0:MCADDR &=H3FC:DELAY = 100
1120 REM = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
1130 REM MAIN BODY OF PROGRAM — KEYBOARD SEQUENCE
1140 GOSUB 2550
1150 PRINT"= = = = = = = = = = SERIAL EPROM PROGRAMMER = = = = = = = = = ="
1160 PRINT" BAUD-RATE SELECTION"
1170 PRINT"The SERIAL PORT programmer can operate at several different bauds."
1180 PRINT" Enter the number of your selection -> ;":BAUD$= INPUT$(1)
1190 PRINT BAUD$:BAUD=VAL(BAUD$):1F BAUD>O AND BAUD<7 THEN 1360
1200 BR$=STR$(300'2"(BAUD-1))
1210 GOSUB 2250
1220 PRINT"========== SERIAL EPROM PROGRAMMER=========="
1230 PRINT" EPROM-TYPE SELECTION"
1240 PRINT"The SERIAL EPROM programmer has the ability to program several"
1250 PRINT" different EPROMs. Select the type of EPROM from the list below:";
1260 PRINT" (1) 2716"
1270 PRINT" (2) 2732/2732A"
1280 PRINT" (3) 2764"
1290 PRINT" (4) 27128"
1300 PRINT" Enter the number of your selection -> ;":ESIZE$ = INPUT$(1)
1310 PRINT ESIZE$ :ESIZE=VAL(ESIZE$):1F ESIZE>O AND ESIZE<5 THEN 1520
1320 DSIZE = 1024 • 2" ESIZE:PAGES = DSIZE/256
1330 EP1$ = STR$(16'2"(ESIZE-1))
1340 EP$= "27" +RIGHT$(EP1$,LEN(EP1$)-1)
1350 DIM ARRAY(DSIZE)
1360 GOSUB 2250:GOSUB 4790:GOSUB 2250
1370 PRINT"========== SERIAL EPROM PROGRAMMER=========="
1380 PRINT" CONDITION OF EPROM"
1390 IF the EPROM you are programming is fully erased then select'
1400 PRINT"EPROM ERASED" from the select ion list below. This will save'
1410 PRINT"the time required to read the EPROM into memory. If the EPROM'
1420 PRINT"has been partially programmed then select 'PARTIALLY PROGRAMMED'
1430 PRINT"and the EPROM will be read into memory prior to programming."
1440 PRINT" (1) EPROM ERASED"
1450 PRINT" (2) EPROM PARTIALLY PROGRAMMED"
1460 PRINT" Enter the number of your selection --> ;":ERA$= INPUT$(1)
1470 PRINT ERA$:PRINT :ERA=VAL(ERA$):1F ERA=2 THEN 1740
1480 PRINT'<<<<< INITIALIZING MEMORY - PLEASE WAIT >>>>>'
1490 FOR I= 0 TO DSIZE- 1 :ARRAY(I) = 255:NEXT I
1500 ON BAUD GOTO 1750,1760,1770,1780,1790,1800
1510 OPEN "COM1:300,n,8,1,rs,cs,ds" AS #3:GOTO 1810
1520 OPEN "COM1:600,n,8,1,rs,cs,ds" AS #3:GOTO 1810
1530 OPEN "COM1 : 1200,n,8,1,rs,cs,ds" AS #3:GOTO 1810
1540 OPEN "COM1:2400,n,8,1,rs,cs,ds" AS #3:GOTO 1810
1550 OPEN "COM1:4800,n,8,1,rs,cs,ds" AS #3:GOTO 1810
1560 OPEN "COM1:9600,n,8,1,rs,cs,ds" AS#3
1570 PRINT"========== SERIAL EPROM PROGRAMMER=========="
1580 PRINT" BASE-PAGE INITIALIZATION"
1590 ON ERA GOTO 1610,1620,1630,1640,1650,1660
1600 PRINT ERA:PRINT :ERA=VAL(ERA$):1F ERA=1 THEN 1700
1610 PRINT ERA:PRINT :ERA=VAL(ERA$):1F ERA=0 AND ERA<7 THEN 1630
1620 PRINT ERA:PRINT :ERA=VAL(ERA$):1F ERA=7 THEN 1640
1630 PRINT ERA:PRINT :ERA=VAL(ERA$):1F ERA=8 THEN 1650
1640 PRINT ERA:PRINT :ERA=VAL(ERA$):1F ERA=9 THEN 1660
1650 PRINT ERA:PRINT :ERA=VAL(ERA$):1F ERA=10 THEN 1670
1660 PRINT ERA:PRINT :ERA=VAL(ERA$):1F ERA=11 THEN 1680
1670 PRINT ERA:PRINT :ERA=VAL(ERA$):1F ERA=12 THEN 1690
1680 PRINT ERA:PRINT :ERA=VAL(ERA$):1F ERA=13 THEN 1700
1690 PRINT ERA:PRINT :ERA=VAL(ERA$):1F ERA=14 THEN 1710
1700 PRINT ERA:PRINT :ERA=VAL(ERA$):1F ERA=15 THEN 1720
1710 IF ERA <> 1 THEN PRINT "<<<<< SELECTION ERROR >>>>>":GOTO 1690
1720 PRINT "<<<<< SELECTION ERROR >>>>>":GOTO 1690
1730 FOR i=0 TO DSIZE-1:ARRAY(i)=255:NEXT I
1740 PRINT ERA:PRINT :ERA=VAL(ERA$):1F ERA=2 THEN 1740
1750 OPEN "COM1:300,n,8,1,rs,cs,ds" AS #3:GOTO 1810
1760 OPEN "COM1:600,n,8,1,rs,cs,ds" AS #3:GOTO 1810
1770 OPEN "COM1:1200,n,8,1,rs,cs,ds" AS #3:GOTO 1810
1780 OPEN "COM1:2400,n,8,1,rs,cs,ds" AS #3:GOTO 1810
1790 OPEN "COM1:4800,n,8,1,rs,cs,ds" AS #3:GOTO 1810
1800 OPEN "COM1:9600,n,8,1,rs,cs,ds" AS#3
1810 PRINT ERA:PRINT :ERA=VAL(ERA$):1F ERA=10 THEN 1820
1820 PRINT ERA:PRINT :ERA=VAL(ERA$):1F ERA=11 THEN 1830
1830 PRINT ERA:PRINT :ERA=VAL(ERA$):1F ERA=12 THEN 1840
1840 PRINT ERA:PRINT :ERA=VAL(ERA$):1F ERA=13 THEN 1850
1850 PRINT ERA:PRINT :ERA=VAL(ERA$):1F ERA=14 THEN 1860
1860 PRINT ERA:PRINT :ERA=VAL(ERA$):1F ERA=15 THEN 1870
1870 PRINT ERA:PRINT :ERA=VAL(ERA$):1F ERA=2 THEN 1880
1880 PRINT ERA:PRINT :ERA=VAL(ERA$):1F ERA=3 THEN 1890
1890 PRINT ERA:PRINT :ERA=VAL(ERA$):1F ERA=4 THEN 1900
1900 PRINT"To initialize the program you must enter the base page":
1910 PRINT"address of the EPROM. This address is generally a HEXADECIMAL value":
1920 PRINT"corresponding to the beginning page of an even 2K-byte boundary."
1930 PRINT "For example 00,08,B0,B8,etc."
1950 GOSUB 3770:REM SET BASE ADDRESS
1960 IF HFLAG = 1 THEN HFLAG = 0:GOTO 1950
1970 IF ERA = 1 THEN 2000
1980 PRINT "A MEMORY IMAGE OF YOUR EPROM IS BEING MADE"
1990 GOSUB 3890:REM MAKE MEMORY IMAGE
2000 GOSUB 2880:REM DISPLAY HELP MENU
2010 PRINT:PRINT .
2020 PRINT "YOUR PRESENT LOCATION IS:"  
2030 GOSUB 2320:REM READ AND DISPLAY DATA
2040 PRINT "COMMAND ->
2050 IKEY$ = INPUT$(1)
2060 IF IKEY$ > = "a" AND IKEY$ < = "z" THEN IKEY$ = CHR$(ASC(IKEY$) AND 95)
2070 KEY$ = INSTR(KEY$, IKEY$): IF K = 0 THEN PRINT "WHAT?"; GOTO 2050
2080 HFLAG = 0
2090 ON K GOSUB 3430, 2380, 2440, 2160, 2500, 2660, 2880, 3550, 3760, 3980, 4240, 4400
2100 REM V P N E 0 W H D I B S L
2110 IF HFLAG = 1 THEN GOSUB 2880
2120 IF HFLAG = 1 OR IKEY$ = "H" THEN 2010 ELSE 2030
2130 REM = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
2140 REM BURN EPROM AND END OPTION
2160 GOSUB 3980
2170 IF IKEY$ <> "N" THEN RETURN
2180 CLOSE:END
2190 REM = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
2200 REM MAIN BODY ENDS HERE - SUBROUTINE MODULES FOLLOW
2220 REM = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
2230 REM DISPLAY STATUS LINE
2250 CLS:LOCATE 25; PRINT USING LINE25$; BR$, EP$, BP$; COMMANDS: "K$
2270 LOCATE 3, 1, 1: RETURN
2280 REM = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
2300 REM DISPLAY LOCATION AND DATA
2320 FDATA = ARRAY(PAGE, 256 + BYTE) AND 255:REM GET DATUM FROM ARRAY
2330 PRINT USING FORMAT$; HEX$(BIAS + PAGE), HEX$(BYTE), HEX$(FDATA)
2340 RETURN
2350 REM = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
2360 REM DECREMENT ADDRESS
2380 IF PAGE = 0 AND BYTE = 0 THEN RETURN ELSE BYTE = BYTE - 1
2390 IF BYTE = -1 THEN PAGE = PAGE - 1 BYTE = 255
2400 RETURN
2410 REM = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
2420 REM INCREMENT ADDRESS
2440 IF PAGE = PAGES - 1 AND BYTE = 255 THEN RETURN ELSE BYTE = BYTE + 1
2450 IF BYTE = 255 THEN PAGE = PAGE + 1 BYTE = 0
2460 RETURN
2470 REM = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
2480 REM OFFSET TO NEW STARTING ADDRESS
2500 ADD$ = "": PRINT: PRINT ENTER NEW LOCATION IN HEXADECIMAL (hhhh) -> 
2510 L$ = INPUT$(1): PRINT L$
2520 IF L$ >= "a" AND L$ <= "z" THEN L$ = CHR$(ASC(L$) AND 95)
2530 IF L$ = "H" THEN HFLAG = 1:RETURN
2540 IF L$ = "Q" THEN PRINT: RETURN
2550 ADD$ = ADD$ + L$: 1F LEN(ADD$) = 4 THEN PRINT ELSE 2510
2560 PAGE$ = LEFT$(ADD$, 2):BYTE$ = RIGHT$(ADD$, 2)
2570 CON$ = PAGE$: GOSUB 3110: IF SUM = -1 THEN 2500
2580 PAGE$ = SUM - BIAS
2590 IF PAGE$ > PAGES OR PAGE$ < 0 THEN PRINT "<<<<< OUT OF RANGE >>>>>"; GOTO 2500
2600 CON$ = BYTE$: GOSUB 3110: IF SUM = -1 THEN 2500
2610 BYTE = SUM
2620 REM = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
2630 REM WRITE TO ARRAY - BYTE BY BYTE
2660 XFLAG = DATUM$ = "" "PRRT << WRITE MODE >> ENTER DATA IN HEXADECIMAL (hh) --> ";
2670 D$ = INPUT$(1): PRINT D$
2680 IF D$ = = "a" AND D$ = = "z" THEN D$ = CHR$(ASC(D$) AND 95)
2690 IF D$ = "H" THEN HFLAG = 1:RETURN
2700 IF D$ = "Q" THEN PRINT: RETURN
2710 IF D$ = "X" THEN XFLAG = DATUM$ = ""; GOTO 2670
2720 DATUM$ = DATUM$ + D$: IF LEN(DATUM$) > 2 THEN 2670
2730 PRINT: CON$ = DATUM$; GOSUB 3110: IF SUM = -1 THEN 2500
2740 IF D$ = = "X" THEN XFLAG = DATUM = ""; GOTO 2670
2760 WRITE TO ARRAY - BYTE BY BYTE
2780 GOSUB 2320:REM WRITE TO ARRAY
2800 GOSUB 2440:REM INCREMENT ADDRESS
2810 GOSUB 2320:REM DISPLAY NEXT LOCATION
2820 GOTO 2660

(continued)
PRINT: "ILLEGAL WRITE TO PREVIOUSLY PROGRAMMED LOCATION >>>>>>"
RETURN

REM HELP ROUTINE
GOSUB 2250: REM CLEAR SCREEN
PRINT "To initialize the program you should enter the beginning page address of the EPROM to be programmed. This value is used when printing to the screen and as a bias value in the write modes."
PRINT "The following single-letter commands are used to control the modes of the EPROM programmer:"
PRINT"
PRINT "(I) INITIALIZE BASE-PAGE ADDRESS — base address is \"BIAS\$\"00\""
PRINT "(N) DISPLAY NEXT BYTE"
PRINT "(P) DISPLAY PREVIOUS BYTE"
PRINT "(0) OFFSET TO NEW PAGE AND BYTE"
PRINT "(L) LOAD ARRAY FROM DISK"
PRINT "(S) SAVE ARRAY ON DISK"
PRINT "(W) ENTER BYTE WRITE MODE (use Q or H to exit, X to edit)"
PRINT "(D) HEXADECIMAL DUMP TO SCREEN"
PRINT "(B) ENTER \"BURN EPROM\" MODE"
PRINT "(H) ENTER HELP MODE (from any input statement)"
PRINT "(E) EXIT PROGRAM"
RETURN

REM CONVERT HEXADECIMAL TO DECIMAL
SUM = 0
FOR I = 1 TO LEN(CON$)
X = ASC(MID$(CON$, (LEN(CON$) + 1 - 1), 1))
IF X < 48 OR X > 70 THEN SUM = -1: 1 = LEN(CON$): GOTO 3190
IF X > 57 AND X < 65 THEN SUM = -1: 1 = LEN(CON$): GOTO 3190
IF X < 64 THEN X = X - 48 ELSE X = X - 55
SUM = SUM + (X'16 - (I-1))
END IF
IF SUM > 255 OR SUM < 0 THEN SUM = -1
IF SUM = -1 THEN PRINT "<<< INPUT ERROR >>>>
NEXT I
RETURN

REM WRITE A BYTE
WPAGE = PAGE OR 128: REM SET WRITE PAGE (W/R = 1)
PRINT #3, CHR$(WPAGE);: REM SEND WRITE PAGE
PRINT #3, CHR$(BYTE);: REM SET WRITE BYTE
PRINT #3, CHR$(DATUM);: REM DATA TO WRITE
PRINT #3, CHR$(STROBE);: REM WRITE STROBE
FOR DEL = 1 TO DELAY: NEXT DEL
RETURN

REM READ A BYTE
PRINT #3, CHR$(PAGE);: REM SET READ PAGE (W/R = 0)
PRINT #3, CHR$(BYTE);: REM SET READ BYTE
PRINT #3, CHR$(DUMMY);: REM DUMMY DATA SENT
PRINT #3, CHR$(STROBE);: REM READ STROBE
RDATA = ASC(INPUT$(1, #3)) REM INPUT DATA
RETURN

REM VERIFY ERASURE
PRINT: "VERIFYING THAT EPROM IS ERASED"
BYTE = 0: PAGE = 0
FOR PAGE = 0 TO PAGES - 1: VS$ = "OK"
FOR BYTE = 0 TO 255
IF (ARRAY(PAGE + 256 + BYTE) AND 255) = 255 THEN VS$ = "<<< NOT ERASED >>>>
NEXT BYTE
NEXT PAGE
BYTE = 0: PAGE = 0
RETURN

REM DUMP TO SCREEN
GOSUB 2250
FOR LN = 1 TO 16
DPAGE$ = RIGHT$("0" + HEXADECIMAL$(BIAS + PAGE), 2)
DBYTE$ = RIGHT$("0" + HEXADECIMAL$(BYTE), 2)
PRINT USING ";DPAGE$;DBYTE$": ;
FOR I = 1 TO 16
DATA$ = RIGHT$("0" + HEXADECIMAL$(ARRAY(PAGE + 256 + BYTE) AND 255), 2)
PRINT USING ";DATA$": ;
NEXT I
NEXT LN
IF PAGE = PAGES - 1 AND BYTE = 255 THEN PRINT "<<<< END OF EPROM >>>>
RETURN
GOSUB 2250: FOR LN = 1 TO 16
NEXT D
NEXT LN
PRINT: "ENTER (C) TO CONTINUE OR (Q) TO EXIT DUMP — > ": IKEY$ = INPUT$(1)
IF IKEY$ >= "a" AND IKEY$ <= "z" THEN IKEY$ = CHR$(ASC(IKEY$) AND 95)
RETURN
3700 PRINT IKEY$: PRINT: IF IKEY$ = "C" THEN 3560
3710 IF IKEY$ = "H" THEN HFLAG = 1: RETURN
3720 IF IKEY$ = "Q" THEN RETURN ELSE 3680
3730 REM *************************************************************************
3740 REM SET BASE ADDRESS
3760 GOSUB 2250
3770 BIAS$ = "": PRINT: PRINT "ENTER BASE-PAGE ADDRESS IN HEXADECIMAL (hh) -> "
3780 B$ = INPUT$(1): PRINT B$;
3790 IF B$ > = "a" AND B$ < = "z" THEN B$ = CHR$(ASC(B$) AND 95)
3800 IF B$ = "H" THEN HFLAG = 1: RETURN
3810 IF B$ = "Q" THEN PRINT: RETURN
3820 BIAS$ = BIAS$ + B$: IF LEN(BIAS$) < 2 THEN 3780
3830 PRINT
3840 CON$ = BIAS$: GOSUB 3110: BIAS = SUM: PRINT: PRINT IF SUM = -1 THEN 3770
3850 PAGE = 0: BYTE = 0: BP$ = BIAS$ + "OO": GOSUB 2250: RETURN
3870 REM *************************************************************************
3880 REM READ EPROM TO ARRAY
3890 PAGE = 0: BYTE = 0: GOSUB 2250
3900 GOSUB 3340
3910 ARRAY(PAGE + BYTE) = RDATA: IF BYTE = 0 THEN PRINT "READING PAGE"; PAGE
3920 BYTE = BYTE + 1: IF BYTE = 256 THEN PAGE = PAGE + 1: BYTE = 0
3930 IF PAGE < = PAGES - 1 THEN 3900
3940 PRINT: PAGE = 0: BYTE = 0: RETURN
3950 REM *************************************************************************
3960 REM WRITE ARRAY TO EPROM
3980 GOSUB 2250
3990 PRINT "<<<< BURN ALL PROGRAMMED BYTES ?? >>> >> >>" > "Y" TO PROGRAM EPROM" (continued)
created with a SAVE command in the program can also be used to enter the data.

A help routine is provided in the program to assist the user during the operation of the programmer. It consists of a menu that contains all the choices available in the driver program. The routine can be entered from any location in the program by typing the letter H. A screen-dump routine and an EPROM erasure-verification routine are also provided.

IN CONCLUSION
The serial-port EPROM programmer isn't designed for volume programming. It's intended to be a cost-effective, transportable programmer that doesn't become outmoded with each new computer and system bus. You'll also find, cleverly embedded in every programming cycle, enough time for you to take a well-deserved coffee break.

CIRCUIT CELLAR FEEDBACK
This month's feedback begins on page 393.

NEXT MONTH
I've always been intrigued by home control and electronic messaging. In March, I'll tackle the subject in earnest, beginning with a Touch-Tone Interactive Message System.

Special thanks to Larry Bregoli for his software expertise.

Editor's Note: Steve often refers to previous Circuit Cellar articles. Most of these past articles are available in reprint books from BYTE Books. McGraw-Hill Book Company, POB 400, Hightstown, NJ 08250.


To receive a complete list of Circa's Circuit Cellar project kits, circle 100 on the reader-service inquiry card at the back of the magazine.
You know you want to do more with Artificial Intelligence. Two problems have held you back: the expense of the hardware and the scarcity of LISP programmers. But no longer. GOLDEN COMMON LISP makes it possible for you to learn and use Lisp on your personal computer. You will know the excitement of expert systems, intelligent data access, and smart programs.

COMMON LISP is the new Lisp standard developed by researchers from universities and corporations such as CMU, MIT, Stanford, UC Berkeley, Digital, LMI, Symbolics, and Texas Instruments. GOLDEN COMMON LISP is the right Lisp for you because it is based on COMMON LISP. Programs you develop using GOLDEN COMMON LISP on your personal computer will run in the COMMON LISP environments of larger, more expensive machines.

With GOLDEN COMMON LISP, every programmer becomes a Lisp programmer. GOLDEN COMMON LISP comes with the Lisp Explorer, an interactive instructional system developed by Patrick H. Winston and San Marco Associates. The San Marco Lisp Explorer guides you through the steps of Lisp programming and makes the full range of Lisp's power accessible to both novices and experienced programmers. The new second edition of the classic Lisp textbook by Winston and Horn is also included. GOLDEN COMMON LISP comes complete with the intelligent GMACS editor (based on EMACS), on-line documentation of all Lisp and GMACS functions, a comprehensive user manual, and program debugging tools. In short, GOLDEN COMMON LISP comes with everything you need to program in Lisp. Features of GOLDEN COMMON LISP for advanced users include co-routines for multitasking, macros for code clarity, streams for I/O, closures for object-centered programming, and multiple-value-returning functions for efficiency.

ORDER GCLISP TODAY using the coupon below. Or call our Customer Service Department at:

(617) 492-2071

Gold Hill Computers brings the language of Artificial Intelligence to Your Personal Computer.
THE MACINTOSH OFFICE

BY JOHN MARKOFF AND PHILLIP ROBINSON

Editor's note: The following is a BYTE product preview. It is not a review. We provide this advance look at this new product because we feel it is significant.

ON THE FIRST ANNIVERSARY of the introduction of the Macintosh, Apple Computer has introduced AppleTalk, which is a new local-area network (LAN), and a series of intelligent networked peripherals, including a laser printer and file server. The company hopes these products will make the "Macintosh office" a popular choice for work groups in large and small corporations.

AppleTalk and the laser printer are scheduled to be shipped in March.

The network was developed to serve as a small-work-group interconnect system, as a tributary to larger high-speed local-area and long-haul networks, and, in its most basic form, as a peripheral bus between an Apple computer and dedicated peripheral devices.

The new Apple LAN concept is a radical departure from common industry thinking about LAN design (for

John Markoff and Phillip Robinson (1000 Elwell Ct., Palo Alto, CA 94303) are BYTE senior technical editors.

(continued)

more information on Apple's plans for the future see the text box 'Steve Drops By' on page 124). Instead of providing a high-bandwidth channel to link personal computers to each other and to larger remote computers, Apple designed its LAN to be a low-speed, low-cost network for small work groups.

The AppleTalk architecture relies on the distribution of "intelligence" in network peripherals and on the clever use of the network's limited speed. Apple is betting that the principal barrier to networking office microcomputers has until now been cost. By focusing on an LAN that is optimized to share resources among small groups, the company hopes to achieve a better match to the organization of the typical office.

Since the introduction of the Macintosh, Apple has changed the name of its LAN from AppleBus to AppleTalk. When Apple first described the LAN, the company emphasized the network's role in providing the Macintosh with "virtual" serial slots for peripherals as an alternative to the open hardware architecture of the Apple II. As it is released, AppleTalk goes beyond this. However, you may still be able to daisy-chain peripherals by adding a smart network controller. But for now, Apple has decided to leave this option to third parties. One manufacturer, 'Tecmar Inc. has already demonstrated the ability of its 68000-based hard-disk system to control both an ImageWriter and an Apple modem.

Apple is moving toward putting microprocessors in all or most of its peripherals. This design philosophy, plus the standardization on the Zilog SCC (serial-communications controller) chip that is now used in the Lisa, Macintosh, and Apple IIc computers, will make the task of networking peripherals simpler.

At the time of AppleTalk's introduction, Apple is only demonstrating the LAN with a prototype 20-megabyte intelligent file-server hard-disk system, which you will need for network applications such as electronic mail and print spooling. However, we were told that-the hard disk will be announced in August 1985 and it will cost $3500. An electronic-mail communications package for AppleTalk is also scheduled to be announced at the same time.

The company is also discussing a variety of future network products such as a bridge to link individual AppleTalk networks, an interface to the recently announced IBM PC LAN, communication servers, network databases, and as many as 50 third-party hardware and software development projects based on AppleTalk. Details of these products aren't yet available; therefore, it is difficult to assess AppleTalk at present. But after several false starts at developing a LAN, Apple is moving toward making it possible to link its products in office and other workplace settings.

APPLETALK

The heart of AppleTalk is the Macintosh serial-communications chip, a two-channel Zilog 8530 SCC that provides synchronous and asynchronous data communications at up to 230.4K bits per second (bps) using a self-clocking data format. (The 8530 will provide data communications at speeds as high as 1 megabit per second, using an external clock. Corvus Systems Inc. has also used this higher-speed scheme in its Macintosh implementation of the Omninet LAN.)

At the physical level, AppleTalk consists of a shielded twisted-pair trunk cable with modules that are passively connected to computer and peripheral nodes via a short drop cable. An individual AppleTalk network can have up to 32 nodes and has a packet-switching protocol and a data rate of 230.4K bps using FM 0 modulation (a bit-encoding technique that provides self-clocking) over a maximum distance of 300 meters.

Externally, AppleTalk is simple, consisting of the connection modules, each of which has two miniature DIN three-pin connectors, and a DB-9 port that connects to the printer port on the Macintosh via a 2-meter cable. Inside each connection module are resistors, a capacitor, and a small transformer, designed so that the link is transformer-isolated and not susceptible to any kind of radiofrequency interference (RFI) or static discharge.

Apple calls the connector modules self-terminating, which keeps you from worrying about line termination and, in combination with the transformer, lets you add nodes to the network and remove them without disrupting network functions. A 100-ohm terminating resistor is included in each connector box, and there are two switch connections that are opened when the miniature DIN connectors are inserted. If both connectors are used, the switches are open, but if one of the connectors is not used, the terminating resistor is connected across the line.

AppleTalk uses a dynamic-addressing scheme that ensures that each node on the network has a unique 8-bit address (there is also a mechanism for internet communications across bridges and through gateways). The AppleTalk destination address is used to "filter" frames at the data-link layer. Frames are not accepted unless their destination address matches the address of the receiving node. The SCC chip facilitates this process by performing the address-recognition function in hardware.

AppleTalk doesn't require that a particular node's address be permanently recorded or set with jumpers. The advantage of this is that you can move computers and peripherals between networks and install them by simply attaching them to the network. For example, Apple claims you can bring your Macintosh to the network, plug it in, insert a disk, and turn it on. No special network configuration is necessary. Setting of the node address takes place when the
computer first looks at some non-volatile memory to find a previous address it has saved, or when it computes a new address based on the generation of a pseudorandom number. The computer then tests the address to see if it already exists on the network by sending a special packet to the address. If the address is already in use, the node there will answer and a new guess must be generated.

(continued)

**THE MAC OFFICE**

We met Burrell Smith and Bud Tribble and the rest of the Macintosh office design crew in the Macintosh headquarters, one of the many Apple buildings in Cupertino, California. After moving beyond the lobby, we heard someone play a pretty piece of music on a grand piano in the center of a large open area that also had sofas and a Ping-Pong table. On the left was the Matisse room; we used the Picasso room on the right. During the introduction, someone mentioned that Steve would drop by later. When Steve Jobs did drop by, he had some interesting things to say about Apple's plans and strategy.

"We hope to be able to offer people two things based on the Macintosh technology. The first, using the graphics and the power of that box, is radical ease of use. That was the first benefit of the Macintosh and that's the one we've really been trumpeting this last year.

"We are just now beginning to demonstrate the second great benefit of that graphic user interface—capabilities that you can't do on any other computer. You can't do the kind of project management you can do on Mac, you can't do stuff you can do with MacDraw, you can't print out entire forms or create forms on other computers. It will take something like the LaserWriter to really drive that home. As we roll out the next pieces that complement the workstation, I think it's going to become very clear to people why the graphic user interface is so important.

"Ultimately, we think that these products are going to be used to help people communicate with each other. Not just plug it together like a telephone or stereo and it works. And its very, very difficult to do wrong. Those little things are what keep you from having to go out and hold people's hands, run them through half-day training courses, and things like that.

"We think that networking is going to start from the bottom up in small work groups. If you've got four people on the network, which is a typical number to start with, it will cost $150 per person for the head end. So you've got to have about $1000 to hook up a computer to the net. It may be worth it someday when there's a lot of great software. But, right now not many are going to pay a thousand bucks to hook up a $2000 computer to a network.

"And that's what AppleTalk is all about. Nobody's hooking up to nets because there isn't enough software that makes it worthwhile. There isn't enough software that runs in nets because if you write software to run in a net, there's nobody to sell it to because there aren't any nets. So it's a circular problem. No nets, no software, no nets. We want to break through that logjam with AppleTalk costing 50 bucks a computer.

"We just wish the whole world would standardize on a net. We'd all be happy. Just give us the jacks in the walls everywhere; we'd have no problem calling it the IBM net or the AT&T net, but it's not coming together. Ultimately, we feel that the standard network in the office is going to be the digital phone switch and not something that Apple or IBM comes up with. It turns out that the rates at which the digital-phone-switch standards are emerging (the CCITT [Comité Consultatif International Téléphonique et Télégraphique] standards) are very close to AppleTalk rates. They're anywhere from 64 kilobits per second up to maybe 192 kilobits per second.

"So the rates we have chosen will probably map well to the ultimate rates of what will be the office network. And that's how the voice-data integration will take place, through a digital CBX, not through our network or IBM's network. The decision that we made was fundamental: put intelligence in the peripherals. The really interesting thing that's happening isn't the products themselves, it's the software standards that are being set. As an example, PostScript is more important. In a way, than the printer [the LaserWriter], "Though we think that particular printer is what's going to make PostScript a standard."
Hardware for your Apple

Computers

Apple

Systems

MISC

Disks

Drive

RAM

Expansion

Video

Caros

Miscellaneous

Modems

Printers

Software & Training

Utilities & System

Home & Educational

Games

Diskettes

Apple

Conroy

Conroy-Lapointe

Lapointe

IBM

IBM Pre-Formatted Diskettes

Conroy-Lapointe

Generik Diskettes

Printers Interfaces & Buffers

Printers

Linotype

Lineprinter

Letter Quality

Plotters

Printers Supples

ORDERING INFORMATION & TERMS: MAIL TO: CONVOY LAPOINTE, 12060 SW Garden Plaza, Portland, OR 97223 — Include your zip code number. Double check your figures for shipping and handling. All item prices in effect as of 12/16. 

SOFTWARE: NO C.O.D. Sales check, money order or wire. Fortune 1000 checks only. All software includes 30 day guarantee. Confirmed sales are non-refundable. 15% restocking fee. 30 day return privilege. No cash refunds. Return postage paid. Use UPS or Federal Express. 


PLOTTERS: All plotters include 30 day guarantee. No cash refunds. Return postage paid. Use UPS or Federal Express. 

ACCESSORIES: All accessories include 30 day guarantee. No cash refunds. Return postage paid. Use UPS or Federal Express. 

ORDER DEFEASE: Mail to FAX only. Orders through Friday, Saturday 3/24. (Still here in New York)

CONVOY LAPOINTE @ 12060 SW Garden Plaza, Portland, OR 97223

1-800-547-1289

THE WORLD'S LARGEST
COMPUTER MAIL ORDER FIRM

ALL MAIL: Conroy-Lapointe, 12060 SW Garden Plaza, Portland, OR 97223

CASH & CARRY COMPUTER STORES, INC.

SAN FRANCISCO, PORTLAND, SEATTLE—SEE BELOW

BYE — FEBRUARY 1985

124
LOW PRICES TO PROFESSIONALS WHO KNOW WHAT THEY WANT AND HOW TO USE IT!

FOR YOUR IBM-PC or XT

<table>
<thead>
<tr>
<th>UST</th>
<th>CALL</th>
<th>MICRON, 4116 Chk, 200 ma</th>
<th>$6.19</th>
<th>$6.24</th>
</tr>
</thead>
<tbody>
<tr>
<td>UST</td>
<td>CALL</td>
<td>MEMOREX IC, 5116 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>MEMOREX IC, 5116 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
<tr>
<td>UST</td>
<td>CALL</td>
<td>UST IC, 7416 IC, 2.4V</td>
<td>$2.25</td>
<td>$2.30</td>
</tr>
</tbody>
</table>

Our References:

- IBM
- Motorola
- Texas Instruments
- Intel
- Texas Instruments
- National Semiconductor
- Hewlett-Packard
- Digital Equipment
- Sun Microsystems
- Lotus
- Microsoft
- Wordstar
- WordPerfect
- Lotus 1-2-3
- Quattro
- Excel
- Access
- Windows
- Novell
- Novell Netware
- Compaq
- Dell
- Gateway
- Toshiba
- HP

For further information, please contact your local IBM-PC or XT dealer.
erated by the new arrival.

AppleTalk divides node addresses into two classes: server node and user node. The system reserves 255 possible addresses; hexadecimal address FF is a special ‘broadcast’ address used to reserve the line for transmission as part of the network's scheme.

AppleTalk is based on an open system architecture (see figure I). Apple has published detailed information on the suite of network protocols that comprise AppleTalk and has held a number of seminars to aid third-party vendors that are developing software and hardware applications for the network.

The AppleTalk protocols implement a packet-switching scheme that provides functional correspondence with the International Standards Organization (ISO) Open Systems Interconnection (OSI) model. Protocols equivalent to the ISO OSI layers 1 through 5 (physical, data link, network, transport, and session) are at the core of AppleTalk.

The access scheme to the network is based on a CSMA/CA (carrier sense multiple access with collision avoidance) model. Although both AppleTalk and Ethernet are based on a bus topology, they differ in the way they handle the problem of data collisions on the network.

Ethernet provides hardware capability for detecting collisions. AppleTalk, on the other hand, implements collision avoidance in software at the data-link level. The AppleTalk Link Access Protocol (ATLAP) software handles the address-assignment mechanism, the frame format, and the frame transmission and reception process.

In the AppleTalk collision-avoidance scheme all transmitters wait until the line is idle. This time interval is determined by the generation of a pseudo-random number whose range is adjusted based on perceived bus traffic.

As part of this scheme each transmitter can send special broadcast frames (addressed to all nodes in the network) that reserve the line by informing other nodes that it is preparing to send a packet. The transmitters use directed frames (or packets) to send data to a single address on the network.

While a transmitting node is sending to a receiving node, a dialogue takes place. If a collision occurs during the dialogue, the sending node backs off and tries again, adjusting the randomly generated time interval. This adjustment follows a linear backoff algorithm that changes dynamically in response to recent network-traffic history. If the node detects collisions among recently sent packets, this suggests higher loading and greater contention for the bus. Thus, the random wait that is generated is calculated over a larger range, effectively spreading out the different contenders for the line.

Apple reports that it has extensively tested AppleTalk's CSMA/CA protocol and is satisfied with its ability to remain stable under heavy network loads.

In addition to ATLAP, AppleTalk consists of a variety of other protocols that generally correspond to other levels of the ISO OSI model.

(continued)
TIED UP WITH DATA RECORDING?

Here comes SEED to set you free.

Are you frequently tied up with typing large amounts of data from printouts into your personal computer, or frustrated at not being able to use it while it is being used as an expensive data collection device? If so, then let a SEED set you and your PC free.

These highly portable and cost effective data recording units allow you to continuously record data wherever and whenever you want via an RS-232C serial interface onto a diskette for analysis or editing later on your PC.

SEED 1 is intended for use with an Apple II compatible disk drive (single or dual drive - 120 Kbyte memory per disk) and after recording, the diskette can be loaded into your Apple II, III or III personal computer.

SEED 2 is intended for use with an IBM PC and has the additional advantages of a built-in disk drive unit, a 350 Kbyte memory, single or double sided, double density disks, and dip switch selectable baud rate, parity and data bits.

An optional analogue/digital conversion unit is available for each model.

Both SEEDs can be used for a really wide range of data recording applications:

- in the office where data can be recorded from mainframe, other computers or serial communication networks
- in the laboratory where results can be recorded from samples being measured continuously, including overnight runs
- on the factory floor where performance data can be recorded from instruments undergoing quality control testing prior to shipment

So now there's no need to get tied up with data recording. All you need is SEED.


Apple is a registered trademark of Apple Computer, Inc. IBM PC is a registered trademark of International Business Machines, Corp.
While ATLAP handles node-to-node delivery of packets on a single AppleTalk network, a Datagram Delivery Protocol (DDP) extends this mechanism to socket-to-socket delivery. Sockets are logical entities in the individual nodes of a network. An individual socket is identified by a 1-byte address. Therefore, there can be as many as 2^56 different socket addresses on a single node. The DDP is designed to provide addressing and packet delivery between several AppleTalk networks connected by a bridge. A bridge might consist of a single node connected to two AppleTalk networks or it might consist of two nodes, each connected to a separate AppleTalk network, connected by a communications channel.

Additional protocols include a routing table maintenance protocol (RTMP) that permits any AppleTalk node to “discover” network routing information, such as the number of the

LAN to which it is directly attached; a name-binding protocol (NBP) that permits users to access network addresses by names rather than numbers; and the AppleTalk transaction protocol (ATP), designed to ensure loss-free delivery of packets from a source socket to a destination socket.

On the Macintosh, these protocols are implemented as 5.5K bytes of code written in assembly language. Because the SCC chip handles address recognition, the network protocols take no system overhead unless a particular node is directly addressed over the network.

Initially, AppleTalk will link groups of Macintosh computers to the LaserWriter laser printer, an impressive 68000-based electronic printing system that will provide hard-copy output of any text or graphical image that can be displayed on the Macintosh screen. The special significance of the LaserWriter is that it is integrated with PostScript, a page-image-description language developed by Adobe Systems, a start-up company founded by a group of electronic-printing experts who recently left Xerox Corporation (see the text box “Adobe Systems and the PostScript Language” below). PostScript is essential to the viability of AppleTalk because it permits extensive compression of the information the LaserWriter needs to print bit-map images.

**Laser Technology**

Laser printers are fast, quiet, and capable of high-resolution printing. Until recently, they have also been very expensive, ranging from $50,000 to $400,000. A laser printer has a raster-scanning laser that projects the print image onto an electrostatically charged photosensitive drum. A set of rotating mirrors manipulates the beam—the laser itself doesn’t move. Wherever the laser beam touches the drum, the static charge is nullified. Toner (particles of colored plastic) is then attracted to those points. The printer rolls paper against the drum and the toner sticks to the paper. Finally, a hot fuser permanently affixes the toner by melting it onto the page.

The price of laser printers has dropped dramatically because of developments such as Canon’s LBP-CX marking engine. That engine, which is also used in Canon’s personal copiers, combines several fundamental printer components into a single, inexpensive, disposable cartridge. Because those same components—including the toner and drum—frequently needed repair and replacement on laser printers, the Canon engine greatly improves reliability.

The LaserWriter’s disposable cartridges (made by Canon) cost $99 each and will print approximately 3000 pages. That puts the price in the range of 3 cents per page. The LaserWriter prints on ordinary copy paper but can also use bond paper, European and legal-size paper, transparencies, envelopes, labels, or even business cards. Several different toner

---

**Adobe Systems and the PostScript Language**

Adobe Systems Inc., of Palo Alto, California, was started by a number of researchers who left Xerox’s PARC (Palo Alto Research Center). In particular, John Warnock, president of Adobe, was a principal scientist at PARC for raster-graphic display techniques. Charles Geschke, the executive vice-president, was a manager of the Imaging Sciences Laboratory at PARC.

Adobe is trying to make PostScript— their text and graphics language—a business standard. Unlike most print-file description languages, PostScript is not a static, data-structured written description: it is a programming language. When the Macintosh communicates with the LaserWriter, it actually sends a program across AppleTalk. According to Geschke, “When the program arrives at the 68000 in the printer and begins executing, it has one very interesting side effect, namely, it drives the video on that laser and produces output. But it is really a program description that is generated on the Macintosh and is executed on the printer.” By using PostScript, the amount of information sent across AppleTalk can be trimmed, in some cases, to just 10 percent more than the raw ASCII (American Standard Code for Information Interchange) data.

PostScript is completely encoded in the printable character subset of 7-bit ASCII code and so is completely invisible across any kind of communications line, not just AppleTalk. PostScript can handle any material: text, line-art, photographs, and even color (for printers that can use it). While photographic images are sent as bit maps, graphics are sent as commands and the fonts are sent as mathematical outlines (based on Bezier cubics) that can be stroked, filled, scaled, oriented, or used as clipping boundaries. And it is flexible, as Geschke pointed out.

"If you’re really into graphic art you can outline fonts, making PostScript outlines, outlines of outlines, outlines of outlines, until you end up with a complete implementation of PostScript fonts. If you’reСно out of fonts, you can substitute a mathematically equivalent PostScript function in place of the font you’re no longer using. If you want to apply a smooth stroke to a line, you can use a mathematical function to produce a smooth curve. If you want to fill a shape, you can use a mathematical function to fill the shape.

Adobe isn’t only working with Apple. You’ll be seeing PostScript in other systems from other companies.

(continued)
Windows With A View Toward The Future

The Window Machine™ occupies only 12K! Written in tight, fast Assembler, it performs like a racing engine... with more power than you’ll probably ever need. Yet, it’s an engine designed to fit in the vehicle of your choice... from a "stripped-down" 128K IBM PC to a fully loaded AT. The programs you write today will run on the broadest range of machines possible... now, and in the future.

Windows Bigger Than Your Screen?

Here’s where the VSI part of our name fits in. VSI means Virtual Screen Interface. Behind each window, there’s a much bigger picture. VSI defines virtual screens rather than just windows. The window itself shows whatever portion of its virtual screen you wish to exhibit at any given point in your program. Each screen can be up to 128 x 255 (columns x rows, or rows x columns). And there are more than 100 screen primitives at your command.

Multilingual Windows

You can order The Window Machine with the language interface of your choice: C, Pascal, Compiled Basic, Fortran, Cobol, or PL1. We’ve even recently completed an interface for Turbo Pascal*, so that now true, full-featured windowing can be utilized with this fine compiler. (Turbo’s own built-in “windowing” procedure is extremely limited).

Why did Simon & Schuster, 3COM, Tymshare, and Revlon choose VSI—The Window Machine?

(and how come you can buy it for such a low price?)

$59.95

ORDER YOUR COPY OF VSI—THE WINDOW MACHINE TODAY

For Visa, MasterCard and American Express orders call toll free: 1-800-227-3800 ext. 986

The Window Machine Includes:

- Zoom Windows
- Multiple Virtual Screens (up to 255)
- Choice of Borders (including flashing borders)
- Support for all Color and Monochrome Video Attributes (no graphics card required)
- Built-in Diagnostics
- And much, much more

Windows That Won’t Break You

We decided to save you a lot of money. So, we left behind fancy binders, monogrammed slip cases and plastic presentation boxes. Instead, you’ll find an extremely powerful tool and a 200 page manual written with an eye toward simplicity, clarity and completeness. (We figured if you wanted ribbons and bows you could always add them yourself.) And by offering you the product ourselves, we were able to cut out all the middlemen and save you a tremendous amount of money.

VSI The Window Machine™


The Window Machine Includes:

- Zoom Windows
- Multiple Virtual Screens (up to 255)
- Choice of Borders (including flashing borders)
- Support for all Color and Monochrome Video Attributes (no graphics card required)
- Built-in Diagnostics
- And much, much more

ORDER YOUR COPY OF VSI—THE WINDOW MACHINE TODAY

For Visa, MasterCard and American Express orders call toll free: 1-800-227-3800 ext. 986

The Window Machine™ $59.95 Shipping and handling included

LANGUAGE INTERFACE:
- C, Compiled Basic, Fortran, Cobol

COMPUTER

Name _____________________________
Address ___________________________
City __________ State ______ Zip Code ______

Card # ______ Exp. Date ______

*California residents add 7.25% sales tax. Orders outside the USA please add $5 for shipping and handling.

AMBER SYSTEMS, INC. 1171 S. Saratoga-Sunnyvale Road, San Jose, CA 95129
FOR DEALER INQUIRIES: CALL OUR 800 NUMBER

Inquiry 18
colors are available.
The Canon engine is used in the LaserWriter and many other new laser printers, from Hewlett-Packard's $3495 LaserJet to the $10,000 OMS 800. These laser printers can turn out eight pages a minute and yet make only about as much noise as a copier. All of these machines can print at the same 300-dots-per-inch resolution. While far better than standard dot-matrix printers, they aren't up to the 1200 dots per inch or better that phototypesetters produce (see figures 1 and 2 for samples of the LaserWriter's output). Still, unless you're a graphics expert, it is hard to distinguish this resolution from typeset text. The difference between the various Canon-based laser printers is in the controllers: each manufacturer uses its own controlling computer.

Because the laser scans synchronously across the page, image dots must be fed to the laser at exactly the right time. That requires data storage in the printer itself. Shipping data to the printer memory as a simple bit map would take too much time for most users. An RS-232C port running at 19,200 bps (bits per second) would take nearly 7 minutes to send the 7,920,000 bits for a single page; even the speedier AppleTalk network would take half a minute. To ease that bottleneck, most manufacturers put some form of intelligence, such as encoded graphics instructions and pre-loads fonts, into the printer controller. Then the computer need only send a condensed form of the print image to the printer controller.

The least intelligent controllers have limited printing capabilities. The Hewlett-Packard LaserJet, for instance, can only print 6 square inches of graphics per page and has a limited set of character fonts. On the other hand, the expensive OMS printer uses a standard Tektronix terminal emulation (a set of graphics protocols). For example, instead of sending a bit map of a circle to that printer, a computer only needs to send the Tektronix instruction to print a circle of a certain size, shape, and position.

**LASERWRITER HARDWARE**
The Apple LaserWriter printer can generate a variety of fonts and high-quality graphics with the help of a powerful built-in computer and the PostScript language.

The LaserWriter's internal computer-controller board was designed by Burrell Smith, a key figure in the Macintosh design group, and is built around an 11.2-MHz 68000 processor, 1.5 megabytes of RAM (random-access read/write memory), and 0.5 megabyte of ROM (read-only memory). The ROM contains the PostScript code.

The laser-printer project's design goals were formed when Adobe Systems suggested that a laser printer could offer graphics without giving up letter-quality text. Part of this involved making the printer controller as intelligent and as fast as possible, so that encoded information could be sent over the AppleTalk LAN to spare the network a huge overhead burden.

Of the LaserWriter's 1.5 megabytes of RAM, half a megabyte is used for temporary scratch-pad buffers and font caching and a full megabyte is devoted to the screen. The LaserWriter has other small memory components, such as a static RAM cache of 4K bytes that allows the 68000 to process faster by executing inner loops without any wait states. In addition, Apple built into the hardware one of the most common input transfer modes. Burrell Smith said, "We do a classical OR between contents of memory and the data you wish to enter to the frame buffer—in a single bus cycle."

Apple is a high-volume producer. To that end, it has kept the component count on the board low—there are only 34 chips plus memory and resistor packs. In comparison, one competing laser-printer controller board has close to 150 chips. The LaserWriter board has been designed, as was the Macintosh, for automatic insertion and test. The chip technology used is generally the same as for the Macintosh: 25-nanosecond PAL (programmable-array logic) chips, 25K-byte dynamic RAM chips, and 256K-byte ROM chips. Smith noted, "What we're trying to do is take relatively expensive technologies and..."
To get a lot out of a printer, you need a lot of programs, right?

Wrong.

True, your customers want to change type sizes, create their own characters, and even print sideways. But you don’t need to stock a lot of different printer utilities. One simple program will blow all the others right off your shelf.

Printworks. It’s loaded.

$69.95 retail. SoftStyle products are distributed by Softsel and Ingram Software.

Simple Menu Control + Pivot Printing™ lets you print sideways quickly and easily.

Prints full IBM character set including line graphics, math and science symbols.

Foreign language characters.

Easily set print modes: condensed, emphasized and more.

Create new characters or entire fonts.

Supports thousands of popular software packages including Wordstar, dBase II and Lotus 1-2-3.

Printworks enhances over 30 dot-matrix printers. C.ITOH Printer (8510, 1550, 7500 all with the letter “E” included in the model number), CENTRONICS Horizon (H80), EPSON (FX-80/100, RX-80/100, JX-80, LQ-1500, MX-80/100 III with Grafix Plus), IBM Graphics Printer, INFORUNNER Riteman (Plus, Blue Plus, IL 15), NEC Printer (P2-3, P3-3), OKIBATA (ML 84 Step 2, ML 92 and 93 with or without Plug ’n Play Kit, Proemark 2350 and 2440), and STAR (Gemini 100X15X, Radia 10/15, Delta 10/15). For the IBM PC, PC/XT, PC/X, Compaq and many other IBM compatibles. Needs 128K and DOS 1.1 or later.
make them ourselves.

Once the print image has been completely set in the RAM, the printer needs to ship it out to the laser apparatus as quickly as possible. That task is aided by the 68000, which helps drive the video electronics. The central processor stores the data in two FIFO (first-in/first-out) memories. That scheme allows a minimum amount of bus contention between the microprocessor and memory. Everything on the board is a slave to the 68000. That flexible architecture is exploited, for example, by the margins of the page to be printed. When the margins move inward, the frame buffer used for generating the bitmap is actually reduced in size—allowing more RAM to cache the fonts.

The Macintosh has nonvolatile parameter memory that allows it to remember certain modifiable control settings between uses. Apple decided to further explore that scheme in the LaserWriter by putting in a 0.5K-byte EEPROM (electrically erasable programmable ROM), which is expandable to 2K bytes. As Smith points out, that is "equivalent to 16,000 DIP (dual-inline package) switches."

The AppleTalk port isn't the only way to drive the LaserWriter. There is also a DB25 connector with completely programmable RS-232C protocols. Adobe indicated that they and others would provide packages that will use translators or emulators to drive TeX, Troff, Scribe, and other mainframe-style composition systems.

What sort of performance does the built-in computer offer for the LaserWriter? According to Smith, when it is combined with perfect hardware, the printer is capable of turning out a page in 6 seconds. With the Apple controller, "We're expecting a 10-second average time per page," he says.

Anything that can be put on the Macintosh screen can be printed by the LaserWriter. When you use the Printer Chooser desk accessory to select the LaserWriter printer instead of the ImageWriter, the Macintosh calls a new printer driver. On the Macintosh, all screen graphics are based on QuickDraw routines called from ROM. Bud Tribble, the Macintosh software manager, says, "The LaserWriter's strategy is different than the ImageWriter's. Even though all the Macintosh's QuickDraw routines are in ROM, every entry point to QuickDraw has a handle on it that allows us to trap out that call and go someplace else. That's what happens during printing to the LaserWriter driver. We trap out all the QuickDraw calls, and when that call comes along, the system translates it to the equivalent PostScript call, which ships it over AppleTalk to the laser printer and prints out." For now, the printer works
Introducing the most complete 24-hour investment service on the market.

Spear Securities has teamed up with The Source™ to bring you the most comprehensive personal investment service ever introduced.

Now you can use any personal computer to trade stocks, options or bonds quickly and inexpensively. Without software. But that's not all.

Immediate access to market intelligence.

If you're going to compete with professional investors, you need more than instant trading. That's why we give you the ability to analyze and compare thousands of companies. And we provide immediate access to critical business news and price changes as they occur.

We even take care of your portfolio updating and record-keeping. And your account is protected up to $10 million.*

Get started for $35-a-trade.

Between now and February 28, 1985, most market orders placed with Spear Securities (up to 1,000 shares) will cost only $35 each. After that, you'll enjoy our regular discount rates, which will save you up to 70% on stock transactions compared to full-cost broker commissions.

The coupon on the right will get you all the details. Fast. Our toll-free number is even faster. Just dial (800) 821-1902.

*Combination of SIPC protection and private insurance. See brochure for details.

SPEAR SECURITIES
The Electronic Investment Center
626 Wilshire Boulevard
Los Angeles, CA 90017

☐ Send me information on how to trade over the counter.
☐ I have a personal computer.
☐ I am currently a member of The Source.

Name ___________________________
Address _______________________

City __________________ State ______ Zip ______

The Source Telecomputing Corporation, a subsidiary of The Readers Digest Association, Inc. The Source services are offered in participation with Control Data Corporation.
PREVENT THE DISASTER OF HEAD CRASH AND DROP OUT.

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 neutralizes dust-holding static electricity while Dust-Off 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.

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 cleaning not provided by liquid cleaners.

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

THE MAC OFFICE

on a first-come, first-serve basis. Later, the file server will function as a spooler. (Apple is investigating print spooling on the Macintosh itself.)

According to Tribble, "A page of QuickDraw calls are translated into approximately 4K bytes of PostScript language, which are then shipped over AppleTalk at 1/4 megabit per second—4K bytes per page is really no great load compared to the 8 million bits required to represent a full bit-map page."

Because of this strategy, MacDraw and MacPaint documents produce different outputs. All of the elements in MacDraw exist as graphical objects: a rectangle is stored as a rectangle, a circle is stored as a mathematical circle, etc. In MacPaint, all the data storage takes place on the bit map. Those 80-dots-per-inch bit maps must be resolved for the higher-resolution LaserWriter. So Bill Atkinson developed a scaling and smoothing program that sits in the laser printer itself.

In fact, there is a fairly close correspondence between QuickDraw and PostScript objects. The Macintosh downloads into the laser printer a preamble of PostScript code that helps it quickly interpret QuickDraw objects. For example, to paint a RoundRec (a QuickDraw command), you would have a RoundRec subroutine residing in the LaserWriter. Half the translation takes place in the Mac, half in the LaserWriter. Text is sent as ASCII (American Standard Code for Information Interchange) data along with font, orientation, fill, scaling, and position information.

Apple has built Times Roman, Courier, Helvetica, and many existing Macintosh fonts into the LaserWriter, which handles these fonts intelligently. For example, once a character is built it is cached and remembered as long as possible. Additionally, the LaserWriter driver in the Macintosh permits direct generation of PostScript commands. Both Adobe and Apple expect independent developers to make use of this facility. Apple reports that there are already more than 20 active, independent LaserWriter software projects.
SIGN-MASTER™
Number 1 in word charts for presentations and reports

Create powerful headlines using SIGN-MASTER's color, size, and font options. Here we chose Bold Roman font.

Highlight a single character, word or an entire line at the touch of a button. Here we focus attention on one number with color and underline.

Indicate source, date, author, etc. with SIGN-MASTER's footnote option. Bold Standard font was used in this example.

THE BOTTOM LINE
PROJECTED EARNINGS
(Millions of $)

<table>
<thead>
<tr>
<th>Year</th>
<th>Sales</th>
<th>Net Income</th>
<th>ROS(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>'78</td>
<td>86.4</td>
<td>5.9</td>
<td>6.9</td>
</tr>
<tr>
<td>'79</td>
<td>121.0</td>
<td>8.8</td>
<td>7.3</td>
</tr>
<tr>
<td>'80</td>
<td>144.0</td>
<td>11.4</td>
<td>7.9</td>
</tr>
<tr>
<td>'81</td>
<td>163.8</td>
<td>13.4</td>
<td>8.2</td>
</tr>
<tr>
<td>'82</td>
<td>182.0</td>
<td>15.7</td>
<td>8.6</td>
</tr>
</tbody>
</table>

Capital expenditure required: $5 Million
Net present value = $24.25 Million
(opportunity cost of capital = 24%)

(Sourced: Annual Report)

SIGN-MASTER is the first program designed to allow everyone from top management down to produce colorful, attention-gaining "word charts" and tables for presentations and reports.

Created on an IBM PC with a compatible plotter or printer, SIGN-MASTER word charts are superior in quality to typing and less expensive than typesetting or printing.

Professional Word Charts Made Easy
In just minutes, this unique menu-driven program lets you create impressive, easy-to-read documents using words, numbers, lines and SIGN-MASTER's simple-to-master Table Mode.

Number 1 in Quality Text
SIGN-MASTER offers the greatest variety of text options. In addition to 6 fonts, 16 sizes and 8 colors, you can justify text, underline, italicize, set margins, spacing, and more.

An Important Presentation Tool
With SIGN-MASTER and any one of over 40 plotters, you can produce full color originals on paper and overheads. The program also works with most popular printers to create the highest quality printer graphics possible.

Make Super Slides Quickly and Economically
Presentation-quality 35mm slides can be created in-house and inexpensively using the Polaroid Palette in conjunction with SIGN-MASTER.

For reports and presentations that get noticed, get SIGN-MASTER — Number 1 in word charts.

The retail price is $245.00. Call or write today for a complete information kit and a demonstration at your nearest dealer. Decision Resources, Inc., 25 Sylvan Road South, Westport, CT 06880 (203) 222-1974

Inquiry 88

SIGN-MASTER is a trademark of Decision Resources, Inc. SIGN-MASTER is available through the following international distributors: Grafisk Datahandling (Örebro) Scandanavia; Telecomputer Micro-Shop (Essen) Germany; Graphic Software Enterprises (Poland); Sanaka; Editel (Paris) France; Summit Bondan (London) U.K.; Celcomp S.A. (Milan) Italy and Computahead and Enke Worldwide.

DecisionResources
Software Designed for Decision Makers

The developers of CHART-MASTER

NEW PRODUCT PROPOSAL
A Breakthrough Chart Tool for the Growing Casual User Market

Proposals Summaries Exhibits Schedules Tables Title Pages
Picture a computer under $1000 that can run Lotus 1-2-3.
To run a powerful program, you need a powerful computer: “powerful” doesn’t always have to mean expensive.

Case in point: PCjr, from IBM.

With its 128KB memory, PCjr can run best-selling business program—Lotus 1-2-3—in its new cartridge form. Giving you the power to integrate spreadsheets and databases, and visualize numbers in charts and graphs.

PCjr’s cartridge format offers some real advantages, too.

A cartridge not only loads much faster than a program on diskette—it uses almost no user memory. So you get more “room to work.”

It can also free the diskette drive to be used for information storage alone.

And perhaps best of all, a cartridge program can’t be erased. Which means your investment is safe.

Of course, PCjr runs diskette programs as well. Over a thousand of the best programs written for the IBM PC. For business, home management, communications, education and entertainment.

And for all of its power, it costs less than $1,000* without monitor.

“But I already have Lotus”1-2-3” on diskette.”

If that’s the case, you may not want to buy the cartridge version. All you need is a PCjr Installation Kit (available free where you bought 1-2-3) and the new 128KB PCjr Memory Expansion Attachment.

This doubles PCjr’s memory. And, by no coincidence, it also doubles the number of programs you’ll be able to run.

So you can use Lotus 1-2-3 on diskette, and over a thousand additional programs that utilize expanded memory.

Picture yourself with PCjr. You can try one out at an authorized IBM PCjr dealer or IBM Product Center:

For the name of the store nearest you, call 1-800-IBM-PCJR. In Alaska and Hawaii, call 1-800-447-0890.

IBM PCjr
Growing by leaps and bounds.

Before or after you buy a PCjr, it’s easy to get answers to your questions. Just call 1-800-222-PCJR.

*IBM Product Center price, monitor not included.
Lotus and 1-2-3 are trademarks of Lotus Development Corp.
Little Tramp character licensed by Bubbles Inc., s.a.
A program to take the tedium out of converting C programs to Pascal
BY TED CARNEVALE

m matter how much you prefer a particular programming language, there are times when it is necessary to use a different one. I found myself in this situation recently after I had written a graphics subroutine library in C for the Pixeltronics high-resolution graphics display board that uses the NEC 7220 GDC (graphics display controller) chip. Since the display was attractive, I decided to incorporate the routines into our lab’s high-speed data-acquisition system.

The data-acquisition program, which controlled A/D (analog-to-digital) conversion and signal averaging, was compiled with Digital Research’s Pascal/MT+ compiler. I chose this implementation of Pascal because it supports floating-point operations using the AMD (Advanced Micro Devices) 9511A, a high-performance arithmetic coprocessor that allows faster on-line data averaging and scaling. To run the A/D converter at top speed, special drivers were written in assembly language. The package’s weak link was its subroutine to display data on a nonstorage oscilloscope, using the DIA (digital-to-analog) section of the converter board. The time required to sweep multiple traces across the oscilloscope screen limited the maximum rate of data acquisition.

It didn’t seem practical to rewrite all of the data conversion software in C just to use the graphics display. Furthermore, we would have to write new drivers to use the AMD 9511A for floating-point calculations in C. Worse yet, the floating-point format and dynamic range of the AMD 9511A are radically different from their counterparts in our version of C (Software Toolworks C80 with optional floats and longs).

For a while I considered linking the rel (relocatable) files produced by C80 (which contain the graphics routines) to the erl (extended relocatable) files generated by Pascal/MT+ (which contain the data-conversion routines). This proved to be especially cumbersome for two reasons.

First, both of these languages use the stack to pass parameters to subroutines. Pascal/MT+ assumes that the subroutine will pop the parameters from the stack, which has the side effect of restoring the stack pointer to its position before the subroutine call. However, C80 expects the calling program to restore the stack pointer. Therefore, repeated calls from a Pascal program to C subroutines would make the stack grow larger and larger, potentially overwriting vital regions of memory. Circumventing this problem requires the crude but effective dodge of inserting a special “unstack” routine after each C routine call, so that the stack pointer would be properly restored.

The second problem is more difficult to deal with and relates to the fact that Pascal lacks local static variables. LINKMT, the linker for Pascal/MT+, issues error messages when it encounters certain conditions in the data segment. Some of my graphics procedures used local static variables, and these modules could not be processed by LINKMT.

In theory this can be overcome by using LIBMT to convert the Pascal erl files to rel files and then linking them to the C80 rel files with Microsoft’s L80. But somehow I could never get this technique to work right. Even if L80 could have produced a functioning mongrel, it would have been needlessly bulky, since the graphics drivers would have their own arithmetic and logic routines extracted from the C library with much needless duplication of similar functions provided by the Pascal library. Still, if it had worked I would have used it.

Having failed to weld C routines to Pascal, I had to rewrite the graphics drivers in Pascal. At first this seemed less awful than it really was. There are enough similarities between these two descendants of ALGOL that major revisions are not necessary for most simple routines. Many of the required changes can be done with any editor using global search/replace commands. For example, C’s block delimiters { and } are direct counterparts of Pascal’s begin ‘and end.

This method is fine if you only have to translate a few short programs, but it has some major problems otherwise. Suppose you accidentally replace the C comment delimiters /* and */ with { and } before replacing the block delimiters with begin and end? And how about the different uses of = in C and Pascal? If you replace each = with : =, then C’s
Listing 1: The C-to-Pascal program, written for the Software Toolworks CB0 compiler.

The C-to-Pascal filter to replace C punctuation and certain key words with their Pascal equivalents.

```
/* C to Pascal - filter to replace C punctuation and certain key words with
their Pascal equivalents.

C form Pascal form

{ BEGIN
} END;
<tab> < 2 blank spaces>
() <nothing>
|| OR

comment start {
comment end }

== =
!= <>
= :=
printf writeln
scanf readln
while WHILE

Usage: ctp < infile > outfile

#define EOF -1
#define EOS '

main()
{
    char c,*letter,word[100];
    int wordlength;
    letter = word;
    wordlength = 0;
    while ((c = getchar()) != EOF) {
        if (isalpha(c)) letter[wordlength ++] = c;
        else {
            if (wordlength > 0) {
                if (wordlength > 0) { /* word ready to check */
                    letter[wordlength] = 'O';
                    wtest(word);
                    wordlength = 0; /* reset index */
                }
                ctest(c); /* process following char */
            }
            wordlength = 0; /* reset wordlength */
        }
    }
}

wtest(word)
char *word;
{
    char *swapword;
    swapword = word;
    switch (word[0]) {
        case 'p': if (strcmp(word,"printf") == 0) swapword = "writeln";
        break;
        case 's': if (strcmp(word,"scanf") == 0) swapword = "readln";
        break;
        case 'w': if (strcmp(word,"while") == 0) swapword = "WHILE";
        break;
        default: break; /* pass unchanged */
    }
}
```

The C functions printf and scanf could be replaced by writeln and readln.

equality test == becomes :=:=,
<= turns into <=:=, and => becomes >=:=.

You could step manually through the file, verifying all replacements one at a time, and this might not take too long if you have excellent eye-hand coordination. If you're really good, you might catch most of the errors before your compiler does. However, I wouldn't even attempt it. I was faced with the task of editing 27 separate files, totaling about 30 pages of drivers and test programs to convert from C to Pascal. After manually translating three of these to Pascal, I decided to write a "filter" that would do as much of the dirty work as possible.

The first step in developing this C program, called CTPC (see listing 1), was identifying what substitutions could be made easily, reasonably, and safely by an unsupervised, i.e., non-interactive, program. The C functions printf and scanf could be replaced by writeln and readln. Where necessary, the In suffixes can be deleted manually at the same time the argument lists are revised.

The only other word substitution that I made was to capitalize WHILE. It is a trivial matter to change the program to perform case substitutions on other words (e.g., for or if). You will also want to replace switch with case and delete any case that appears in the C source. In addition to the block and comment delimiters, the non-alphanumeric characters that I decided to replace included tab (replaced with two spaces, my own format preference for Pascal), double quote, empty pairs of parentheses, logical "and" (&&), logical "or" (!), and the various uses of =.

(continued)
Join The Leader

...and be a Leader!

MicroAge is the computer solution leader. Throughout the United States and Canada, businesspeople rely on MicroAge for advice, leading products, and service when computerizing their companies.

But remaining the leader takes talented professionals who are willing to invest in their own community. People who are willing to assume a leadership position. That's why MicroAge is meeting with individuals who want to own and operate a MicroAge sales organization.

Owning a MicroAge franchise is more than running a store. We sell multi-user systems, local area networks and telephone systems...along with personal computers. We provide service, installation and training for our customers.

If you would like to develop a long-term relationship serving the businesses in your area, let's talk business! Call or write:

MicroAge
COMPuter stores
"The Solution Store"

1457 West Alameda • Tempe, AZ 85282
1-800-245-4683

In Arizona or outside the continental U.S. call (602) 968-3168

"The Leader In Multi-User Technology"
The next question was how to perform the substitutions. I decided the program should read through the file one character at a time, building words and testing them one at a time, while checking nonalphanumeric characters for any necessary replacements. For my purposes, I defined a word as a string of alphanumeric characters bounded by nonalphanumeric characters (including underline and numerals). This convention places restrictions on the labels that can be used in a program. For instance, printf would change into writeln, and new_file would become new_readln. If you use reasonable prudence in choosing names, you will avoid such undesired side effects.

An array of type char is used for temporary storage of each word. This array is arbitrarily much longer than any variable, function, or constant label that I am ever likely to use. Words are built one character at a time, starting with the first alphanumeric character encountered. The appearance of a nonalphanumeric character signals the end of each word. An index variable keeps track of the length of the word, and a pointer indicates the location for the next character.

When a nonalphanumeric character is found, the length of the word is examined. If the word length is nonzero, the program branches to a string comparison and conditional replacement routine. This routine handles each word in a similar fashion. It seemed easiest to use C80's strcmp (string compare) function to identify replaceable words. This function is not difficult to simulate if it is lacking from any particular C implementation.

Nonalphanumeric characters are treated in a somewhat different manner. Some, like tab or ", are simply replaced directly. Others, like / or &, are replaced only if followed by a second character such as * or another &, respectively. The various = constructs are all handled differently.

For the sake of convenience, I used a UNIX-like command-line specification for input and output filenames.
Networking Raised to a Greater Power

Advanced Technology. With it, IBM tripled the speed of the PC and increased its memory capacity five-fold. Nowhere is this increase in computing power more important than in networking situations. If the AT's technological advances have prompted you to look into a multi-user network, you owe it to yourself to take a closer look at MultiLink Advanced™ ... a unique multi-tasking, multi-user networking system that runs programs under PC-DOS 3.0.

Eight Workstations for the Price of an AT. MultiLink Advanced™ represents the next generation in networking systems for IBM microcomputers. The system enables terminals, connected to a single AT, to emulate IBM-PC's having up to 448K of RAM (The PC-Shadow™ terminal, shown above, even has a PC look-alike, as well as work-alike keyboard and display).

This means that instead of spending $3,000 per workstation for a PC with a Kilobuck "Network Interface Board," you can use inexpensive terminals ... eight of which cost less than an IBM AT. Even if you need only one workstation connected to your AT, you'll realize significant savings.

MultiLink Advanced™ ... Instant Access to All of Your Resources. Central to most multi-user situations is the need to coordinate a variety of printers. With what's been described by PC-Tech Journal as "...by far, the best print spooler for the IBM PC," MultiLink Advanced™ gives users the option to print either at their workstations, or at a central location. In addition, programs and files can be shared by multiple users locally or through use of a modem. Just think of it ... having remote access to an AT with a lightweight terminal/modem.

Although designed to take advantage of the AT, MultiLink Advanced™ runs on all versions of PC-DOS, except 1.0, and certain implementations of MS-DOS. A wide range of leading programs are supported which include WordStar, dBASE III, Multimate, and Lotus 1-2-3.

Get the Advanced Story Today. Call The Software Link Today for complete details and the dealer nearest you. MultiLink Advanced™ is immediately available at the suggested retail price of $495 and comes with a money-back guarantee. VISA, MC, AMEX accepted.
Listing 2: Sample output of the CTPC program, a partial processing of the program's own source file.

```c
#define EOF -1
#define EOS '

main
BEGIN
char c;*letter,word[100];
int wordlnth;
letter = word;
wordlnth = 0;
WHILE ((c = getchar) < > EOF) BEGIN
if (isalpha(c)) letter[wordlnth ++] = c;
else BEGIN
if (wordlnth >0) BEGIN { word ready to check }
letter[wordlnth] = EOS;
word[wordlnth] = EOS; { pass or replace it }
wordlnth = 0; { reset index }
END;
ctest(c); { process following char }
END;
END;
END;
```

The typical command line reads

CTP < INFILE.XXX > OUTFILE.YYY

Listing 2 is part of the file CTPPAS produced by using CTP to process itself.

This filter program was designed to perform simple substitutions. It passes #define, #ifdef, and #include statements unchanged. It does not label functions or procedures, generate type definitions, reorganize variable declarations, or perform other radical alterations. Nor does it eliminate the need for program restructuring to compensate for major differences between C and Pascal (the lack of local static variables in Pascal being one of the more annoying problems). However, it does remove most of the error-prone aspects of building a Pascal program on the framework of a C program.
Why buy "ADDITIONAL EXPENSIVE PC'S" just to get additional users!

Kimtron is the only one that enables you to expand your IBM PC, XT, AT or the other PC compatibles to Multi-Tasking and Multi-User system at a fraction of the cost of additional PC's. Only Kimtron can display the screen exactly as your PC monochrome monitor, even for software like Lotus 1-2-3 or Word Star. Plus only Kimtron provides an IBM PC keyboard look-alike.

Operators will not only think and feel the KT-7/PC as if they're using IBM PC, but the KT-7/PC provides many more useful features such as tilt, swivel and height adjustment of monitor, optional amber screen, a dedicated serial printer port for each user at no extra cost, and optional 14 inch screen.

In addition, the KT-7/PC is designed for flexibility so that it can also be used as an industry compatible ASCII terminal.

Kimtron, a 5-year technology leader - we're going places and want you to join the Kimtron family of satisfied users. For more information about our KT-7/PC and your other terminal needs, call the Kimtron Corporation.

(408) 727-1510

NOTE: IBM PC, XT, and AT, Lotus 1-2-3, and Word Star are trade marks of IBM Corporation, Lotus Development Corp., and MicroPro International Corp.
Winning isn't easy when you have to work harder than your PC because your relational database falls short. That's why experienced users power their PC's with the Revelation® "Applications Environment" from Cosmos.

More than a relational database. Revelation gives you the tools and flexibility you need to prototype and develop even the most exotic microcomputer applications with relative ease and efficiency. Revelation uses plain English to create files, fields, entry screens and menus, process information, make simple inquiries or generate complex reports.

Revelation's R/DESIGN applications generator does the work for you, or you can switch to Rev's structured R/BASIC language for precise program customization. You can make changes in programs, screens or data structures in a matter of seconds without having to start from scratch.

Revelation works with MS/DOS™ so you can take advantage of all your favorite microcomputer software packages, and Rev's "Open Environment" communications concept allows interactive access to many mainframe and minicomputer systems. Networking and runtime versions are also available.

When you need more than a simple database, Rev up your PC with Revelation, the "Applications Environment" from Cosmos.

Contact us by phone or write and we'll arrange an unforgettable demonstration for you with a Cosmos representative in your area.

MS/ DOS™ of Microsoft Corp.

Inquiry 75
SIMULATE A SERVO SYSTEM

Letting the computer handle the math eases the designer's job

A servo mechanism is essentially a small motor that controls a larger motor. A servo-control system consists of the logical instructions needed to guide the servo mechanism. Control systems were brought out of the laboratory and into practical use about the time guided missiles were developed for World War II. The original vacuum-tube type was big, heavy, and expensive, but integrated-circuit (IC) technology has reduced the size of control-system technology as well as others. Now, almost the entire servo-control electronics package fits into a single IC, as in present model-airplane radio-controlled servos. Consequently, the cost of these systems has been reduced so that they are now found in automobile cruise-control systems, stereo turntables and tape decks, kitchen appliances, and home-workshop tools.

A reduction in the size and cost of servo-control systems, however, has not reduced their complexity. The design of servo-control systems remains one of the most intricate of the electrical engineering sciences. However, the computer's simulation ability has simplified the designer's job. Simulation is now a common part of the servo-control system engineer's tool kit, and similar simulation, though not as complex, can be effected with home computers.

As an example, let's design an electronic weighing scale. Figure 1 is an illustration of how such a scale would be arranged. A balance beam forms the main part of the scale, along with the weight pan on the left. On the right side, instead of the normal balance weights, we attach a solenoid. The solenoid is designed so that the pull on the solenoid armature is directly proportional to the current in the coil. A sensor, such as a low- (continued)
friction potentiometer, forms an error detector that gives a voltage proportional to the angle by which the scale is out of balance. The servo-control system uses this error signal to change the current through the solenoid to eliminate the imbalance. The current in the solenoid coil is now proportional to the weight in the pan, and a current meter is calibrated to read in weight units.

Figure 2 is the type of diagram a designer would draw for this kind of feedback servo-control system. The circle at the left represents a summing junction. The output to the right of the junction is the sum of the inputs to the other two (or three) quadrants. As shown here, the junction indicates the difference between the commanded or desired quantity, \( O_c \), and the actual quantity, \( O \). The servo-control computer operates on this difference and outputs a voltage to the actuator. The actuator is a physical device, usually a force transducer that drives the quantity to be controlled either up or down so that the actual value equals the desired value. At this point the system is balanced, and the error signal (or feedback) will remain at zero unless some perturbing force displaces the system or a new input value is commanded.

A servo-control designer is concerned with several aspects of the system's behavior. First and foremost is stability. That is, does the system indeed act to reduce the error, and not, as servo-control systems have a habit of doing, actually cause the error to increase wildly? How soon will the system reach a new equilibrium? If it takes too long to settle down, the system may not be usable in practice. Is the amount of error that remains after the system reaches a new equilibrium sufficiently small? Ideally, you'll have no error but in practice you'll probably have some and will have to decide if it is tolerable.

Without simulation you have to use complicated differential equations to try to predict a mechanism's behavior. Computer-based simulation does the math for you. In addition, simulation lets you design more complex servos, whose behavior could not be predicted easily by normal differential equation methods. Figure 3 charts a typical simulation. After setting the initial conditions, the program enters the iterative loop (input, model, output, update). It scans user or process input to see if conditions are to be changed. If the simulation is supposed to be continuous, such as the physical simulation we will be working with, input is best done with a keyboard-monitoring routine to keep the program running between inputs. The heart of the simulation is the next step—the math model. In this block, the computer performs its mathematical operations on the equation that describes the system being simulated. Almost any system or
Are you battling incompatible office automation systems?

Now, in just minutes, you can get two incompatible office automation systems to work together. To swap documents in letter perfect order.

All without battling a single modem, service bureau, telephone company or instruction manual.

Announcing the KEYWORD 7000, an exciting new breakthrough in office automation compatibility.

It's here! A compact new hardware/software device that can convert diskettes quickly. Easily. With no cleanup.

That means you can swap diskettes between all the major office automation systems without losing headers, footers, tabs, underlines, or any other formatting codes.

What's more, the KEYWORD 7000 costs just pennies a page. Compared to service bureaus at $3. And rekeying at $4.50.

But that's not all. With Keyword, you'll discover a whole new cost-saving world of office efficiency...using the office automation systems you have right now!

To find out more, call 1-800-227-1817 ext. 812A and get your complimentary copy of How to Win the Compatibility Battle. Exciting New Facts about Today's Office Automation Compatibility Solutions. Or fill in—or attach your business card to—the tear-out coupon. And mail.

Call 1-800-227-1817 ext. 812A for your free booklet.
situation that can be mathematically described in a cause-and-effect relationship can be simulated by a computer. Next, the program displays or prints an output. Then the time variable is incremented and, if the program is not terminated by some condition that exceeds its limits, the program repeats.

Listing I: This program is written in TRS-80 Level II BASIC but can be adapted to any of the BASIC dialects.

10 REM SCALE SERVO CONTROLLER
20 REM by Don Stauffer
30 CLEAR 200
40 REM EDIT ASSIGNMENT STATEMENTS TO ALTER CONTROL CONSTANTS
50 PR= 0 REM PRINT CONTROL VARIABLE
60 TH= 0 REM SCALE BALANCE BEAM ANGLE
70 TM= 0 REM BEAM ANGLE DURING LAST ITERATION
80 W= 0 REM INITIAL WEIGHT IN PAN
90 JS= 5 REM BEAM MOMENT OF INERTIA
100 D= 5 REM DISTANCE FROM PIVOT TO WEIGHT OR SOLENOID
110 K=10 : REM SCALE FACTOR, SOLENOID CURRENT TO FORCE
120 K1 = -0.4 : REM PROPORTIONAL SERVO CONSTANT
130 K2 = 0 : REM RATE SERVO CONSTANT
140 K3 = 0 : REM LAG SERVO CONSTANT
150 DT=0.2 : REM TIME INCREMENT
160 T = 0 REM INITIAL TIME
170 ST= 0 REM STOP PARAMETER
180 REM BEGIN SIMULATION LOOP
190 IF PR > 1.5 GOSUB 5000
200 REM CHECK FOR INPUT
210 GOSUB 1000
220 REM COMPUTE CONTROL CURRENT
230 REM COMPUTE MOTION
240 REM DISPLAY AND PRINT OUTPUT
250 REM UPDATE TIME
260 IF T< 0.5 THEN 200
270 STOP
1000 'CHECK FOR INPUT
1010 IF PEEK(14400)= 128 THEN GOTO 1010
1020 IF PEEK(14340) = 8 THEN ST= 1
1030 IF PEEK(14340)< > 128 THEN RETURN
1040 PRINT@65," ",
1050 INPUT"CHANGE WEIGHT";W
1060 IF W< 0 THEN W= 0
1070 RETURN
2000 REM COMPUTE CONTROL CURRENT
2010 IF ER< -10 THEN ER= -10 ELSE IF ER> 10.0 ER= 10.0
2020 I=K2*(TH-TM)/DT+K1*ER+K3*(ER+EM)
2030 IF PEEK(14340)< > 126 THEN RETURN
2040 IF PEEK(14340)< > 126 THEN RETURN
2050 RETURN
3000 TM=TH
3010 J=JS+W*D
3020 F=K1
3030 LC=F*D
3040 LW=W*D
3050 AA=(LC-LW)*J
3060 WD=WD+AA*D
3070 TH=TH+WD*D
(continued)
YOUR DAYS OF BUYING TERMINALS ARE OVER!
Now there's SmarTerm terminal emulation software for your IBM* PC, XT, AT or compatible system. All SmarTerm products offer comprehensive and exact terminal emulation, powerful file transfer facilities, and include TTY mode to link you to The Source, CompuServe, Dow Jones or other popular time-sharing services. We've included features such as ASCII and binary file transfer, multiple setup configurations, XMODEM and PDIP* protocol support, "smart" softkeys, plus European DOS support.

SmarTerm 100 is your choice for DEC* VT100, VT102 and VT52 emulation.
SmarTerm 125 has all the features of SmarTerm 100, plus VT125 ReGIS graphics support. For Data General Dasher* D100, D200 or D400 emulation, you need SmarTerm 400.

More than 15,000 users are already "hooked" on SmarTerm. Try it for 30 days, with full refund privileges, and you will be too.

Persoft, Inc. - 2740 Ski Lane Madison, WI 53713
(608) 273-6000 - TELEX 759491

AFTE R
SMARTERM™, WHAT DO YOU DO WITH YOUR OBSOLETE TERMINAL?

See your name in print! Send us your ideas for uses of obsolete terminals replaced by SmarTerm. The best ideas will be used in future ads. Write Persoft, Dept. FISH., 2740 Ski Lane, Madison, WI 53713.
The program shown in listing 1 follows this flowchart closely. The program is written in TRS-80 Level II BASIC, but I have attempted to use as few nonstandard instructions as possible. You can adapt this program to any of the BASIC dialects (see the text box "Program Changes" on page 153, for more information). Lines 50–170 set the physical constants’ values and give initial values to variables. The stop variable ST (in line 170) is used to terminate the program upon command. The program must be edited to change the values of any of the constants except weight, which can be changed by the operator. PR is a variable printout control. PR = 0 results in no hard copy, PR = 1 gives you a tabular list of the variables shown on the screen, and PR = 2 gives a graphic trace of the indicated weight. Line 5000, referenced if PR > 1.5, is used to set up the scale of the printer and to print an axis.

Line 200 is where the main loop begins. Line 1000 looks for a user input. If you press the W key, the program stops and expects a new value for the weight on the pan. The S key and the space bar also have functions, which I’ll describe later. The subroutine starting on line 2000 is the math model of the control computer block in figure 2. We will be able to understand this block better after we begin to play with the servo simulation. The subroutine that begins at line 3000 is also part of the math model and represents the physics of our scale. It represents Newton’s second law of motion as applied to rotating systems. (The text box "Physics Math Model" on page 153 has more details about the mathematical model of our scale.) The force applied to the solenoid equals the current after it is multiplied by a scale factor (line 3020). Torque is equal to the product of a force (F) multiplied by a distance (D). so the torque in the beam is equal to the product of F multiplied by D (line 3030). Assume that the distance from the pivot to the weight is the same as that from the pivot to the solenoid, so line 3040 calculates the torque due to the weight. Therefore, line 3050 determines the angular acceleration by finding the net difference between the torque.
due to the weight and the torque due to the solenoid current, and then that net difference is divided by the moment of inertia. Lines 3050 and 3060 integrate the acceleration to angular velocity and angle.

The subroutine starting at line 4000 displays the output on the screen. The program displays elapsed time, the deflection angle, the solenoid current, and the indicated weight. For reference, the actual weight is also displayed in the upper left corner. If a hard copy is desired (PR equal to or greater than 1), the print routine continues. Lines 4050–4070 output the table, and the graphic output is begun by the command at line 4080. The table output routine slows down execution considerably, so don't use it unless you find an interesting case. If you don't want a hard copy, the subroutine returns to the main program. If you haven't set the stop variable, the program loops back to line 200 and continues.

The subroutine starting at line 5000 scales the characters per inch in both directions and draws an axis. In operation, the graph is drawn vertically down the paper. (The values given are those needed with a C. Itoh ProWriter.) Other printers will require different values in lines 5000 and 5010. Line 5000 puts the ProWriter in condensed (17 characters per inch) mode and sets the vertical feed to 12 lines per inch. You can set these values to any you like. Line 5010 puts the printer into the graphics mode. Be forewarned: The program does not take the printer out of the graphics mode. You have to do it manually.

You usually start the program with no weight on the pan (W = 0). Pressing the W key for about one second stops the program and the computer will prompt you for the value of weight you want to add. The scale will work well with any weight less than 10 units. Other keys include the S key, which will stop the program (you can also hit the Break key) and the space bar, which freezes the operation for as long as you hold it down. You have to edit the program to alter the servocontrol constants, the physical parameters of the scale, or the printout command. I recommend that you avoid printing anything until you have a setup you really want to document. The printer slows down the simulation; especially when you call for graphics. In fact, while the computer is executing the subroutine that does the scaling (line 5000), expect a lengthy pause. After several seconds the normal screen and simulation will appear.

**SERVO THEORY**

After typing in the program with the values given in listing 1, go ahead and run it to see that it works. Don't worry (continued)

---

**Program Changes**

The BASIC I used in this program is Radio Shack Level II BASIC, but you can easily convert the program to other computers. I minimized commands unique to the Level II interpreter. The CLEAR command in line 30 clears for string space and is needed only for the graphic print option. The keyboard-scanning routine in lines 1010 to 1030 checks the keyboard for depressed keys. Using a normal INPUT statement would stop the program once every iteration, while we want the program to continue. The PEEKs look at the memory area of the memory-mapped TRS-80 keyboard. The Apple should use the same technique, although the memory locations will be different. Line 1010 looks for the space bar and freezes the program for as long as the key is depressed. Line 1020 looks for the S key. Line 1030 looks for the W key. For the Commodore 64 use the GET command. The other main thing to watch for is the manner in which an output is sent to a line printer. If no printer is used, PR in line 30 will always be set to zero, and no changes are required. If a printer is used with another computer, however, modifications must be made. The TRS-80 merely uses the command LPRINT followed by the desired outputs, as in line 4050. For Apples, change all LPRINTs to PRINTs, preceded each one with a PR#1, and follow it with a PR#0. For the Commodore 64, you must use the OPEN command before each output to the printer, followed by an OPEN 1,0 to return the output to the screen.

The other area of the program you may need to modify contains the graphics commands to printers other than the ProWriter. These parameters are discussed in the main text.

---

**Physics Math Model**

The code in lines 3000–3090 is a mathematical model of the physics of our scale. The scale operates according to Newton's second law of motion, but it is expressed in a form for angular motion, which may make it seem a little unfamiliar. Newton's second law is ordinarily expressed as:

\[ F = MA \]

For rotary or angular motion, however, it is expressed as:

\[ AA - LI/J \]

where \( AA \) is the angular acceleration (degrees per second squared), \( L \) is the net torque (difference between the torques in opposite direction), and \( J \) is the moment of inertia. Moment of inertia is the resistance to a change in rotation and is the rotary equivalent of mass. The moment of inertia is a function of the beam's structure and of the weight added to the pan (line 3010). Torque equals force times distance. For our scale, we assume that the distance between the weight and the pivot is the same as the distance between the pivot and the point where the solenoid applies its force. Thus, line 3030 represents the torque generated by the solenoid, while 3040 represents the torque from the applied weight. Line 3050 calculates the angular acceleration. Line 3060 integrates the acceleration to find the angular velocity; 3070 integrates once more to find the angle. Line 3080 represents mechanical stops that prevent the beam from rotating more than 10 degrees in either direction.
Sperry, performance has never been a question of how we strut our stuff, but of how well we pass muster.

So while other PC’s parade their bells and whistles and fancy footwork, the Sperry PC quietly proves its superiority.

Superiority in graphics. With a brilliant display of color and design.

Ergonomic superiority. With a far more comfortable and infinitely more operable keyboard.

Operational superiority. With its ability to run 50% faster than most other PC’s.
And all of this at a price well below the standard. But the area in which the Sperry PC clearly demonstrates its leadership is compatibility. It is our understanding of this critical concept that has made the Sperry PC so compatible with software for the IBM PC. And in terms of its ability to be compatible with your company's most important source of information, the Sperry PC is peerless. Because the Sperry PC plugs into the main computer. Whether that main computer is Sperry, IBM, or both.

The Sperry desktop and portable PCs. By comparison, everyone else will seem a little flat-footed. But when you're out to lead the parade, you have to be on your toes.

A full-color reproduction of this original Sempe illustration, suitable for framing, is available with our compliments. Call or write for it, and we'll also send you an information kit on our family of PC's.

Telephone toll-free 1-800-547-8362.
Sperry Corporation, P.O. Box 500, Blue Bell, PA 19424-0024.
about making sense out of the simulation yet. Before we do any experiments, let's look at some elementary servo theory. Figure 4 shows the most simple form of servo controller. This is known among servo designers as a proportional control system. The controller merely takes the error signal \((Q_c - Q)\) and multiplies it by a constant, known as the "gain constant." In our example, we want the angle of the scale to be zero. Thus, the commanded value of \(Q_c\) will always be zero, and our error is always equal to \(-Q\), where \(Q\) is the scale's actual angle. The output signal to the actuator and, as mentioned previously, the restoring force on the scale are proportional to the error.

Now consider for a moment how you want your scale to act. Obviously the weight readout should be close to the actual weight in the pan. There are other desirable features, too. Beam balances seem to take forever to settle down and show whether they are indeed in balance. Electronic scales can also exhibit such oscillations, so we would like ours to settle down quickly. Additionally, if the scale comes to rest with the beam not level, there may be an inaccuracy. With these three criteria, let's run the program with the initial values from listing 1 and see how the scale performs.

As we start out, the scale is in balance and everything stays at rest with the scale at zero angle. Now press the W key until you see the prompt for weight. Try type in a value, such as 5.0. This adds 5 ounces to the scale. The scale is now out of balance, and the beam swings to a negative angle. The control system senses this angular error and increases the solenoid current. This attracts the beam and slows it down. Now the current-generated force exceeds the weight, and the beam's angle moves back toward zero. When this happens, the solenoid shuts off the current and the cycle repeats. We have built a good oscillator. Our simulation will continue to oscillate like this forever. Figure 5 is a plot of a cycle of this condition. Stop the program now, as it is neither exciting nor instructive beyond this point. Pivot friction in an actual scale would eventually reduce these oscillations. However, it would take a long time and its effect would be small in a well-built scale. Consequently, I left friction out of my simulation model. Playing with the value of \(K_1\) will affect the period of the oscillation.

**Figure 4:** In a proportional control system, the error between the actual and the commanded value is multiplied by a gain constant to drive the actuator.

**Figure 5:** Continuous oscillation is a common feature of a proportional control system with no damping.

**Figure 6:** A proportional-plus-rate system uses the output variable's rate of change as part of the control calculation.
tion but won’t eliminate it.

The way the servo designer eliminates eternal oscillation is to add “rate damping” to the system. Figure 6 shows a proportional-plus-rate system. The symbol \( \dot{Q} \) with a dot over it (pronounced “Q dot”) represents \( Q \)’s rate of change over time. Again, \( Q \) is our controlled variable, the angle of the scale. In calculus, this is the time derivative. We add rate damping to our system by setting \( K_2 \) to some non-zero value. Try a value of \(-4\) in line 130 and run the program again. Figure 7 shows a typical result. Now we have reduced most of the oscillation, although a small amount of excess motion remains. The excess motion eventually stops, but the speed at which it stops is sluggish. The scale could almost be considered practical now. However, in addition to the sluggish response and the excess motion, [continued]

Figure 7: The addition of rate-of-change feedback creates a damped oscillation.

Figure 8: The addition of a quantity proportional to the integral of the controlled quantity reduces error when the system reaches equilibrium.
we have another problem. As the system approaches equilibrium, we still have an angle error of about 1 degree. This is not drastic, but we can do much better.

Specifically, we will add yet another block to the system (shown in figure 8) and create a proportional-plus-rate-plus-integral, or proportional-plus-rate-plus-lag, system. Although this is beginning to look like a formidable circuit, don't be dismayed. This is as complicated as it gets. We can create a proportional-plus-rate-plus-lag servo by changing $K_3$ to a nonzero value. Try $a = -3$ for $K_3$ in line 140 and run the system again. We've speeded up the response and increased the excess motion. But as the system damps out, we see that a greatly reduced angle is obtained. Since an increase in $K_2$ reduced the excess motion before, let's try increasing it again, this time to $-8$. Now that's more like it. Although there is still some excess motion, it quickly stops (see figure 9).

The reading reaches equilibrium in a few seconds, and the angular error is less than one-tenth of a degree. You can improve your results even more by further refining $K_2$ and $K_3$. We have now designed a practical servo-controlled scale that is stable and becomes quiescent with reasonable speed. Play around with the system. As with any computer simulation, you can't hurt anything. If you want to see things really go awry, try putting in a value for any of the three servo constants with the opposite sign.

This simplified simulation illustrates much of the behavior of the typical servo system. You can easily modify the program to represent a speed-control servo (e.g., an automobile's cruise control). The professional engineer must still dabble in the realms of complex variables, nonlinear differential equations, and other forms of higher math, but simulations similar to this one are revolutionizing the design of servo systems.
100 MHz scope, counter, timer, multimeter: All one integrated system.

Now make measurements faster, easier, with greater accuracy and user confidence.
The Tek 2236 makes gated counter measurements, temperature, time, frequency, resistance and voltage measurements push-button easy. You see results concurrently on the 9-digit numeric readout and CRT display.

Its complete trigger system includes pushbutton trigger view, plus peak-to-peak auto, TV line, TV field, single sweep and normal modes.

At just $2650, the 2236 includes the industry's first 3-year warranty on all parts and labor, including the CRT.

Integrated measurement system, 3-year warranty. 15-day return policy. And expert advice. One free call gets it all! You can order, or obtain literature, through the Tek National Marketing Center. Technical personnel, expert in scope applications, can answer your questions and expedite delivery. Direct orders include probes, operating manual, 15-day return policy, full warranty and worldwide service back-up.

Order toll-free: 1-800-426-2200

Extension 57

In Oregon call collect:
(503) 627-9000 Ext. 57
Or write Tektronix, Inc.
P.O. Box 1700
Beaverton, OR 97075
We Just Made Our Terminals Look Even

$1595
Best Selling Graphics Better.

NEVER BEFORE HAVE DEC COMPATIBILITY AND GRAPHICS BEEN SEEN AT A PRICE THIS LOW.

At $1395, the Visual 102G is the only DEC compatible terminal with Tektronix compatible graphics at a price this low. The 102G actually outperforms the VT240. Unlike DEC's machine, it uses the full screen for superior Tektronix emulation. The keyboard is more compact and has 16 programmable, nonvolatile function keys. Powerful graphics capabilities give you a higher resolution (768 x 293) in a terminal with power and features emulating the Tektronix 4010/4014. And it's fully compatible with the DEC VT102.

Compared to the DEC VT220, buying the Visual 102G is like getting a DEC compatible terminal with free graphics.

AT $1595, RESOLUTION AND FEATURES THIS SHARP ARE A SIGHT TO BEHOLD.

For those who require even higher resolution graphics than the 102G, the Visual 500/550 terminals deliver it with full Tektronix 4010/4014 emulation. 768 x 585 resolution on a large, easy to read 14" screen gives you remarkably sharp text and graphics displays. The 500 emulates the DEC VT52,** Data General D200,** Lear Siegler ADM 3A** and Hazeltine 5000 terminals. The 550 is DEC VT100 ** protocol compatible and a character or block mode terminal that complies with the ANSI X3.64 standard.

Never before have such features and graphic resolution been seen at this price.

ALL THREE TERMINALS OFFER MORE THAN MEETS THE EYE.

The Visual 102G, 500 and 550 are fully compatible with all of the major software available. This includes PLOT 10*, DISSPLA*, TELL-A-GRAPH*, SAS/GRAF, DI 3000/GRAFMaker, INFOgraph, SPSS, TERMPLATE, DR Graph, GSX**, and all GSX* products.

Each of the terminals comes with a wide variety of advanced resident graphics features, including vector draw; point plot; circle, arc and rectangle draw and fill; multiple line styles and patterns; as well as an auxiliary port that supports a variety of printers, plotters and data tablets.

BEING NUMBER THREE, WE DO OUR BEST TO LOOK OUT FOR NUMBER ONE: YOU.

Visual Technology Incorporated is the third largest producer of graphics terminals in the industry. It's been your widespread acceptance of our products that has allowed us to offer you a price second to none.

If you're in the market for graphics terminals with the optimum combination of features, resolution and price, look no further. Call Visual today.

VISUAL See for yourself.*

Visual Technology Incorporated
540 Main Street, Tewksbury, MA 01876
For more product information, call 1-800-341-5200 (1-800-462-5560 in MA) or 1-617-851-5000.
Inquiry 325
Snuggle The SQUASH™ AC Power Controller comfortably underneath your computer monitor; plug your computer and peripherals into the back panel and you’ll have complete power control of all of your accessories at your fingertips. Not only do you gain added convenience, but with EPD’s advanced surge protection and EMI-RFI filtering technology The SQUASH will keep your computer from becoming a vegetable. And it’s backed by a lifetime performance guarantee.

It’s compatible with IBM*, Apple*, Commodore*, Columbia*, and most other desktop computers.

The SQUASH, ask for it at your local dealer. It’s part of a new harvest of products from the folks who brought you The LEMON™.

DON’T PLUG IN WITHOUT US.

Electronic Protection Devices Inc.
P.O. Box 487, Stoneham, MA 02180
(617) 279-0424 • 1-800-343-1813

*All of the above titles are trademarks, registered trademarks, or service marks of third parties.
INTRODUCTION TO IMAGE PROCESSING

INTRODUCTION TO IMAGE PROCESSING, or I/P as it is often abbreviated, is a branch of computer graphics based on image data—the pieces that make up a picture. In essence, image processing is a special form of two-dimensional (and sometimes three-dimensional) signal processing. Scenes are developed from a camera-like sensor, either a conventional film-based system or a scanner, and manipulated so that they provide more information. I'd like to show just how common I/P is and describe some of its fundamentals.

Image processing is a powerful suite of techniques for uncovering information. Some of the techniques are comparable to photographic darkroom processes, but much more is involved. The principal idea behind image processing is to make an image more informative, or, in communications jargon, to extract more signal from the noise.

Commercial television has trouble displaying more than a dozen different gray levels. The human eye can perceive more levels of gray, but not many. If you need to be able to distinguish between shades of gray that are finer than you can see, you enter the realm where image processing can help. A black-and-white image-processing system can usually distinguish at least 32 gray shades.

Typically, computer systems treat images as arrays, or series of elements. The number of elements in an array determines the resolution of the image, and the number of bits available to any element of the array (or word size) determines the number of “colors” or gray-scale values each element can have. The smallest element of a picture corresponds to a single element of the data array. This element is called a pixel, an abbreviation for picture element. Popular choices for the number of pixels in an image are either based on powers of 2 (256 by 256, 512 by 512, or 1024 by 1024) or on hardware standards like the 525-line commercial television system.

The number of bits in a given pixel determines the number of unique gray values or colors available. Eight-bit pixels provide 256 different gray values in black and white or 256 unique colors. Most larger systems have 24-bit pixels—8 bits each for red, green, and blue—which translates into over 16 million unique colors. That many colors is more than one can display on a monitor, and certainly more than you can distinguish visually.

At least three standard systems are used to describe color. (See reference 2 for more background on color theory.) The additive system works by considering the amount of red, green, and blue light you would have to add together to create a specific color. Color television works precisely this way. If you take a close look at a color television or video monitor screen, you'll see triplets of colored dots. Each triplet contains a dot of each of the additive primary colors, red, green, and blue. This triplet represents the single pixel, the smallest element in the picture whose color you can specify. Similarly, I/P systems are almost always based on the red-green-blue additive system.

In contrast, when you're mixing paint, you mix the subtractive primary colors. The subtractive primary colors are cyan, magenta, and yellow.

Finally, human visual perception is often parameterized by hue, saturation, and intensity (or value). Hue is the simplest to understand; it is the “color” or dominant wavelength you see, for example, red versus green. Saturation, sometimes called purity, is easy to think of in terms of mixing white into a pure color. Red and pink are the same hue, but they differ in saturation—red is more saturated than pink. Intensity (or value) is the relative brightness of a color. When the relative brightness of a color. When you view a red wall with the sun shining brightly on it and then when the light is dim, the difference in “reds” appears only in intensity.

Jeffrey L. Star is a development engineer at the Remote Sensing Research Unit, Department of Geography, University of California, Santa Barbara, CA 93106.
Since all three of these systems are alternative ways of describing color, you might expect that you could freely convert (or "transform") between them, and you'd be right (see references 2 and 3). From here on, however, I'll be discussing the red-green-blue additive system.

**IMAGING IN ACTION**

My particular area of interest is image processing for satellite remote sensing. Several U.S. federal agencies, in particular NASA (National Aeronautics and Space Administration) and NOAA (National Oceanic and Atmospheric Administration), fly satellites with imaging sensors.

NASA's Landsat 5 is the most interesting such satellite now in operation. Landsat has two imaging systems: the Multispectral Scanner (MSS) and the Thematic Mapper (TM). Both are multiband imaging systems. Because of their fields of view and the satellite's orbital parameters, they cover the globe between latitudes 80 north and 80 south about every 18 days. Ground resolution for MSS is approximately 80 meters (that is, each pixel represents an area on the ground that is 80 meters on a side). For TM, ground resolution is approximately 30 meters. (Data from these sensors is available to the public from NASA. Ask for The Landsat Tutorial Workbook: Basics of Satellite Remote Sensing; see reference 6.)

Photo 1 comes from the NASA Landsat TM, showing a portion of southern California at the edge of the Salton Sea. The different colors correspond to rock type, and the San Andreas and associated faults run generally parallel to the shore. The image in photo 1a is a multiband color composite, produced as if several cameras with different filters were providing distinct information on the same scene. The image in photo 1b is pseudocolor processed (see explanation below). Photos 2a and 2b are from the Landsat MSS.

**I/P SYSTEMS AND SOFTWARE**

Systems for image processing range over almost all of the computer field—from Apples and IBM Personal Computers (PCs), through small minicomputers, to mainframe installations. While small PDP-11s have been the standard in the past, the Motorola 68000 microprocessor and DEC VAX systems seem to be the emerging standards. The following are a few of the commercially available systems.

ApplePIPS, for the Apple II with Apple DOS 3.3, and MicroPIPS, for the IBM PC with PC-DOS 2.0, are available from The Telesys Group Inc., Columbia, Maryland, at a cost of $495 each. These packages come with demonstration Landsat satellite data and are an excellent way to learn the rudiments of image processing. Classification (see definition below) and other higher mathematical functions are included in an advanced version of the software.

RIPS (Remote Image Processing System, Spectral Data Corp., Hauppauge, New York) is a Z80, S-100 bus 8-inch CPM system with a 256-by-240-by-12-bit image memory. The base price is under $20,000 for the complete system. Software packages cover a broad range of applications. RIPS will process satellite data that the EROS Data Center (Sioux Falls, South Dakota) now supplies on 8-inch floppy disks. Upgrades include video input and a 9-track tape drive.

The IIS Model 75 (International Imaging Systems, Milpitas, California) and COMTAL/3M Vision One (COMTAL/3M, Altadena, California) are dedicated image-processing systems that include display memory, a video processor, a parallel interface to a computer, a track ball and function pad, digital-to-analog (D/A) converters, and a comprehensive software library. A typical small system as a peripheral to another computer might cost $50,000, and upgrades include a Motorola 68000 or DEC PDP-11 embedded microcomputer, with Winchester and 9-track magnetic-tape storage. These systems are typically used at universities and research agencies.

The only specialized hardware you must have for image processing is a display driver and a monitor, although when performance or image quality is important a great deal of specialized equipment is available. Among the components of display drivers are frame buffers, D/A converters, and lookup tables.

A frame buffer is the key to any image-processing system. This bank of memory stores the image data. Most medium-size systems use several banks of 512 by 512 elements; in I/P jargon, the rows of the frame-buffer matrix are the lines of the image, and the columns are the samples along each line. A typical choice for a color I/P system
is to have four memory banks or channels—one each for red, green, and blue, and a fourth for intermediate calculations and superposition of graphics and annotation.

Frame buffers and their associated control circuitry can get complicated. Some systems give you an option to segment memory on the fly. For example, a given system can have 128K bytes of image memory, and you could configure it as either 512 by 512 by 4 bits (16 colors), or 1024 by 1024 by 1 bit (black versus white), or 256 by 256 by 16 bits (64 kilocolors). Often, a system implements zoom and pan, which let you expand a smaller area in the image space to cover the entire display. You can accomplish zoom most easily by pixel replication; for any original pixel, the system displays a 2-pixel by 2-pixel square on the screen. This procedure provides a twofold magnification of any linear feature, and, of course, a fourfold reduction in the area displayed.

A digital-to-analog converter transforms the contents of the image memory into a form compatible with your monitor. The number of different intensity levels that a D/A converter can output is related to the number of bits it is designed to handle; the more bits, the more distinct colors or gray levels it can produce. Few systems use D/A converters with more than 8 bits of resolution. As mentioned earlier, for a full-color system this arrangement translates into 8 bits on each of three channels (red, green, and blue), a total of 24 bits of color information per pixel, or over 16 million unique colors. The outputs of the D/A converters are generally formatted to either a standard RS-170 composite video or, in higher-resolution systems, sent to the display via separate R, G, and B (red, green, and blue) cables.

A lookup table is an important part of an image-processing system and, like other lookup tables in the computer field, it is a table of stored data for reference purposes. The lookup table performs mapping between each unique input data value and some predefined output value. Applications include color or density mapping and calculations that must be performed rapidly. You could also use a lookup table to assign any particular value in image memory to an arbitrarily displayed color; this method of color determination is pseudocolor processing (more later). You could also use a lookup table to change the contrast range of a displayed image by setting up the table with a nonlinear transformation between input and output gray values; this adjustment of range can make the output intensities more distinct from one another or compensate for a nonlinear film emulsion or an electronic sensor response. In the same way, you could use the lookup tables, for example, to take square roots of the image values. This capability is particularly valuable if you are using the data in the image in a mathematical model or a statistical classification. You can then "recycle" the output of the lookup table back into a memory plane, which allows you to save enhanced images and manipulate them further.

Video processors are essentially array processors designed to work with the contents of frame buffers. They are dedicated computation units for performing certain routine operations on images, such as computing the ratio of two colors in an image. They permit relatively small computers and IP systems to work in “real time,” which is comparable to the time it takes to refresh an image on the screen (typically 1/30 second for a standard interlaced display, such as on a color television or microcomputer).

A frame grabber digitizes the output of a video camera and places the resulting image into memory. Video inputs are usually limited in terms of geometric accuracy and the number of available gray levels.

A video film writer is designed to produce color slides and prints with better resolution than a standard color CRT (cathode-ray tube). Again, on a color monitor a red, green, and blue dot make up a single pixel. The monitor's ability to display color depends on the limits of your eye's resolving power to merge the three color dots. Simply taking a photograph of a monitor works moderately well, but the quality is limited by the nature of the phosphor array (not much better than 1-millimeter resolution at best) and the curved screen.

Inside a video film writer are a black-and-white, high-resolution flat-screen monitor and three color filters. A single piece of film (color slide film or instant print film) is exposed to the monitor three times—first through the red filter, then the green, and finally the blue filter. This way, instead of the red, green, and blue dots being at a different place (as on a CRT), they are superimposed for each and every pixel. The business computer (continued)
graphics and computer-aided design/computer-aided manufacturing (CAD/CAM) uses for video film writers are numerous, with video film writers now available for under $4000. Some of the manufacturers include Celtic, Polaroid, Dunn, and Matrix.

If you want to turn an image into an array of numbers and you need more resolution and accuracy (or "spatial detail") than you can get from a video camera, you probably need an electromechanical scanner. The original image—transparency, film negative, or paper print—is mounted on a cylindrical carrier (similar to an old Edison cylinder phonograph). As the cylinder rotates, a photodetector scans along its axis and picks up image data. These scanners are generally large and expensive machines, but they have spatial resolution (in terms of pixel size) in the tens of micrometers.

The reverse process—turning digital data into a photograph—is performed by a device called a film writer. In this case, the cylinder holds a piece of film, which is exposed to a modulated light source (sometimes based on a laser in some commercial instruments). Such a device is capable of much higher resolution output than any monitor or video film writer; one manufacturer's specifications report a 25-micrometer raster over a 250-millimeter film negative. Negative and positive images and transparencies can be produced this way with high accuracy and geometric fidelity.

**IMAGE-PROCESSING OPERATIONS**

The principal operations involved in image processing are relatively simple. (Problems arise when you have large data sets. For example, the latest images from space derived from the Landsat Thematic Mapper satellite are from a piece of the earth's surface about 180 kilometers on a side and contain 300 megabytes of data.) A number of the key

(continued)
Raging C.

Concise structure and fast execution make C the ideal language for applications and system-level programming.

And compared with other MS-DOS C compilers, Microsoft® C consistently produces the fastest executable code.

It supports the full C language and includes an extensive library of subroutines that implement most UNIX™ compatible functions.

Small, medium, compact, and large memory models give you flexibility in selecting the addressing requirements of your software.

Programs can be designed to make effective use of the available memory of your computer, up to one megabyte.

Microsoft C Compiler provides you with a complete development system including the compiler, run time library, linker and library manager, and full support of MS-DOS 2.0 directory structure (pathnames) and I/O redirection.

How do programmers feel about Microsoft C?

“...In the top category for its quick compile and execution time, small incremental code, best documentation, and consistent reliability.”
—Ralph Phraner, BYTE Magazine

“Best for software development.”
—Bill Hunt, PC Tech Journal

“Produces good, tight-running programs.”
—Peter Norton, Softalk

Call 800-426-9400 to order the raging C. $500*

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 C in action.

*Price exclusive of handling and Washington State sales tax. Microsoft is a registered trademark and MS is a trademark of Microsoft Corporation. UNIX is a trademark of Bell Laboratories.

**Reprinted with permission, BYTE Magazine, August '81.
image-manipulation functions are explained below.

Radiometric operations manipulate the intensity of the pixels in an image. For example, a given image may be washed out: all the pixel values are in a small range, and they are all very light. One type of radiometric operation, called contrast stretching, takes the darkest values in the image and forces their value to black, forces the lightest values to pure white, and linearly varies all the intermediate values. An example of contrast stretching is shown in photo 2.

A series of images based on a test case in Sweden. Photo 2a shows the raw Landsat satellite data. In 2b, the image has been contrast-stretched so that the dark areas, representing water, show up better.

Another radiometric operation is density slicing, where you display only those pixel values whose intensity is in some specified range. This operation is often used to highlight or classify objects in the image that have a characteristic brightness or color. Photo 3 illustrates a 10-nanosecond x-ray pulse during the heating of a magnetically confined argon plasma. In this image, red indicates the most intense x-ray emission and blue the least intense emission. The radial lines indicate the direction of the plasma motion prior to x-ray emission.

Sometimes color coding aids in the interpretation of the density-sliced image; for example, objects whose brightness is in a specified range are displayed in red. This process, known as pseudocolor processing, is shown in photos 1b, 2d, and 3.

Spatial operations are another family of manipulations that fall into several categories. One such category is registration procedures, which are used to take an image and force it to "overlay" another. For example, any map projection is a distortion of the earth's surface, and to superimpose an aerial photograph onto a map you need to "stretch" the photograph. (Imagine painting the photograph on a rubber sheet and then stretching the sheet until objects on the image overlay the same objects on the map.) Photo 2c shows the effect of a registration procedure. The upper portion is original data, and the lower portion has been rectified to a base map. Notice that features are both rotated and changed in shape; this is a typical application.

Another category of spatial operations is filtering, a term used in a signal-processing context. For those who are mathematically minded, think of a Fourier analysis. In this case, a two-dimensional Fourier transform. By isolating the high-frequency components in a scene (those that recur repeatedly), you can find edges, as shown in photo 4, a neck x-ray. The first view is the original x-ray, while the second has been enhanced by spatial filtering. The improvement in the ability to see structure is dramatic. Other smoothing operations remove high-frequency noise from an image in the same way that a filter on your stereo can reduce the sound of scratches and pops on an old record.

Spatial texture, the variation in pixel brightness in a small specified region, can be important in understanding an image. Texture is often calculated as the standard deviation of the nearest neighbors around a pixel, and this deviation can be displayed as an image itself.

Feature extraction and classification, also spatial operations, are powerful tools for image analysis. For example, if certain features in an image are a unique color or gray level, a simple statistical exercise is to "teach" the system to find the features. Unfortunately, feature extraction is almost never this easy. Pattern recognition is a complicated science itself and enters the realms of multivariate statistics, geometry, artificial intelligence, and radiative transfer theory. The end result of feature extraction is similar to photo 2d, where water is represented by the color purple and the regions that are peppered with yellow (continued)
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.
As hardware prices drop while capabilities improve, image processing will be used more.

correspond to known ground cover.

In the realm of multiple-image operations, another family of I/P manipulations, image processing can be considered three-dimensional: \( x \) and \( y \) are the rows and columns of the image, and \( z \) (the third dimension) is a spectral or time component. For example, you can have high-altitude color infrared images of agricultural crops taken at different times through the growing season. An image of a hydraulic system from both visible and infrared scanners can help detect overheating in the system by interpreting the infrared band as heat. In each case the data has a third dimension.

Data compression can be an important feature in an image-analysis system. At a theoretical level, the most efficient representation of a scene is to describe the location and orientation of the highest-level object description. ("High-level" is used here in the same way that BASIC is described as a high-level programming language as compared to assembly language. A high-level object description is "This is a house," as compared to "This is a square white object 2.5 feet by 2.5 feet in size."). This form of representation requires that you be able to distinguish all the objects in the scene, which is possible in only limited circumstances. On a more practical level, it is often possible to describe the image, using statistical techniques like principal-components analysis, or reduce the size of the data set with other techniques, such as run-length and difference encoding. Data compression becomes most important when image data must be transmitted or where large amounts of image data must be stored.

DOWN-TO-EARTH APPLICATIONS

Image processing is now being used in a number of disciplines. Medical people use image processing to construct pseudocolor images from CAT (computer-aided tomography) or PET (positron emission tomography) scanners. Photo 5 shows a series of images generated during a study of blood flow in a rabbit's heart.

Art, advertising, and publishing people use pseudocolor and other techniques in the pursuit of more effective graphics. In the era of computer text editing, the idea of "cut and paste" is common; here, however, this approach includes full-color images and graphics. While straight graphics systems, in general, have difficulty with halftone illustrations and precise color balancing, an image-processing system can handle text, line art, and images in full color.

Structural engineers use I/P to examine weld x-rays for imperfections. Photographers can use I/P for a multitude of image enhancements that are either difficult or impossible in a conventional darkroom.

In each of these settings, people are interested in improving an image's ability to convey certain kinds of information. As hardware prices continue to drop while capabilities improve, image processing will become even more widely used. Courses in image processing are already available at many universities around the country, and in a remarkable range of subject areas; at the University of California, Santa Barbara, for example, I/P is taught in the geography department at levels ranging from beginning to advanced.

ACKNOWLEDGMENTS

I'd like to thank David Eckhardt and Earl Hajic, University of California, Santa Barbara, for their help preparing this article, as well as Robert Crippen (University of California, Santa Barbara), SATSCAN (San Francisco, California), COMTAL/3M (Altadena, California), and International Imaging Systems (Milpitas, California) for providing data and images.

REFERENCES

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.
THE ADVENTURE CONTINUES . . .

$49.95

SOMETHING BRAND NEW

INSTANT DATABASES . . . BECAUSE THAT'S HOW MOST OF US NEED INFORMATION . . . INSTANTLY!

Homebase provides you instant access to a whole realm of databases. Just hit the hotkey to freeze whatever software you're working in, and you're ready to find, insert or manipulate data.

This is much more than a simple cardfile or mini-database. You'll be able to set up your own templates, define parameters such as the length of a field, and do rapid key searches. You can have thousands of records in a database. And numerous databases on your menu.

THE TOOLS YOU NEED.

We've included a powerful set of tools that will save you time and help you organize information, schedule, calculate and a whole lot more. All within a quick keystroke . . . regardless of the software you're running!

You may find a few of these in some "desktop" products . . . but nothing else approaches the power of Homebase!

- Instant Databases
- Phone Message Pad
- Rolodex™
- Appointment Calendar
- Calculator
- Notepad
- Time and Expense Diary
- Programmable Hotkey (You choose the key that gets you to your Homebase)
- Electronic Mail (as an automatic multi-task)
- Tables and Pages (for those things you always need to look up)
- Alarm Clock (including Musical Snooze Alarm)
- To-Do List
- Quickterm Terminal (available even when you're working in another program)
- Autodialer
- Template Maker (for designing your own databases)
- DOS Services
- Rolodex Card Printer
- Mailing Label Printer
- Data Transfer (between databases or your other software)
- Cut and Paste (great for putting together an Electronic Mail letter that combines a chunk of spreadsheet, some text from a document, and a few notes)
THE EXCITEMENT IS BACK

With the Electronic Mailbag of Your Dreams

ELECTRONIC MAIL THAT TAKES CARE OF ITSELF... IN THE BACKGROUND

(While you're running WordStar, Lotus, dBase, a compiler or whatever)

We wanted electronic mail that could take care of itself while we were busy on the computer doing something else. We always felt that there was something strange about having to play postman every time a piece of electronic mail was due. It was always a case of loading up a communications package and either waiting for the mail or going out to fetch it. Now, we've got it! And you can have it, too! With HOMEBASE, Electronic mail can arrive while you're working in another piece of software. Up in the corner of your screen, a signal lets you know that there's incoming mail. You can read it as it comes in, if you want. Or you can ignore it, and your mail will automatically file itself... to be read at your leisure.

When you're sending Electronic Mail, it's just as easy. Once you've written and addressed your letter, the rest is done for you. Automatically, while you're back working in another piece of software.

CHECK THE DIFFERENCE IN VALUE!

<table>
<thead>
<tr>
<th>HOMEBASE</th>
<th>SIDEKICK</th>
<th>POLY WINDOWS</th>
<th>SPOTLIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notepad</td>
<td>Notepad</td>
<td>Notepad</td>
<td>Notepad</td>
</tr>
<tr>
<td>Autodialer</td>
<td>Autodialer</td>
<td>Calendar</td>
<td>Calendar</td>
</tr>
<tr>
<td>Appointment Calendar</td>
<td>Calendar</td>
<td>Calculator</td>
<td>Calculator</td>
</tr>
<tr>
<td>DOS Services</td>
<td>Calculator</td>
<td>ASCII Table</td>
<td>Game</td>
</tr>
<tr>
<td>Calculator</td>
<td>Roleoloe x Card Printer</td>
<td>Rolodex</td>
<td>Alarm</td>
</tr>
<tr>
<td>Rolodex Card Printer</td>
<td>Tables and Pages</td>
<td>Rolodex</td>
<td>File Cards</td>
</tr>
<tr>
<td>Rolodex</td>
<td>Alarm Clock</td>
<td>Rolodex</td>
<td>$49.95</td>
</tr>
<tr>
<td>Roleol oe</td>
<td>Template Maker</td>
<td>Roleoloe</td>
<td>$49.95</td>
</tr>
<tr>
<td>Notepad</td>
<td>Instant Databases</td>
<td>Roleol oe</td>
<td>$49.95</td>
</tr>
<tr>
<td>DOS Services</td>
<td>Data Transfer</td>
<td>Roleol oe</td>
<td>$149.95</td>
</tr>
<tr>
<td>Calculator</td>
<td>Cut and Paste</td>
<td>Roleol oe</td>
<td></td>
</tr>
<tr>
<td>Roleol oe</td>
<td>Programmable HotKey</td>
<td>Roleol oe</td>
<td></td>
</tr>
<tr>
<td>Roleol oe</td>
<td>Phone Message Pad</td>
<td>Roleol oe</td>
<td></td>
</tr>
<tr>
<td>Roleol oe</td>
<td>Time and Expense Diary</td>
<td>Roleol oe</td>
<td></td>
</tr>
<tr>
<td>Roleol oe</td>
<td>To-do List</td>
<td>Roleol oe</td>
<td></td>
</tr>
<tr>
<td>Electronic Mail</td>
<td>Electronic Mail</td>
<td>Roleol oe</td>
<td></td>
</tr>
<tr>
<td>Quickterm Terminal</td>
<td>Quickterm Terminal</td>
<td>Roleol oe</td>
<td></td>
</tr>
<tr>
<td>Displaying Label Printer</td>
<td>Displaying Label Printer</td>
<td>Roleol oe</td>
<td></td>
</tr>
<tr>
<td>$49.95</td>
<td>$49.95</td>
<td></td>
<td>$49.95</td>
</tr>
</tbody>
</table>

WHY ARE YOU GETTING SO MUCH SOFTWARE FOR SUCH A SMALL PRICE?

Amber Systems makes tools for programmers including VS-1-The Window Machine. We make mouse drivers, asynchronous drivers and electronic mail packages for a number of companies. Now, we've decided to use these tools, plus some new ones that aren't yet on the market, to produce new concepts in software. Because we make the tools ourselves, our costs, and consequently yours, are the lowest possible... with never a compromise in quality.

YES! Site licenses are available for companies... large and small. If you would like to order a single copy, now, to examine and show around your company, its cost can be deducted, later on, from your site license. For further information on site licenses call 408-996-1883.

ORDER YOUR COPY OF HOMEBASE TODAY!

For VISA and MasterCard Orders Call Toll Free 1-800-227-3800 ext. 986
(Call anytime — lines open 24 hours a day, 7 days a week)
or fill in this ORDER FORM and enclose a check, money order or your VISA or MasterCard number.

HOMEBASE is available for the IBM PC, XT and true compatibles $49.95 $5 for shipping and handling*

NAME __________________________________________________________
TITLE __________________________________________________________
COMPANY NAME _________________________________________________
ADDRESS _________________________________________________________
CITY ___________________________ STATE ______ ZIP ____________
HOME PHONE ( ) WORK PHONE ( )
☐ CHECK ☐ MONEY ORDER ☐ VISA ☐ MASTER CARD # ________________ Exp. date __________
☐ 30-day money-back guarantee!

SEND TO:

AMBER SYSTEMS, INC.
1171 S. Saratoga-Sunnyvale Road
San Jose, CA 95129

*California residents add 6% sales tax. Outside U.S., please add $15. Checks must be on a U.S. bank and in U.S. dollars. Sorry, no C.O.D. or purchase orders.

For dealer and site license information, call 408 W9-1883.
WHEN I WAS ASKED to find articles under the umbrella of scientific computing, I realized that BYTE readers would probably best be served by articles focusing on the main aspects of microcomputer applications in science: development of tools of the trade, data acquisition, data analysis and reduction, and modeling of scientifically interesting systems or phenomena. This month's theme articles delve into those areas.

In "The Birth of a Computer" Dr. James H. Wilkinson, F. R. S., tells a fascinating story of the building of one of the earliest digital computers based on the designs of Alan Turing. Despite the 30-odd years since this work took place, the account is surprisingly fresh and relevant to today's use of computers in science.

The arithmetic underlying calculations is often ignored by users, regardless of their scientific background, yet it is important to know that the basis for these fundamental computer "tools" is sound. Richard Karpinski discusses one approach to learning about the arithmetic implemented on computers, the program Paranoia. This work, like so many others in the realm of scientific computation, owes much to the careful and detailed analyses performed and persistently reported by Professor William Kahan of Berkeley.

Data acquisition can be a difficult task involving expensive equipment. Some of the issues in the analog-to-digital conversion aspect of data acquisition are described by Dr. Lincoln Ford. For those with tight budgets, Kiyohisa Okamura and Kamyab Aghai-Tubriz present the hardware and software design of a Commodore 64-based system. To round out data acquisition, BYTE Technical Editor Tom Clune reviews the main avenues for interfacing experiments to computers.

Once the data is in the machine, it must be processed before it can be regarded as useful information. One technique for removing noise from data is Fourier smoothing, discussed by Eric Aubanel and Keith Oldham.

Having gained some understanding of a system, a scientist can attempt to model it—to generate or simulate the outcomes of experiments and "pictures" of what is going on. Earl J. Kirkland literally pictures molecules with an Apple Macintosh. Alan Curtis introduces the subject of modeling dynamic systems such as large-scale chemical or nuclear processes.

We have tried to strike a reasonable balance between depth and breadth in our coverage of scientific computing. In a field as large and sophisticated as this, the editorial choices made are never entirely satisfying. Nonetheless, we think that these articles present some fascinating glimpses into a complex domain.

—John C. Nash, Contributing Editor, Scientific Computing
interact with a Genius

The Ultimate in IBM PC/XT® compatibles.

The Super XT Plus by Super Computer is a better alternative than the standard PC/XT configuration. The 256Kb of dynamic RAM with parity can be upgraded to 640Kb. Eight I/O slots give you the maximum in tailored expandability. A 16 Bit 8088 Microprocessor with an 8087 coprocessor option gives you the speed to tackle the heavy jobs. Two half-height 360 Floppy Disk Drives are matched with a half-height 5 Mb Removable hard Disk and a 10 Mb fixed Hard Disk. A Multifunction card is included with Serial and Parallel ports, Clock Calendar, Game port, and memory expansion to 384K. An Ultra High-Res Taxan* monitor equipped with Persyst's B.O.B.* Board gives you the highest resolution possible (720 x 400). A unique 135 Watt Power Supply offers 220 Voltage conversion as an option. The Super Computer PC/XT

Interact with a Genius!

* 1984 Super Computer Inc.

DEALER AND OEM INQUIRES INVITED

SUPER COMPUTER
Manufacturer/Distributor
17813 South Main St. Suite 103, Gardena, CA 90248
213/532-2133

IBM PC/XT is a registered trademark of International Business Machines Corp. Taxan is a registered trademark of Taxan Corp.

Persyst is a registered trademark of Personal Systems Technology, Inc.
THE BIRTH OF A COMPUTER

conducted by John C. Nash

An interview with James H. Wilkinson on the building of a computer designed by Alan Turing

The story of the construction of the first computers is both fascinating and instructive. Understanding the insights and decisions of computing's innovators may explain how the technology evolved to its present state and may illuminate the directions it might take in the future.

Among computing's innovators were Alan Turing (see page 65 for a review of a Turing biography) and the men he assembled to help him build a computer based on his Universal machine. Turing's team included James H. Wilkinson, a mathematician who had studied at Cambridge and worked for the British government as a ballistics engineer doing numerical analysis of explosives problems during World War II.

This interview was conducted for BYTE by Dr. John C. Nash and took place on July 13, 1984, at the Ninth Householder Gatlinburg Conference held at the University of Waterloo, Waterloo, Ontario, Canada.

BYTE: Dr. Wilkinson, how did you become involved with Alan Turing and his computer?
JHW: Shortly after the war, I discovered that a Mathematics Division was being set up at the National Physical Laboratory (NPL). I got in touch with E. T. Goodwin, who had been a colleague of mine at Cambridge in the Maths Lab. He was one of the first to join this new division. He invited me to have a chat with him at NPL in Bushy Park, Teddington, and there I met Turing, who I knew already by reputation as something of an eccentric. Turing and I had a long discussion, and I was very impressed with him. Presumably he must have been reasonably satisfied with me since he said if I came to NPL he would like me to work with him. I think that this offer and my friendship with Goodwin were the decisive factors. So in May '46, six and a half years after I joined the government service, I moved to NPL (as I thought then, temporarily) instead of going back to Cambridge University.

Turing had worked alone on the logical design of an electronic computer. When I arrived, he had presented his plans to what you might call a "review committee" at NPL. This consisted of a small group of Fellows from the Royal Society. The committee decided that Turing's ideas were basically sound, and they gave him a mandate to go ahead and recruit the appropriate staff.

Up to that time everything associated with the project had been done by Turing himself. He was a man with an original and inventive mind. His design had practically nothing in common with the group of computers which arose out of discussions at the Moore School of Electrical Engineering at the University of Pennsylvania. John W. Mauchly and J. Presper Eckert had already successfully completed the construction of the first electronic computer, the ENIAC (this was not a stored-program computer), and their influence was at its peak. When I went to NPL in May '46, Turing was working on what he called version 5 of [his] computer, though I never saw any documents relating to versions 1 to 4. Turing was not a great documenter, and no doubt the earlier versions were buried in the rubble on his desk.

Perhaps I should attempt to give some idea of the flavor of version 5, a typical Turingesque creation. It was (continued)
a serial machine using mercury delay lines for storage, with a pulse repetition rate of what I still call a megacycle, being rather old-fashioned in such matters.

BYTE: Define a megacycle.
JHW: The basic pulse frequency was provided by a master clock which had a 1-megacycle pulse rate. It worked in binary, of course. That decision was taken early on and was regarded as irrevocable. The word length was 32 binary digits, which is rather better than 9 decimals.

BYTE: They were fixed point?
JHW: Yes. They were fixed point, but one of the earliest things that I did [at Turing's request] was to program a set of subroutines for doing floating-point arithmetic. These were later to become rather important in the history of NPL. Right from the start, Turing was impressed with the importance of speed. It is possibly not widely known that at that time most people weren't. For instance, Maurice Wilkes at Cambridge (who quite early became one of our principal competitors) took the view then that electronic computers were so fast that it was much more important to get one built than to make special efforts to increase its speed. and his views were generally shared. Turing took the opposite view, and most of the special features of his machine were designed to make it as fast as possible. There was merit in both views, but it was certainly true that the machines we were designing then were not nearly so fast as they appeared to be. However, Turing's obsession with speed certainly made for a very untidy machine. A great weakness of mercury delay lines is access time. In order to make them reasonably economic, it is necessary to store a number of words in each delay line. Clearly, if one stores consecutive instructions in consecutive positions in a delay line, one could perform only one instruction per major cycle, and indeed the early machines (other than ACE) that were based on mercury delays suffered from this weakness. [Editor's note: ACE—automatic computing engine—was the name given to

store. As you can well imagine, this made for what one would call "difficult" coding. I'm not sure that "difficult" is the right word. I would say such coding was tiresome or tedious. Also it made the design of automatic programming languages more laborious, while at the same time it made them more desirable. However, this feature of the machine turned out to be rather important; it meant we could do up to 16 instructions per major cycle, i.e., about 64 microseconds per instruction.

This practice later became known as "optimum coding" or "latency coding," but Turing never used that term. It was characteristic of him to see his machine as the basic one, all the others being out of step.

BYTE: What was the ACE's total memory?
JHW: Well, Turing envisioned a memory of 200 long delay lines, which would have given 64000 words.

BYTE: About 24K bytes?
JHW: Yes, and although that may sound rather small now, it was really very ambitious for that time. I am sure Turing would never have contemplated or supported the building of a smaller machine.

Shortly after I joined NPL, Turing moved on to version 6 and then rapidly to 7 and 8. Those were four-address code machines. [Editor's note: A four-address machine had up to four address operands after an instruction, one of which would be the memory location of the next instruction.]

The earlier machine, version 5, is hard to describe in these terms. But its successors performed instructions of the type A+B to C and selected the position D of the next instruction, which was necessary because they were not in consecutive positions.

BYTE: A complete instruction would occupy one word?
JHW: Yes, but it was a more powerful instruction than that on a conventional one-address code machine. Another striking difference in Turing's design was that he had a number of one-word delay lines and the arith-

(continued)
BUY A 1200 BPS MODEM FOR UNDER $200!

Special Offer

INFOMATE 212PC $149

FEATURES:
- 1200/300/110 bps, full duplex
- Internal card for IBM PC/XT or compatibles
- Bell 212A and 103 compatible
- CROSSTALK software compatible
- MODEM-MATE software included
- Auto-dial, Auto-answer
- Tone or rotary dialing, auto-selected
- Call progress monitoring
- 6 diagnostic test modes
- Asynchronous data format
- 1 year limited warranty

The INFOMATE 212PC comes complete with MODEM-MATE software and will run other popular programs such as CROSSTALK and PC TALK III. The 212PC plugs into any of the computer's full size expansion slots and communicates with all commonly used 1200 or 300 bps modems.

Yes, it's true! Cermetek is selling your choice of two 1200 bps modems for under $200. There's no catch! We want you to take advantage of this spectacular deal and find out what communications can do for your computer. It's as simple as that.

CROSSTALK SOFTWARE ONLY $95!

Now you can purchase CROSSTALK software, with your INFOMATE modem, for $100 under the retail value. This version of CROSSTALK will run on IBM PC's or compatibles with 96K of memory, 1 disk drive, and PC DOS 1.1 or 2.X. You may only purchase CROSSTALK software with one of the INFOMATE modems and this offer is limited to one software package per modem.

ORDER TODAY!
Offer expires 3/31/85. Offer is limited to quantities on hand.

INFOMATE MODEMS
by Cermetek Microelectronics
1308 Borregas Avenue
Sunnyvale, CA 94086-3565
(800) 862-6271 (In California call 408/752-5000)
BYTE: This was all on paper.

JHW: Naturally; we had no working computer. Because of the optimum coding, floating-point arithmetic (and other important routines such as double-length arithmetic) was much faster on Turing’s machines than it was on its competitors. The speed of floating-point routines, but when in 1947 Donald Davies, Mike Woodger, Gerald Alway, Billy Curtis, and John Norton joined the team, they all played a part in polishing them up.

BYTE: This all enabled me to get really extensive working experience with floating-point computation before it was practical elsewhere. I am sure this is why floating-point error analysis first made headway at NPL.

Turing continued with the logical design of machines, but after a while he began to get very dissatisfied. The policy had been adopted that the actual construction of the computer should be undertaken by some other government department such as the Ministry of Supply, where personnel experienced in pulse techniques as a result of working on radar were available.

I never liked that decision, but the director of NPL, Sir Charles Darwin (great-grandson of the great Charles Darwin), was not a very easy man to argue with. Remember, I was quite a junior member of the NPL staff at that time. But as I saw it, there were only two possibilities. Either the external group would be successful, in which case, if they had any imagination at all, they would take control of the computer themselves. Alternatively, they might fail. It seemed to me that we were in a no-win situation.

Although I have used the term “optimum coding,” most programs fell a good deal short of the optimum speed attainable. To achieve this would have been far too tedious. However, when it came to very important subroutines such as floating-point arithmetic, optimum speed was almost achieved. As I mentioned before, I produced the first set of floating-point routines, but when in 1947 Donald Davies, Mike Woodger, Gerald Alway, Billy Curtis, and John Norton joined the team, they all played a part in polishing them up.

BYTE: It was all on paper.

JHW: Naturally; we had no working computer. Because of the optimum coding, floating-point arithmetic (and other important routines such as double-length arithmetic) was much faster on Turing’s machines than it was on its competitors. The speed of floating-point arithmetic turned out to be very important for me. When we finally built our computer, we dusted down our early routines and polished them up further. By the standards of the time they were very fast indeed, and this enabled me to get really extensive working experience with floating-point computation before it was practical elsewhere. I am sure this is why floating-point error analysis first made headway at NPL.

Turing continued with the logical design of machines, but after a while he began to get very dissatisfied. The policy had been adopted that the actual construction of the computer should be undertaken by some other government department such as the Ministry of Supply, where personnel experienced in pulse techniques as a result of working on radar were available.

I never liked that decision, but the director of NPL, Sir Charles Darwin (great-grandson of the great Charles Darwin), was not a very easy man to argue with. Remember, I was quite a junior member of the NPL staff at that time. But as I saw it, there were only two possibilities. Either the external group would be successful, in which case, if they had any imagination at all, they would take control of the computer themselves. Alternatively, they might fail. It seemed to me that we were in a no-win situation.

Although I have used the term “optimum coding,” most programs fell a good deal short of the optimum speed attainable. To achieve this would have been far too tedious. However, when it came to very important subroutines such as floating-point arithmetic, optimum speed was almost achieved. As I mentioned before, I produced the first set of floating-point routines, but when in 1947 Donald Davies, Mike Woodger, Gerald Alway, Billy Curtis, and John Norton joined the team, they all played a part in polishing them up.

BYTE: This was all on paper.

JHW: Naturally; we had no working computer. Because of the optimum coding, floating-point arithmetic (and other important routines such as double-length arithmetic) was much faster on Turing’s machines than it was on its competitors. The speed of floating-point arithmetic turned out to be very important for me. When we finally built our computer, we dusted down our early routines and polished them up further. By the standards of the time they were very fast indeed, and this enabled me to get really extensive working experience with floating-point computation before it was practical elsewhere. I am sure this is why floating-point error analysis first made headway at NPL.

Turing continued with the logical design of machines, but after a while he began to get very dissatisfied. The policy had been adopted that the actual construction of the computer should be undertaken by some other government department such as the Ministry of Supply, where personnel experienced in pulse techniques as a result of working on radar were available.

I never liked that decision, but the director of NPL, Sir Charles Darwin (great-grandson of the great Charles Darwin), was not a very easy man to argue with. Remember, I was quite a junior member of the NPL staff at that time. But as I saw it, there were only two possibilities. Either the external group would be successful, in which case, if they had any imagination at all, they would take control of the computer themselves. Alternatively, they might fail. It seemed to me that we were in a no-win situation.

Although I have used the term “optimum coding,” most programs fell a good deal short of the optimum speed attainable. To achieve this would have been far too tedious. However, when it came to very important subroutines such as floating-point arithmetic, optimum speed was almost achieved. As I mentioned before, I produced the first set of floating-point routines, but when in 1947 Donald Davies, Mike Woodger, Gerald Alway, Billy Curtis, and John Norton joined the team, they all played a part in polishing them up.

BYTE: This was all on paper.

JHW: Naturally; we had no working computer. Because of the optimum coding, floating-point arithmetic (and other important routines such as double-length arithmetic) was much faster on Turing’s machines than it was on its competitors. The speed of floating-point arithmetic turned out to be very important for me. When we finally built our computer, we dusted down our early routines and polished them up further. By the standards of the time they were very fast indeed, and this enabled me to get really extensive working experience with floating-point computation before it was practical elsewhere. I am sure this is why floating-point error analysis first made headway at NPL.

Turing continued with the logical design of machines, but after a while he began to get very dissatisfied. The policy had been adopted that the actual construction of the computer should be undertaken by some other government department such as the Ministry of Supply, where personnel experienced in pulse techniques as a result of working on radar were available.

I never liked that decision, but the director of NPL, Sir Charles Darwin (great-grandson of the great Charles Darwin), was not a very easy man to argue with. Remember, I was quite a junior member of the NPL staff at that time. But as I saw it, there were only two possibilities. Either the external group would be successful, in which case, if they had any imagination at all, they would take control of the computer themselves. Alternatively, they might fail. It seemed to me that we were in a no-win situation.

Although I have used the term “optimum coding,” most programs fell a good deal short of the optimum speed attainable. To achieve this would have been far too tedious. However, when it came to very important subroutines such as floating-point arithmetic, optimum speed was almost achieved. As I mentioned before, I produced the first set of floating-point routines, but when in 1947 Donald Davies, Mike Woodger, Gerald Alway, Billy Curtis, and John Norton joined the team, they all played a part in polishing them up.

BYTE: This was all on paper.

JHW: Naturally; we had no working computer. Because of the optimum coding, floating-point arithmetic (and other important routines such as double-length arithmetic) was much faster on Turing’s machines than it was on its competitors. The speed of floating-point arithmetic turned out to be very important for me. When we finally built our computer, we dusted down our early routines and polished them up further. By the standards of the time they were very fast indeed, and this enabled me to get really extensive working experience with floating-point computation before it was practical elsewhere. I am sure this is why floating-point error analysis first made headway at NPL.

Turing continued with the logical design of machines, but after a while he began to get very dissatisfied. The policy had been adopted that the actual construction of the computer should be undertaken by some other government department such as the Ministry of Supply, where personnel experienced in pulse techniques as a result of working on radar were available.

I never liked that decision, but the director of NPL, Sir Charles Darwin (great-grandson of the great Charles Darwin), was not a very easy man to argue with. Remember, I was quite a junior member of the NPL staff at that time. But as I saw it, there were only two possibilities. Either the external group would be successful, in which case, if they had any imagination at all, they would take control of the computer themselves. Alternatively, they might fail. It seemed to me that we were in a no-win situation.
Not long ago, PC Magazine called MDBS III “The most complete and flexible data base management system available for microcomputers.” That’s a powerful statement. But then, MDBS III is an amazingly powerful software package. So powerful, in fact, that it lets you build mainframe-quality application systems on your micro or mini. MDBS III is not for beginners. It’s for application developers with large data bases or complex data interrelationships who want to define data base structures in the most natural way—without resorting to redundancy or artificial constructs. It’s for professionals who can appreciate its extensive data security and integrity features, transaction logging, ad hoc query and report writing capability and its ability to serve multiple simultaneous users. And if you want the power and the glory that only the world’s most advanced data management system can provide, MDBS III is for you. For information on MDBS III and our professional consulting services, write or call Micro Data Base Systems, Inc., MDBS/Application Development Products, 85 West Algonquin Road, Suite 400, Arlington Heights, IL 60005. (800) 323-3629, or (312) 981-9200. MDBS III. ABSOLUTE POWER.

WE’LL GIVE YOU THE POWER.

YOU TAKE THE GLORY.

MDBS III is a trademark of Micro Data Base Systems, Inc.
In appreciation of your patronage we are giving a program diskette for the IBM PC to all our customers who make a purchase of $100 or more. This program features popup menus and permits continuous or intermittent time display, alarm for appointments, etc. A Bellsoft program with a retail value of $20.

DATA BASE MANAGEMENT SYSTEMS
Fox and Geller Quickcode ......... $145
Knowledgeman ........... ........ $335
Samna Ill .......................... $269
Wordstar 2000 for IBM PC ........... $269
Wordstar 2000 + ........... $259
Lotus 123 .......................... $294
Symphony ......................... $415

ACCOUNTING
CLOUT 2 ........................... $129
Wordstar, Pro Pack ................. $245

FREE COMPUTER ALARM CLOCK!

LANGUAGES
Lifeboat Lattice C Compiler .......... $295
Microsoft C Compiler .......... $315
Microsoft Pascal Compiler .......... $215
Microsoft Basic Compiler .......... $256
Microsoft Basic Language ........ $275
CP/M-86 for IBM PC ............... $37
Concurrent CP/M-86 ............... $160

FOR PC DOS
PC Paint ............................ $85
Norton Utilities ..................... $48
Copy II PC .......................... $24
Prokey V5.0 ........................ $75
Harvard Pitch Manager ............. $70
Microsoft Flight Simulator .......... $32

HARDWARE
ABC Printer Switch ................. $65
Micro Fazer Parallel ............... $165
Hayes 1200 Modem ................ $450
Hayes 1200b Modem for IBM PC .... $270
48K RAM Chips (16) 150 NSEC .... $39
Anchor Signam 120 baud Modem .... $225
10 MB Int. Hard Drive for the PC .... $750
30 MB External Hard Drive for IBM PC .... $169
Princeton RGB Monitor .............. $899
Taxan RGB Vision 425 ............. $390

COMPUTERS
Leading Edge Computer 256K ...... Call
IBM Computer ........................ Call
Corona Computer ....... .......... Call
Televideo Portable & Software .... $1795

BOARDS FOR THE IBM PC
Hercules Color Board with Par. Port .. $169
AST Six Pack ......................... $245
386K Board with 256K .............. $275
Quadcolor I ........................ $115
STB Graphics II Board ............. $335
Tecmar Graphics Master ............ $495
New Quadram Multifunction Board .... Call

PRINTERS
Dot Matrix Printers include a Free $35 Print Set Program .... Call
Gemini 10X .......................... $70
Gemini 15X .......................... $70
Okidata 82A, 83A, 93P ............... $345
Okidata 92A ......................... $345
Okidata 84P ........................ $345
Juki 6100 ........................... $325
Juki 6300 ........................... $899
Call on all Epson Models ............ $345
Silver-Ray ........................... $345
Abati LQ20 ......................... $325
Diablo ............................... $325

INTERVIEW

portant developments of the century. However, from our point of view Thomas's preferences were unfortunate. But worse was to come. Thomas and Turing had absolutely nothing in common and were scarcely capable of being civil to each other. So there we have the situation where the leaders of the two groups were completely incompatible.

This, naturally, made Turing even more unhappy, and he began to talk seriously of leaving. Finally, he left in 1948 and joined the group led by Freddy Williams and Tom Kilburn at Manchester. They were making rapid strides in the construction of a computer based on what became known as the "Williams-Kilburn store." Turing's decision was, in my opinion, an unfortunate one. He should have returned to Cambridge where he still held a fellowship at Kings.

I was left in charge of a team which consisted of six people including myself. We had virtually no contact with the electronics group, and at that stage Goodwin, who was in charge of the Desk Computing Section, had a long discussion with me. He said, "You know this enterprise looks now as though it's going to found. Before you can be held responsible for its failure, would you not prefer to become a member of the Desk Computing Section?"

Well, I just couldn't accept that. By this time I was hooked on computers. so I said I would sweat it out and see what could be done.

Then a miracle occurred. Thomas left and went into industry where he had always belonged. The person who succeeded him, F. M. Colebrook, was an old radio engineer with very little knowledge of pulse techniques but a great fund of common sense. When he'd been in the post about two weeks, he came over to see me and he said, "You and I appear to be holding a very unhealthy baby." He went on to invite the four senior members of our group (Alway, Davies, Woodger, and myself) to join him in the Electronics Section on a semi-permanent basis and attempt to achieve something together. This would be
about May or June of 1948. Colebrook was a remarkable tactician, and soon we were all working rather well together. There were one or two uneasy weeks, but soon the animosity died down. E. Newman was in technical charge of the electronics group; he had worked on the H2S airborne radar system during the war and already knew quite a lot about pulse techniques. He and I got on remarkably well and that was a great help.

In those days supplies were a problem, but fortunately one member of the electronics group, W. Wilson, a giant of a man, knew everybody in the supply world and was able to solve this problem satisfactorily. After we had spent a month or two building bits and pieces and generally finding our feet, Colebrook said, "Why don't we get together now and try to build a pilot machine, the success of which will demonstrate to the authorities that we are competent and therefore ensure the continuation of the enterprise." Then, in the light of success—we didn't hint at failure—we would go on and build the full-scale ACE.

Now it so happened that we had done a little experimental work in 1947 in the Mathematics Division when Harry Huskey had spent a sabbatical year with us. At that time we had designed just such a miniature machine based on Turing's version 5. This enterprise had been stopped by Darwin when the Electronics Section was formed.

To a large extent we resurrected this machine, incorporating, of course, a substantial number of improvements. It was to be called the Pilot ACE and, effectively, it would be the smallest machine based on the logic of version 5, which would demonstrate the practicality of it.

BYTE: How large a machine was the Pilot ACE?
JHW: I suppose I was largely responsible for deciding on the size and scope of the machine, but any of the other three could by that time equally well have done so. In order to have some specific objective, I decided that (continued)
At 80 characters per second, the DaisyMax 830 is one of the fastest letter-quality, daisy wheel printers you can buy.

And that means you no longer have to sacrifice image quality to increase productivity!

Speed and superb quality are but two of a long list of benefits you get with the DaisyMax 830.

Multiple users can share the DaisyMax 830 since it is designed for heavy volume word processing environments. Plus, you get standard interfaces for easy installation, and friction, tractor and cut sheet feeders to handle all your office forms. All these great features also are available in the DaisyMax 320, offering print speeds up to 48 cps.

And of course both printers feature rugged reliability—a hallmark of Fujitsu products earned from over 30 years as a technology leader and equipment supplier to companies worldwide. Reliability backed by TRW service nationwide.

Contact your nearest distributor for your local dealer.

Inquiry 116
it should be capable of solving fully automatically a set of 8 to 10 linear equations by Gauss elimination. This it would do in a matter of a second or two, very impressive for that time.

BYTE: So you needed to store at least 150 numbers and the word width was 32 bits?

JHW: In fact we decided to have 10 long delay lines, that is, 320 words. We started to design the chassis in late '48, some chassis being designed by the "mathematicians" and some by the "engineers". In the event, the mathematicians probably designed slightly more than half the chassis. I must emphasize that I am now talking about the detailed electronic design, not just the logical design. We put our newly won knowledge of electronics to immediate use.

We started to send our blueprints to the NPL workshop towards the end of that year. As each chassis arrived from the workshop, we put it into the main frame.

BYTE: Literally a main frame?

JHW: Yes, there really was a frame. We decided to use a plug-in assembly and planned to have spares of key chassis.

By the standards of the time it was an incredibly small machine physically, and yet it was in many regards much more powerful than either EDSAC or SEAC. Direct comparisons are not really possible, but Pilot ACE was substantially faster on most problems, and it could solve some problems the other two couldn't.

BYTE: And the clock cycle was still 1 megacycle?

JHW: Yes, still 1 megacycle, a slightly tough decision. Wilkes had decided on 500 kilocycles. Certainly some of the problems we had would have been a lot easier at 500 kilocycles.

BYTE: It is interesting that the Apple II is a 1-megacycle or 1-megahertz machine, by comparison. [Editor's note: This refers to the instruction rather than clock rate.]

JHW: Yes, that's right.

The completed chassis would have started to arrive. I imagine, well through '49, I'm afraid progress was not documented. It so happened that the first chassis to arrive had been designed by Alway and myself, two of the mathematicians of the team, and naturally we put them into the main frame and got them working.

Then when the next chassis arrived—which Alway and I had not designed—we assisted in its installation because we already knew about the earlier chassis. Thus, without any conscious decision being made, Alway and I became the debuggers.

BYTE: Weren't the chassis somewhat different from each group? Or were these different components?

JHW: Of course, the various chassis had entirely different functions. Thus several were associated with the line counter, several with the logical control, and then there was one chassis for each delay line. (The latter were, of course, all identical.)

BYTE: The line counter is . . . ?

JHW: This was the section which counted the basic 32 pulses in a word time.

BYTE: All this is now on one chip?

JHW: Yes, of course, and much more. Our units were vast by today's standards in spite of being small by the standards of the contemporary design. Pilot ACE was also unique among the early computers in being extremely mobile. The main frame was on wheels and when the computer was finished, we wheeled it back to Mathematics Division without affecting its performance.

BYTE: Was it power-hungry?

JHW: It consumed somewhat less than 10 kilowatts, which was quite low. But we didn't have any forced cooling, and perhaps the construction was a little too compact for that. When we were assembling it, we were, of course, standing in front of it all day. It was like working in front of a 10-kilowatt fire, a rather trying experience.

BYTE: Did you have much component trouble?

JHW: Not really. Our main problem
Inquiry 226

I 180 cps dataprocessing printing
I 90 cps text quality printing
I 30 cps letter quality printing
I Dot addressable graphics
I Bit image or raster graphics
I 10, 12, 13.3 and 17.1 cpi allows for up to 136 char. on 8 in. line
I IBM compatibility
I Serial and Parallel interfaces
I Bi-directional tractors
I Multisheet forms handling

3 speeds and graphics, too.
Dataproducts 8010—under $550 at MTI.

Whether you buy, lease or rent, you'll find MTI is the one source for all the computer and data communications equipment, applications expertise and service you'll ever need. At great prices. Call us.

mti systems

A SUBSIDIARY OF DUCOMM INCORPORATED

Computer & Data Communications Equipment
Sales / Leasing / Service / Systems Integration


New Jersey: 718/677-0677
Ohio: 513/891-7050
Kentucky: 518/931-9351
Pennsylvania: 818/883-7633
California: 800/883-7633

3 speeds and graphics, too.
Dataproducts 8010—under $550 at MTI.

Whether you buy, lease or rent, you'll find MTI is the one source for all the computer and data communications equipment, applications expertise and service you'll ever need. At great prices. Call us.

mti systems

A SUBSIDIARY OF DUCOMM INCORPORATED

Computer & Data Communications Equipment
Sales / Leasing / Service / Systems Integration


New Jersey: 718/677-0677
Ohio: 513/891-7050
Kentucky: 518/931-9351
Pennsylvania: 818/883-7633
California: 800/883-7633

A knee-top APL system for idea processing.
A new epoch in the history of personal computing.

The Ampere Computer Model WS-1 represents the best of a new breed of personal computers. Designed by a free-thinking innovative team, it combines the flexibility of state-of-the-art technology with the power of the most robust APL interpreter available on the market today.

- Battery operation
- 6 MHz 8000G CPU
- 54K-512K bytes RAM
- T25K bytes ROM
- 265x80 character LCD
- Bit-mapped Graphics
- Multiple Windowing
- Multi-Job, Multi-task OS
- for powerful networking
- Coherent DB-WP-CALC-Graphic
- Intelligent Phone Function
- Voice/Data Storage Microcassette

For distributor information and product details, please contact:
Ampere, Inc., Asahi Bldg., 5-29, 7-chome Naka-Shiokoku, Shinkoku-ku, Tokyo, Japan
Phone: 03-365-0825, Telefax 03-365-0999, Telex 313101 AMPERE
IP Sharp Mail Box Code: ANP (Group Code APL-W)
related to the size of the number on the switches. Now this program, admittedly rather small, had to be fed in one instruction at a time. In binary, from the 32 keys. At the time the design of the delay lines needed improving; the amplifiers were somewhat unstable. So we kept feeding in the program, and it kept being forgotten before we could complete the input. So I said to Alway, "Let’s try it four or five more times, and if it doesn’t work, we’ll call it a day and go home.”

Well, we put it in about four times, and suddenly all the lights came on. This could have happened in any case, and it didn’t guarantee the program was working. However, we made the input number smaller and the lights came on more slowly.

BYTE: So the amplifiers had settled down?
JHW: Yes. Then we doubled the number, and the lights came up twice as fast. We made the number three times as large and they came up three times as fast. On a binary machine that was quite convincing, so we said, “It must be working,” and went home rejoicing. That program later became rather famous on the machine. It was known affectionately as “Successive Digits” or “Suck Digs.”

Sometime before this, Teddy Bullard (later Sir Edward) had succeeded Darwin, and when he visited the Electronics Section (in late April 1950) he asked me how it was going. I replied that we should have something going in a week or two. Bullard was a very forthright chap, and he said with some scorn, “Come on, you can’t pull the wool over my eyes. I’ve heard it’s going very badly.” (He had heard this, quite justifiably, via Harry Huskey.) I said, “You may well have heard this, and indeed it was true, but it’s coming along nicely now, and in a week or two I confidently expect it to be working.”

Naturally, when it did work, I tried to get in touch with him as I had promised to do. I tried to phone him. He wasn’t there. Now the machine wasn’t really very good at that stage.
and might stop working at any time. The director could not be traced, and I was pacing up and down, saying, "The bloody director is never here when you want him;" when he stepped into the room via the window. His opening words were, "Here's the bloody director. I hear it's working."

I showed him this program, and he played with it and agreed that it was working. Then he turned to me with a grin and said, "It may be working, but the program's somewhat less than epoch-making," with which we had to agree, but it was very heartening for us.

We continued to add the chassis one by one, and by the end of June most of it was assembled. We didn't at that time have a multiplier, nor had we planned to have one, on Pilot ACE.

**BYTE:** You would use successive addition? JHW: Yes; it was to be done by a subroutine, optimum coded so that it was not too slow. In fact, the optimum-coded version was about as fast as the automatic multiplier on EDSAC. So as soon as it began to do significant things, Bullard began to press us to have an Open House Day and to demonstrate it to the world. Well, I was a bit anxious about that because it wasn't really reliable enough. The amplifiers on the delay lines were still inclined to be unstable. However, Bullard was a very impetuous man, and he finally landed us with these "demonstration days."

**BYTE:** When was that?

JHW: It would have been November of 1950. By that time we could do a variety of significant things, but it was still not a very reliable machine. One of the troubles we had at that time was with the power supply—not our power supplies but that of the Central Electricity Generating Board. For instance, in the evening when everyone arrived home and switched on electric fires, the voltage would drop suddenly, and that gave us problems.

**BYTE:** Historically there was a coal shortage (continued)
PRINTERS

Anadex 9625B $1129
96200W $2039
DHP500 $2259

Brother
DX-3 $539
HR-25 $649
HR-32 $875

C-Itoh
A-10-30 $479
F-10 Parallel or Serial $909
15 CPR Serial or Parallel $1049
8510 Parallel ( froze t ) $1315
8510 SP $1399
8510 SCP $1499
8510 BR $1335

Comrex
CR-2E Call
CR-4 Call
CR-420 Call

Datasouth
D5180 $1839
538 $1719
C150 $999

Epson All Printer Models Call

Informrunner
Reloader w/Tractor $424
Reloader 15 $499
Reloader Blue w/Tractor $929

Juki
5500 Call
6100 $399
6300 $599

NEC
2010 2015 2030 $639
2050 $799
3510 3515 3530 $1215
3550 $1269
7100 7175 7350 $1649
8850 $1779
970 $798
970-P $397
970A (User Station) $389

Okidata All Printer Models Call

Panasonic
1031 $275
1032 $410
1033 $709

Silver Reed
EXP400 $235
EXP500 Parallel $339
EXP500 Serial $399
EXP500 Parallel $399
770 Parallel $705
770 Serial $705

Star Micronics
All Printer Models Call

Tally
Sprint 80 $245

Toshiba
P3400 Parallel or Serial $709
P3515 Parallel or Serial $1215

COMPUTERS

Alto All Computer Models Call

Amdek
Call

Columbia

Corona

PC-22 Dual Drive $1599
PC-22 Hard Disk $2099
PC-22 Dual Drive $2099
PC-22 Hard Disk $2399

Leading Edge

NEC

PC-6501 Computer $1299
PC-6501-90 Battery Pack $1919
PC-8206A 32K Ram $219
PC-8271A-01 AC Adapter $16
PC-8281A Recorder $16

Northstar

All Computer Models Call

Sanyo

MBC-750 Portable $799
MBC-550-2 System $559
MBC-866 $499

Television

Television $389

Wyse

Zenith 2-29 $209

MODEMS

Anchor Automation

Zenith 2-29 $209

Maxwell MD-1 (Qty 100) $175
MD-2 (Qty 100) $199

Damas

Sea Of Thieves $149

DOS

AST 6 Pack Plus $285

PARADISE

Super Price

CALL

CPU

SMART MODems

Gemini 10X or 10XPC

With Cable & Paper

Super Price

CALL

MAXELL

Order Line: 1-800-528-1054
Order Processing & Other Information: 602-954-6109

2222 E. Indian School Rd.
Phoenix, Arizona 85016

Prices reflect 3% to 5% cash discount. Product shipped in factory cartons with manufacturer's warranty. Please add $9.00 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.

FEBRUARY 1985 • BYTE 189
at that time?
JHW: Yes. Such things added to our difficulties. We knew, too, that when SEAC had had its first demonstration—a little before us—it had been a fiasco, even though SEAC had, in general, been working reasonably well. During the whole of the time allotted to the press demonstration, it never once worked. You will find the early years abound with such bad-luck stories.
I must confess to having been pessimistic. We decided to have two popular programs for the daily press. For the first, they would give us a six-figure decimal number and the computer would tell them if it were a prime, and if not, output a factor.

For the second program, they would give us any date from the year 0 up to the year 9999 and it would output what day of the week it was. It covered both the Julian and Gregorian calendars and dealt with all leap years. In all, quite an amusing little program. Mike Woodger produced that program.

BYTE: And where did he discover the technique?
JHW: He worked it out for himself. Such programs are good fun, of course, but they leave one mercilessly exposed to the vulgar gaze. Someone puts in the current date, which is Wednesday, say, and the machine promptly says Thursday! So they're very much more dangerous. If you tell the press it's solving a partial differential equation, you can swear blind it's solving a partial differential equation and they would be hard put to prove it is not. Finally, we were to have one serious program; this traced skew rays through a set of lenses.

Well, we decided on this last program and announced it, only to find that we couldn't get the program to work. Two days before the press show it had still never worked, and we didn't know whether the program had a bug or whether it was due to computer malfunction. Then, just two days before the show, Alway and I accidentally found it was a minor machine fault which was not invoked at all in our other programs.

We got all three programs working then. just in time. The arrangement was that Bullard would entertain the popular press and I would give the demonstrations. The whole thing was to cover three days; one day with the popular press, one with the technical press, and a third day for VIPs including our competitors. Wilkes had his machine running in Cambridge and was justifiably proud of it. Williams and Kilburn from Manchester were also coming.

BYTE: They had a machine too, didn't they?
JHW: They had a little hookup at that...
You've probably already outgrown your personal computer.

Introducing the TeleVideo Personal Mini. Your simplest PC growth path.

The TeleVideo Personal Mini. The first PC compatible multiuser system.
**SOFTWARE HIT PARADE**

- **Symphony (Lexus)** 465.
- **PFS:Report (Software Pshg.)** 78.
- **PFS:Write (Software Pshg.)** 69.
- **dBase III (Ashton-Tate)** 460.
- **dBase II (Ashton-Tate)** 328.
- **Framework (Ashton-Tate)** 480.
- **Multime (Multimeaker)** 22.
- **Chart (Microsoft)** 179.
- **Multiplan (Microsoft)** 129.
- **WordStar (Micropro)** 335.
- **UK Tax Saver Your Income Tax** 34.
- **Book and 2 diskettes**
  - (Apple II, IBM only) 48.
- **Your New Baby** 29.
- **Kermit Story Maker** 23.
- **Personal Pearl (pearlsof) data- enslining system**
  - reporting/editing system 235.

**OUTPUT DEVICES**

**Printers by Star, Epson, C. Itoh, Amdek, Panasonic, Okidata, Diablo, Brother:**

- **Star Micronics Gemini 10X** 22.
- **Epson LP-1500-New 24-pin** 285.
- **Letter worthy dot matrix**
  - Epson LX-800/1400/Tractor Se1d
- **Graftrax +** 250.
- **Okidata 52**
- **Amdek Printers**
  - Model: LK-530 135.
- **PFSFile (Software Pshg.)**
  - PFSFile ¥450-
  - PFSFile ¥500-
  - PFSFile ¥600-
  - PFSFile ¥700-
  - PFSFile ¥800-

**COMMUNICATIONS**

- **Mark X Auto Dial/Auto Answer** 119.
- **Anchor Mark XII Smartmodem**
  - 220.
- **Hyves Smartmodem 1200/300**
  - 490.
- **"Cossack" software**
  - 135.
- **Voic keyboard/phone software for IBM PC and compatibles**
  - 495.
  - Features: mem. manager, call tracking, etc.

**POWER DEVICES**

- **Datashield back-up power source**
  - 200 PC-200 watt 390.
- **"BITS" Power back-up 250W 695.
- **Brooks 5 Outlet-Surge Suppressor**
  - 54.
- **Computer Power Inc.-500 VA 320.**
- **Tripp Lite 425 VA** 360.

**COMMUNICATIONS**

- **Mark X Auto Dial/Auto Answer** 119.
- **Anchor Mark XII Smartmodem**
  - 220.
- **Hyves Smartmodem 1200/300**
  - 490.
- **"Cossack" software**
  - 135.
- **Voic keyboard/phone software for IBM PC and compatibles**
  - 495.
  - Features: mem. manager, call tracking, etc.

**FREE CATALOG**

- This space can accommodate only a few of the exceptional values available from AB. Our latest catalog is packed with fascinating items, top brands, thousands of items. For a free copy call or write.

**ORDER LINE, 9 AM-6 PM EST**

**800-822-1211**

**IN PA., 215-622-7727**

**CUSTOMER SERVICE**

**215-822-7727**

**ABComputers**

252 BETHLEHEM PIKE

CAMDEN, PA 19105
INTERVIEW

time, but it could scarcely be called a computer. They hadn't built the Mark I by that time. Their little hook-up was the first anywhere ever to run a stored program. It worked in 1947 and found the highest common factor of two numbers. This was, of course, a great deal smaller even than the Pilot ACE. However, it was an impressive "first" and I well remember being very heartened when I saw it working.

My point then, is that Open Day was doomed to be a failure. The plan for the first day was that Bullard was to entertain the press upstairs, while downstairs we made sure the computer was working. We were to receive a signal when Bullard was almost through. We did, and immediately the machine stopped working. We found out, almost at once, that it was a chassis associated with one of the delay lines. We plugged in a spare. Unfortunately we knew that the amplifier, as it warmed up, would become unstable; the amplifier would then need to be retuned and in 10 minutes all would be fine from then on.

So we were expecting to run into trouble almost as soon as the demonstration started. Well, the press arrived. They threw numbers at us and the computer factorized them like a charm. It was indefatigable!

We moved on to the "dates" program. It worked as it had never worked before: the day of Trafalgar, Waterloo, King George V's birthday.

We moved on to the ray tracing. It traced rays like a fiend; nothing could stop it. It continued in this vein from 10 till 1 o'clock. Then the press went away to lunch. We immediately looked at the output from the delay line, that is, the shape of the pulse coming out. It was the best output we'd ever seen!

The computer factorized numbers like a charm.

Further press representatives came in the afternoon; still a faultless performance.

The next day we had the technical press, and it was the same story. Never before had it worked for anything approaching this time period without a fault. The third day the VIPs came. Surely it would let us down now? Not a bit of it. Wilkes was there. I have always found him a very fair man, but naturally he was not prepared to give anything away. He didn't get a chance; it was perfect. It had already been decided that there would be a fourth day when it would

(continued)
be put on show for the staff of NPL. This was a Saturday. The computer had a small fault before our audience arrived, but we soon put this right, and once again it performed flawlessly. The chances of such a performance must have been a million to one against.

On Monday we came in feeling rather jubilant. The computer was down, and it took us about a week to get it working again!

BYTE: Today a lot of people are coming into computing with no background in calculation. Many of the machines they're using don't have the properties that ACE did, with double-precision accumulation of inner products. People have very little knowledge of this. How can these ideas be got across to them?

JHW: It's a really difficult question, and I wouldn't claim to know the complete answer to it. Our experience with the Pilot ACE was really rather special. In order to get the most out of a machine with such a small store, user cooperation was essential on a scale which in many ways is not achieved even now. This gave one an intimacy with the machine; we were forced to look at the numbers and thereby achieved a deep understanding of what was going on. One can, of course, do this with modern computers; indeed the potential for doing it is actually greater, but one has to realize what it is one should be doing and why. For iterative methods we used acceleration techniques which were actually under the direct control of the operator. (For instance, when we were using the power method for the determination of the dominant eigenvector of a matrix, we could follow the progress of the vector on a cathode-ray tube screen. We had a cathode-ray display which showed the contents of any long delay line. We would look at the screen (which showed 32 components of the current vector), and we would see how fast it was converging. We would put a piece of paper over it, and we could say, for example, "It's gaining a binary digit every three iterations, so the ratio of the dominant to the subdominant eigenvalue must be about 2 to the power \(\frac{1}{2}\)." We could then set up a shift of origin on the input keys that would give much faster convergence.) This work was commonly done by assistants who were in no sense qualified mathematicians, but they became very expert indeed. It is surprising how well they understood the battery of acceleration techniques available and how efficiently they used them. When later we went over to more automatic techniques, they complained we were "taking the guts out of their work." They really loved these early programs. The familiarity and intimacy gained with the computing process was fully comparable with that which one gets on a hand desk machine, where perforce you see every number. But on ACE that familiarity was gained quickly and painlessly. This experience was invaluable. Is there any way you can get it now? Of course there is, but one needs to know what is worth having and to have the incentive to output it.

BYTE: I would say my own experience is that we are transferring large-machine "faceless" programs down to the personal computers, where in fact one can go back to the ACE ideas.

JHW: Yes. I agree. The potential is there, and it's much greater, really, than it was on ACE. But in my experience, many people who do computing are reluctant to look at numbers. At Stanford the general level of our students has been pretty high, but I would say their main weakness is in their inability to look at outputs and extract the meaningful information in them. In fact, somewhat to my surprise, they are generally less efficient at this than the assistants I used to have at NPL in the ACE days, in spite of having far superior mathematical qualifications. Most of those assistants had experience with desk computers and had learned to "look at numbers." The Pilot ACE forced them to continue with this habit.

I certainly do not want to suggest that the way to acquire this habit is to serve an apprenticeship on hand desk computers, but we have yet to learn how to instill the relevant knowledge.

FURTHER READING

HOW TO BUY SOFTWARE WHEN ALL THE ADS LOOK THE SAME.

We know it's hard to choose a software house. All the ads say the same thing—"Lowest prices," "fastest delivery," "best support," "biggest inventory."

Trouble is, although the claims are the same, the companies are very different. Which is why we want you to know some important facts about us:

1. **800-SOFTWARE** is one of the oldest and most reputable firms in the industry. Our customers include IBM, GE, Hewlett-Packard, Xerox, AT&T, and thousands of other satisfied buyers.

2. Our National Accounts Program offers volume discounts and valuable services to large software users. We offer incredibly low prices on large bids!

3. We have a giant, $1,000,000 inventory. Which means we can offer next-day delivery if needed.

4. With every product you get friendly, expert technical support. Have a question? You'll be glad you bought from 800-SOFTWARE!

5. We'll match our competitors' prices on most products. We never cut service.

6. We never charge extra for credit card purchases, nor do we process for payment until the product is shipped. (Our competitors don't make this claim!)

7. You'll automatically receive our Technical Support Newsletter—a great way to stay up-to-date.

8. We are members of the Better Business Bureau and the Direct Marketing Association.

9. *And* your repeat business. Which is why we work so hard to keep you happy. Give us a call and let us prove it!

### CHECK OUT ALL OUR INCREDIBLE BUSINESS SOFTWARE PRICES:

<table>
<thead>
<tr>
<th>Software</th>
<th>Price</th>
<th>Hardware, Etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lotus 1-2-3</td>
<td>$309</td>
<td>AMIGOS Monitors CALL</td>
</tr>
<tr>
<td>Lotus Symphony</td>
<td>$439</td>
<td>AST Products CALL</td>
</tr>
<tr>
<td>CrossTalk</td>
<td>$105</td>
<td>ATT CDEX Training CALL</td>
</tr>
<tr>
<td>SuperCalc 3</td>
<td>$209</td>
<td>EPSON Printers NEW LOW PRICES!</td>
</tr>
<tr>
<td>Hayes Smartmodems</td>
<td>$489/$409</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Software</th>
<th>Price</th>
<th>Hardware, Etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>WordStar 2000</td>
<td>$829</td>
<td>HERCULES Color Card $199</td>
</tr>
<tr>
<td>MicroPro</td>
<td>$139</td>
<td>MAXELL &amp; MEMOREX DISKETTES CALL</td>
</tr>
<tr>
<td>Symphonie</td>
<td>$1439</td>
<td>NORTON UTILITIES 4 EB</td>
</tr>
<tr>
<td>MultiMAX</td>
<td>$129</td>
<td>OKIDATA Printers NEW LOW PRICES!</td>
</tr>
<tr>
<td>MicroPro2</td>
<td>$1239</td>
<td>PRINCEON GRAPHICS MONITORS CALL</td>
</tr>
<tr>
<td>WordStar Pro Package/P.P. Plus</td>
<td>$269/$239</td>
<td></td>
</tr>
<tr>
<td>InfoStar</td>
<td>$129</td>
<td>QUADRANT CALL</td>
</tr>
<tr>
<td>ChartStar</td>
<td>$129</td>
<td>WESTERN UNION EASYLINE FREE</td>
</tr>
</tbody>
</table>

**WE ALSO CARRY HUNDREDS OF OTHER PRODUCTS!**

To order call toll-free: 800-227-4587 OR 415-644-3611

800-SOFTWARE, INC.
940 Dwight Way
Berkeley, CA 94710

Copyright 800-Software 1984

---

800-SOFTWARE, INC.
940 Dwight Way
Berkeley, CA 94710
<table>
<thead>
<tr>
<th>State</th>
<th>Cities</th>
<th>Distributors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>Birmingham, Aiken, Augusta, Huntsville, Montgomery, Opelika, Montgomery, Tuscaloosa, Anchorage</td>
<td>Radio Supply Center</td>
</tr>
<tr>
<td>Arizona</td>
<td>Flagstaff, Tucson, Yuma</td>
<td>RadioShack</td>
</tr>
<tr>
<td>Arkansas</td>
<td>Little Rock, Fort Smith, Jonesboro, Hot Springs, Fayetteville, Little Rock</td>
<td>Radio Supply Center</td>
</tr>
<tr>
<td>California</td>
<td>Burbank, San Diego, Los Angeles, Santa Clara, San Francisco, San Jose, Oakland, Sacramento, Stockton</td>
<td>RadioShack</td>
</tr>
<tr>
<td>Colorado</td>
<td>Denver, Colorado Springs, Fort Collins, Greeley, Pueblo, Littleton</td>
<td>RadioShack</td>
</tr>
<tr>
<td>Connecticut</td>
<td>Bridgeport, Manchester, New Haven, Norwich, Waterbury, Hartford</td>
<td>RadioShack</td>
</tr>
<tr>
<td>Delaware</td>
<td>Wilmington, Milford, Newark, Middletown, Dover</td>
<td>RadioShack</td>
</tr>
<tr>
<td>District of Columbia</td>
<td>Washington, D.C.</td>
<td>RadioShack</td>
</tr>
<tr>
<td>Florida</td>
<td>Jacksonville, Orlando, Tampa, Fort Lauderdale, Miami</td>
<td>RadioShack</td>
</tr>
<tr>
<td>Georgia</td>
<td>Atlanta, Savannah, Macon, Augusta, Columbus</td>
<td>RadioShack</td>
</tr>
<tr>
<td>Hawaii</td>
<td>Honolulu, Kahului, Koloa, Hilo, Kauai</td>
<td>RadioShack</td>
</tr>
<tr>
<td>Illinois</td>
<td>Chicago, Springfield, Rockford, Elgin, Kankakee</td>
<td>RadioShack</td>
</tr>
<tr>
<td>Indiana</td>
<td>Indianapolis, Fort Wayne, Hammond, South Bend</td>
<td>RadioShack</td>
</tr>
<tr>
<td>Iowa</td>
<td>Des Moines, Cedar Rapids, Waterloo, Davenport</td>
<td>RadioShack</td>
</tr>
<tr>
<td>Kansas</td>
<td>Kansas City, St. Joseph, Wilmington, Independence, Topeka</td>
<td>RadioShack</td>
</tr>
<tr>
<td>Kentucky</td>
<td>Louisville, Lexington, Frankfort, Covington, Paducah</td>
<td>RadioShack</td>
</tr>
<tr>
<td>Louisiana</td>
<td>New Orleans, Baton Rouge, Lafayette, Shreveport</td>
<td>RadioShack</td>
</tr>
<tr>
<td>Maine</td>
<td>Portland, Bangor, Lewiston, Augusta, Farmington</td>
<td>RadioShack</td>
</tr>
<tr>
<td>Maryland</td>
<td>Baltimore, Hagerstown, Frederick, Cumberland, Cumberland, Hagerstown</td>
<td>RadioShack</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>Boston, Worcester, Lowell, Fall River, Holyoke</td>
<td>RadioShack</td>
</tr>
<tr>
<td>Michigan</td>
<td>Detroit, Ann Arbor, Grand Rapids, Lansing, Midland</td>
<td>RadioShack, Inc.</td>
</tr>
<tr>
<td>Minnesota</td>
<td>Minneapolis, St. Paul, Duluth, Rochester, Mankato</td>
<td>RadioShack, Inc.</td>
</tr>
<tr>
<td>Mississippi</td>
<td>Jackson, Oxford, Hattiesburg, Biloxi, Tupelo</td>
<td>RadioShack, Inc.</td>
</tr>
<tr>
<td>Missouri</td>
<td>St. Louis, Kansas City, Springfield, Columbia, Jefferson City</td>
<td>RadioShack, Inc.</td>
</tr>
<tr>
<td>Montana</td>
<td>Butte, Great Falls, Helena, Missoula, Billings</td>
<td>RadioShack, Inc.</td>
</tr>
<tr>
<td>Nebraska</td>
<td>Omaha, Lincoln, Grand Island, Beatrice, Norfolk</td>
<td>RadioShack, Inc.</td>
</tr>
<tr>
<td>Nevada</td>
<td>Las Vegas, Henderson, Reno, Carson City, Elko</td>
<td>RadioShack, Inc.</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>Manchester, Exeter, Derry, Concord, Nashua</td>
<td>RadioShack, Inc.</td>
</tr>
<tr>
<td>New Jersey</td>
<td>Newark, Jersey City, Elizabeth, Trenton, Paterson</td>
<td>RadioShack, Inc.</td>
</tr>
<tr>
<td>New Mexico</td>
<td>Albuquerque, Santa Fe, Farmington, Roswell, Farmington</td>
<td>RadioShack, Inc.</td>
</tr>
<tr>
<td>New York</td>
<td>New York, Buffalo, Rochester, Syracuse, Albany</td>
<td>RadioShack, Inc.</td>
</tr>
<tr>
<td>North Carolina</td>
<td>Greensboro, Asheville, Winston-Salem, Raleigh</td>
<td>RadioShack, Inc.</td>
</tr>
<tr>
<td>North Dakota</td>
<td>Fargo, Grand Forks, West Fargo, Dickinson</td>
<td>RadioShack, Inc.</td>
</tr>
<tr>
<td>Ohio</td>
<td>Cleveland, Columbus, Cincinnati, Toledo, Akron</td>
<td>RadioShack, Inc.</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>Oklahoma City, Tulsa, Norman, Muskogee, Stillwater</td>
<td>RadioShack, Inc.</td>
</tr>
<tr>
<td>Oregon</td>
<td>Portland, Eugene, Salem, Medford, Coos Bay</td>
<td>RadioShack, Inc.</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>Providence, Warwick, Newport, Pawtucket, Westerly</td>
<td>RadioShack, Inc.</td>
</tr>
<tr>
<td>South Carolina</td>
<td>Greenville, Columbia, Charleston, Myrtle Beach</td>
<td>RadioShack, Inc.</td>
</tr>
<tr>
<td>South Dakota</td>
<td>Sioux Falls, Rapid City, Pierre, Brookings</td>
<td>RadioShack, Inc.</td>
</tr>
<tr>
<td>Tennessee</td>
<td>Nashville, Memphis, Knoxville, Chattanooga, Clarksville</td>
<td>RadioShack, Inc.</td>
</tr>
<tr>
<td>Texas</td>
<td>Austin, Houston, Dallas, San Antonio, El Paso</td>
<td>RadioShack, Inc.</td>
</tr>
<tr>
<td>Utah</td>
<td>Salt Lake City, Ogden, Provo, St. George, Las Vegas</td>
<td>RadioShack, Inc.</td>
</tr>
<tr>
<td>Vermont</td>
<td>Burlington, Montpelier, St. Albans, Williston</td>
<td>RadioShack, Inc.</td>
</tr>
<tr>
<td>Virginia</td>
<td>Richmond, Virginia Beach, Norfolk, Alexandria</td>
<td>RadioShack, Inc.</td>
</tr>
<tr>
<td>Washington</td>
<td>Seattle, Spokane, Tacoma, Everett, Bellingham</td>
<td>RadioShack, Inc.</td>
</tr>
<tr>
<td>West Virginia</td>
<td>Charleston, Beckley, Morgantown, Charleston</td>
<td>RadioShack, Inc.</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>Milwaukee, Madison, Green Bay, Appleton, Eau Claire</td>
<td>RadioShack, Inc.</td>
</tr>
<tr>
<td>Wyoming</td>
<td>Cheyenne, Casper, Laramie, Rawlins, Douglas</td>
<td>RadioShack, Inc.</td>
</tr>
</tbody>
</table>

For Distributor Information, write or phone JIM-PAK, 1355 Shoreway Road, Belmont, CA 94002 (415) 595-5836
**One-Stop Component Center**

- Quality Components
- Over 700 Items Available From Our 500 Authorized JIM-PAK Distributors
- Competitive Prices
- Distributors Welcome
- For information call (415) 595-5936 Telex #176043

---

**MICRO CHARTS**

**Instant Data on the Most Popular Computer and Microprocessor Parts**

- Fully decoded data
- Compact 8½" x 11" size
- Durable plastic
- Clear and concise tables for:
  - Full instruction set, disassembly, ASCII, base conversion
  - Pinout and much more...

*Part No.*

- ML280: 280 CPU
- ML6502: 6502 (65XX)
- ML7400: 5400/7400 TTL Pinouts
- ML8080A: 8080A/8085A
- ML8086: 8086/8088

---

**DATA BOOKS**

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>30001</td>
<td>Nat. CMOS (CD4000/74C)</td>
</tr>
<tr>
<td>30003</td>
<td>National Linear</td>
</tr>
<tr>
<td>30005</td>
<td>National TTL Logic</td>
</tr>
<tr>
<td>30009</td>
<td>Intersil Data</td>
</tr>
<tr>
<td>30013</td>
<td>Zilog Microprocessor</td>
</tr>
<tr>
<td>30014</td>
<td>National Intuitive IC CMOS Evolution</td>
</tr>
<tr>
<td>30015</td>
<td>National Intuitive Op Amps</td>
</tr>
<tr>
<td>30016</td>
<td>National Voltage Regulator</td>
</tr>
<tr>
<td>30017</td>
<td>National MOS Memory</td>
</tr>
<tr>
<td>30018</td>
<td>National CMOS (74HC, RAMs, PROMs)</td>
</tr>
<tr>
<td>30019</td>
<td>National Interface, Bipolar (LSI &amp; Memory), Prop. Logic</td>
</tr>
<tr>
<td>210830</td>
<td>Intel Memory Components</td>
</tr>
<tr>
<td>230843</td>
<td>Intel Microsystem Components</td>
</tr>
</tbody>
</table>

---

**FIBEROPTICS**

**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
- Receiver PCB
- One meter of plastic optic fiber
- All necessary electrical hardware
- Complete step-by-step instructions
- Theory of operation
- Tutorial information

**Part No. ELK-1**

**OWI Educational Electronic Robot Kits**

- MV915: Piper-Mouse (Sound Sensor)
- MV916: Peppy (Sound/Touch Sensor)
- MV918: Memcoo Crawler (Programmable Memory)
- MV931: Mr. Bootman (Wired Control)
- MV935: Circular (Remote Control)
- MV939: Medusa (Sound Sensor)

---

**DATAHIELD SURGE PROTECTOR**

- Eliminates voltage spikes and EMI/RFI noise before it can damage your equipment or cause data loss.
- 6 sockets • 6 ft. power cord
- Brown-out/black-out reset switch • Brown-out notification (audible alarm) • 6 mo. warranty

**Part No. Model 100**

---

**CONNECTORS**

**SOLDER-TYPE CONTACTS**

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>57-30360</td>
<td>36 Contact Plug (Centronics)</td>
</tr>
<tr>
<td>57-60360</td>
<td>36 Contact Socket (Centronics)</td>
</tr>
<tr>
<td>57-30500</td>
<td>50 Contact Plug</td>
</tr>
<tr>
<td>57-60500</td>
<td>50 Contact Socket</td>
</tr>
</tbody>
</table>

---

**GENDER CHANGERS**

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>JRSMM</td>
<td>Gender Changer (Connects 2 DB25P) RS232</td>
</tr>
<tr>
<td>JRSFF</td>
<td>Gender Changer (Connects 2 DB25S) RS232</td>
</tr>
<tr>
<td>JCENMM</td>
<td>Gender Changer (Connects 2 Male Centronics cables)</td>
</tr>
<tr>
<td>JENFF</td>
<td>Gender Changer (Connects 2 Female Centronics cables)</td>
</tr>
</tbody>
</table>

---

**The Famous Silicon Chip**

**Part No. MCK-1**

**Memory Key Chain (Gold)**

- Includes the popular verse:
  - "I'm a computer memory chip
    Just a little brain
    I do so many things for you
    Too many to proclaim
    Look through my window
    See what makes me tick
    A thousand tiny circuits
    And my silicon chip."

---

**NEW!! 1985 ITEMS!!**

**FEBRUARY 1985 • BYTE 197**
OUR COMMUNITY NEEDS MORE CORPORATE HEROES.

The United Way volunteer gives a gift that's hard to measure.

Because without his or her contribution of time, energy and dedication, the community services and local programs of United Way simply cannot exist.

United Way has much to do in our community. From day care for the young to services for the elderly. So this year, be generous. Give yourself.
A LOW-COST DATA-ACQUISITION SYSTEM

BY KIYOHISA OKAMURA AND KAMYAB AGHAI-TABRIZ

A compromise between cost and quality, this system is adequate for many research projects.

COMMERCIALY AVAILABLE data-acquisition systems are quite expensive. A decent system may cost as much as or more than the entire annual equipment budget of an engineering department at a small educational institution like ours. Our solution to this problem was to design and build our own system. A reasonable compromise between price and quality, our system includes a Commodore 64 computer, a video display, a disk drive, and some miscellaneous hardware for about $800. It has only 8-bit data acquisition, but you can design a 12-bit system by using one and one-half I/O (input/output) ports (i.e., 12 bits) as the data-input pins. Furthermore, during breaks between experiments, our system can provide you with entertainment. Have you ever heard of a data-acquisition system you can play Pac-Man on?

HARDWARE

The circuit diagram to interface the real world to the Commodore 64 is shown in figure 1, and the corresponding hardware is shown in photo 1. For analog-to-digital (A/D) conversion, we use an 8-bit ADC0804. To multiplex the multichannel analog input signals, we use the multiplexer (MUX) chip 4051. The outputs are connected to data lines PBO–PB7 of Complex Interface Adapter 2 (CIA2) through the Commodore 64’s User Port CN2. The input channel selection is done by the three bits PBO, PB1, and PB2 of CIA1, which are connected respectively to C(MSB), B, and A(LSB) of the 4051. For example, channel 0 is selected by CBA-000, channel 1 by CBA-001, and so on. This multiplexing arrangement can accept up to eight analog signals. However, our plotting software is limited to three channels. The graphic resolution decreases as the number of channels displayed on the screen increases. Handshaking between the ADC and CN2 can be done through a pair of connections: WR(ADC) to PC2(Commodore 64) and INT(ADC) to FLAG(Commodore 64). The latter is optional, and we don’t use it in our software.

The analog signal to be connected to each input terminal of the MUX CD4051 in figure 1 should be properly conditioned, which involves amplifying and biasing the signal so that the voltage level is between 0 and +5 V. Because +5 V is used as a voltage reference in the ADC, the signal should be made to come as close as possible to the full range of the ADC, without exceeding the full-range limit, for maximum resolution. Therefore, you may need an amplifier between each transducer and the MUX. In our case, since the output of each transducer was relatively large, we used an analog computer for signal conditioning. For a very small signal you can use a differential amplifier. According to figure 1, one of the two lead wires for the input signal is for return and should be grounded.

(continued)
The ADC converts analog input voltage to 8-bit binary data with 0 V corresponding to 00000000 and +5 V to 11111111. The computer shows only the decimal equivalent on the screen, that is, 0 to 255 for 0 to 5 V, respectively. Any value between these two extremes is proportionally converted. For example, a converted data of 1 (decimal unity) corresponds to an analog input to 0.2 V \((1 \times 5/255)\). Similarly, a data value of 37 corresponds to 0.73 V \((37 \times 5/255)\), and so on. If you want to store or display the value of input directly expressed in voltage, all you have to do is divide the acquired data by 51 \((255/5)\).

Using this method of conversion together with a manufacturer’s calibration data sheet for a transducer, we can determine the correlation between the original physical quantity and the acquired data in the computer. Another method we often use is direct calibration.

The accuracy of the A/D conversion depends partly upon the accuracy and stability of the voltage supplied to REF/2 (pin 9). We used the reference voltage from the Commodore 64’s 5-V power supply. Our measurements show that this voltage is actually 4.98 V with a ripple component of less than 0.5 percent. It is quite stable and accurate enough for undergraduate experiments conducted in our laboratories. If you want greater accuracy, use a more reliable voltage reference for pin 9.

The serial data is output to pin M of CN2, which is connected to the coaxial cable as shown in figure 2. The other end of the cable is connected to the serial port of a receiving computer either directly or through a line driver/receiver, depending on the compatibility of the two computers’ serial ports. For example, the Commodore 64 and TRS-80 we are using in our laboratories are not RS-232C-compatible. In the Commodore 64, binary state 1 corresponds to +5 V and binary 0 to 0 V at pin M. On the other hand, at the RS-232C terminal of the TRS-80, binary state 1 corresponds to 0 V and binary 0 to +12 V. Therefore, these two computers are incompatible in both voltage levels and polarity. This incompatibility can be resolved by line driver MC1488 as shown. If the receiving computer uses +12 V and -12 V with inverted polarity, you should connect point P to the receiving RS-232C. With noninverted polarity, use point Q instead.

We use a 500-foot coaxial cable to connect a Commodore 64 in one laboratory to a TRS-80 in another laboratory. We haven’t noticed any voltage drop or noise at the receiving end.

SOFTWARE

[Editor's note: The program for data acquisition is available for downloading via BYTEnet Listings. The telephone number is (603) 924-9820.] The main portion of the program uses several assembly-language subroutines that are loaded in machine-language form via BASIC statements. When you load the program, the menu in photo 2 appears. The menu and software are self-explanatory, so we’ll only discuss the software briefly. When downloading the program, eliminate all state-

**Figure 1:** A schematic for the A/D converter for the Commodore 64 data-acquisition system.
ments headed with REM except for line 10, since they are strictly for comment and if typed in, they occupy too much space in RAM (random-access read/write memory).

When the main program is executed, all subroutines written in assembly language are poked into the appropriate locations as sequential data. Therefore, you should store the data (listings 2, 3, 4, and 5) as sequential files. Assign names (listing2, listing3, and so on) to these files. When the main program is executed, these programs will be poked into the locations shown in the first column of each listing.

A data-transmission subroutine is part of the main program. The transmission format is 2400 bps (bits per second), 7 data bits, 1 stop bit, and no parity check. This part of the program is also self-explanatory, but you have to remember to throw switch SW1 to the +5 V position when you use it. The screen displays the data as it is being transmitted from the Commodore 64. At the end of transmission, the screen displays an instruction: switch to ADC and press any key. You then throw SW1 back to the previous position so that the CIA is connected to the ADC.

The standard sampling rates of A/D conversion programmed in the main program are 1000, 500, and 100 samples per second; you can select the rate as part of the data-acquisition subroutine. In addition, you can set any sampling rate by yourself by adjusting parameters \( q \) and \( w \) in line 1110. This setting corresponds to the default value when the instruction for selecting the sampling rate is displayed on the screen. The maximum rate available is 4360 samples per second at \( w = q = 1 \). If you have three channels, this implies the sampling rate of 1453 samples/second for each channel. To lower the sampling rate, just increase \( q \) and/or \( w \). These parameters are used in time-delay loops in the assembly program with parameter \( w \) in the inner loop and parameter \( q \) in the outer loop. Delay parameter \( w \) has a greater effect on lowering the sampling rate than parameter \( q \) does.

To calibrate the exact sampling rate, we used a square wave from a crystal oscillator as an input. Since the frequency of the crystal oscillator is quite accurately known, the sampling rate can therefore be determined.
The Silver Fox™ Trots through Lotus like 1,2,3

The Silver Fox has always run hundreds of programs originally written for the IBM-PC. Now with its new compatible video board and GW Basic it runs the most popular and powerful software in microcomputing, including Lotus 1,2,3, dBASE II, Multiplan, the PFS series, and even Flight Simulator. Yet you still get an incomparable combination of hardware and software at a price that invites comparison.

MORE HARDWARE

Each Silver Fox comes with an 8088 CPU, 265K of RAM, monochrome and color video, and printer port all on a single board. Plus you get more than twice the storage of a standard PC, 16 Megabytes on dual 5 1/4" floppies, and the Fox will read and write to all popular PC formats.

Standard equipment also includes a better keyboard, and a 12" high-resolution, green monochrome monitor, with a full 25x80 column display. And although the Silver Fox doesn't have "compatible" expansion slots you can add serial ports, modems, plotters, printers, joysticks, and 8087 co-processor, and/or a hard disk.

Because the Silver Fox is born on a totally automated line in Japan it is simply more reliable than PCs that are assembled by hand. So we back each Silver Fox with a one year limited warranty, four times the industry standard.

FREE SILVERWARE

Were this not enough, each Fox comes with the best free software bundle in the business including:

- MS-DOS 2.1
- Color BASIC
- GW BASIC
- HAGEN-DOS
- Quikdisc
- Datemate

If you didn't think you could buy you this much computer, give us a call at

**$1397**

and we'll rush you a brochure that will tell you how it can.

The Silver Fox is sold exclusively by Scottsdale Systems Ltd., 617 N. Scottsdale Road, Scottsdale, AZ 85257. Trademarks: Silver Fox, HAGEN-DOS, Quikdisc, Datemate, and Multiplan. Scottsdale Systems Ltd. WordStar and CalcStar are trademarks of Micropro International. MS-DOS, Multiplan, Microsoft Corporation, FILEBASE, XWIP Software, Inc., IBM-PC, personal computer, and all other products and services mentioned in this advertisement are the property of their respective owners. The program stores data sequentially in RAM. In case of multiple channels (e.g., displacement x for channel 0, velocity v for channel 1, and acceleration a for channel 2) the data is stored in the following order: x(1), v(1), a(1), x(2), v(2), a(2), x(3), ..., where x(1) and x(2) are the first and the second bytes of data for x, and so on. They are stored sequentially in RAM with the starting address of 32769. The number of data points for each channel is 320 by default but can be changed. Since there are 320 pixels in the horizontal direction of the screen, 320 data points per channel is the maximum number of data points that can be displayed at one time.

CONCLUSION

We've found this system perfect for student use and adequate for some types of research. Though the system has many limitations, it is inexpensive and, above all, it's better than no system at all.

We would like to express our appreciation for the help Mr. William Welscher, a graduate student of agricultural engineering at North Dakota State University, gave us during the preparation of the manuscript of this article.
Finally,
a New DBMS Technology

INFORMA is what NETWORKING is all about:
INTERACTIVE REAL-TIME DATASHARING

The experts say . . .

Corvus Systems, Inc.
"INFORMA is one of the finest multi-user Database Management Systems available for the OMNINET* Local Area Network.”
Sid Arora, Third Party Marketing Manager

TeleVideo Systems, Inc.
"INFORMA is one of the finest, true multi-user Database Management Systems we have seen run on the TeleVideo Personal Mini.”
Mark Calkins, Product Marketing Manager

Novell
"Many of our Netware end users have found INFORMA to be a very powerful and versatile Database Management System.”
Rob Walton, Manager of Independent Software Development

3COM Corporation
"The INFORMA DBMS is one of the best examples of the benefits users achieve with multi-user network software.”
Robert Buchanan, Jr., Software Product Manager

• FAST  • POWERFUL  • EASY TO USE

• 10 Level Security

• 50 Keys (indexes) per record

• 8000 fields per record

• 1 sec. access from 35,000 record file

• 255 screens per record

• Unlimited math and relational operations
  • Intuitive “Query by Example”
  • Full Formatting Reporter

UNLIMITED PROCESSING INCORPORATED
8382 Baymeadows Road, Suite 8
Jacksonville, Florida 32216
(904) 641-8330  (800) 874-8555
Telex 350754  (800) 874-4185

Incredible Introductory Offer

Single-user
$199
regularly $795

LAN/Multi-user
$599
regularly $1495

Available on over 20 operating systems including IBM's new PC NETWORK
In just the last few months, The NETWORK has saved its members more than $24,000,000 and processed over 60,000 orders.

The nation's largest corporations depend on PC NETWORK!

On our corporate roster are some of the nation's largest financial industrial and professional concerns including some of the most important names in the computer industry: IBM

plus thousands of satisfied consulting firms, small businesses, user groups, municipalities, government agencies and value-wise individuals ACROSS THE NATION! Their buyers know that purchasing or renting from PC NETWORK saves them time, money and trouble. And the NETWORK's rental charges are far less than other software rental services—JUST 20%...

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.

CALL TOLL FREE 1-800-621-S-A-V-E

PC NETWORK
320 West Ohio
Chicago, Illinois 60610

CALL NOW ... Join The PC NETWORK and start saving today!!

PC NETWORK • MEMBERSHIP APPLICATION

YES! I wish to become a member of PC NETWORK™ and receive a free catalog featuring thousands of computer products, all at just 8% above DEALER WHOLESALE PRICES. I will also periodically receive "THE PRINT-OUT", 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.

I am under no obligation to buy anything. My complete satisfaction is guaranteed. Please check (X) all boxes that apply.

Basic Membership Special V.I.P. Membership

- One-year membership for $8

- Two-year membership for $15

- Business Software Rental Library for $25 add-on per year—WITH 20 day rentals

- Games Software Rental Library for $10 add-on per year on limited quantity merchandise specials

- Bill your credit card VISA MasterCard American Express

Account Number Exp. Month Year

- Check or money order enclosed for

Name

Address

City State Zip

Telephone ( )

My computer(s) is [ ] IBM PC [ ] IBM XT [ ] IBM AT [ ] Apple II [ ] Macintosh [ ] Other

Signature

Please allow 2-3 weeks after receiving your membership validation for your order to be processed.

Copyright © 1984, PC NETWORK, INC.
PC NETWORK

... WITH THESE 15 UNIQUE BENEFITS

1. COST + 8% PRICING — The NETWORK purchases millions of dollars in merchandise each month. You benefit in receiving the lowest price available and all at just 8% above published dealer wholesale price.

2. OUR 500 PAGE WHOLESALE CATALOG — Members receive our 500 page wholesale catalog containing over 20,000 hardware and software products for the IBM PC, Apple, and over 50 other popular computer systems. THE NETWORK'S CATALOG IS THE LARGEST SINGLE COMPILATION OF PERSONAL COMPUTER PRODUCTS AVAILABLE TODAY. NOW UPDATED QUARTERLY!

3. IN-STOCK INSURED FAST HOME DELIVERY — The NETWORK maintains a giant multi-million dollar inventory of most popular products, allowing us to ship many orders from stock. Non-stock items are typically maintained in local warehouses just days away from The NETWORK and YOU. We pay all insurance expenses on your shipment. EMERGENCY OVERNIGHT SERVICE IS AVAILABLE ON REQUEST.

4. 10 DAY RETURN POLICY — If you are not satisfied, for any reason with any hardware component purchased from The NETWORK within 10 days of receipt, we will refund your entire purchase (less shipping) with no questions asked.

5. MEMBERSHIP SATISFACTION GUARANTEE — If for any reason you are not satisfied with your membership within 30 days, we will refund your dues IN FULL.

6. EXPERIENCED CONSULTANTS — The NETWORK hires consultants, not order takers, to aid you in product selection. Our consulting staff possesses in excess of 150 man years of personal computer product experience. We back our consultants with our money back guarantee: IF ANY PRODUCT RECOMMENDED BY OUR CONSULTING STAFF FAILS TO PERFORM AS PROMISED — WE WILL TAKE IT BACK AT OUR EXPENSE FOR A 100% REFUND.

7. FREE TECHNICAL SUPPORT — The NETWORK supports every product it sells. Our qualified TECH-SUPPORT staff will help you assemble your system, interpret vendor documentation and get your software and hardware to work. WE WILL GIVE YOU ALL THE HELP YOU NEED, WHEN YOU NEED IT — FREE!

8. OPTIONAL BUSINESS RENTAL LIBRARY — All members can join our BUSINESS RENTAL LIBRARY featuring over 1000 available titles for just $25 PER YEAR above the base membership fee. This entitles you to rent business software AT JUST 20% of the DISCOUNT PRICE FOR A 14 DAY PERIOD. If you decide to keep the software, the entire rental fee is deducted from the purchase price. VIP MEMBERS GET A FULL 28 DAYS for just $30 above the V.I.P. base fee. This also includes the game library privileges for a $5 combination savings.

9. OPTIONAL GAME SOFTWARE RENTAL LIBRARY — The Game Rental library is available to members for just $1 PER YEAR and permits evaluation (or just enjoyment) of any game or educational software product at savings of up to 90% from the normal store price.

10. SPECIAL SAVINGS BULLETINS — THE PRINTOUT — Issued Quarterly at no charge to Network members only! The Printout contains all the New Product listings and price changes you need to keep your Catalog up to date. Also, we buy excess dealer inventories, and store bankruptcy closeouts, which we turn around and make available to our members at fantastic savings via THE PRINTOUT.

11. DISCOUNT BOOK LIBRARY — Working with numerous publishers and distributors, The NETWORK has assembled a library of over 1000 computer related books and manuals at savings of up to 75% from the normal store price.

12. MEMBERSHIP REFERRAL BONUS — Our most valuable source of new members is you! To date almost 40% of our members have been referred by word of mouth from other satisfied members. For those of you who refer new members, The NETWORK will credit a cash bonus to your account applicable to any future purchase.

13. CORPORATE ACCOUNT PROGRAM — Almost 50% of The NETWORK's members are corporate buyers and users. (see opposite page left). The NETWORK can establish open account status and assign designated account managers to expedite orders, and coordinate multiple location shipments.

14. QUANTITY DISCOUNTS — For large corporations, clubs, and repeat or quantity buyers The NETWORK can extend additional single order discounts, when available to us from our manufacturers and distributors.

15. PRICE PROTECTION — The PC Industry is crazy!!! Prices change not yearly or monthly or even weekly but often day by day! These changes are sometimes up but are mostly down!!! THE NETWORK GUARANTEES THAT IN THE EVENT OF A PRODUCT PRICE REDUCTION, BETWEEN THE TIME YOU PLACE YOUR ORDER AND THE TIME THE PRODUCT SHIPS YOU WILL ONLY PAY THE LOWER AMOUNT!!

Inquiry 246
We apologize for our evasiveness. After our last advertisement, many of you felt compelled to contact us regarding the implication that The Shoebox Accountant is completely integrated on a single disk. Although we would like to confirm that a single disk holds general ledger, accounts receivable, accounts payable, and payroll modules, queuing files, and the powerful reporting capabilities for which CYMA Corporation is so well known, and offers the entire program for a mere $395, modesty prevents us from doing so. As ever, we prefer our same, subtle approach.

Nice Box.
Fully Integrated.
FOURIER SMOOTHING WITHOUT THE FAST FOURIER TRANSFORM

by Eric E. Aubanel and Keith B. Oldham

An in-depth look at using the Fourier transform to remove noise from your data

IN THE SCIENTIFIC AND BUSINESS communities, gathering and analyzing data are very important activities. Data is often collected as a set of values of some variable (e.g., sales in business or current in electrochemistry) against some independent variable, most often time, at evenly spaced intervals. The data is then analyzed for the presence of significant trends. Sometimes these trends are difficult to discern because of the presence of noise or other short-duration perturbations in the data. You can attenuate the noise either by performing replicate experiments and signal averaging or by smoothing the data. The second approach is probably the less satisfactory of the two; it is commonly adopted, however, because the alternatives are more costly or time-consuming.

The three most common methods for smoothing data are moving-average, least-squares, and Fourier transformation. In the moving-average method, each data point is replaced by the average of itself and \( n \) neighboring points on either side of it. The advantage of this method is that it is very easy to program. The disadvantages include: the first and last \( n \) points are not smoothed to the same degree as the rest of the data set because they don't have \( n \) neighbors on each side of them; you must sample at a rate much faster than the fastest transient that you wish to study; and the method flattens the signal more than other smoothing methods.

The least-squares method identifies the line of the order you specify that minimizes the sum of the squares of distances between the data points and the calculated line. The advantages of this method are that it will permit you to easily generate statistical information on the goodness of fit, and it does not require that the data be collected at regular intervals. The disadvantages of the method are that it assumes that you know the basic form of the equation that the data satisfies, and the method is disproportionately biased by one or two very bad data points because it will twist the line of fit to spread the error over the entire data set.

Fourier transformation and inversion is probably the best method, since it lends itself naturally to identifying and eliminating noise. The reason for this is that noise is usually present at high frequencies, whereas the signal proper is usually at low frequencies. Fourier transformation produces the frequency spectrum. By eliminating the high-frequency portion of the spectrum and performing an inverse Fourier transform, you can obtain the original data without much of the noise—the "smoothed" data. The primary disadvantage of this method is that the data points must be collected at regular time intervals.

There are several reasons why Fourier smoothing is not practiced as often as other methods. Descriptions of Fourier transformation are often couched in unfamiliar jargon, though a few authors have succeeded in explaining Fourier transformation theory in simpler terms (see

(continued))
FOURIER SMOOTHING

A second reason is the common misconception that Fourier transformation and inversion are massive number-crunching operations that require large computers and cannot be implemented on the small personal computers that people are increasingly using for data collection and processing. Further, the success of the "fast Fourier transform" has spawned the belief that it is the only practical algorithm for transformation and inversion.

Before discussing the principles and operation of our BASIC subroutine for Fourier smoothing, let's look at the discrete Fourier transform, the removal of high frequencies, and the features of the fast Fourier transform. Our program does not execute fast Fourier transformation, though it does incorporate some of the same features. It is not especially fast when executed in a high-level programming language on a microcomputer, but it can achieve excellent smoothing in an acceptable length of time.

DISCRETE FOURIER TRANSFORMATION

A good explanation of the continuous and discrete transformations can be found in the article by Stanley and Peterson in the December 1978 issue of BYTE (reference 1). We will outline only some of the important features of the discrete Fourier transform.

Performing a discrete Fourier transform on a sequence of real valued data \( x_0, x_1, \ldots, x_{N-1} \) produces two sets of real valued transforms:

\[
R_k = \frac{1}{N} \sum_{j=0}^{N-1} x_j \cos \left( \frac{2\pi jk}{N} \right) \quad k = 0, 1, \ldots, N-1
\]

\[
l_k = \frac{-1}{N} \sum_{j=0}^{N-1} x_j \sin \left( \frac{2\pi jk}{N} \right) \quad k = 0, 1, \ldots, N-1
\]

To regenerate the real valued data from the transforms, the following operation is performed:

\[
x_j = \sum_{k=0}^{N-1} \frac{1}{N} \left( R_k \cos \left( \frac{2\pi jk}{N} \right) - l_k \sin \left( \frac{2\pi jk}{N} \right) \right)
\]

The operation above is called Fourier inversion.

The information content of the original data is transferred, on Fourier transformation, into about the first half of the \( R_k, l_k \) numbers, i.e., those having \( 0 \leq k \leq \frac{N-1}{2} \) (if \( N \) is odd; \( 0 \leq k \leq \frac{N}{2} \) if \( N \) is even). The second half merely duplicates the first in magnitude: \( R_{N-k} = R_k, l_{N-k} = -l_k \) (see Stanley and Peterson for a good illustration of this).

REMOVING HIGH FREQUENCIES

The procedure for removing high frequencies can be represented as a multiplication.

\[
R_k \rightarrow f_k R_k; \quad l_k \rightarrow f_k l_k
\]

by a function \( f_k \) (the so-called digital filter function). The simplest filter function is a rectangle, which would cut off the transforms for \( k \geq E \). Such a sudden cutoff can lead to a false accentuation of frequencies corresponding to transform points in the vicinity of \( E \). To avoid this you can use a quadratic filter function, which results in a gradual attenuation (see figure 1). The filter function we have incorporated into our algorithm is

\[
f_k = \begin{cases} 1 - \left( \frac{k}{E} \right)^2 & k = 1, 2, 3, \ldots, E-1 \\ 0 & k = E, E+1, \ldots \end{cases}
\]

The smaller the value chosen for the integer \( E \), the more denuded of high frequencies the subsequent invert will be: the closer \( E \) is to \( \frac{N-1}{2} \) (or to \( \frac{N}{2} \) if \( N \) is even), the less affected the regenerated signal will be.

Because there is no purpose in calculating those values of \( R_k \) and \( l_k \) that duplicate others or that will be replaced by zeros, the equations for Fourier transformation and inversion can be abbreviated to the following equations:

(6) \[
R_0 = \frac{1}{N} \sum_{j=0}^{N-1} x_j
\]

(7) \[
R_k = \frac{x_0}{N} + \frac{1}{N} \sum_{j=1}^{N-1} x_j \cos \left( \frac{2\pi jk}{N} \right)
\]

\( K = 1, 2, \ldots, E-1 \)

(continued)
Why pay more for 10 or 20 Meg drives than you have to? Our 10 Meg internal hard disk subsystem is priced at $794, with the 20 Meg model going for $1088. Our external 10 Meg goes for $944, 20 Meg for $1238.

Our drives are fully compatible with any IBM PC or PC-compatible with 64K RAM and PC-DOS 2.0 or later.* Qubie's drives boot directly from the hard disk. You can power up the PC and load the system directly, without using any floppy disks. No software patches or drivers to install.

Using the same amount of power as a floppy drive, the Qubie' hard disk uses less energy than other aftermarket drives.

The drives come complete with 1 dir software. 1 dir's commands are in English, eliminating the need to type in DOS commands, and are all selected by using cursor control keys. 1 dir even explains commands with HELP screens that give you online advice when you need it.

Qubie' drives are made of special plated recording media. They withstand the vibration and movement that has damaged hard disks in the past. In fact, Qubie' drives have been selected by several computer makers for use in their portable computers.

Good service starts with answering your questions before and after you buy. It continues with same or next day shipment of your order. Since we only sell a few selected products, we have the information and inventory to help you fast.

We perform repairs in our own service department within 48 hours, should you ever need service during the one year warranty period.

Our price is the whole price. All prices include UPS surface charges and insurance. In a hurry? Two day UPS air service is just $12.

Corporations, dealers and institutions, call for volume purchase price information.

*Call for information.
FOURIER SMOOTHING

(8)
\[ I_k = -\frac{1}{N} \sum_{j=1}^{N-1} x_j \sin \left( \frac{2\pi jk}{N} \right) \]
\[ k = 1, 2, \ldots, E-1 \]

(9)
\[ x_0 = R_0 + 2 \sum_{k=1}^{E-1} f_k R_k \]

(10)
\[ x_j = R_0 + 2 \sum_{k=1}^{E-1} f_k R_k \cos \left( \frac{2\pi jk}{N} \right) - f_k R_k \sin \left( \frac{2\pi jk}{N} \right) \]
\[ j = 1, 2, \ldots, N-1 \]

where \( \hat{x}_j \) is the high-frequency-stripped analog of \( x \). Note that \( R_0 \) is now expressed separately from \( R_k \) as well as \( x_0 \) from \( x \), and that \( I_0 = 0 \) because \( \sin 0 = 0 \). The factor of two in equations 9 and 10 is present as a result of restricting \( E \) to be less than \( N \) and by taking advantage of the symmetries \( (R_{N-k} = R_k, I_{N-k} = -I_k) \) already noted.

Though we used the word "abbreviated" to describe equations 6 through 10, their implementation still requires a lot of computation. Approximately 20NE multiplications or divisions and 4NE cosine or sine evaluations are needed to implement these equations straightforwardly. For example, if \( N = 200 \) and \( E = 20 \), about 16,000 trigonometric functions are needed, along with 80,000 multiplications. Some microcomputers take as long as 0.2 second to calculate a single trigonometric function and would spend almost an hour on this aspect of a Fourier program alone.

FAST FOURIER TRANSFORMS

To meet the problem of the large number of multiplications and other operations required to implement Fourier transformation and inversion straightforwardly, the fast Fourier transform (FFT) algorithm was invented. Books have been written on this topic, but here we can do no more than cite some of the features of the FFT.

The FFT has several advantages. (1) By using the properties of the sine and cosine functions, the number of needed sines and cosines is drastically reduced. (2) Similarly, the number of multiplications is drastically reduced, these, in effect, being replaced by additions. (3) The same routine, virtually unchanged, can be used for Fourier transformation and inversion. (4) No storage space is needed beyond that required for the initial data; the transforms simply "overwrite" the original numbers. (5) The total processing time is massively reduced, especially when \( N \) is large.

The disadvantages of the FFT algorithm, for our present purposes, are as follows. (1) To function efficiently, \( N \) is required to be a power of 2. (2) Even though far fewer are needed, the evaluation of sines and cosines may still be a bottleneck and therefore a memory-consuming "sine lookup table" must be incorporated into time-efficient FFT algorithms. (3) The algorithm is inherently "square," being designed to generate \( 2N \) outputs from \( 2N \) inputs; thus it cannot exploit the potential savings in the "rectangular" task of producing only \( E \) outputs from \( N \) inputs. (4) Because of the need to perform "bit inversions," programming in anything except machine language is not efficient.

To deal with situations in which the number of input data cannot be conveniently made a power of 2, the technique of "zero-filling" is often used. This inflates the number of points to be processed from \( N \) to the next higher power of 2—for example, from 200 to 256—with a consequential increase in storage and time requirements but without any benefit to our present task. On the contrary, because it may introduce a sharp discontinuity (see examples), zero-filling hinders smoothing.

For data-smoothing purposes, the disadvantages of the FFT often outweigh its advantages. This was the conclusion we reached after we had implemented a smoothing procedure that relied on a standard FFT routine. We therefore designed the algorithm that is the subject of this article. This new algorithm is not an FFT. It shares with the FFT the first two advantages cited above but does not share any of the disadvantages.

PRINCIPLES OF THE ALGORITHM

Notice that equations 7, 8, and 10 are all of the form

(11)
\[ G = \sum_{m=1}^{M} U_m \cos \left( \frac{2\pi ml}{N} \right) + V_m \sin \left( \frac{2\pi ml}{N} \right) \]

when \( G, m, U_m, V_m, M, \) and \( l \) are appropriately interpreted.

To evaluate expression 11 our algorithm uses the following principle: The sum is split into odd-\( m \) and even-\( m \) terms.

(12)
\[ G = \sum_{m=1,3}^{M} \cos \left( \frac{2\pi (m+1)l}{N} \right) + \frac{2\pi}{N} \]
\[ + V_m \sin \left( \frac{2\pi (m+1)l}{N} \right) \]
\[ \text{and the arguments of the trigonometric terms are modified in the odd-} m \text{ moiety. Next, addition formulas are used to expand the modified functions and the } m \text{ is then replaced by } 2m-1 \text{ in the first summation and by } 2m \text{ in the second. After collection of terms, this leads to} \]
How many long unproductive hours have you spent “in line” for your simulation? Well, no more. MICROCAP and MICROLOGIC can put you on line by turning your PC into a productive and cost-effective engineering workstation.

Both of these sophisticated engineering tools provide you with quick and efficient solutions to your simulation problems. And here’s how.

**MICROCAP: Your Analog Solution**

MICROCAP is an interactive analog circuit drawing and simulation system. It allows you to sketch a circuit diagram right on the CRT screen, then run an AC, DC, or Transient analysis. While providing you with libraries for defined models of bipolar and MOS devices, Opamps, transformers, diodes, and much more, MICROCAP also includes features not even found in SPICE.

MICROCAP II lets you be even more productive. As an advanced version, it employs sparse matrix techniques for faster simulation speed and larger networks. In addition, you get even more advanced device models, worst case capabilities, temperature stepping, Fourier analysis, and macro capability.

**MICROLOGIC: Your Digital Solution**

MICROLOGIC provides you with a similar interactive drawing and analysis environment for digital work. Using standard PC hardware, you can create logic diagrams of up to 9 pages with each containing up to 200 gates. The system automatically creates the netlist required for a timing simulation and will handle networks of up to 1800 gates. It provides you with libraries for 36 user-defined basic gate types, 36 data channels of 256 bits each, 10 user-defined clock waveforms, and up to 50 macros in each network. MICROLOGIC produces high-resolution timing diagrams showing selected waveforms and associated delays, glitches, and spikes—just like the real thing.

**Reviewers Love These Solutions**

Regarding MICROCAP ... “A highly recommended analog design program” (PC Tech Journal 3/84). “A valuable tool for circuit designers” (Personal Software Magazine 11/83).

Regarding MICROLOGIC ... “An efficient design system that does what it is supposed to do at a reasonable price” (Byte 4/84).

MICROCAP and MICROLOGIC are available for the Apple II (64k), IBM PC (128k), and HP-150 computers and priced at $475 and $450 respectively. Demo versions are available for $75. MICROCAP II is available for the Macintosh, IBM PC (256k), and HP-150 systems and is priced at $895. Demo versions are available for $100. Demo prices are credited to the purchase price of the actual system.

Now, to get on line, call or write today!

**Spectrum Software**

1021 S. Wolfe Road, Dept. B
Sunnyvale, CA 94087
(408) 738-4387
Inquiry 295
Listing 1: The Microsoft BASIC version of the Fourier-smoothing algorithm.

2 ' Fourier smoothing...
4 * FOURIER SMOOTHING WITHOUT THE FAST FOURIER TRANSFORM PROGRAM
6 ' By Eric E. Aubanel and Keith B. Oldham
8 *
10 CLS
12 INPUT "ENTER NUMBER OF DATA POINTS"; N
14 REM LEAVING R AND I ARRAYS UNDIMENSIONED
16 N2 = INT((N+1)/2) + 1: DIM X(N), X1(N), U(N2), V(N2)
18 FOR I = 0 TO N - 1
20 INPUT ... ELSE 42
40 GOTO 28
42 END
44 REM FOURIER ALGORITHM SUBROUTINE BEGINS
AT LINE 60. LINE NUMBERS ARE THE SAME AS
FOR THE HP VERSION OF THE SUBROUTINE
60 Pl = 3.141593
70 PRINT "NUMBER OF TRANSFORM POINTS 
TO BE KEPT":
80 INPUT E
90 IF E > INT((N + 1)/2) THEN PRINT "E TOO LARGE" 
: GOTO 70
100 IF E < INT(E) OR E <= 1 THEN GOTO 70
110 IF E > INT(E) OR E <= 1 THEN GOTO 70
120 REM
130 IF Q > 0 THEN 330
140 'CALCULATE R(0)
150 G = 0
160 FOR J = 0 TO N - 1
180 G = G + X(J)
190 NEXT J
200 R(0) = G/N
210 Q = 1
220 REM
230 'CALCULATE X(l)
240 PI = 3.141593
250 FOR K = 1 TO E
260 T = 2
270 S = T + 1
280 FOR J = 1 TO N
290 X(J) = X((J-1)/2) + T
300 NEXT J
310 IF K = 1 THEN 220
320 IF K = E THEN 220
330 REM
340 'CALCULATE X(K) FROM X(L)
350 FOR K = 1 TO E
360 ...
Our multi-mode printers accelerate from 100 cps to 480 cps

Speed and quality have never been as successfully combined. Professionals who want only the best will also appreciate:

**Their versatility.** Wide range of attractive characters sets in 16 national versions, as well as math symbols, bar codes and teletex. Dual ports, parallel (CENTRONICS™/ EPSON™ compatible) and serial (RS-232C/RS-422) interfaces. DIABLO™ 630 emulation optional.

**Their resolution.** Finest print quality available on matrix printers. So good you can even print signatures. Bit mapping graphics in single and double density modes, 6 dots densities in each mode. A circle on the screen means a circle on the paper too!

**Their quality.** Swiss high quality construction. Quality that lasts - thanks to their exclusive «moving-ruby» head.

**Their multicolored printing.** Text and graphics printing in 8 colors on both models 615 and PC-Printer 2.

**HERMES®**

The impressive printers

Made by HERMES PRECISA INTERNATIONAL, CH-1401 Yverdon, Switzerland

HERMES printers are distributed in Austria, Canada, Cyprus, Finland, France, Greece, Jordan, Kuwait, Lebanon, Saudi Arabia, South Africa, Spain, Sweden, Switzerland, United Kingdom, USA, West Germany.

In the Grand Prix of office automation, HERMES multi-mode printers always come in first. Both 400/480 cps data and 100/120 cps single pass near letter quality are possible with the same print-head.

To receive a sample of the finest quality matrix print-out and additional information on the HERMES printers, please return the coupon below.
FOURIER SMOOTHING

1080 C = COS(S); S = SIN(S)
1090 FOR P = 1 TO P1
1100 U(K1 + 1) = 0; V(K1 + 1) = 0
1110 K1 = INT((K1 + 1)/2)
1120 FOR K = 1 TO K1
1130 L = 2*K - 1
1140 U = U(L)*C - V(L)*S + U(L + 1)
1150 V(K) = U(L)*S + V(L)*C + V(L + 1)
1160 U(K) = U
1170 NEXT K
1180 S = 2*S*C; C = 2*C*C - 1
1190 NEXT P
1200 X1(J) = R(O) + 2*(U(1)*C + V(1)*S)
1220 NEXT J
1230 RETURN

Listing 2: The straight-line procedure for eliminating the "end effect" can be MERGED with listing 1 without modification. Note that this listing is not a stand-alone program.

140 'STRAIGHT LINE CALCULATION
150 S1 = 0; S2 = 0
160 D = INT(N/10)
170 FOR J = 0 TO D - 1
180 S1 = S1 + X(J)
190 S2 = S2 + X(N - J - 1)
200 NEXT J
210 XI = S1/D; XJ = S2/D
220 M = (X2 - X1)/(N - D)
230 B = (X1 + X2)/2 - M • N/2
270 X(J) = X(J) - M • J - B
970 X1(0) = X1(0) + B
1210 X1(J) = X1(J) + M • J + B

where \( c \) and \( s \) are abbreviations for \( \cos(2\pi/N) \) and \( \sin(2\pi/N) \), respectively, if \( M \) is odd, equation 13 calls for the values of \( U_{M-1} \) and \( V_{M-1} \), which were not present in equation 11: these terms are to be interpreted as zero.

A comparison of equations 11 and 13 shows that, at the expense of having to evaluate two new coefficients, we have condensed the number of summed terms by a factor (almost or exactly, according to the parity of \( M \)) 2. A careful analysis shows that if such a condensation procedure is repeated \( P \) times, where \( P = \text{Int}\{\log_2(2M-1)\} \), then a single \( |m=1| \) term remains, from which \( G \) is easily calculable.

By adopting this \( P \)-fold condensation procedure, we have reduced the number of sines and cosines that each need to be evaluated from \( M \) to \( P+1 \), or from 198 to 9, for example. In fact, you can get away with evaluating only one sine and one cosine, since the arguments involved \( (2\pi l/N, 4\pi l/N, 8\pi l/N, \ldots, 2^{P+1}\pi l/N) \) form a sequence in which each is double the previous argument, allowing the duplication formulas \( \sin 2\theta = 2\sin \theta \cos \theta \) and \( \cos 2\theta = 2\cos^2 \theta - 1 \) to be used with advantage. It must be emphasized that our algorithm is for Fourier smoothing alone.

OPERATION OF THE ALGORITHM

[Editor's note: The listings reprinted here are Microsoft versions of the authors' HP programs. The HP listings are available on the FROMBYTE file area of BYTEnet Listings, (603) 924-9820, under the names FTBAS and FTEXTBAS.]

The data to be smoothed is entered into array \( X(I), I = 0 \) to \( N-1 \), where \( N \) is the number of points. The number of iterations of the condensation procedure, \( O \), is initialized to zero. Lines 140 through 230, 270, 970, and 1210 have been omitted from the subroutine listing. These lines can be filled with a straight-line modification of the data, which we will discuss in the next section.

The degree of smoothing, \( E \), must be an integer greater than 1 and less than \( N/2 \) (half the total number of points). The first transform calculated is \( R_o \), followed by the evaluation of \( R_k \) and \( i_k \) for \( k = 0 \) to \( E-1 \) (see below). Then the first inverse transformed point \( \hat{X}_0 \) is calculated, using the quadratic filter function and \( R_0 \). Finally, the rest of the inverse transforms \( \hat{X}_j \), for \( j = 1 \) to \( N-1 \), are calculated using \( R_k \), \( I_k \) and the quadratic filter function. These inverse transforms consist of the smoothed data and are stored in array \( X(I), I = 0 \) to \( N-1 \).

After one pass through the subroutine, you may want to select a different degree of smoothing. To do so, you execute the subroutine again. Since many of the transforms will have been calculated previously (the number currently existing is \( O \)), this second execution of the subroutine will require fewer transform calculations (or none if greater smoothing—i.e., a smaller \( E \)—is chosen).

EXAMPLES

Let's take a look at three types of applications of our algorithm: on scientific data, meteorological data, and annual agricultural statistics.

Our first example concerns electrochemical data acquired in this laboratory during studies of very low con-
Gifford has the network solution. It's simple, fast, secure, complete, and it works. Multiuser Concurrent DOS is based on Digital Research's Concurrent DOS, the only major microcomputer operating system specifically designed for networking.

Users can share disks and printers transparently, and can also take advantage of true multiuser features like file and record lockout. And Gifford has added a bundle of features, reminder messages, message of the day, automatic startup and shutdown procedures, and easily prepared files for initializing terminals, printers, and network nodes.

Gifford's Virtual Terminals™ increase productivity.

Gifford nets a big one: Simplicity.

If you've gone through the ordeal of typing as many as seven commands just to get on and off a network, Gifford has your number. A single, menu-driven network command handles all your network options.

The safety net.

Multiple users can mean multiple security problems. Gifford's security enhancements include login account names and encrypted passwords to control access to the system. Users can be further restricted to specified terminals, user areas, programs, or nodes on the network. You're also safe from excessive down time, since the modular network architecture gives you immunity from single point failure.

Gifford adds to your net worth.

Our enhancements of Concurrent DOS make it possible to get more and better work done in less time. Networkwide features include electronic mail, event calendar, inter-terminal communication, user time accounting and usage report telecommunications,
FOURIER SMOOTHING

centrations of heavy metal in water. Because the signal is so small, it is contaminated with noise (see figure 2). Fourier smoothing the data eliminates the noise, leaving the signal proper. This illustrates the virtue of Fourier smoothing experimental data acquired electronically, since it can eliminate the high-frequency noise originating from the instrumentation. The peak height, which is proportional to the metal concentration, can be quantified easily from the smoothed curve.

Choosing the right degree of smoothing, by varying $E$, is a matter of trial and error. The effects of undersmoothing and oversmoothing are illustrated in figure 2. We obtained the best smoothing when $3 \leq E \leq 9$.

Consider a graph of daily maximum temperature readings for the period of January 1982 to June 1983, shown in figure 3. There is a clear seasonal variation, but there is also a great deal of scatter. This scatter is caused by short-term variations in the temperature due to changing weather conditions. To better examine the underlying seasonal variations, it would help to eliminate the short-duration fluctuations of temperature. A direct application of Fourier smoothing, however, produces the red line shown in figure 3, which is obviously not satisfactory. The smoothed curve does not match the data at the ends. The cause of this "end effect" is that some high frequencies not due to noise were eliminated in the smoothing process. The "genuine" high frequencies come from the discontinuity between the beginning and the end of the data. The discrete Fourier transform treats the data as periodic; that is, it assumes that the last points are followed by replicas of the initial points (see figure 4a). Thus the transform "perceives" a sudden jump between the end of one period and the beginning of the next. Sudden

Figure 2: An example of Fourier smoothing scientific data. The data represents a derivative neopolarogram at a static-mercury-drop electrode. The black line, showing proper smoothing, was obtained by $N = 72$, $E = 8$. In the red line, showing undersmoothing, $E = 20$. In the oversmoothed blue line $E = 4$.

Figure 3: Daily maximum temperatures at the Peterborough, Ontario, weather station from January 1982 through June 1983. The red line ($N = 546$, $E = 9$) provides an example of false smoothing due to an "end effect." To correct for this effect, subtract a straight line (black) joining the ends of the unsmoothed data. The resulting "normalized" smoothing is shown by the blue line ($E = 7$).

Figure 4: An explanation of the "end effect," which results from the discrete Fourier transform treating the data as periodic (a). The sudden jumps between one period and the next produce "genuine" high frequencies (not associated with noise) in the transform spectrum. To eliminate the "end effect," subtract a straight line joining the ends from the data. The result of this operation is shown in (b). Notice that now the data begins and ends at the same ordinate value, which means that there are no sudden discontinuities from the transform's point of view.

(continued)
THE LARGEST CAPACITY DISK EMULATOR YOU HAVE EVER SEEN.

You know about disk emulators. They’re fast semiconductor disk drives. Very fast. But until now, the most disk storage you could get on a single board was 1Mbyte. (That was from AS, too.) Now we have news that’ll really blow your socks off... 2 Megabytes on a single board. Available NOW. That’s not a pie-in-the-sky promise.

That’s enough storage for dozens of large programs and hundreds of kilobytes of data files. Enough for almost anything you want to do with a disk drive. But that’s not all. With SemiSpool, our CP/M print spooler, you can implement a print buffer hundreds of kilobytes long in seconds. All in software. At no extra cost.

Another thing about disk emulators. Unless they’re from SemiDisk Systems, they’re probably afraid of the dark. Lose power or turn the computer off, and your valuable data goes to that big backup disk in the sky. But our Battery Backup Units keep SemiDisk data flying high while your computer is off, and up to 10 hours during a complete blackout.

So remember this: SemiDisk Systems has been building dedicated microcomputer disk emulators longer than anyone. And larger. And faster. And at a much lower cost. And that’s not a lot of hot air.

AT A PRICE YOU NEVER THOUGHT YOU’D SEE

<table>
<thead>
<tr>
<th></th>
<th>512K</th>
<th>1Mbyte</th>
<th>2Mbyte</th>
</tr>
</thead>
<tbody>
<tr>
<td>SemiDisk I, 5-100</td>
<td>$995</td>
<td>$1795</td>
<td>$2549</td>
</tr>
<tr>
<td>SemiDisk II, 5-100</td>
<td>$1295</td>
<td>$2095</td>
<td>$2499</td>
</tr>
<tr>
<td>IBM PC, XT, AT</td>
<td>$945</td>
<td>$1795</td>
<td>$2499</td>
</tr>
<tr>
<td>QX-10,QX-16</td>
<td>$799</td>
<td>$1795</td>
<td>$2499</td>
</tr>
<tr>
<td>TRS-80 II,12,16</td>
<td>$995</td>
<td>$1795</td>
<td>$2499</td>
</tr>
<tr>
<td>Battery Backup Unit</td>
<td>$150</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SemiDisk Systems, Inc.
P.O. Box GG, Beaverton, Oregon 97075
503-642-3100

jumps correspond to high frequencies, which in turn result in more high frequencies in the transform spectrum.

The solution to the problem of retaining genuine high frequencies from transformed data is to subtract a straight line joining the beginning and the end of the unsmoothed data. Initially we thought of subtracting a line joining the first and last points. However, since the unsmoothed data contains a lot of scatter, the straight line joining the end points would not necessarily match the beginning and end of the trend. We dealt with this problem by taking the first and last 10 percent of points, averaging each set, and joining the two resulting points. The procedure consists of subtracting the line from the unsmoothed data, smoothing the modified data, then adding the line on to the smoothed data. As mentioned before, the effect of subtracting the line is to eliminate end discontinuities (figure 4b). To include this procedure in the smoothing subroutine, you should merge the program steps shown in listing 2 with listing 1.

The result of treating the data in figure 3 with a straight line is shown as a blue line, which produces a much better fit. Note that a greater degree of smoothing is used here than in the "unnormalized" (red) line. Since we have now eliminated most "genuine" high frequencies, we can filter out more high frequencies.

Historical statistics can be found on such varied subjects as wheat production and the number of hospital beds. In many cases there is an upward trend, due to the increasing population and increasing costs. To examine a trend over a long period of time, you may want to smooth the data.

Our third case concerns wheat production in Canada from 1906 to 1974 (see figure 5). There is a great deal of noise, which makes it difficult to draw a definitive trend by eye. The Fourier-smoothed curve shows an upward trend, as expected, but not in a straight line. This is important, because a straight-line fit might be an oversimplification for a particular analysis.

There are other, more subtle sources of high frequencies that will not be discussed but should be mentioned.

Sudden discontinuities other than the end type may occur in the data, and these may be treated by subtracting several straight lines where appropriate. You can also handle this problem by smoothing the continuous segments separately instead of treating the data as a whole. Another source of high frequencies is a sudden change in slope, which is more difficult to correct. Here it is necessary to subtract an appropriate curve that matches the portion of the data that changes slope abruptly.

REFERENCES
Cross-Assemblers to Beat the Band!

Development Tools That Work
Avocet cross-assemblers are fast, reliable and user-proven in over 4 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 almost any personal computer and process assembly language for the most popular microprocessor families.

Your Computer Can Be A Complete Development System
Avocet has the tools you need to enter and assemble your soft-ware and finally cast it in EPROM:

VEDIT Text Editor makes source code entry a snap. Full-screen editing plus a TECO-like command mode for advanced tasks. Easy installation - INSTALL program supports over 40 terminals and personal computers. Customizable keyboard layout. CP/M-80, CP/M-86, MSDOS, PCDOS...

EPROM Programmers let you program, verify, compare, read, display EPROMS but cost less because they have all features of stand-alone plus RS-232 interface.

- EPROM Programmers - Similar features to 7228, but program as many as 8 EPROMS at once. 7956-8A stand-alone version copies from a master EPROM. 7956 lab version has all features of stand-alone plus RS-232 interface.
- 7228 Advanced Programmer $549
- 7128 Standard Programmer $429
- 7956 Laboratory Gang Programmer 1099
- 7956-SA Stand-Alone Gang Programmer 879
- GDX Driver Software 95
- 481 8748 Family Socket Adaptor 98
- 511 8751 Socket Adaptor 174
- 755 8755 Socket Adaptor 135
- CABLE RS-232 Cable (specify gender) 30

HEXTRAN Universal HEX File Converter — Convert assembler output to other formats for downloading to development systems and target boards. Also useful for examining object file, changing load addresses, extracting parts of files. Converts to and from Intel, Motorola, MOS, RCA, Fairchild, Tektronix, TI, Binary and HEX/ASCII Dump formats. For CP/M, CP/M-86, MSDOS, PCDOS...

Model 7956 and 7956-SA Gang Programmers — Similar features to 7228, but program as many as 8 EPROMS at once. 7956-8A stand-alone version copies from a master EPROM. 7956 lab version has all features of stand-alone plus RS-232 interface.

- 7228 Advanced Programmer $549
- 7128 Standard Programmer $429
- 7956 Laboratory Gang Programmer 1099
- 7956-SA Stand-Alone Gang Programmer 879
- GDX Driver Software 95
- 481 8748 Family Socket Adaptor 98
- 511 8751 Socket Adaptor 174
- 755 8755 Socket Adaptor 135
- CABLE RS-232 Cable (specify gender) 30

68000 CROSS-ASSEMBLER — With exhaustive field testing completed, our 68000 assembler is available for immediate shipment. XMAC68K supports Motorola standard assembly language for the 68000 and 68010. Macros, cross-reference, structured assembly statements, instruction optimization and more. Linker and librarian included. Comprehensive, well-written manual.

To find out more, call us toll-free.

1-800-448-8500

Would you hire an entire band when all you need is one instrument? Of course not.

So why use a whole orchestra or computers when all you need is one type of micro-processor?

The secret? Avocet's family of cross-assemblers. With Avocet cross-assemblers you can develop software for practically every kind of processor — without having to switch to another development system along the way!
**Commodore Accessories**

**RS232 ADAPTER FOR VIC-20 AND COMMODORE 64**

New!

The JE232CM allows connection of standard serial RS232 printers, modems, etc. to your VIC-20 and C-64. A 6 -pole switch allows the inversion of the control lines. Complete installation and operation instructions included. 

- **Plugs Into User Port**
- **Provides Standard RS232 signal levels**
- **Uses & Sign In/Sign Out**
- **Ready to Send**: Request to Send, Data Terminal Ready, Data Set Ready

JE232CM

**$39.95**

---

**VOICE SYNTHESIZER FOR APPLE AND COMMODORE**

Great Educational Tool!

- **Over 250 words vocabulary allows the formation of more than 500 words**
- **Built-in speaker, volume control, and headphone jack**
- **Recreates a clear, natural male voice**
- **Plug-In user control**
- **Builtin amplifier, speaker, volume control, and headphone jack**
- **Over 250 word vocabulary affixes allow the formation of more words**

JE280AP

**$149.95**

---

**Computer Memory Expansion Kit**

IBM PC, XT and Compatibles

Most of the popular Memory Boards (e.g. Quadram™ Expansion Boards) require 500瓦字体。The JE840 does not require these boards to expand memory. The JE840 is simple to install.

- **IBM/PC XT**
- **IBM PAT**
- **IBM/PC XT Expansion (JE840)**
- **IBM/PC XT Expansion (JE840)**

JE840

**$179.95**

---

**Apple Accessories**

**5WAPPLE™ Direct Plug-In Compatible Disk Drive and Controller Card**

The ADD-1 Disk Drive uses Shugart SA390 mechanics - 143K -- 360K, 5.25". Compatible with Apple Control-Ler and IBM PC. This drive comes with connector and cable - just plug it into your disk controller card. Size: 6.1" x 3.3/4" H. Weight: 8-9/16". Add: $19.95.

ADD-14 (Disk Drive)...

**$19.95**

---

**More Apple Compatable Add-Ons...**

APF-1 (Coding Farmer with spray protection)...

KHP-1007 (Switching Power Supply)...

JE616 (Novelty)...

KB-468 (Keyboard w/optional for II & II+)...

JE612 (40 Col. - VIC for use)...

ADD-12 (5" Half-Height Disk Drive)...

**$179.95**

---

**DISK DRIVES**

- **IBM/PC XT**
- **IBM/PC XT**
- **IBM/PC XT**
- **IBM/PC XT**

IBM PAT

**$179.95**

---

**UV-EPROM Eraser**

- **Erases up to 6 chips within 21 minutes (1 chip = 30 minutes)**
- **Apple Control-Rers**
- **Apple Control-Rers**
- **Apple Control-Rers**

JE644 (Eraser)...

**$74.95**

---

**JE654 EPROM PROGRAMMER 6K to 64K EPROMS -- 24 & 25 Pin Packages**

- **Programs and validates EPROMs**
- **Checks for properly erased EPROMs**
- **Compliments the JE654**
- **Checks for properly erased EPROMs**

JE654 (Programmer)...

**$95.00**

---

**EPMOPRGRMRM W/JE655 Option JE654-ARS**

- **Full EPROM PROGRAMMING**
- **JE655 EPMOPRGRMRM W/JE655 Option JE654-ARS**
- **JE655 EPMOPRGRMRM W/JE655 Option JE654-ARS**
- **JE655 EPMOPRGRMRM W/JE655 Option JE654-ARS**

JE654-ARS...

**$119.95**

---

**EPROM JUMPERS (JE615)**

- **JE615**...
- **JE615**...
- **JE615**...
- **JE615**...

JE615 (Jumper)...
TOLL FREE 1-800-233-8760

TO ORDER
CALL TOLL FREE
800-233-8760

or send order to
Lyco Computer
P.O. Box 5088
Jersey Shore, PA 17740

Customer Service 1-717-327-1825

RISK FREE POLICY
In-stock item shipped within 24 hours of order. No deposit on COD orders. Free shipping on prepaid cash orders within the Continental U.S. PA residents add sales tax. APO, FPO. and International orders add $5.00 plus 3% for priority mail service. Advertised prices show 4% discount for cash, add 4% for Master Card or Visa. Personal checks require 4 weeks clearance before shipping. All items subject to change without notice.
PARANOIA: A FLOATING-POINT BENCHMARK

by Richard Karpinski

Test the quality of your software, not just its speed

FLOATING-POINT ARITHMETIC was created to make programming easier and programs faster. It is complicated so that your programs can be simple, but rough edges and pitfalls are common in floating-point systems.

The Paranoia benchmark was designed to find and notify you of those places where actual results are not good enough. It reports pitfalls discovered in a systematic checkout of the arithmetic used by the computer running it. Why Paranoia? Webster's Ninth New Collegiate Dictionary (Springfield, MA: Merriam-Webster Inc., 1983) provides the following as its second definition of paranoia: "a tendency on the part of an individual or group toward excessive or irrational suspiciousness and distrustfulness of others"—an apt description of this program, which looks for problems at every turn. This article looks into the workings of floating-point arithmetic to see why you need such quality tests and how they work.

LIFE WITHOUT FLOATING POINT

Remember those heavy mechanical calculators with 10 long rows of keys? If you wanted to use measurements in fractions rather than whole numbers, you could set the decimal point somewhere in the middle of the field. Numbers could grow or shrink on either side of it, but the point itself was really fixed. This is enough for many hand calculations where you need only 5 or 10 steps to get the final result. Fixed-point calculations like this are simple and match the pencil-and-paper methods we learned in grade school. They are easy to understand and use, and they work quite well almost all the time.

Almost is not enough, however. Even events that happen quite rarely require careful attention when you are designing a computer system. Because computers are so much faster than we are, a system that works correctly on 99.999 percent of its data can still fail once every second. With paper and pencil, if a few numbers don't fit within the limits you have chosen, you can write smaller or use another sheet of paper. Mechanical calculators and computers are not so flexible.

If you set up a calculator for numbers of the form \( mmm.mmm.mmm.mnm \), for example, an intermediate result of 1 million is hopelessly damaged. There is no place to put the digit in the millions place. This problem is called overflow. There are calculators with 20 or 30 digits or even more, but you can't really solve the problem this way. Long calculations continually require you to copy an intermediate result from the calculator's dials back onto the keys in order to shift it to the left or the right to accommodate the overflow. The copying process is error-prone and tedious for those who do it. (Originally, these people were called "computers").

Very small numbers in this format also suffer. Numbers smaller than 1
one-millionth are lost entirely. They
underflow to zero. Even numbers as
large as 1 one-thousandth lose most
of their significant digits. Only 3 of the
12 digits of precision initially provided
remain.

When overflow and underflow prob-
lems arise in hand calculations, and
even in many computer applications
that have tight constraints on hard-
ware and timing, you can solve them
by rescaling the numbers—multiplying
or dividing them by 10, 100, or 1000-
to bring the number back into view.
Naturally, you must keep track of each
scaling operation you perform so that
you can readjust the final answer
properly.

You must also check to see if this
problem arises at every possible
place, although such checking makes
every program longer and more com-
plicated. This high cost of being ex-
tremely careful must be weighed against
the fact that the unchecked version
works most of the time. In fact, you
may have tested the unchecked version
with thousands of cases and consider
it completely debugged.

In principle, if you know enough
about the numbers that arise, you can
build the rescaling shifts into your
procedure so that they don't take any
extra effort during the calculation
itself. This can save up to two-thirds
of the time that floating-point calcula-
tions take. John von Neumann, often
called the father of computing, held
the view that such a priori analysis
was the proper approach. He saw no
need for floating point. However,
most programmers now agree that
the analysis required is far too costly
and error-prone to ignore floating-
point hardware.

**SCIENTIFIC NOTATION**

As researchers and scientists have
probed the further reaches of our
world, they have developed scientific
notation to express very large and
very small numbers with equal preci-
sion. For example,

\[
602,300,000,000,000
\]

becomes \(6.023 \times 10^{23}\) while

\[
0,000,000,000,006,624
\]

becomes \(6.624 \times 10^{-23}\). The preci-
sion or uncertainty figures for these
numbers look very different until you
express them in scientific notation:

\[
5.0 \times 10^{10}
\]

for the first versus

\[
5.0 \times 10^{-18}
\]

for the second.

When you consider imprecise
numbers, it is easy to become con-
fused between absolute uncertainty
and relative uncertainty—relative to
the size of the value involved. The
relative uncertainty here is referred to
as "half a unit-in-the-last-place" or "½
ulp." Since we want computers to
cope quickly and precisely with a
wide range of numbers, we adapt the

(continued)
In a one-to-one comparison, Westrex-One.

The new Westrex One. Compare it for yourself.

See the Westrex One in action, and you'll understand why it's far and away the winner in any one-on-one comparison.

Westrex One has the versatility that gives your product extra value. It produces some of the crispest, clearest Dot Matrix printing you can find. Plus a comprehensive variety of type fonts and styles. And the ability to handle intricate graphics. Custom interfaces where required.

Naturally, because it's built and backed by Westrex/Division of Litton, it's a reliable, long lasting product. We kept moving parts to a minimum, so there's less to go wrong.

If you need a printer with Flexibility... Quality... High Performance, the Westrex One is the 1 for you.

Send for free comparative performance matrix and make your own "one-to-one" evaluation. Contact Westrex/Division of Litton OEM Products, 51 Penn Street, Fall River, MA 02724. (617) 676-1016.
TELEX: 651490, Please Relay WNJW.
科学记数法用于任务。您不需要存储的“x 10”部分，因为它不随变量中的各种数字变化，每个数字都包含一个带有不同显著性分数和一个整数指数的分数。重新缩放后没有丢失。"指数"是变量，其中重新缩放操作会根据它们的关系来调整。您可能会预期，指数是代表的表达式中存在的指数，每个数字被重新缩放后自动执行操作来删除任何丢失的数字，并达到最大数字数量的显著性分数。

我们使用十进制表示法（基数10）进行数值，但计算机通常使用二进制表示法（基数2）来匹配其内存和逻辑电路组件。在二进制中，您，例如，使用一个显著性分数2和1，这表明一个大于1的数字及其指数。有些计算机使用十六进制表示法（基数16）；它们的显著性分数可以是任意的，但是当将指数调整到以2为基数的指数时，您可以将指数调整到以10为基数的指数。

有时，您可以在接近最高精度的答案时接受较少的精度。在这种情况下，您必须接受一个较小的答案。在这种情况下，您必须接受一个较小的精度。

1号端口

科学记数法用于任务。您不需要存储的“x 10”部分，因为它不随变量中的各种数字变化，每个数字都包含一个带有不同显著性分数和一个整数指数的分数。重新缩放后没有丢失。"指数"是变量，其中重新缩放操作会根据它们的关系来调整。您可能会预期，指数是代表的表达式中存在的指数，每个数字被重新缩放后自动执行操作来删除任何丢失的数字，并达到最大数字数量的显著性分数。

我们使用十进制表示法（基数10）进行数值，但计算机通常使用二进制表示法（基数2）来匹配其内存和逻辑电路组件。在二进制中，您，例如，使用一个显著性分数2和1，这表明一个大于1的数字及其指数。有些计算机使用十六进制表示法（基数16）；它们的显著性分数可以是任意的，但是当将指数调整到以2为基数的指数时，您可以将指数调整到以10为基数的指数。

有时，您可以在接近最高精度的答案时接受较少的精度。在这种情况下，您必须接受一个较小的答案。在这种情况下，您必须接受一个较小的精度。

1号端口

科学记数法用于任务。您不需要存储的“x 10”部分，因为它不随变量中的各种数字变化，每个数字都包含一个带有不同显著性分数和一个整数指数的分数。重新缩放后没有丢失。"指数"是变量，其中重新缩放操作会根据它们的关系来调整。您可能会预期，指数是代表的表达式中存在的指数，每个数字被重新缩放后自动执行操作来删除任何丢失的数字，并达到最大数字数量的显著性分数。

我们使用十进制表示法（基数10）进行数值，但计算机通常使用二进制表示法（基数2）来匹配其内存和逻辑电路组件。在二进制中，您，例如，使用一个显著性分数2和1，这表明一个大于1的数字及其指数。有些计算机使用十六进制表示法（基数16）；它们的显著性分数可以是任意的，但是当将指数调整到以2为基数的指数时，您可以将指数调整到以10为基数的指数。

有时，您可以在接近最高精度的答案时接受较少的精度。在这种情况下，您必须接受一个较小的答案。在这种情况下，您必须接受一个较小的精度。
"Now when I talk, my broker listens."

No matter what kind of investing you do, there is a Dow Jones Software product that will make you and your broker a better team.

Dow Jones Investor's Workshop™ is the perfect software for private investors who want an introduction to the world of computerized investing. The Investor's Workshop creates reports and charts that give you a clear picture of the performance of your investments. It enables you to become more proficient in portfolio management and technical analysis.

Dow Jones Market Manager PLUS™ is a powerful portfolio management system for serious investors. It allows you to easily monitor and account for your security transactions while providing printed reports for review and tax records. These reports include Holdings by Portfolio, Holdings by Security, Realized Gain/Loss and Dividend Transaction.

Dow Jones Market Analyzer™ is designed for sophisticated investors who chart stocks. The Market Analyzer stores historical quotes and updates daily data on your securities. It constructs comparison and price and volume charts, allowing you to test theories, identify trends and improve the timing of your investment decisions.

Each of these programs communicates with Dow Jones News/Retrieval®, the leading electronic information service.

For more information, mail coupon or call:
1-800-345-8500 ext. 48
(Alaska, Hawaii and foreign call: 1-215-789-7008 ext. 48)

Dow Jones Investor's Workshop available for Apple*IIe, Apple*IIe and Apple*II Plus.
Dow Jones Market Manager PLUS available for IBM*PC, Apple*II and Apple*Macintosh®.
Dow Jones Market Analyzer available for IBM*PC, IBM*XT, Apple*II and TI Professional.

These errors are not mistakes in the process but the inevitable result of restricting the width of floating-point numbers. A carefully built arithmetic system can round meticulously whenever approximation is required. However, in order to round correctly, extra (guard) digits are needed temporarily in the course of ordinary calculations.

Guard digits reduce error. In a four-digit system you may need five or more digits to maintain accuracy until the result is rescaled. For example, $1.144 \times 10^7$ minus $8.336 \times 10^6$ really needs five digits. Without the extra digit this simple subtraction suffers an error of 4 to 6 ulps, a serious defect that makes numerical programming even more difficult and error-prone.

To illustrate with the guard digit, $11.44$ minus $8.336 \times 10^6$ yields $03.104$, which results in an answer after rescaling of $3.014 \times 10^6$ without the guard digit. $11.44$ minus $8.333$ (if truncated) yields $03.11$ for a result of $3.110 \times 10^6$ and $11.44$ minus $8.34$ (if rounded off) yields $03.10$ for a result of $3.100 \times 10^6$.

The need for guard digits becomes quite clear. What about your computer? Often the specific details of the arithmetic used on a given computer are known only to its designers. Yet they are important to programmers and other users who want to get good, precise, accurate answers.

Professor William Kahan at the University of California at Berkeley wrote Paranoia for just this reason. Paranoia checks many of the arithmetic details of your computer. For each aspect that is not handled in the best way, Paranoia reports what sort of difficulty will ensue from its use.

The full Paranoia program is some 700 lines of BASIC. Listings 1 and 2 show an extract sufficient to test for the use of a guard digit in addition and subtraction. If some part of the routine seems confusing, you may find it helpful to try a pencil-and-paper example with a four-digit system like the one above. These programs were simplified from the Pascal translation of Paranoia by B.A. Wichmann of the National Physical Laboratory in England. The full program guards itself against many (rare) problems that might possibly arise. Full Paranoia also rechecks critical calculations by a second method, just to be sure.

**TEST YOUR CALCULATOR**

You can use essentially the same guard-digit procedure to test your pocket calculator. Without checking for radic, etc., the results of two simple expressions will signal the...
If you've got a computer, you've got a problem. Because every computer comes equipped with something you didn't bargain for—static.

Static is the major cause of computer malfunctions, downtime and lost productivity. And sooner or later a static problem could result in costly repair charges.

But you can eliminate your problem and improve your productivity with Staticide®. So effective, just one application to floors, furniture, walls and equipment keeps the entire workstation area static-free for up to six months.

Staticide is the number one topical anti-static formula on the market. And still the most effective! Don't accept substitutes.

And when it comes to eliminating static and cleaning CRT screens, new Staticide® Wipes™ is the answer. These handy towel-ettes are non streaking and will not harm sensitive electronic components.

Try Staticide and Staticide Wipes. After all, you may not have been charged for that something extra that came with your computer... but it may very well charge you.

Staticide
by ACL Incorporated
1960 E. Devon Avenue
Department 101
Elk Grove Village, IL 60007
(312) 981-9212 Ext. 101
PARANOIA

Listing 1: A Microsoft BASIC program to test for the presence of a guard digit in subtraction. Note: fpwidth is the smallest number formed by multiplying one by the powers of the radix. It is calculated by successive multiplications, until the product when added to 1.0 no longer gives an exact result. (Width is a Microsoft BASIC reserved word and cannot be used as the variable name.)

```basic
10 ' Guard — Test if add/subtract has a guard digit
20 ' 30 One = 1.0 ' Floating-point constants
40 Half = 0.5
50 Zero = 0.0
60 MinusOne = -1.0
70 ' 80 ' variables:
90 ' 100 ' Radix Calculated floating-point radix
110 ' Precision Significant digits in base Radix
120 ' 130 ' Precision
140 ' fpwidth Radix (or Radix ' Precision)
150 ' Wide First estimate of fpwidth
160 ' 170 ' UlpOne Unit in last place of just less than one
180 ' UlpRadix Radix * UlpOne
190 ' 200 ' OneMinus One = UlpOne calculated with care
210 ' RadixMinus Radix = UlpRadix
220 ' 230 ' s, t, u Working variables
240 ' x, y, z
250 ' 260 ' Find a Wide so big that adding one does not change it by one
270 ' 280 ' Wide = One
290 ' 300 ' Double it until it grows so large that
310 ' 320 ' x = Wide + One ' Adding one does not change it or
330 ' (with rounding) changes it by 2
340 ' 350 ' y = x - Wide ' So the difference is zero or 2
360 ' 370 IF ( MinusOne + ABS( z)) < Zero THEN 310
380 ' 390 ' The change is the radix
400 ' Find the radix (or number base) as the minimum increase in Wide
410 ' Remember that Wide is just large enough that the units place
420 ' is not represented, so a one in the last represented place
430 ' (the tens place, for decimal) is exactly the radix itself.
440 ' Try it by hand:
450 ' 460 ' y = One
470 ' 480 ' Radix = Wide + y ' No change on first addition
490 ' 500 ' Radix = Radix - Wide ' Until some change happens
510 ' 520 ' IF Radix = Zero THEN 480 ' The change is the radix
530 ' 540 ' PRINT "Radix = "; Radix
550 ' 560 '
```

PARANOIA
PARANOIA

570 ' Find the precision in Radix digits
580 ' 590 Precision = Zero
600 ' fpwidth = One
610 ' 
620 ' Precision = Precision + One ' Count the digits
630 ' fpwidth = fpwidth • Radix ' And increase fpwidth
640 ' y = fpwidth + One ' Until adding one
650 ' 
660 ' IF ( y - fpwidth) = One THEN 620 ' Is imprecise
670 ' 
680 PRINT "Precision = ": Precision
690 ' 
700 PRINT "fpwidth = ": fpwidth
710 ' 
720 UlpOne = One / fpwidth
730 ' 
740 ' PRINT "Closest relative separation found is UlpOne = "; UlpOne
750 ' 
760 OneMinus = ( Half - UlpOne) + Half
770 UlpRadix = Radix • UlpOne
780 ' 
790 RadixMinus = Radix - One
800 RadixMinus = (RadixMinus - UlpRadix) + One
810 ' 
820 x = One - UlpOne
830 y = One - OneMinus
840 z = One - x
850 ' 
860 s = Radix - UlpRadix
870 t = Radix - RadixMinus
880 u = Radix - s
890 ' 
900 ' IF y = UlpOne THEN 920
910 ' GOTO 960
920 ' IF t = UlpRadix AND u = UlpRadix THEN 940
930 ' GOTO 960
940 ' PRINT "Add/subtract has a guard digit as it should."
950 ' GOTO 980
960 ' PRINT "Add/subtract lacks guard digit, cancellation obscured."
970 ' 
980 ' END ' Guard

Listing 2: Pascal program to test for the presence of a guard digit in subtraction.

program Guard; { Test if add/subtract has a guard digit }

const
One = 1.0; { Floating-point constants }
Half = 0.5;
Zero = 0.0;
MinusOne = -1.0;

var
Radix : real; { Calculated floating-point radix }
Precision : real; { Significant digits in base Radix }

Width : real; { Precision (or Radix • Precision) }
Wide : real; { First estimate of Width }

(continued)
CO-PROCESSING
The most cost effective way for Z80 system owners to obtain 16/32 bit processing power and software compatibility is via the HSC CO-16 Attached Resource Processor.

CO-16 is compatible with any Z80 system running CPM 2.2 or CPM 3. A few examples include:

- KAYPRO 2/4/10
- TRS 2/3/12/16
- AMPRO LITTLE BOARD
- HEATH 89
- SUPERBRAIN
- XEROX 820
- TELEVIDEO 802/803
- MORROW
- EPSON OX-10
- LOBO
- OSBORNE 1/EXEC
- CROMEMCO

Every CO-16 is delivered with:

- 16/32 bit micro processor
- 16 bit Operating System
- 256 Kilo RAM
- Z80 interface
- 16 bit RAM disk driver
- CPM80 2.2 RAM disk driver
- CPM 2.2 or CPM 3 compatibility
- sources with tools
- hardware diagrams
- board level or case with power supply.

The only Z80 16 bit co-processor includes:

- INTEL 8086
- 6Mhz no wait states
- MSDOS 2.11
- IBM BIOS emulator
- Memory expansion to 768K
- 8087 math co-processor
- 3-channel Real Time Clock
- Runs many IBM PC applications
- Share hard disk space with CPM80
- PC diskette compatibility

Dealer, Distributor and OEM's invited
Hallock Systems Company, Inc.
267 North Main Street
Herkimer, N.Y. 13350
(315) 866-7125

PARANOIA

```pascal
UlpOne : real; { Unit in last place of just less than one }
UlpRadix : real; { Radix x UlpOne }
OneMinus : real; { One - UlpOne calculated with care }
RadixMinus : real; { Radix - UlpRadix }
s, t, u : real; { Working variables }
x, y, z : real;

begin {Guard}
{ Find a Wide so big that adding one does not change it by one. }
Wide := One;
repeat

Wide := Wide + Wide; { Double it until it grows so large that }
x := Wide + One; { Adding one does not change it or }
y := x - Wide; { So the difference is zero or 2 }
z := y - One { And this becomes +1 - one }

until ( MinusOne + abs( z ) ) >= Zero;

{ Find the radix (or number base) as the minimum increase in Wide }
{ Remember that Wide is just large enough that the units place is }
{ not represented, so a one in the last represented place }
{ (the tens place, for decimal) is exactly the radix itself. }
{ Try it by hand. }

y := One;
repeat

Radix := Wide + y; { No change on first addition }
y := y + y; { So double y }
Radix := Radix - Wide { Until some change happens }

until Radix <> Zero; The change is the radix!

write( 'Radix = ', Radix );

{ Find the precision in Radix digits }

Precision := Zero;
Width := One;
repeat

Precision := Precision + One; { Count the digits }
Width := Width + Radix; { And increase Width }
y := Width + One { Until adding one }

until ( y - Width ) <> One; { is imprecise }

write( 'Precision = ', Precision );
write( 'Width = ', Width );

UlOne := One / Width;
write( 'Closest relative separation found is UlpOne = ', UlpOne );

OneMinus := ( Half - UlpOne ) + Half;
UlRadix := Radix * UlpOne;
```

(continued)
Finally there's a foolproof way to protect software against unauthorized duplication. The technology is all on the disk and is installed on a hard disk *without the ongoing need for a floppy key.*

Prolok™ doesn't need add-on hardware. Instead each diskette is marked with a unique, physical "fingerprint." No two are alike. A precise description of the individual print is encoded magnetically. The fingerprint AND the description must match exactly before the software is decrypted and released to the system. No match, no access.

Its genius is its simplicity and familiarity. Prolok looks like an unprotected disk, loads like an unprotected disk, works like an unprotected disk. The user feels immediately at home and in command. It's as easy as A>PROLOK B: filename.

Backups are easily made via normal system utilities. However, to be read they must be accompanied in the system by the original Prolok disk, *except when installed on a hard disk.*

Prolok puts the casual copier—and even the deliberate pirate—out of business. It barely increases the price of your product, yet it makes sure your customers don't buy one program and copy ten.

Several command line slash (/) options are built into Prolok diskettes for customized security, depending on your needs.

Software can be loaded easily onto Prolok diskettes using any system from a PC to commercial mass duplication equipment.

Prolok is an engineering breakthrough of Vault Corporation, which has been successfully safeguarding software since the inception of security disk technology. Over 3500 businesses and organizations protect their valuable programs with Prolok.

Simply contact Vault Corporation at 2649 Townsgate Road, Suite 500, Westlake Village, CA 91361. Or phone us at 800-445-0193 (U.S.) or 800-821-8638 (California). And find out why software freebies are becoming a thing of the past.
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 ts can be displayed in contrasting colors.
- Can use optional Microsoft Mouse as pointing device

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
- Microsoft Mouse (optional)

WINTERK CORPORATION, 1801 South St., Lafayette, IN 47904-2993, Phone: (317) 742-8428, Telex: 70-9079 (WINTERK CORP UD)
PARANOIA

RadixMinus := Radix - One;
RadixMinus := (RadixMinus - UlpRadix) + One;

x := One - UlpOne;
y := One - OneMinus;
z := One - x;
s := Radix - UlpRadix;
t := Radix - RadixMinus;
u := Radix - s;

if (y = UlpOne) and (z = UlpOne) and (t = UlpRadix) and (u = UlpRadix)
then writeln('Add/subtract has a guard digit as it should.');
else writeln('Add/subtract lacks guard digit, cancellation obscured.');
end {Guard}.

9 / 27 * 3 + 1
and
9 / 27 * 3 + .5 + .5
A smaller test in Pascal could be:
if (-9 / 27 * 3 + 1) =
(-9 / 27 * 3 + .5 + .5)
then writeln('Add/subtract has a guard digit.');
else writeln('Add/subtract lacks guard digit.');

CONCLUSION
Paranoia is an unusual benchmark: it tests the quality of your software, not just its speed. Most common computer arithmetics have a half-dozen or more flaws that Paranoia finds, reporting what kinds of calculations are harmed by them. Its use can be highly rewarding to those who seek to achieve very accurate, precise, numerical results from their programs.

Meet The Controllers.

Power Control™ protects computer circuitry and data stored in memory against the damage voltage spikes can cause.

Puts on/off control of your computer, terminal, printer, and more at your fingertips in a slim panel unit sized to fit underneath your computer terminal.

Contains a master switch (to turn your computer, terminal, printer, a modem or a lamp on or off at the same time) and three additional switches to turn peripherals on or off in any order.

Relax Technology.

To order: phone 415/471-6112 or mail to: Scott Whipple Rd., #25, Union City, CA 94587
California Residents add applicable sales tax. Prices include shipping.

Power Control 1: $69.95*
Power Control 2: $89.95*
Power Control 3: $129.95*
10 amp circuit breaker, RFI noise filtering, IEC power connector.
Cross suppression between all 4 outlets. Illuminated switches. 3-stage RFI filter.
Check for $ enclosed.

©Relax Technology. The company that works so you can relax and get down to business.
When it comes to printers, we have the two best names in the business.

The Xerox line of Diablo printers.

There are a lot of printers to choose from. But there's only one Diablo line. And it's part of Xerox.

To begin with, there are our Diablo daisywheel printers which have been voted number one for print clarity and quality in a brand preference study.* But that should come as no surprise since we had a headstart on the rest of the industry, inventing the daisywheel back in 1972.

There are also our Diablo dot matrix printers, known for their speed and endurance, they deliver perfect letter definition under the heaviest use.

For producing just about any visual presentation from graphics to text, our high quality Diablo color ink jet printers generate seven vibrant colors to create over 4,000 variations.

Every Diablo printer is unusually quiet, reliable and compatible with most computers on the market including the IBM PC. All are part of Team Xerox, a wide array of products, people and services to meet all your information needs.

The Xerox line of Diablo printers is serviced by the national Xerox service force and Diablo service centers across the country.

So if you're in the market for a printer, go with two of the best names in the business. For the location of the Xerox office, authorized Diablo or Xerox dealer nearest you, call 1-800-833-2323, ext. 802.

*Source: Datamation Magazine 1983 Brand Preference Study of printer preference by end users and OEMs.

Color Ink Jet Printers
Full color graphics and text capabilities make these some of the most versatile in the world.

Daisywheel Printers
We invented the technology, and now it's the accepted standard among letter-quality printers.
Dot Matrix Printers
At draft speed, characters come out crisp and clear; at up to 400 cps. At correspondence quality speed, characters are so readable they make the term "computer printout" almost obsolete.

Diablo Dot Matrix Printers combine speed and low cost, maintenance-free printers. Their various designs and configurations are designed to provide clear and easy legibility. Their low noise output is perfect for long-term reliability to provide you with years of computer system service.

Parallel interfaces enable the Dot Matrix to work with your computer. Diablo and graphics combine to give you the best print quality in over 1000 characters per second, or roughly 300 pages per minute in a general office environment.

For more information about the Diablo line of products, please contact your nearest Diablo office or authorized Diablo dealer.

1983 REVENUE BY QUARTER ($MILLIONS)

PRODUCT
- XP1
- XP2
- XP3
- XP4
- XP5
- XP6

BENEFITS
TS INFORMATION IN AN EASILY READABLE, COLORED FORMAT. DIRECTS YOU TO WHERE YOU WANT IT!!

A WIDE RANGE OF COLORS AND CHOICES.

KERS.

EASE.

AND RECOGNIZABLE...
MicroWay is the world's leading retailer of 8087's and high performance PC upgrades. We stock a complete selection of 8087's that run at 5 and 8mhz. All of our coprocessors are shipped with a diagnostic disk and the best warranty in the business - 180 days! We also offer daughterboards for socketless computers such as the NEC PC and PCjr, and a board which increases the clock speed of the 80287 in the PC AT. Our new NUMBER SMASHER™ will run the IBM PC at clock speeds up to 9.5mhz and achieves a throughput of 1 megaflops with 87BASIC/INLINE, Intel Fortran, or Microsoft Fortran. Software reviewers consistently cite MicroWay software as the best in the industry! Our customers frequently write to thank us for recommending the correct software and hardware to meet their specific needs. They also thank us for our same day shipping! In addition to our own products which support the 8087 and 80287, we stock the largest supply of specialized software available anywhere. These include three FORTRANS, three PASCALS, APL, Intel's ASM-86 and PL/M-86, several Cs, 87BASIC/INLINE, 87MACRO, 87FFT, 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, support for Lotus 1-2-3, 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: 617-746-7341.
MODELING
MASS-ACTION
KINETICS

by Alan Curtis

In the future, microcomputers may have a substantial role in major scientific computations

At the United Kingdom Atomic Energy Research Establishment, Harwell, we have assembled scientific and technological applications of our FACSIMILE reaction-kinetics program. All can be run on one mainframe or another, but for the purposes of this article I have selected a few of those that now run on an IBM PC with 512K bytes of RAM (random-access read/write memory).

Like other simulation modelers such as DYNAMO, FACSIMILE facilitates the calculation of a set of differential equations that describe the continuous evolution of a system from a known initial configuration and then flexibly formats the output.

Simulation models solve problems repeatedly and carry out thorough statistical analyses to find the best fit among parameters. For such work, whether the microcomputer is practical depends on your point of view. A fairly large program that takes, say, three minutes on an IBM mainframe might well run all night on the PC, provided you use an 8087 math coprocessor; without it, running time would probably be about 10 times longer (this is a guess—we haven't checked it out).

Let's take a look at several examples of how simulation models can be used.

Uranium from Seawater?

Seawater contains uranium, an extremely valuable fuel, at an extremely low concentration. Suppose we want to extract the uranium. The question is whether an economically viable extraction process exists. We might try pumping the seawater through an ion-exchange column, a tube tightly packed with minute spheres of a resin that preferentially absorbs uranium ions from solution and replaces them with ions of another metal. When sufficient water has been pumped through, the column is removed and cut up, and ordinary chemical means remove the uranium (now at high concentration in the resin) for further processing. Obviously the value of the recovered uranium must offset the costs of manufacturing the resin and the tubes, of the pumping power, and of the postprocessing to recover the uranium from the resin.

A feasibility study of the problem called for a simulation model because the rate coefficients for the absorption of uranium by the resin were not known. Experiments removed supposedly identical ion-exchange columns at different times, pumped different rates of seawater, and analyzed uranium contents at various points along the columns. Parameter-fitting options might have determined the best fit for these experimental results.

As it turned out, variations in properties, mainly the density of packing of the resin from one column to another, and even along the length of a single column, invalidated the model, which assumed a single uniform column. A more complicated (continued)
model might have involved some of the variability, but the experiments had shown that the whole process was not likely to be economical anyway.

Such negative results are not failures in scientific investigations. On the contrary, we understand far better the requirements for the simulation if we decide to pursue it again.

A modified model, now used for demonstration purposes, contains parameter values chosen to exhibit significant saturation. (There are other ways of solving the problem of modeling an ideal ion-exchange column if you know that saturation is negligible.)

To model the behavior of the column, we divided its length into 20 equal-size sections. One array of 20 variables represents the concentration of uranium in the seawater in each section. A second array represents the concentration in the resin, and a third array checks for saturation by monitoring available absorption sites in the resin. The simulation models the flow of seawater by passing material from one element of the array to the next at a rate reflecting the time it takes for the water to move the length of a section.

The first element receives material with the concentration in the incoming water; the last element sends material to a "waste" variable. The simulation of the exchange process between solution and resin uses modeling features for chemical reactions; a second-order reaction between corresponding elements of the first and third arrays represents absorption, and a first-order reaction represents the reverse process. The program runs on the IBM PC in about 550 seconds (compared with 2.5 seconds on the IBM 3081K), so that even a parameter-fitting run, which executes several dozen simulation runs, could be done overnight on the micro. It is fair to say that this investigation could have been done on the PC from the beginning.

The model provides three types of output: "snapshot" graphs, which show how the concentrations vary along the column at any time; "time-course" graphs, which illustrate how integrated quantities, such as the total uranium trapped in the resin, vary with time; and tables of numbers that give more accurate time histories of these integrated quantities. Figure 1 is a snapshot graph from this problem. By plotting the independent variable (distance along the column) along the y-axis and the dependent variables along the x-axis, a printer can plot graphs of any length. Points X represent the concentration of uranium in solution, multiplied by 100,000,000; points Y represent concentration in the resin, multiplied by 10,000; points S represent available sites, multiplied by 10,000.

**STARTING UP A CHEMICAL REACTOR**

In a 1981 thesis for Imperial College, London, I. T. Cameron proposed this chemical-engineering problem. It is much simpler than the others described here, but in practice it had proved difficult to solve.

Initially a chemical reactor contains neutral gas. A pump starts to supply liquid feedstock through an inlet valve, compressing the gas and reducing the flow from the pump because of back pressure. A chemical reaction takes place in the vessel, and product mixed with unused feedstock, driven by the gas pressure and the liquid head, flows out through an outlet valve. In time the system reaches a steady state, but the main focus of the simulation is the start-up transient. Results of interest include the peak gas pressure and temperature (for vessel design) and the loss of unused feedstock and substandard product. The model includes the ef-

![Figure 1: A snapshot graph from the ion-exchange-column problem.](image-url)
If you’re using more than one of these... 

**THE INTEGRATOR** from ModTech.

With THE INTEGRATOR™ you can combine your choice of the world's most powerful software into your own custom-integrated system. Plus, you get a series of powerful office tools.

**The greatest integrated system.**

Lotus™ 1-2-3™, dBase II™, WordStar®, and other standards act as one super-powerful software system using THE INTEGRATOR.

No prepackaged integrated software product can match the power, versatility, and features of THE INTEGRATOR and your software.

More important, THE INTEGRATOR allows you to use the files you've collected over time. Prepackaged integrated systems may not.

There are no new commands to learn to run your software. It remains unchanged; use it as always.

THE INTEGRATOR simplifies computing for the novice and expert alike, by shielding the user from the operating system with Help screens and Pull-down menus.

THE INTEGRATOR takes command of the operations, the reformatting of files, eliminates salutation commands and keystrokes. You work faster and more efficiently.

**THE INTEGRATOR also adds four quick, useful office tools.**

A daily calendar with an alarm to remind you of important engagements, a full function calculator which can save and execute repetitive functions, a Note Pad for quick ideas, and a floppy-dump File Cabinet to free up hard disk space.

An IBM PC/XT®, or workalike with 256K, a hard disk, and any of the software above is all you need.

Your local ModTech™ dealer has more information and the ability to add other software packages to the list. Even programs you've designed yourself.


---

**DEATH OF A STAR**

When a typical "main sequence" star has been burning and radiating energy away for a few billion years, it has transmuted all of its original lighter elements into carbon and oxygen and must enter a carbon-burning phase. During this time, the internal pressure needed to support the star's weight against its own gravitational attraction has required high density and temperature, which in turn make the star opaque to radiation.

According to Planck's law, the star radiates at a rate determined by its surface area and temperature. Therefore, when the star's lighter elements are exhausted and its energy from nuclear reactions becomes inadequate to support its weight, it starts to contract under gravity; this increase in internal temperature until it reaches about 1 billion degrees.

![Figure 2: A time-course graph from Cameron's reactor problem. A = concentration of feedstock; B = concentration of an intermediate (on larger scale); P = concentration of product; 1 = inlet flow rate; 2 = outlet flow rate.](image-url)
VersaForm's new XL database isn't just promises—it's here now! And it offers—YES, FOR ONLY $99—all the features you'd expect in a database costing 4 times as much.

Accounting applications are XL's strength. Invoicing, purchasing, receivables, and shipping almost create themselves as you design the forms—and XL transfers data between them. There's an Invoicing, A/R and Inventory application—source code included—in the package that shows how it's done. The power's there. And unlike packaged accounting programs, you can do them YOUR way.

**PRICE**

<table>
<thead>
<tr>
<th>VersaForm XL</th>
<th>dBASE III</th>
<th>R-BASE 4000</th>
</tr>
</thead>
<tbody>
<tr>
<td>99</td>
<td>695</td>
<td>495</td>
</tr>
</tbody>
</table>

**VERSATILITIES**

- XL's structured language can access multiple files. 48 built-in functions give control of file access, printing, and user dialogues. You'll develop transaction-based applications with an ease you've never experienced before. And all at this unheard-of low price.
- VersaForm XL's unique form-oriented data structures let you easily set up forms and ledgers—even those with columns! Application development is FAST, FAST, FAST. And since forms are the way that businesses already store their data, the transition is smooth. That's why VersaForm XL is so easy to operate even for high-turnover clerical people—It starts from where they are now.
- Automatic data entry checking and on-screen calculation make transactions error-free. Stored print formats make output formatting a snap—you can quickly match existing paper forms. VersaForm XL's report generator is clear and intuitive. Designers can pre-install reports, users can set up their own.
- Query-by-forms (at no extra cost) lets users go right to the data they need. No query language to learn—forms are the natural language of business.

**Ironclad Money-Back Guarantee**

Try VersaForm XL for 30 days. If you're not fully satisfied, return it. We'll gladly refund your money.
Order now, and have the pleasure of using the right tool at the right price. You can't lose!

VersaForm XL runs on IBM PC, XT, AT and compatibles. Requires 192K, two 360KB drives, DOS 2.0 or later. Hard disk recommended.
Standard VersaForm (single file, no language) available for 64K, 2-drive Apple II or 128K IBM PC $69.

**Inquiry 187**

Visa 434

Toll-Free: 1-800-538-8157 ext 880
In California
Toll-Free: 1-800-672-3470 ext 880

Enclose check or money order with coupon. Include $4.50 for U.S. Shipping and handling. $7.00 for C.O.D. California Residents add 6.5% tax.

Charge my: MasterCard, Visa

Account No. Expires

PLEASE PRINT CLEARLY

Name

Address

City State Zip

Phone Signature

FEBRUARY 1985 • BYTE 243
Generation of smog in urban areas is a complex phenomenon that involves numerous reactions among over 100 trace gases in the atmosphere.

Kelvin. This temperature is sufficient to cause carbon nuclei to begin fusing together to form heavier elements. This carbon-burning process supplies the necessary energy to make further gravitational contraction unnecessary. If the star is an ordinary one—not too big—the temperature generates enough pressure to keep the star stable until the carbon is exhausted. The temperature and density do not rise further, and the carbon-burning phase takes place relatively slowly, in conditions of hydrostatic equilibrium. In a more massive star, however, the pressure is inadequate. contraction continues, the temperature and density continue to rise, and carbon burning proceeds explosively fast; the star becomes a supernova. In either case, the phase is extremely short: in relation to the earlier leisurely history of the star, typical durations may be a week or two for an ordinary (less massive) star or about a second for a supernova.

Simulations have been successful for both the hydrostatic and the explosive carbon-burning phases. In both cases, the set of nuclear reactions is the same, but the rate coefficients depend on temperature and density, variables that vary with time in a way determined by the stellar dynamics. To model the hydrostatic version, temperature and density are kept constant and rate coefficients are computed only once, at the start of the run. For the supernova version, temperature and density are defined as functions of time, and the rate coefficients are frequently recalculated during the run.

The coding of the nuclear reactions, although they are numerous, is relatively easy because their structure is exactly that of chemical reactions. Protons, neutrons, neutrinos, alpha particles, and 36 heavier nuclides are simulated.

A run of the hydrostatic version takes about 8200 seconds (2.3 hours) on the PC, compared with about 25 seconds on the IBM 3081K. This is a larger speed ratio than average—about 330:1—but we may be able to improve the performance. The supernova version takes about 67 seconds on the 3081, so we expect it to take about 22,000 seconds (say, 6 hours) on the PC. Output consists of time-course graphs of the mass fractions of the various nuclides, plotted on logarithmic scales for time and for the mass fractions, and of tables giving numerical values for the mass fractions as functions of time. The graphs show clearly the stages at which the various nuclides are produced or used up; in many cases, this occurs in straight lines on the log-log plot, indicating mass fractions proportional to a (positive or negative) power of the time.

PHOTOCHEMICAL SMOG GENERATION

The generation of photochemical smog in urban areas is an extremely complex phenomenon that involves numerous reactions among well over 100 trace gases in the atmosphere. Important elementary steps in the process involve the breaking of chemical bonds when a molecule absorbs solar radiation; these steps switch off rapidly as sunset approaches and switch on equally fast.
Which electronic mail service delivers much more than mail?

Every one of these electronic mail services does a very good job of delivering the mail.

But only one delivers so many more online services with equal expertise.

The Source.

With The Source, you can have the daily news delivered along with your daily mail. Make airline reservations. Trade stocks. Hold a computer conference. Communicate with thousands of people who share your interests.

Even get the latest word on new hardware and software products, in seconds.

All this, and more, along with the electronic mail service called “the most powerful available anywhere.”

And all for just $49.95, plus reasonable hourly usage fees.

Call 800-336-3366* and you can have the power of The Source working for you in a matter of minutes.

Or for more information, visit your nearest computer dealer or mail the coupon below.

The Source is a service mark of Source Telecomputing Corporation, a subsidiary of The Reader's Digest Association, Inc. The source services are offered in participation with Control Data Corporation, Source Telecomputing Corporation, 1985. MCI Mail is a service mark of MCI Communications Corp. EasyLink is a service mark of Western Union. In Virginia or outside the continental U.S. call 703/734-7500.

Please send me more details about The Source.

Name ____________________________________________ Telephone # ________

Address __________________________________________

City __________________________ State ______ Zip ________

□ □ I own a personal computer.

yes no

Mail to: Source Telecomputing Corp.

1616 Anderson Road

McLean, VA 22102

CCBY02

The Source

The most powerful resource any personal computer can have.

SourceMail™

Electronic Mail

Mailgram® Message Service

PARTICIPATE™

Computer Conferencing

CHAT Interactive Communications

News Bulletins

UPI News Service

Associated Press

Scripps-Howard News Service

Accu-Weather™

The Washington Post

Electronic Edition

Sports

BYLINES Feature News

Portfolio Management

Real-Time Stock Quotes

Delayed Stock Quotes

Spear Securities Online Trading

Media General

STOCKVUE

Donoghue Investment Newsletter

INVESTEX Research Reports (1st Qtr. 1985)

Management Contents

Publication Abstracts

Employment Services

UNISTOX Market Reports

Commodity World News

BIZDATE Business Magazine

MICROSEARCH™ Hardware, Software Reviews

Member Directory

POST Bulletin Board Classifieds

Member Publications

Official Airline Guide®

A-Z Worldwide Hotel Guide

Travel, Hotel Reservations & Ticketing

Restaurant Guides Travel Tips, Tours, Discounts

Movie Reviews

CompuStore Electronic Shopping

Games, Educational Quizzes
at dawn. Rate coefficients also depend on smaller day/night variations such as temperature and water vapor content. Thus the behavior of the chemistry during the night is quite different from that during the day, and the switching processes are technically difficult for many differential-equation solvers to handle.

The model of this process is by far the largest and most complicated of those described here. The model involves a total of 300 reactions among 153 chemical species; the data occupies about 620 lines of code. The model also requires larger working arrays than the others, but it can be fitted into 470K bytes of RAM.

Simulating 50 hours of real time (thus seeing how much greater the pollution is on the second day than the first) takes about 110 seconds on the IBM 3081 K; we are not yet able to run it on the PC, but we might expect a speed ratio similar to that for the astrophysical problem. It is thus at the limit of practicability on the PC (at present) so far as running time is concerned, but it is interesting that the model would still run faster than real time. Simulation of the second 24 hours takes about one-third of the total time, and we would expect subsequent days to run at approximately this speed.

Output consists mainly of time-course graphs, which illustrate clearly the build-up, with afternoon peaks and nighttime troughs, in the concentrations of the important pollutants.

CONCLUSION
I have presented only a few of the many scientific and engineering applications that are practicable on a micro like the IBM PC with 512K bytes of RAM and an 8087 math coprocessor. I hope, nevertheless, that I have conveyed a feel for what I am sure has a very big future—the use of microcomputers for major scientific computation.
The Handy New LogicScope™ 136

True Dual Trace • 10 MHz Real Time Bandwidth • 3 Input Channels • I/O Port
Digital Waveform Storage • Boolean Waveform Operations • Audio Functions
8.0 (L) x 4.5 (D) x 1.75 (H) Inches • 1.25 Pounds • 9 Volt Battery/AC Operation

Consider the LogicScope 136

- The LogicScope 136 is the next logical step in test instrumentation for you. It combines many of the features and capabilities of sophisticated logic analyzers and oscilloscopes... and it fits in your hand. Never before has so much technology been available in so small an instrument, at such a low price.
- The pocket-sized LogicScope 136 is made possible by a patented breakthrough in display technology. The conventional CRT has been replaced by a unique array of 400 LED’s that permits simultaneous display of two digital waveforms.
- The 136 can be used for viewing single shot events, or repetitive waveforms. It can be operated in real time mode, or in memory mode which permits acquisition and storage of up to 50-100 bit waveforms. These can be recalled, logically compared (AND, OR, EXCLUSIVE OR) to other input waveforms, or output to an external device via an I/O port. This I/O port will also accept future add-on 136 Modules.
- Its very low cost, convenience and ease-of-use make the LogicScope the ideal instrument, for designing, troubleshooting or repairing digital systems. Made in U.S.A.

Consider its Engineering & Field Service Applications:

- On microprocessor-based systems, check the timing relationship of various parameters relative to the system clock and other key events. Its storage capability allows visual and logical comparison of non-repetitive waveforms to known reference signals. Output in the start-up of the digital device can be compared to reference signals to determine the operating state of the device. Questionable waveforms can be stored for analysis.
- Its light weight and small size make the LogicScope convenient to take on every service call. The 136 provides much more information for troubleshooting a digital system or peripheral than a logic probe or digital counter without having to lug an oscilloscope or logic analyzer along.

Contact us for the name of your local distributor
ASYST multiple windows permit side-by-side comparisons. The two-dimensional FFT routine, shown, is one of the many built-in functions.

With ASYST, data acquisition and analysis routines can be combined to create powerful, menu-driven functions.

Now acquire, analyze, and graph data all at the same time.

Introducing
ASYST, Scientific Software.

ASYST. The most powerful scientific software package available for a personal computer.
ASYST is the only software that turns an IBM PC, or compatible, into a complete scientific workstation—offering full data acquisition, analysis, and graphics capabilities.

• ASYST puts you in direct control of your data. Its unique interactiveness allows you to start reducing data even as it is being collected—graphing as you proceed.
• Multiple graphics windows permit quick visual comparison and allow you to select segments for further manipulation.

ASYST gives you the speed and precision of a minicomputer—at a fraction of the cost. And because it works on a PC, you can pull information through the analytical process without timesharing delays or software bottlenecks.
• ASYST fully utilizes an IBM PC with the 8087 coprocessor. This unique combination takes all intermediate calculations to the 80-bit precision level, offering precision exceeding that of other micros—as well as many minis and mainframes.
• A 1024-point Fast Fourier Transform, with ASYST and an IBM PC with 8087 chip, takes less than 3 seconds. An optimum performance custom routine tested on a DEC 11/23 + minicomputer with FPF 11" took 2 seconds—at five times the price.
ASYST automatic graphics are flexible enough to handle the most demanding applications.

ASYST integrates analysis functions with graphics. On-screen cursors allow interactive selection of curve segments.

Three integrated modules.
ASYST is composed of three separate, but fully-integrated, modules—Module 1: System/Graphics/Statistics; Module 2: Analysis; and Module 3: Data Acquisition.
- Module 1 works alone—or with either of the other two modules—allowing you to tailor the system to your specific needs.
- All functions are always available for your use. You never have to leave the system to access any of its capabilities.

Module 1: System/Graphics/Statistics establishes the environment. Among other features, it provides data representation and storage capability; supplies arithmetic, trigonometric, hyperbolic and other mathematical and statistical functions; and provides direct graphics output and display. Array manipulation, control of vectors and matrices, automatic plotting, file manipulation, programming control structures, and a built-in text editor are all included in Module 1.

Module 2: Analysis reduces and analyzes data and includes a powerful selection of analytical functions. They include Eigenvalues, Eigenvectors, and polynomials. Least squares approximations, curve fitting, convolutions, integration, differentiation, smoothing, and Fast Fourier Transform are only a few of the automatic functions provided.

Module 3: Data Acquisition allows ASYST to interface with laboratory instruments to capture data directly with a minimum of keyboarding. Standard commands such as "A/D.IN" are all that are needed to carry out communication between ASYST and standard interface boards. A/D and D/A conversions, digital I/O, timing, and triggering are all supported. Commands can be combined in programs to provide customized automatic acquisition and control.

Built-in routines make ASYST easy to use. Programmability lets you customize.
You don’t have to be a computer expert to utilize ASYST. Instead of rigid, unreadable computer syntax, you deal with an assortment of built-in commands that do what their names indicate—XY.DATA.PLOT, ARRAY.EDIT, FFT, etc.
- Interactively use pre-programmed commands to get immediate control of your work.
- Combine and modify commands to extend the capability of the system for your custom applications. ASYST is fully programmable.

Supported by extensive, top-down documentation.
ASYST layered documentation—with examples, a quick reference card, and a cross-referenced index—lets you go only as deep as your needs require. A comprehensive, on-line “help” system is always ready to supply additional assistance.

30-Day No-Risk Offer.
1-800-348-0033
In New York State call (212) 702-3241. Call our ASYST hotline for more information.

MACMILLAN SOFTWARE CO.  
An Affiliate of Macmillan Publishing Company  
866 Third Avenue  
New York, NY 10022
TRANSTECTOR Has A Better Way To Eliminate Computer Malfunctions.

Computer foul-ups are enough to bring out the beast in even the most patient of individuals. But when random logic errors, memory loss, software damage or component failures have driven you to the brink, don't resort to wielding a sledgehammer. Fight back with TRANSTECTOR SYSTEMS.

TRANSTECTOR is the world's leading manufacturer of transient overvoltage protection systems for sensitive electronics. In fact, many FORTUNE 500 companies, such as NCR, General Electric Medical Systems and Johnson Controls, have chosen TRANSTECTOR to safeguard equipment they sell.

Now, that same famous technology is available to you. Ask your dealer for details on how TRANSTECTOR protectors can save you money—not to mention your mental health.

TRANSTECTOR

10701 Airport Dr.
Hayden Lake, ID 83835
(208) 772-8515

For the name of the TRANSTECTOR SYSTEMS authorized dealer nearest you, call toll-free:

800-635-2537

FREE POSTER!

1985 Transect Systems • TRANSTECTOR is a registered trademark of Transect Systems, Inc.
VIEWING MOLECULES WITH THE MACINTOSH

by Earl J. Kirkland

A BASIC program provides 3-D images of complex molecules

RESEARCHERS HAVE GAINED valuable insights into how molecules work by examining the basic physical structures of the molecules, which in part determine their functions. Scientists have learned, for example, that the physics of electronic conduction in a silicon crystal is influenced by the basic symmetries of the crystal.

The relative physical sizes and shapes of two molecules may also influence the rate at which they interact chemically (since, for two chemicals—i.e., atoms or molecules—to interact, they must first come into contact with each other). This is the case with a particular class of biochemical substances called enzymes, which are responsible for controlling the rate of biochemical activity without themselves being changed (i.e., they are biological catalysts). The size and shape of the enzyme molecule influences which other biochemical substances (molecules) may bind to it and hence be influenced by it.

We can gain some understanding of the basic functions of molecules by examining the size and shape of a given molecule, using either a real physical model or a computer-graphics representation of the molecule. References 1, 2, and 3 give some examples of graphic representations of molecular structure and their usefulness in understanding molecular function.

Molecules are far too small to be seen with optical microscopes, and electron microscopes are just becoming capable of directly imaging a few specialized types of molecules. Most of the molecular structures that we know today have been determined by X-ray diffraction studies of large crystals. A crystal can be thought of as a very large, single molecule composed of a small structure of a few atoms repeated many times. This repetitive nature allows researchers to analyze many identical molecules at one time and obtain a reasonable "signal-to-noise" ratio in the results.

Before the advent of computer graphics, researchers had to go through the elaborate process of building 3-D models of each molecule for further study. Because this molecular-structure data is often generated by a computer, it is a practical alternative to also let the computer draw a 3-D perspective view of the molecule using computer graphics.

Earl J. Kirkland (Cornell University, Ithaca, NY 14853) holds a doctorate in applied physics and is a research associate at Cornell's School of Applied and Engineering Physics. His work involves computer image processing of electron micrographs.

X-ray diffraction patterns cannot be directly interpreted but require a computer to digest the diffraction pattern. The computer outputs a sequence of numerical data describing the three-dimensional (3-D) positions of the atoms inside the molecule. This numerical data is rather difficult to understand without further reduction. Simple structures with only a few atoms may be intuitively visualized from the raw numerical data, but the more interesting or important structures often contain hundreds of atoms, each with its own numerical coordinate (x,y,z). Intuition is inadequate for complicated structures such as these.

(continued)
tool for visualizing the structure of large molecules in three dimensions. Sophisticated (and expensive) computer hardware and software systems for displaying molecules and crystals in 3-D perspective are discussed in references 4 and 5.

The Apple Macintosh has enough resolution and speed to draw 3-D perspective views of relatively large molecules and to rotate them in space (not in real time but fast enough to be interactive). Although not as good as the more sophisticated systems (several of which are discussed in references 4 and 5), the Macintosh is certainly less expensive and can provide quite usable and educational results. MODEL3D, a program written in Microsoft Macintosh BASIC 1.0 and designed to run on the 128K-byte Mac, is capable of displaying up to 600 atoms in three dimensions, with hidden-surface removal, and azimuthal and polar rotations (these terms are defined below).

**MOLECULES**

For the purposes of this discussion, think of a molecule as a group of atoms that are bound together in a well-defined structure. Each molecule has a given number of one or more different types of atoms and each atom has a specific 3-D coordinate associated with it. A molecule may be as simple as two atoms or as complicated as the DNA molecule with its thousands of atoms. The atom-to-atom spacing varies from one molecule to the next and is determined by the chemistry and physics of the bonds. Typical atomic spacings are on the order of a few angstroms (1 angstrom = 10^{-10} centimeters).

Each atom in the molecule or crystal has a further substructure consisting of a small nucleus of positive charge (protons and neutrons) surrounded by a larger, negatively charged electron cloud. The outer electrons in this cloud form the actual bond to the neighboring atoms. The radius of the atom (i.e., the electron-cloud radius) varies from one type of atom to the next. (Typically, atomic radii are on the order of 1 angstrom.) This atomic structure may be modeled graphically as a slightly fuzzy sphere whose radius is the radius of the electron cloud. The specific 3-D coordinate of the atom is associated with the center or nucleus of the atom. Therefore, to describe a whole molecule all you need is a list containing the 3-D coordinate and size of each atom in the molecule. This will be represented as the coordinates \((x,y,z)\), and atomic sizes (or radii) \(s_i\), for \(i=1,2,3,...,n\), where \(n\) is the total number of atoms in the molecule.

**ROTATION**

Once you have the list of atomic coordinates inside the computer, you can rotate the atomic structure to any angle prior to viewing it. In three dimensions there are two possible independent rotations about a given center (or any other given point). They will be referred to as an azimuthal rotation (about the \(z\)-axis) and a polar rotation (about the \(x\)-axis). To azimuthally rotate the molecule about its center point \((x,y,z)_0\) through an angle \(\phi\), you must transform each atomic coordinate \((x,y,z)\) as:

\[
x'_i = (x_i-x_0)\cos(\phi) + (y_i-y_0)\sin(\phi) \\
y'_i = -(x_i-x_0)\sin(\phi) + (y_i-y_0)\cos(\phi)
\]

and to rotate through a polar angle \(\theta\), you must transform each atomic coordinate as:

\[
x''_i = x'_i/\cos(\theta) + (z_i-z_0)\sin(\theta) \\
y''_i = y'_i\sin(\theta) + (z_i-z_0)\cos(\theta)
\]

The computer uses the new resulting rotated coordinates \((x',y'',z')\) to calculate the 3-D perspective view of the molecule. For convenience you may define the center of rotation \((x,y,z)_0\) to be halfway between the minimum and maximum extent of the molecule (along each axis).

**3-D PERSPECTIVE**

To display a molecule in 3-D on a computer screen, the light coming from the two-dimensional CRT (cathode-ray tube) screen must be made to appear as if it comes from a three-dimensional object (i.e., the molecule). One way to do this is illustrated in figure 1 (see also references 4 and 6). The human observer is in the "viewing position" at a distance \(D\) from the CRT screen, which is illustrated as a two-dimen-

![Figure 1: A perspective view of a three-dimensional object as projected onto a two-dimensional CRT screen. The point \((x,y,z)\) represents the center of a 3-D sphere, and \((x,z)_h\) represents the projected screen coordinates.](image)
sional \(xz\) plane, seen from the side. Projected on this “screen” is a 3-D molecule, of which one atom has the coordinates \((x,y,z)\).

We then trace several light rays from the viewing position through the three-dimensional-object points. The points where these rays intersect the CRT plane is where the object should be placed when drawn on the CRT screen. By comparing similar right triangles formed with the viewing position, the \(y\)-axis, and either the \((x,y,z)\) or \((x,z)\) points, we can calculate the screen coordinates as:

\[
X_v = D_x \frac{1}{(D - y)} \\
Z_v = D_z \frac{1}{(D - y)}
\]

In practice, the leading multiplicative factor of \(D\) will be dropped because the screen coordinates will be rescaled later to fill the screen. The apparent size of each atom should also be scaled as above so that the atoms appear smaller as they get further away.

In realistic 3-D perspective, some atoms will be in back of other atoms and hence should not be visible. This is the so-called “hidden-surface problem.” An easy, if crude, solution is to simply sort the atoms by depth and draw from the back forward, always overwriting each successive layer of atoms. When each successive atom is drawn it exactly overwrites the portion of the object that it would normally obscure. This is the approach I have used here.

THE PROGRAM

I have implemented the theory outlined above in MODEL3D (listing 1), a program written in Microsoft BASIC for the Macintosh. (Editor’s note: The source code for MODEL3D is available for downloading via BYTEnet Listings. The number is (603) 924-9820.) The program first asks for the name of the data file containing the atomic coordinates of the molecule you wish to draw. You can obtain this information from college-level chemistry or physics textbooks, or from the

Listing 1: The Source listing of MODEL3D, a Microsoft BASIC 1.0 program to draw 3-D perspective views of molecules.

```basic
10 '   *** MODEL3D.BAS ***
20 ' Draw a 3D perspective view of a molecule with rotation
30 ' For private, noncommercial use only.
40 ' © E. Kirkland 4-JUL-84, added printer distortion 9-SEP-84
50 ' 60 ' NOTE: Remember to shrink command window to lower left
70 ' hand corner so that the lower right side of screen is visible
80 ' 90 ' DEFINT I-N,DEFSNG O-Z,DEFSNG A-G
100 DIM IE(4),IP(12),X(600),Y(600),Z(600),S(600)
110 ' 120 ' Define shading bit patterns for sphere
130 IP(O)= &H4411:IP(1)=IP(0):IP(2)=IP(0):IP(3)=IP(0)
150 IP(8)=&HFFFF:IP(9)=IP(8):IP(10)=IP(8):IP(11)=IP(8)
160 ' 170 ' Ask what to do
180 CLS:INPUT "Data file name: ",FILE$
190 INPUT "Azim., polar angles: ", PHI, THETA
200 INPUT "Viewing distance: ",VIEWD:INPUT "Size mag.: ",SMAG
210 ' INPUT "Type 1 for printer":IPRINT
220 ' Printer distortion correction factor
230 IF IPRINT=1 THEN DISTORT=1.094 ELSE DISTORT=1
240 TIM#= TIMER
250 PHI= PHI•3.14159/180!:THETA =THETA •3.14159/180!
260 CP = COS(PHI):SP = SIN(PHI):CT = COS(THETA):ST = SIN(THETA)
270 ' 280 ' Read atomic coordinates from data file and scale
290 OPEN FILE$ FOR INPUT AS #1
300 XMIN=1E+25:XMAX= -XMIN:YMIN=XMIN:YMAX=XMAX
310 ZMIN = XMIN:ZMAX = XMAX:N = 0
320 WHILE NOT EOF(1)
330 N = N + 1
340 INPUT#1,X(N),Y(N),Z(N),S(N)
350 IF X(N)>XMAX THEN XMAX=X(N)
360 IF X(N)<XMIN THEN XMIN=X(N)
370 IF Y(N) > YMAX THEN YMAX = Y(N)
380 IF Y(N)<YMIN THEN YMIN=Y(N)
390 IF Z(N)>ZMAX THEN ZMAX=Z(N)
400 IF Z(N)<ZMIN THEN ZMIN=Z(N)
410 WEND
420 PRINT N "atomic coord."
430 XMIN = .5•(XMAX+XMIN):YMIN = .5•(YMAX+YMIN)
440 ZMIN = .5•(ZMAX+ZMIN):PRINT "Rotating...
450 ' 460 ' Rotate molecule around its center
470 FOR I=1 TO N
480 XA=X(I)-XMIN:YA=Y(I)-YMIN
490 X(I)=CP•XA+SP•YA:Y(I)= -SP•XA+CP•YA
500 YA=Y(I):ZA = Z(I)-ZMIN
510 Y(I)=CT•YA+ST•ZA:Z(I)= -ST•YA+CT•ZA
520 NEXT I:PRINT "Sorting...
530 ' 540 ' Sort by depth (shell sort)
550 IGAP = INT(CSNG(N)/2)
560 WHILE IGAP>1
570 FOR I=IGAP+1 TO N
580 FOR J=I TO N-IGAP STEP -IGAP
590 IF X(J)<X(I) THEN X(I)=X(I):X(J)=X(J)
600 IF Y(J)<Y(I) THEN Y(I)=Y(I):Y(J)=Y(J)
610 IF Z(J)<Z(I) THEN Z(I)=Z(I):Z(J)=Z(J)
620 NEXT J
630 NEXT I:PRINT "Drawing...
640 ' 650 ' Draw atoms
660 IF IPRINT=1 THEN DISTORT=1.094 ELSE DISTORT=1
670 FOR I=1 TO N
680 X=A(I):Y=B(I):Z=C(I)
690 X=CT•X+ST•Y:Y= -ST•X+CT•Y
700 I=I+1
710 NEXT I
720 PRINT "End of program."
730 END
```

(continued)
crystallographic technical literature. Wyckoff's six-volume series (see reference 12) offers an encyclopedic tabulation of many molecular structures. [You can also make up your own coordinates, following the format below, to experiment with the program.]

Prepare the data file using MacWrite. As shown in the example in figure 2, each line of the file represents one atom in the molecule and has four numbers. The first three numbers of each line are the \((x,y,z)\), coordinates rotation angles (in degrees), the viewing distance \((D\) in figure 1; in the same units as the atomic coordinates and sizes), the atomic-radius size magnifier (this can be used to expand or contract the apparent size of each displayed atom; to get the normal size from the input file, type \(I\), and finally, also save the file as "text-only" instead of the default "entire-document."

Alternatively, if the molecule is a crystal, you can generate a data file containing the atomic coordinates for it by programming the rules for the repetitive structure of the crystal in a separate BASIC program, as I did for the crystal silicon (see below).

After asking you for the name of the data file, the program asks for the rotation angles (in degrees), the viewing distance \((D\) in figure 1; in the same units as the atomic coordinates and sizes), the atomic-radius size magnifier (this can be used to expand or contract the apparent size of each displayed atom; to get the normal size from the input file, type \(I\), and finally, (continued)
We Set the Standard in Prices!

For IBM PC Add-On Products.
Superior quality products and services at lowest prices.

Look at what we have to offer, before you buy any add-on products for your IBM PC.

**QJC-01.** 10 MB internal hard disk subsystem at $725 too low to quote!

Our half-height 10 MB hard disk comes complete with controller, cables. Microscience drive and easy to follow instructions. It fits inside one of your floppy slots and draws same amount of current as a floppy. It is compatible with DOS 2.0, 2.1 and 3.0 without any patches. In fact, you can simply boot up from the hard disk. This is the same hard disk system you see advertised for hundreds of dollars more.

- 20 MB half-height internal hard disk $1095.
- 20 MB drive for PC AT $895.

**QJC-02.** Streaming cassette tape back-up subsystem. $777.

Now, you can back-up your 20 MB of hard disk in less than 10 minutes. This half-height cassette tape system fits inside your IBM PC and is very easy to install. It comes with a controller card, cables, cassette drive, one cassette tape and all necessary software. You can perform image back-up as well as file by file back-up and restore.

- 20-60 MB Cartridge tape subsystem $995.

**QJC-03.** 300/1200 baud internal modem. $275.

This auto dial/auto answer plug-in modem lets your PC talk to the world with reliable and easy operation. It is FCC certified. Bell 103/212 compatible as well as fully Hayes compatible. You can run all the popular communication programs as well as our superior QIC Com software program.

- Expansion box with 10 MB hard disk $1495.

**QJC-04.** Half-height floppy drive. $129.

This half-height floppy is the quietest drive on the market. It draws the least amount of current and is compatible with your PC's floppy controller card. It's double sided, double density.

**QJC-05.** Five function card. $199. (64 K RAM Set $33.00).

Our five function card includes memory expansion from 0 to 384K. one serial port, one parallel port one game port and one battery back-up clock calendar. RAM disk, print spooler and clock utilities are also included.

**CALL US TODAY AT**

408-942-8086

One Year Guarantee
No Risk. All our products are guaranteed for one year. And remember, if for any reason you are not completely satisfied within 30 days, you can return it for a full refund. Check out our competition and find out which is best. We know better.
Figure 2: A sample data file showing the three-dimensional coordinates for one unit cell of silicon. This was generated by the program in listing 2.

Listing 2: A Microsoft BASIC program to generate the three-dimensional coordinates for a silicon lattice.

```basic
10  DIMENSIONS...SIGEN.BAS...
20  ' Generate a Silicon lattice of Nx, Ny, Nz unit cells
30  'E. Kirkland 15-SEP-84
40  DEFINT I-N:DEFSNG A-G,0-Z
50  INPUT "Generate Nx,Ny,Nz Silicon unit cells: ",NX,NY,NZ
60  INPUT "Output file name: ",FILES
70  OPEN FILES FOR OUTPUT AS #1:SIZE= .15
80  FOR IX=0 TO NX
90  FOR IY=0 TO NY
100  FOR IZ=0 TO NZ
110    WRITE#1,IX,IY,IZ,SIZE
120    IF (IX=NX) OR (IY=NY) OR (IZ=NZ) GOTO 230
130    WRITE#1,IX + .5,IY + .5,IZ,SIZE
140    WRITE#1,IX+ .5,IY,IZ + .5,SIZE
150    WRITE#1,IX,IY + .5,IZ + .5,SIZE
160    WRITE#1,IX + .5,IY+ .5,IZ + 1,SIZE
170    WRITE#1,IX + .25,IY + .25,IZ+ .25,SIZE
180    WRITE#1,IX+ .25,IY+.75,IZ+.75,SIZE
190    WRITE#1,IX+.75,IY+.25,IZ+.75,SIZE
200    WRITE#1,IX+.75,IY+.75,IZ+.25,SIZE
210    NEXT IZ
220    NEXT IY
230    NEXT IX
240  CLOSE#1:END
```

A circle appears elliptical printed with the Imagewriter.

whether the drawing is to be printed. The Apple Imagewriter printer has a slightly different aspect ratio than the screen, so that a circle on the CRT screen appears slightly elliptical when printed. The program can apply a predistortion to the drawing (multiplying the x coordinate by 1.094) so that it will appear normal when you print it.

The program then reads from the data file until it encounters an "end-of-file" (EOF) condition (the total number of input lines determines the total number of atoms in the molecule). An "Input Past End" error indicates that the data file contains extra characters.

After reading in the atomic coordinates and size data, the program rotates them about the center point and sorts them by depth using the Shell sort method (see references 7, 8, and 9). The program then projects these new coordinates into the viewing screen coordinates with a 3-D perspective and scales them. If at this point the program signals, "Out of Memory," type CLEAR, 20000 and run the program again.

The final portion of the program draws a sphere at each of the projected atomic coordinates, from the back forward, to fulfill the hidden-surface requirements. The "sphere" is drawn using three QuickDraw FILL-oval calls with different shading patterns (see Appendix E of the Microsoft BASIC 1.0 manual). The first call draws a light-gray circle filling the whole atomic radius, the second draws a dark-gray circle with a slightly smaller radius, and the third draws a black circle with a still smaller radius. The net effect is a shaded circle that looks like a sphere. For a print-out of the drawing, use the print-screen (Shift-Command-4) command.

(continued)
A few smart reasons to buy our smart modem:

<table>
<thead>
<tr>
<th>Features</th>
<th>Ven-Tel 1200 PLUS</th>
<th>Hayes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1200 and 300 baud, auto-dial, auto-answer</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Compatible with &quot;AT&quot; command set</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Can be used with CROSSTALK-XVI or Smartcom II software</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Regulated DC power pack for cool, reliable operation</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Eight indicator lights to display modem status</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Speaker to monitor call progress</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Attractive, compact aluminum case</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Two built-in phone connectors</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Compatible with The Source and Dow Jones News Retrieval</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Unattended remote test capability</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Phone cable included</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Availability</td>
<td>Now</td>
<td></td>
</tr>
</tbody>
</table>

**Price**

- Ven-Tel 1200 PLUS: $499
- Hayes: $699

The Ven-Tel 1200 PLUS offers high-speed, reliable telecommunications for your personal computer or terminal. Whether you use information services or transmit 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
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/time 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/time 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.

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
<th>In</th>
<th>Out</th>
<th>Model</th>
<th>Price</th>
<th>In</th>
<th>Out</th>
</tr>
</thead>
<tbody>
<tr>
<td>MFJ-1241</td>
<td>79.95</td>
<td>1</td>
<td>2</td>
<td>MFJ-1244</td>
<td>139.95</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>MFJ-1242</td>
<td>99.95</td>
<td>2</td>
<td>2</td>
<td>MFJ-1245</td>
<td>169.95</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>MFJ-1243</td>
<td>119.95</td>
<td>2</td>
<td>3</td>
<td>MFJ-1246</td>
<td>199.95</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>MFJ-1247</td>
<td>119.95</td>
<td>2</td>
<td>4</td>
<td>MFJ-1248</td>
<td>99.95</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

AC Power Centers

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. 5A, 125V, 1875 watts. Aluminum case. Black, 18x2x3/4 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

 MFJ-1233
$129.95


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.

VIEWING MOLECULES

Note that if two atoms are located at exactly the same depth (distance from the viewer), this program will arbitrarily draw one atom in front of the other. (Obviously this will make a difference only if the atoms are close enough to each other so that their radii overlap.) This problem will probably not be significant in most cases and may be easily overcome by

Figure 3: A 3-D perspective view of 2- by 2- by 2-unit cells of a silicon lattice. The data file was generated by the program in listing 2.

Figure 4: Another 3-D perspective view of the 2- by 2- by 2-unit cell structure in figure 3.
rotating the molecule so that one atom is slightly in front of (or behind) the other. A proper solution to this problem is beyond the scope of this exercise.

**EXAMPLES**

As I mentioned above, a crystal may be thought of as a single large molecule whose structure is a simple pattern repeated many times. Silicon forms a crystal structure with a basic repeat distance of 5.43 angstroms. It is composed of two interpenetrating face-centered cubic (fcc) lattices (see references 10 and 11), with one fcc lattice offset from the other by \( \frac{1}{4}, \frac{1}{4}, \frac{1}{4} \) \times 5.43 angstroms. There are roughly \( 6.25 \times 10^{18} \) unit cells per cubic millimeter of silicon. Large crystals of silicon in this form (with suitable treatment) are commonly used to make the vast majority of integrated circuits in use today. For example, the Motorola 68000 processor is composed of two interpenetrating \( \frac{1}{4}, \frac{1}{4}, \frac{1}{4} \) \times 5.43 lattices (see figure 3) and an edge of the cube (figure 4). Note the slight slope (like a roof of a house) visible in figure 4. The vertical edge in the center is nearer to the observer than the two outer edges on the left and right and hence appears larger (taller) than the outer edges in 3-D perspective. Note the characteristic symmetry of silicon that the graphic representation reveals.

Figure 5 is a computer-graphic representation of the aspirin molecule, whose structure is given in reference 12. The chemical formula for aspirin is \( \text{HOOC-C}_{6}\text{H}_{5}-\text{CH(OH)}\text{CH}_{3} \). I have arbitrarily depicted the hydrogen atoms with a small radius to distinguish them from the other atoms in the molecule. The aspirin molecule has a large hexagonal carbon structure (benzene) on the bottom and clusters of carbon, hydrogen, and oxygen on the top.

**CONCLUSIONS**

Computer graphics offers a convenient way to visualize three-dimensional structures of molecules as an aid to understanding the behavior of the molecules. The Apple Macintosh computer is capable of displaying a graphic representation of fairly complex molecules. Although there are large computer systems that can produce better graphic representations, they are beyond the price range of most individuals. The Macintosh gives a spectacular performance in relation to its cost. Even though MODEL3D is written in interpreted BASIC, most of the actual graphics is done by the Macintosh ROM via the QuickDraw subroutine. Hence, the program runs relatively fast. These built-in graphics routines make the Macintosh very useful for this application.

**REFERENCES**

IT ALL ADDS UP...

IBM SYSTEMS
Starting as low as
$1399

64K, 1-DS/DD DRIVE KEYBOARD

NEC PRINTERS
- NEC 8000-L... $899.00
- NEC 8000... $1999.00
- NEC 8800... $1999.00

TANDON
- 5¼" 320K Floppy... $169.00
- VisiCalc IV... $159.00

IDEAdisk
- 6MB to 40MB Hard drives with removable Cartridge back up as low as $1499.00

ART RESEARCH
- Six Pak Plus... $449.00
- Mega Paks... $999.00
- I/O Plus... $139.00

QUADRAM
- New Quadboard... $499.00
- Quadlink 64K... $479.00
- Quadboard II... $499.00
- Quad 512 Plus... $599.00
- Quadcolor I... $599.00

PARADISE
- Multi-Discard Card... $399.00
- Modular Graphics Card... $199.00

Open Access
Harvard Project Manager... $399.00

IBM/APPLE
- Write... $89.99
- Graph... $159.00
- Report... $69.99
- File... $89.99
- Pian... $89.99

ELECTRONIC ARTS
- Get Organized... $139.00

DISKETTES
- maxell.
  - 5¼" MD-1... $19.99
  - 5¼" MD-2... $29.99
  - 8" FD-1... $19.99
  - 8" FD-2... $49.99
- VERITAM
  - 5¼" SSD/HD... $82.99
  - 5¼" DD... $79.99
- RIB
  - 5¼" Disk Head Cleaner... $14.99

PC COMPATIBLES
- PC-150 Desktop... CALL
- PC-160 Portable... CALL
- PC-120 PowerPort... CALL
- COLUMBIA
  - Desktops... CALL
  - Portables... CALL

APPLE
- Apple III-68K
  - Apple III Professional Pack... CALL
  - Apple III... CALL

MONITORS
- SANYO
  - SC-100 Color... $249.00
  - SA-1000 Color... $159.00

- NEC
  - 12" Color... $129.00

DISKETTES
- maxell.
  - 5¼" MD-1... $19.99
  - 5¼" MD-2... $29.99
  - 8" FD-1... $19.99
  - 8" FD-2... $49.99
- VERITAM
  - 5¼" SSD/HD... $82.99
  - 5¼" DD... $79.99
- RIB
  - 5¼" Disk Head Cleaner... $14.99

MODEMS
- Hayes
  - 400 Med-Res RGB... $319.00
  - 420 H-Res RGB (IBM)... $469.00

COMPUTER MAIL ORDER
TOLL FREE ORDER LINE
1-800-233-8950
In PA Call: (717) 327-9575

WEST
P.O. Box 5669, Dept. A102
Sedalia, NY 69049
Order Status Number: (717) 327-9576

EAST
477 E. 3rd St., Dept. A102
Williamsport, PA 17701
Customer Service Number: (717) 327-1450

CANADIAN ORDERS
Ontario/Quebec: 1-800-268-3974
Other Provinces: 1-800-268-4559

Open purchase orders accepted with net 30 days, subject to credit approval. Next day shipping on all stock items. No risk, no deposit on C.O.D. orders and no waiting period for certified checks or money orders. Add 3% (minimum $5) shipping and handling on all orders. Larger shipments may require additional charges. NV and PA residents add sales tax. All items subject to availability and price change. Call today for our catalog.

260 BYTE • FEBRUARY 1985
...THE BEST PRICES

HOME COMPUTERS

PRINTERS

AXIOX

AT-100 Atari Interface Printer $159.00
AT-660 Atari Bidirectional $289.00
GP-100 Parallel Interface $189.00
GP-700 Color Printer $459.00
GP-880 Parallel Printer $499.00

EMC

401 Letter Quality $69.99
BX-80 Dot Matrix $49.99
BX-100 Dot Matrix $49.99

COMPUTER

Olympia

Compact 2, $469.00
Compact 3, $499.00

SILVER REED

TF-1000, $119.00
Tractor Feed, $119.00

RAINBOW

Greenplay $199.00

INTERFACES

PRACTICAL PERIPHERALS

Graphboard, $64.99
Serial Card, $39.99
Microbuffer II $179.00
Microbuffer 35K $199.00

QUADRANT

Microfazer - Printer Buffers starting at $129.00

NEC

PC-8801 Portable Computer $299.00
PC-8831 Disk Drive $619.00
PC-8891A, Thermal Printers $149.00
STARP

PC-1280 $159.99
PC-1261 $159.99
PC-1260 $159.99
PC-1580A $159.99
CE-1580 Printer Cassette $174.99
CE-1580 Color Printer Cassette $174.99
CE-1580 4K RAM $29.99
CE-2580 16K RAM $29.99
CE-1815 16K RAM $134.99
CE-2500 ROM Library es $29.99

KOALA

Atari 8-bit (ROM) $79.99
IBM $99.99

Microfazer Graphics Pad $39.99

CALL WHILE SUPPLIES LAST

600XL & 800XL

550 Interface $109.00
CX30 Paddles $29.00
CX40 Interface $129.00
1020 Recorder $239.00
1020 Color Printer $399.00
1020 Dot Matrix Printer $299.00
1027 Letter Quality Printer $299.00
1025 Defenser $299.00
1030 Direct Connect Modem $599.00
1030 Disk Drive $419.00
Touch Table Software $159.00
Light Pen $84.99
1040 Printer Enduf $159.00
1040 Print/Border $159.00
1040 Modem $219.00
1040 Printer $399.00
1040 Color Printer $399.00
4025 Defender $129.00

MEMORY BOARDS

Indus Drive $199.00
RS-100 Parallel $199.00
RS-100 Printer $199.00
RS-100 Disk Drive $199.00

DISK DRIVES

Swp

ATR-6000 16K 280 CPM $349.00
ATR-6000-84K 280 CPM $499.00

BIT 3

Full View 80 $239.00

MODEMS

Microbit MB-100 $199.00
Microbits $199.00

COMMODORE

HEWLETT PACKARD

41C $119.99
41CX $189.99
41C $248.99

CP/M

Number 3 $199.00

1-800-233-8950

THE BEST PRICES

TOLL FREE ORDER LINE

1-800-233-8950

In PA Call: (717) 327-9370

WEST

P.O. Box 6688, Dept. A102
Stateline, NV 89449
Customer Service Number: (717) 327-1450

ONTARIO/QEBC: 1-800-268-3974

CANADIAN ORDERS

Other Provinces: 1-800-268-3974

Mississauga, Ontario, Canada L5J 1L1

MCB 8025 $399.00
SBC 8026 $399.00
B186-80 $99.00
B180 3000 Upgrade $499.00
3031 LP Printer $159.00
6030 Disk Drive $129.00
6820 Disk Drive $129.00
6825 Printer $159.00
4025 Printer $159.00
4040 Printer $144.00
Silo Office $499.00
The Manager $199.00

PROFESSIONAL SOFTWARE

Database $69.99
Report (64) $59.99
Superbase 64 $59.99

Other Commodore $399.00

POWER

Word Pro Plus $189.00
Word Pro 6 Plus $189.00
Word Pro 4 Plus/6 Plus $239.00
Info Pro $69.00

SOPHEER SOFTWARE

Word Pro 2 Plus $189.00
Power Pro Plus $199.00
Word Pro 4 Plus $189.00

SOFHEIR SOFTWARE

Word Pro 3 Plus/5 Plus $239.00
Info Pro $199.00

Fleet System 1 $239.00

FEBRUARY 1985 • BYTE 261
NOW AVAILABLE
THE MANUAL:
FOR ALL
THE POPULAR
PROGRAMS.

LOTUS 1-2-3
SYMPHONY
FRAME WORK
dBASE II
MULTIPLAN
WORDSTAR
APPLE WORKS

Only $14.95 EACH

LOTUS 1-2-3 is a trademark of Lotus Development Corporation.
Symphony is a trademark of Ashton Tate.
Frame Work is a trademark of Ashton Tate.
dBase II is a trademark of Microsoft Corporation.
Wordstar is a trademark of Micropro International.
AppleWorks is a trademark of Apple Computer Corporation.
Multiplan is a trademark of Microsoft Corporation.
THE MANUAL is a trademark of Management Information Source, Inc.

PLEASE SEND ME THE FOLLOWING BOOKS:
☐ Lotus 1-2-3 $14.95
☐ Symphony $14.95
☐ Frame Work $14.95
☐ dBase II $14.95
☐ Multiplan $14.95
☐ Wordstar $14.95
☐ Appleworks $14.95

(Corporate discounts available.)

CARD No. _____________________ Exp. Date ________
NAME ________________________
ADDRESS ______________________
CITY __________________________ STATE _________ ZIP ________
TOTAL ENCLOSED $ ____________ ☐ VISA ☐ MasterCharge
SIGNATURE _____________________ ☐ AMEX ☐ CHECK

MANAGEMENT INFORMATION SOURCE, INC.
3543 N.E. Broadway, Portland, Oregon 97232
A medical researcher examines the capabilities and limitations of an important laboratory device

Almost all laboratory computer applications can be described as one of the following functions: (1) control of experiments, including timing and synchronizing external events and setting external voltages; (2) data acquisition, usually through the digital conversion of analog electrical signals; (3) data storage; and (4) data analysis. While data storage and analysis make computers most appealing in the laboratory, these functions are common to most computer applications. The functions that make laboratory applications different from other computer uses are the first two, control of experiments and data acquisition. The following discussion is directed at these two areas. The two functions together require five distinct hardware components: analog-to-digital (A/D) converters, digital-to-analog (D/A) converters, digital input/output (I/O) ports, counters, and an accurate frequency generator. This discussion is developed from my experience with a hardware device that provides all five functions.

A/D Conversion
In a typical application, analog signals from some electronic device are sampled and converted to digital data at regular intervals. Usually sampling continues for some well-defined period. The sampling may progress at different speeds at different times. For example, it is frequently desirable to record high-speed events that occur within the setting of lower-speed events. To record both types of events with an analog recorder (an oscilloscope or chart recorder), it is usually necessary to make two recordings, one at a high speed and one at a low speed. Using a computer, it is relatively simple to record a single input at different speeds.

Analog-to-digital conversion is perhaps the most critical of laboratory applications because errors at this step will greatly distort the data. It is also frequently the function that most taxes the speed of the computer. Speed at this stage is sometimes limited by the A/D converters.

Lincoln E. Ford, M.D., is an associate professor of medicine and cardiology at the University of Chicago (Cardiology Section, Department of Medicine, University of Chicago, 950 East 59th St., Chicago, IL 60637). His hobbies include gardening and skiing.

but more often it is limited by software. Ultimately, the software is limited by the design of the computer, but more frequently it is limited by having to perform some other task concomitantly. One such task is the generation of control pulses during A/D sampling.

In many instances the initiation of an A/D recording must be synchronized with the experiment. Instead of having an external device initiate the A/D conversion sequence, it is tempting to have the computer control the experiment at the same time that it is collecting data. An additional advantage of this combined approach is that the data collection is very accurately synchronized to the experimental procedure. The difficulty with this approach is that it requires the computer to perform two tasks at once. This can call for some relatively sophisticated programming, particularly when high speeds are necessary.

Interface Boards
There are several commercially available devices that will perform at least four of the five functions required for
the laboratory applications described above. Several of my colleagues and
I bought the LabMaster board made
by Tecmar because it provides all five
functions and because it was the first
one available. It also costs less than
more recent devices. It consists of a
motherboard that fits into the IBM PC
and a daughterboard that houses the
A/D converters outside the computer.
This arrangement isolates the incom­
ing analog signals from electrical in­
terference inside the computer.
The Data Translation Company
makes a similar board that has the
capability of direct memory access
not available on the LabMaster but
does not have the Tecmar board's
programmable counters. We preferred
the Tecmar board in part because we
wanted to put out logic pulses to con­
trol the experimental apparatus while
collecting data with the A/D converter.
The five programmable counters
simplify this task because they
operate independently of the central
processing unit of the host computer.
The counters can be programmed to
begin counting the same frequency
pulses that trigger the A/D conver­
sions. When they have completed
their count they toggle their external outputs without intervention from the
computer. Thus, the logic pulses are
synchronized exactly to data acquisi­
tion without interfering with the high­speed operation of the central
processor.
When very high speeds are not re­
quired, the digital I/O port can be
used for applications control. Al­
though most commonly used as a
single interface to other digital equip­
ment, the individual channels in the
port can be used separately to con­
trol different pieces of apparatus. In
addition, these channels can be con­igured to accept logic pulses from the
apparatus, thereby allowing a bidirec­tional interaction.
A final way of controlling experi­
ments is to use the DA converters to
set voltage levels for external devices.

POSSIBLE IMPROVEMENTS
In spite of our general satisfaction
with the Tecmar board, we found
several areas that need improvement.
both in the LabMaster and in the
other devices that are available. As
explained in John Mertus's letter to
BYTE ("Data Collection with an IBM
PC" October 1984, page 14), the
absence of direct memory access on
the Tecmar board severely limits this
board in multistasking operations.
The cable connections could be
greatly improved. Tecmar sells a set
of cables for external connections to
the board, but they are simply that—
bare cables. Users must make their
own interfaces. We have made an
interface box with BNC connectors for
each connection, and while we were
at it, we put in some buffer chips to
protect the digital I/O ports. Several
other manufacturers supply slightly
less primitive connections for their
device, but at best these consist of
screw terminals for bare wires. I do
not know of many laboratory scien­
tists who relish the thought of bring­
ing their signals out on bare wires.
Any manufacturer who supplied a
device with an interface having stan­
dard connectors such as BNCs and
well-protected inputs would find a
ready market.

There is one improvement related
to signal processing that I would
especially like to see. This is the ad­
dition of filters to the analog inputs of
the A/D converters. It is well known
that no information can be derived
about the frequency components of
a digitized signal that are greater than
half the sampling frequency. Noise
and oscillations in the signal that are
faster than the sampling frequency at
best decrease the signal-to-noise
ratio. In many cases, faster signals in­
troduce "aliasing," spurious low­
frequency oscillations that result from
sampling a high-frequency oscillation
at systematically different parts of its
period. Although filters generally in­
troduce lags in electronic signals, the
lags introduced by antialiasing filters
are likely to cause far less signal
distortion than will high-frequency
oscillations. The antialiasing device
should consist of a low-pass filter with
a sharp cutoff frequency near the
sampling frequency. The main argu­
ment against such a filter is that the
sampling frequency varies widely,
sometimes within the same record, so
that the cutoff frequency must be
made to vary in the same way. The
solution to this problem is to use an
integrator that averages the signal be­tween sample intervals. A. F. Huxley
and G. L. Reed recently described a
clever circuit that performs this
averaging (see "An Automatic
Smoothing Circuit for Input to Digital­
ing Equipment," Journal of Physiol­
gy, volume 292: 1979, page 11P). It is trig­
ered by the same clock pulse that
triggers the A/D conversions, so that
its cutoff frequency always varies with
the sampling frequency.
A major way in which A/D con­
verters could be improved is by the
use of separate converters for each in­
put channel and the use of on-board
data buffers. Most computer-con­
trolled multichannel devices have a
single A/D converter with a multi­
plexer that switches different channels
into it. Only one channel is converted
at a time, so that the samples in each
channel are displaced in time relative
to those in other channels. This time
displacement can cause a systematic
error when the data from one chan­
nel is plotted as a function of that in
another. The samples from different
channels can be brought into coinci­
dence either by using separate A/D
converters for each channel or by
holding the signals from all channels in
sample-and-hold circuits that are
triggered when the first channel
begins its conversion. The advantage of
separate converters and on-board
data buffers is that they increase the
speed of operation while effecting the
synchronization.

COMPUTER CONSIDERATIONS
Your choice of interface board has an
effect on the size of the central pro­
cessor and data bus needed. Most
data is collected from 10-, 12-, or
16-bit A/D converters, so one A/D
conversion will require a 2-byte word.
In a machine with a 16-bit bus (a true
16-bit computer) entire words can be
moved at once. In a smaller computer
We make everybody look good.

No matter what kind of computer you have, chances are your output would look better on an NEC monitor.

Need the finest in color graphics? We've got the monitor for that.
Need easy-view amber screen for lots of word processing? We've got it.
A bigger screen? A small screen? A more affordable screen?
Check it out; We've got them.
So it's no wonder we're becoming everybody's No. 1 choice for monitors.
Special cables or boards may be necessary so call NEC service department for details. Or see your nearby dealer.

NEC monitor models: (a)JB1201: 12" monochrome; (b)JB1205: 12" amber monochrome; (c)JC1215: 12" color composite with audio; (d)JC1216: 12" color RGB; (e)JB1260: 12" monochrome; (f)JC1460: 14" color RGB; (g)JB1410: 14" monochrome; (h)JC1410: 14" color RGB. Specifications and prices are subject to change without notice.

For the location of your nearest NEC dealer dial 1-800-323-1728. In Illinois, 1-312-228-5900.

NEC Home Electronics (U.S.A.), Inc., Personal Computer Division, 1401 Estes Avenue, Elk Grove Village, IL 60007, NEC Corporation, Tokyo, Japan.
having an 8-bit bus, words must be
moved in two sequential steps. This need to make two-step transfers great-
ly slows most of the computer’s oper-
ation. Since most time-critical opera-
tions involve data transfers along the bus, this slowing occurs at a very vulnerable stage. Although a true 16-bit computer transfers data twice as fast as an 8-bit machine, it does not follow that a 32-bit computer would be still faster in handling integer data. Since integer data occurs in 2-byte words increasing the bus size to 32 bits would not produce any increase in speed unless some way could be devised to move two words at once. The 16-bit machines available today are therefore as large as many operations require.

A question related to size is whether it is better to have several small, single-purpose computers or one large, multipurpose machine. My own preference is for the former. A major consideration is cost. In addition, the failure of a single computer in a group does not incapacitate the entire laboratory in the way that the failure of a single large computer does. Another advantage of a group of computers is that each can be dedicated to a single task. Even with the best multitasking arrangements, there will always be some time-critical operation that requires the uninter-
ruptedly use of the computer, forcing other users to wait. With multiple computers such interactive interruptions do not occur.

The main disadvantage of small computers is that they are slow. This disadvantage is usually more than offset by the ability to dedicate the machine to a specific task for an extended period.

THE IBM PC COMPROMISE

In spite of the negative considerations about the 8-bit bus, my colleagues and I bought several IBM PCs for use in the laboratory. We selected this computer rather than a true 16-bit machine because of its popularity. Many peripherals and programs are available for it, and we felt that it would not go out of production near-
ly as quickly as some of the other, less popular models.

We have found the PC to be as good as or better than expected in almost all areas except for one peculiarity: the absence of a limited interrupt or a software-controllable wait state. Once an A/D conversion is made, a flag consisting of one bit in a status register is set. The computer must then detect the flag and take the digital data from the converter. The PC can detect the flag in only two ways: polling the status register or generating a full interrupt. A full inter-
rupt, together with its return, requires 83 clock cycles. This many cycles would take more than 20 microseconds (µs) just to detect the flag. Polling takes substantially less time. Using a polling routine, we have written se-
quential A/D sampling programs that operate at a rate of 22 µs per conver-
sion. Over half that time is spent poll-
ing the status register. If a more rapid way of detecting the flag could be devised, this routine could operate at more than twice the speed. If the central processor could be put in a wait state immediately before each A/D conversion and be released by the “A/D done” flag, detection of the con-
version would be virtually instantaneous. An otherwise-similar com-
puter that had such a capability would be able to accept A/D conversions about every 10 µs.

SOFTWARE

Software is the most crucial part of any laboratory system. Clever pro-
gramming can introduce great flex-
ibility and compensate for many defi-
ciences in hardware. Poor program-
ing can hobble even the best sys-
tem. The time required to develop good programs should not be under-
estimated. Many of us have bought a piece of equipment that was physically capa-
ble of performing some desired task only to find that weeks of programming were required to make it work. For those of us who have had this experience, there is no stronger selling point for equipment than the concomitant availability of adequate programs to run it.
COLOR MAGIC brings to the S100 bus a new level of compatibility with the IBM-PC. In combination with our other boards, COLOR MAGIC allows execution of IBM PC-DOS programs without modification. COLOR MAGIC maps to the same port addresses and memory space as the IBM-PC color graphic board.

COLOR MAGIC has the following features:
- 32 K bytes of onboard video memory
  (The IBM-PC has only 16 K bytes)
- Display modes:
  - 80 by 25 alpha-numeric
  - 40 by 25 alpha-numeric
  - 160 by 100 16 color graphic
  - 320 by 200 4 color
  - 640 by 200 4 color – 32K version
  (not supported by IBM)
- RGB and composite video outputs
- Light pen input
- IBM-PC compatible keyboard interface onboard

COLOR MAGIC is supported under MS-DOS 2.11 now and will be supported under Concurrent DOS by MAR 1. With COLOR MAGIC in combination with our other high performance boards, you can now configure an S100 bus system with up to 8 times the performance of an IBM-PC and 1.5 times the performance of an IBM-PC/AT. If your application requires IBM compatibility and high performance, LOMAS DATA PRODUCTS is the only logical choice.

PRICE...16K VERSION – $595.00, 32K – $695.00

ANNOUNCING MEGARAM:

THE HIGH PERFORMANCE DYNAMIC RAM FOR THE S100 BUS

Application programs being written for today’s 16 bit computers are requiring more and more memory, while the performance requirements of the memory are increasing as the 16 bit processors require faster and faster access times. MEGARAM has been designed to address this problem and provide FAST, RELIABLE, HIGH DENSITY memory for the S100 BUS. MEGARAM requires no wait states with any of our 8086 (up to 10MHz) or 80186 CPU boards and only one wait state with our 68000 CPU board. Our board does not resort to piggybacking to attain up to 2 Megabytes of on board memory (piggybacking generally reduces reliability). Parity is included to insure data corruption, due to memory errors, will not go undetected.

286 Kbyte $595.00
1Mbyte $1955.00 – (Feb 1) 2 Mbytes $3295.00

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

RAM61 HIGH PERFORMANCE STATIC RAM
High speed (100ns) low power CMOS static RAM, 128K bytes extended addressing

PRICE $995.00

LDP2 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 $595.00

CP/M-86, MP/M-86 and CONCURRENT CP/M-86 are trademarks of Digital Research.

M-DOSS is a trademark of Microsoft.

**Lightning One is a trademark of Lomas Data Products, Inc.

**HSC12K is a trademark of IBM.

LOMAS DATA PRODUCTS, INC.
66 Hopkinton Road, Westboro, MA 01581
Tel: (508) 366-6434 FAX: 369-6272

For orders outside the U.S., contact our exclusive dealers:

Australia — JAMRON PTY LTD. (02) 65-2220
England — UNIVERSUM (01) 262-273
Malaysia — DATA COMPUTER (M) Sandakan Berhad, T19558

Prices and specifications are subject to change.
### Dot Matrix Printers

- **BROTHER/DYNA**X
- **CITIZEN**
- **EPSON**
- **IBM-PC Software**

### Monitors

- **AMDEK**
- **PGS**
- **ROLAND DG**
- **QuadLink (IBM)**

### MOUSE SYSTEMS

- **PC-Mouse w/Paint**
- **QuadRAM**
- **QuadVue (TTL output)**
- **QuadLink (IBM)**

### APPLE Peripherals

- **ALS**
- **BOSS**
- **DOMINO**

### Macintosh Software

- **DATABASES**
- **Macromedia**
- **MAC!**

### TECHNICAL SALES DESK

- **(603) 881-9855**

---

**HIGH TECHNOLOGY AT AFFORDABLE PRICES**

**THE BOTTOM LINE**

MILFORD, NH 03055-0423 • TECHNICAL (603) 881-9855 • ORDER DESK (800) 343-0726

---

**LITERA QUALITY Printers**

- **BROTHER/DYNA**X
- **NEC**
- **MEMOTECH**

### Letter Quality Printers

- **BROTHER/DYNA**X
- Starwriter (16 cps)
- Starwriter (40 cps)
- **STAR MICRONS**
- **MEMOTECH**

### Memotech

- **DX-15**
- **DX-25**
- **DX-35**
- **NEC**
- **Microline 92**
- **92 w/PC compatibility**

### Modems

- **HAYES**
- **SMARTMATE**
- **SMARTMODM, 300 bd**
- **SMARTMODM, 1200 BD**

### SYSTEMS

- **IBM-PC Software**
- **IBM-PC Peripherals**

---

**HIGH TECHNOLOGY AT AFFORDABLE PRICES**

**THE BOTTOM LINE**

MILFORD, NH 03055-0423 • TECHNICAL (603) 881-9855 • ORDER DESK (800) 343-0726

---

**LANGUAGES**

- **M@CASM (Assembler)**
- **MacPort (Level 1)**
- **MacPort (Level II)**
- **MICROSOFT BASIC 3.0**

**WORD PROCESSING**

- **Hayden Speller**
- **Mac Daisy Connection**
- **Mac EPSON Connection**
- **Mac Spell Right**

**GRAPHICS**

- **Building Blocks**
- **Click Art Series**
- **Commercial Interiors**

**OTHER**

- **Copy II Mac**
- **Dow Jones Straight Talk**
- **Hey, MAC! Newsletter**

---

**Embassy Hardware**

- **3W1 Diskettes (10 pkg)**
- **Diskette Holder**
- **Field Pro Carrying Case**

**MAC!**

- **Call (800) 343-0726**
INTERFACING FOR DATA ACQUISITION

by Thomas R. Clune

A comparison of three interfaces

THE USE OF MICROCOMPUTERS for data acquisition in the sciences is surprisingly limited. It is widely recognized that the need for such applications exists. But I discovered in my experience at Brandeis University that most researchers have either had bad experiences with data acquisition on minicomputers or simply don't feel that they have the time to learn what they would need to know to retool their labs. Nonetheless, the advantages of computerizing are so substantial that microcomputer-based data acquisition is slowly moving into the lab. In this article, I'll share some of my experience with different approaches to computerizing data acquisition. Since I find the IEEE-488 to be the most versatile option for laboratory data acquisition, I will devote a fair amount of time to explaining that interface. My hope is that my experience may ease the problems that you might encounter in computerizing your setup.

THE PROBLEM

There are three basic reasons why microcomputers are so important in the context of data acquisition. First, for a minicomputer or mainframe to be affordable, its use must be shared by more than one person, but in data acquisition, it is crucial to have the computer's attention when the data is ready. Microcomputers make single-user systems affordable. Second, mainframe computers are generally not located in the laboratory. Thus, in any but very low speed data-acquisition contexts, there is a communications bottleneck created by the data transmission. Third, there is no common standard for interfacing with laboratory instruments on mainframes. So each laboratory setup presents substantial and individual problems of design and implementation that exacerbate the financial and logistical difficulties.

At least one other concern is fueling the drive toward computerization. The cost of turnkey instruments has become so high that most institutions are unable to afford the state-of-the-art equipment needed to conduct research. This is particularly irritating because most instruments in the sciences have essentially the same components. You end up paying over and over again for a built-in chart recorder, a waveform digitizer, a monochrometer, a photomultiplier, etc. And when the new generation of an instrument comes out with a broader dynamic range or some other improvement in one component, the entire turnkey instrument must be replaced. We simply can't afford to pay for research done that way any more. With the availability of microcomputers, we don't have to. We can tie chart recorders, waveform digitizers, and whatever else we need together into a dedicated instrument and recycle the components as the field or our research evolves.

A/D CONVERTERS

The least expensive way to automate a lab is with an analog-to-digital (A/D) (continued)
The speed of a transient tracked by D/D equipment is not limited by the computer's throughput.

Instead of junking a high-quality analog instrument in the interests of modernizing, use the capabilities available in your lab now. One big advantage of this kind of setup is that you can use a very slow A/D converter. This is desirable for two reasons: first, a slow A/D converter will be better made than a comparably priced high-speed board, and second, since you will only need a 30-Hz-or-so A/D converter, most noise in the lab will be too fast for the A/D converter to respond to it. Further, your low-pass filter will be able to cut out line voltages, which are an inevitable source of noise in any lab.

D/D AND RS-232C

If an A/D converter won't meet your needs, you need stand-alone instruments that can transfer digital information to the computer via a digital-to-digital (D/D) interface. The first advantage of D/D over A/D is that data may be analyzed at high speed and the digital "snapshot" of the analysis stored in a buffer of a few kilobytes on the stand-alone instrument. The buffer data can then be downloaded to the computer at whatever speed the interface will support. That is, A/D conversion necessarily requires realtime analysis, whereas the speed of a transient that can be tracked by D/D equipment is not limited by the microcomputer's throughput. Of course, speed of data transfer is still important because it determines how quickly the instrument can repeat an analysis.

D/D interfaces come in two flavors: serial, which transfers information at a bit at a time; and parallel, which transfers data a word (commonly one byte) at a time. The most common serial port is an RS-232C interface. There are a lot to dislike about the RS-232C. First, it is not standard. There are two ends to an RS-232C interface: the DTE (data-terminal equipment) end and the DCE (data-communications equipment) end. Often the two instruments you want to hook together will both be configured as DTEs, so you will probably have to create a cable that matches your particular setup once you find out what it is. Second, the only handshaking provided is on the level of whole messages. The interface does not verify that data has been received before proceeding. It is very easy to lose data on this interface. Third, RS-232C is a notoriously noisy interface—perhaps no worse than an A/D converter, but that isn't saying much. Fourth, RS-232C is slow. Since it sends only one bit at a time, it has a built-in speed disadvantage over parallel interfaces. And interference is an increasing problem with increasing transmission rates (as is true of any system). Finally, RS-232C is able to connect only two devices together. Thus, coordination and control of multiple data sources requires more than one RS-232C port on the computer and makes for devilishly difficult software integration.

The strong points of RS-232C are twofold. First, it is capable of transmitting information over long distances by telephone. Second, it is the only interface available on some older instruments. If you have to use it, you learn to live with it. But you'll never learn to love it.

IEEE-488

The IEEE-488 is a byte-serial, bit-parallel interface that overcomes the problems of the interfaces outlined above. First, the interface is incredibly resistant to interference. For example, at the Brandeis University chemistry department, we used the interface in a pulsed-nitrogen-laser experiment and found that the data transmission was unaffected by noise in any environment where the computer itself was able to function. Figure 1 shows the physical layout of the cable that provides such excellent noise immunity.

The second virtue of IEEE-488 is that the interface has a bus structure. That is, you can interface up to 15 devices at a time using the same board. This structure simplifies process control and allows true simultaneous data acquisition, as we shall see presently.

(continued)
The PCturbo 186™ takes a good computer and makes it the BEST!

First the standard was the IBM™ PC. Then it became the IBM PCAT with its high processing speed. For those, however, who have an IBM PC and need PC AT-like performance, Orchid Technology will put you out in front again with a new standard—the PCturbo 186. The PCturbo outperforms the PC AT in speed with fast disk access, and unmatched performance while providing complete software compatibility.

Best of all, PCturbo allows you to protect your existing hardware and software investment without the cost of replacing your existing PC or the need to learn to use a new computer and its software. Simply install the PCturbo adapter board and Orchid's "Productivity Software" and your PC becomes a powerful turbo-driven computer.

The PCturbo 186 is actually a second computer within your PC. Powered by the advanced Intel 80186 processor, the PCturbo is transparent to your favorite programs like Lotus 1-2-3, Symphony, dBase II or III, Framework and Multimate, running them at turbo speeds. So, with PCturbo, your PC looks and acts the same as before; it just runs faster.

While the PCturbo is speeding up your processing power the 8088 microprocessor in your PC takes care of the I/O functions. Most importantly, complete compatibility is assured since the PCturbo allows you to switch back and forth between Turbo Mode and PC Mode with a simple command.

Since PCturbo boosts the processing speed of your PC, there's no more waiting to re-calculate spreadsheets or to retrieve data. With the unique built-in features like automatic disk caching, electronic RAM disks and print spooling, you can get even more done in less time. Now isn't that why you bought a PC in the first place?

TECHNICAL DETAILS:
Hardware
• Single slot plug-in board with high-speed 16-bit processor (80186).
• Up to 640K memory expansion for a maximum of 1.28 Megabytes total memory.
• Simple "one-step" installation.

Software
• Runs IBM PC-DOS 2.x/3.x on either the IBM PC/XT and versions of most compatibles.
• Provides high speed disk caching, RAM disk and print spooling.
• Standard PC (8088) operation for total compatibility.

Write or call for more information today.

ORCHID TECHNOLOGY
47790 Westinghouse Drive
Fremont, CA 94539
(415) 490-8586  Telex: 709289

Inquiry 239

FEBRUARY 1985 • BYTE 271
Third, the interface is fast for a micro. Data can be transferred at up to 1 million bytes per second (using special tristate drivers on the lines) and without any special care will support transmission rates of about 250K to 300K bytes per second using DMA (direct memory access).

Fourth, the interface is standard and widely available. All IEEE-488 instruments are plug-compatible, and the interface is available on every major kind of laboratory device. Over 2000 devices are currently available with an IEEE-488 interface. Given that the standard was not set in its current form until 1978 and that there is a lag between specification and implementation, the rapid adoption of the standard gives an indication of how sorely needed it was.

The primary limitation of the standard is that the total cable length on an installation cannot exceed 20 meters without special (and expensive) repeaters. In practice, you will seldom need to exceed that length. And given that long cabling slows transmission rates and is more susceptible to noise, you generally do better to keep the cabling short anyway.

**THE STANDARD EXPLANATION**

The IEEE-488 standard is relatively involved because it accommodates a wide variety of uses. In the rest of this article, I'll examine the standard and then take a close look at a setup using the interface.

IEEE-488 began life as the General-Purpose Interface Bus (GPIB) of the Hewlett-Packard Corporation. In 1975, the IEEE adopted the GPIB as its standard. Some minor modifications were made to the standard in 1978, but IEEE-488 still goes by the name GPIB on HP products.

Devices on the interface may perform three kinds of functions. They may be talkers: that is, they may transmit data to other devices on the interface. Of course, there can be only one active talker at any given time. Alternatively, a device may be a listener—it may receive data or instructions from another device on the interface. There may be more than one active listener on the interface at any given time. And a device may act as a controller, a coordinator of which device may talk when and which devices may listen. Finally, a device may do nothing but stand by. A device may, at different times, assume any of the above functions.

The interface supports two modes of operation: command and data. As the name suggests, the command mode is for process control. For example, if one of the devices on the interface is a digital multimeter (DMM), the controller may program the DMM for reading DC voltages in the 3-volt full-scale deflection range. In the data mode, data is transferred from talker to listener(s) over the interface.

The interface has 24 lines, 8 of which are ground lines. The other 16 are divided into three groups: 8 bi-directional data lines, 3 data-byte control lines (handshake lines), and 5 general interface-management lines.

The three-line handshake protocol functions as follows: When information is going to be transferred over the bus, the listeners must be ready to receive the data. If they are not, they signal NRFD (not ready for data) by...
Expand Your PC
To A Multi-User System
With Advanced Digital’s PC-Slave

Up To 32 Users
Expanding your PC to a multi-user system is easy. Simply plug in a PC SLAVE processor board and ASCII terminal for each user. With ADC’s unique Master/Slave concept, each user runs independent of other users without speed degradation.

RTNX executive software turns your PC into a master processor and shares disks, peripherals and data with slaves. ADC’s PC-File Server provides you with additional expansion slots, hard disk drive and a high-speed streaming tape back-up for your IBM PC System.

PC SLAVE FEATURES:
- 8 MHz, 8088 CPU
- 256 kB of RAM, expandable to 768 kB
- Two Serial I/O Ports

Advanced Digital Corporation, USA
5432 Production Drive, Huntington Beach, CA 92649
Tel. (714) 891-8484 • Telex 183210 ADVANCED HTBH

Advanced Digital, Limited
27 Princes Hanover Square
London W1R 8NO • United Kingdom
(01) 409-0077 • (01) 409-3351 • Telex 265840 FINEST

*RTNX is a trademark of LOGICRAFT
*PC-DOS is a trademark of International Business Machines
*MOS-DOS is a trademark of Microsoft Corporation
*LOTUS 1-2-3 is a trademark of Lotus Development Corporation
*Wordstar is a trademark of Micro-Pro Corporation
pulling the NRFD line low (low is defined as true by the IEEE-488 standard). The NRFD line has an open-collector design, so if any one listener is not ready, the line is kept low. When all the listeners are ready, the NRFD line goes high. If the talker is ready to transmit data, it sets the DAV (data valid) line low. The transition of the DAV line triggers the resetting of the NRFD line and the listeners pick up the latched byte of data. When each listener receives the data, it releases the NDAC (not data accepted) line, which is also open-collector. When all listeners have received the data, the NDAC line goes high, causing a reset of the DAV line, which in turn triggers the resetting of the NDAC line. This sequence, outlined in figure 2, is repeated for each byte in a transmission. It may not be immediately apparent why three lines are useful in this sequence. At first glance it appears that the DAV and NDAC line would accomplish everything necessary for the transmission of data. However, the NDAC line is released as soon as the IEEE-488 board of the listener has received the data. The information must still be downloaded from the IEEE-488 data register to, for example, the computer’s main memory to be stored more permanently. By releasing the talker as soon as the data has been transferred, the talker becomes free to prepare the next byte for transmission at the same time that the listeners are “digesting” the last byte, so the rate of information transfer may be maximized. The NRFD line is thus necessary to prevent the possibility of a listener’s data register being prematurely overwritten.

Since each byte of data transferred is a self-contained event on the interface, there must be some way of signaling the end of a data-transfer sequence. This may be done in two ways. The one I will mention here is to use one of the bus-management lines, the EOI (end or identify) line. When a talker sets this line, it signals that the data-transfer sequence is complete.

The “identify” in EOI applies to the controller’s use of the line. If the interface is to be used for process control, there must be a way for the controller to monitor the “fitness for duty” of the various devices. One way it may do so is by conducting a parallel poll of the devices. If the controller asserts ATN (attention) and EOI, each device responds by using one data line to say whether or not it has any problems. If one does, the computer (the controller) can query that device further to determine the precise nature of the difficulty. The limitation of a parallel poll is that the controller must initiate the inquiry. IEEE-488 also provides for a serial poll, in which a device in trouble may alert the controller that all is not well by asserting SRO (service request). The computer then can ask each device in turn what its status is to determine the source and nature of the problem.

ATN serves another, more general purpose as well. Any time the controller asserts ATN, it can change the function of a device from, say, talker to listener. When ATN is asserted, the board goes into the command mode. All subsequent information is control data. In general, control information will apply to only some of the available devices. How is the information restricted to only the appropriate devices’ attention? Each instrument on the interface must be assigned a unique 5-bit address, generally by DIP (dual-inline package) switches on the backplane of the instrument. Valid addresses are numbers up to and including 30. When the computer wants to address its control data to a specific set of devices, it asserts ATN and outputs a list of the appropriate address numbers (notice that the same string of outputs would be treated as data were the board not in the command mode). Table 1 shows the protocols of the computer addressing for different functions. If a device is being told to listen to control information, an addressed command follows its address-to-listen call. Addressed control information defined by the IEEE-488 standard includes GTL (go to local), which releases a device from remote control; SDC (selected-device clear), which resets a device to its default setting; PPC (parallel-poll configure), which is used to assign a data line to a device for answering a parallel poll; GET (group-enable trigger), which initiates simultaneous data acquisition by each addressed device; and TCT (take control), which passes control of the bus management from the present controller to the specified device.

Two other kinds of multiline commands are shown in table 1. First is a secondary address. This is information after the primary address that configures a device for a particular kind of operation. This is one way that a DMM may be set for DC volts, for example. The primary address specifies the DMM device number; and the secondary address specifies the DC voltmeter function in the DMM. The significance of secondary addresses is not part of the standard. Each manufacturer decides whether

![Figure 2: The logic flow of the IEEE-488 handshake sequence. Low is true.](image-url)
SOME DARK TRUTHS ABOUT BACKING UP YOUR DATA ON TAPE.

• Tape backup manufacturers promise speed, peace of mind and a good nights sleep for a small investment!

• Your sleep can turn into a nightmare when your hard disk crashes!

• If your replacement disk has bad sectors in locations that were good on your original drive, the restoration of a 'physical image' backup will not work as it cannot distinguish bad sectors and will attempt to write on the bad sectors. You will lose all data continuity from that point on!!

The DATASAFE addresses all the problem issues of tape backup. The DATASAFE has a simple and elegant tape self threading tape transport system that puts it far ahead of any other on the market. It has been consistently tested for over 150,000 self threading loads without failure.

• Unlimited Capacity
Each tape holds 10 meg data on the ADI 1010 and 20 meg on the ADS 1020, but this does not limit the capacity, using the MS-DOS BACKUP utility, you can backup any amount of data.

• No Fancy Installation
The DATASAFE can be mounted internally (it is dairy chained off the existing floppy controller so you don't need any additional slots), or you can use the standalone unit. The standalone unit plugs into the connector at the back of the computer. It needs no special installation. You can easily move it from computer to computer.

• Easy to Use
The tape drive looks just like a floppy to the computer, the DOS commands you are familiar with just the same on the DATASAFE.

The DATASAFE uses industry standard 1/4" tape on a self threading 2.2" spool. You just drop the reel in the drive and close the door-the drive does the rest, no messing with leader tape! The loading arrangement is similar to the system used in large computers. You do not have to pay fancy prices for tape cartridges, the 10 or 20 meg spools are only $14.95 (US)/$22.95 (C)

THE TAPE MEDIA

• Random Access
If your hard disk fails, the DATASAFE can be used just like a disk with a seek time of 45 sec end to end! No more down time for hard disk failures.

To order in U.S.A. or Canada
Call Toll Free:
1-800-268-5412

Internal Mount ADI 1010
U.S.A. $695.00
Canada $1195.00

Standalone ADS 1010
U.S.A. $945.00
Canada $1495.00

BUSINESS MACHINES INC.
762 Gordon Baker Rd., Willowdale, Ont. Canada M2H 3B4
Tel.: (416) 497-0531 Telex: 06-986133

1050 Clinton St., Buffalo, New York 14206
Tel.: (716) 694-5366 Telex: 916428

Inquiry 336

FEBRUARY 1985 • BYTE 275
Pascal and C Programmers

Your programs can now compile the FirstTime™

FirstTime is an intelligent editor that knows the rules of the language being programmed. It checks your statements as you enter them, and if it spots a mistake, it identifies it. FirstTime then positions the cursor over the error so you can correct it easily. FirstTime will identify all syntax errors, undefined variables, and even statements with unmatched variable types. In fact, any program developed with the FirstTime editor will compile on the first try.

More than a syntax checker!
FirstTime has many unique features found in no other editor. These powerful capabilities include a zoom command that allows you to examine the structure of your program, automatic program formatting, and block transforms. If you wish, you can work even faster by automatically generating program structures with a single keystroke. This feature is especially useful to those learning a new language, or to those who often switch between different languages.

Other Features: Full screen editing, horizontal scrolling, function key menus, help screens, inserts, deletes, appends, searches, and global replacing.

Programmers enjoy using FirstTime. It allows them to concentrate on program logic without having to worry about coding details. Debugging is reduced dramatically, and deadlines are more easily met.

FirstTime for PASCAL $245
FirstTime for C $295
Microsoft PASCAL Compiler $245
Microsoft C Compiler $395
Demonstration disk $25

Get an extra $100 off the compiler when it is purchased with FirstTime.
(N.J. residents please add 6% sales tax.)

Spruce Technology Corporation
110 Whispering Pines Drive
Lincroft, N.J. 07738
(201) 741-8188 or (201) 663-0063

Dealers: enquires welcome. Custom versions for computer manufacturers and language developers are available.

FirstTime is a trademark of Spruce Technology Corporation.

INTERFACING

to use secondary addresses and, if so, what they will mean. The last kind of multiline command is a universal command. Reasonably enough, universal commands apply to all devices on the bus and are therefore not preceded by an address list. The universal commands defined by the standard include LLO (local lockout), which disables instrument front-panel control; DCL (device clear), which resets all devices to their factory-selected default states (this is the universal version of SDC); PPU (parallel-poll unconfigure), which deactivates parallel polling; SPE (serial-poll enable), which initiates a serial poll; and SPD (serial-poll disable), which terminates a serial poll.

The logical difference between the uniline commands and the multiline commands is that uniline commands are unconditioned. That is, they operate immediately instead of requiring that the bus be in command mode. The last two uniline bus-management lines illustrate the need for such immediacy. REN (remote enable) places a device under computer control when a device is first going to be addressed by the computer; this provides the “warm boot” needed to get its attention. IFC (interface clear) is the “panic button.” When the controller asserts IFC, the active talker must immediately relinquish control of the data lines to the computer. As you can see, the standard is rather involved. But it is not complete.

HPIB
The IEEE-488 standard ensures electrical compatibility among instruments, but it does not insure that two instruments will understand each other. The analogy has been drawn between IEEE-488 and the telephone system: You can call Rome on your telephone, but you may not understand what the person who answers the phone is saying. Similarly, the IEEE-488 standard does not specify the code that is to be used by instruments in transmitting data. Some instruments speak binary, some speak ASCII, etc. The Hewlett-Packard Corporation has developed a software standard for IEEE-488 data that is not universally employed. However, it is the most common format for data transmitters on the bus. The protocol is called the Hewlett-Packard Interface Bus (HPIB). GPIB and HPIB are often used interchangeably, but strictly speaking GPIB is the IEEE-488 standard and HPIB is the conformance to HP’s software protocol. HPIB specifies the following:

1. All information is transferred in ASCII code.
2. Information is transmitted “left to right”; that is, “C A T” is transmitted “67 65 84,” not “84 65 67.”

(continued)

Table 1: IEEE-488 interface management command bit protocols. These apply only when the controller asserts ATN. A=address bit, C=command bit, S=secondary address bit, N=not used.

<table>
<thead>
<tr>
<th>Data Lines Bit</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 6 5 4 3 2 1 0</td>
<td>addressed command</td>
</tr>
<tr>
<td>0 0 0 C C C</td>
<td>universal command</td>
</tr>
<tr>
<td>0 0 1 C C C</td>
<td>address to listen</td>
</tr>
<tr>
<td>0 1 A A A A</td>
<td>address to talk</td>
</tr>
<tr>
<td>1 0 A A A A</td>
<td>secondary address</td>
</tr>
</tbody>
</table>
| 1 1 S S S S    | (continued)
Hot to plot.

Epson® puts the HI-80™ four-pen plotter on your desk for $599.

If you're still doing your charts and graphs in black and white, have we got a plotter for you.

High speed, low cost.
The new Epson HI-80 is small enough to sit on your desk, yet it plots in any four of ten available colors at a remarkable nine inches per second, with resolution, accuracy and repeatability comparable to units costing twice as much.

No. 1 on the charts.
The HI-80 draws on paper for reports, or acetate for overhead projection. It has 42 intelligent commands to reduce programming time. And it even prints text formatted for the Epson RX-80™ dot matrix printer.

It's an Epson.
Which means you can count on it to be extraordinarily reliable, extremely versatile, supported by virtually all graphics software, and backed by the Epson one-year Number One Warranty.

Get an art department for your desk. Get an Epson HI-80 Plotter.

Number one. And built like it.

Epson
Epson America, Inc.

2780 Lomita Boulevard • Torrance, CA 90505 • (213) 539-9140 • Call (800) 421-5426 for the Epson dealer in your area. In California call (213) 539-9140
The significance of a device's program data is determined by the manufacturer, not IEEE-488.

3. All sequences of data transmission end with ASCII 13 (a carriage return) and, optionally, ASCII 10 (a linefeed) instead of using the EOI line.

The advantage of the standard is that data can be fed directly to a printer to produce properly formatted output in continuous-data-collection applications. Of course, the biggest advantage of the standard is simply that it is a standard.

**USING THE INTERFACE**

So much for the standard. Now let's take a look at how to use it. Manufacturers of IEEE-488 interface boards provide interface drivers for you, so using the interface is easier than learning about the standard in the first place. Usually the interface driver is a set of assembly-language routines that you can call. In high-speed applications you want an assembly-language driver. But in the program I provide here (listing 1), I use an interpreted BASIC driver. The program is taken from a course in interfacing I taught at Brandeis University. It is used to calculate the lattice energy of solid argon from temperature and pressure data pairs. This is a low-speed application, with readings being taken every 30 seconds. Thus, an interpreted BASIC interface driver will provide adequate speed. A further benefit to me is that students can study the driver routines to understand how the interface works. Tecmar also makes an assembly version of its interface driver.

The equipment used in this experiment includes an IBM PC with 128K bytes of memory, a Tecmar IEEE-488 interface board for the PC, two HP 3478A DMMs with IEEE-488 installed, a copper-constantan thermocouple wire, and a Barytron 220 pressure transducer. The program listing includes only the data-acquisition part of the program, and Tecmar's interface driver routine is not reprinted here. Before the experiment can be run, the DMMs must be set to their respective addresses (17 and 19) by DIP switches on the DMM backplanes.

The program is largely self-explanatory. I will limit my remarks on it to points that the listing may not make sufficiently clear. Notice the statement `BD.ADDR%=&H310` in line 40. This initializes the beginning memory location of the 16-byte buffer used for communication between the IEEE-488 interface and the computer. `MY.ADDR%=1` in line 60 declares that the computer's device address number will be 1. Both these variable names are specified by the driver software. Line 110 shows the way that the Tecmar driver routine is invoked. The routine begins at line 10000 and is merged with your application program. `PARAM` is the variable name for any parameter to be passed to the driver routine. In this case, the operation performed is initializing the IEEE board for controller operation. In line 130, `ADTR` is the mnemonic for asserting REN to let the DMMs know that they are connected to and will be controlled by the computer. Line 150 contains the information to be output to the DMM that will monitor the pressure transducer. The significance of this data is determined by the DMM manufacturer.

```
Listing I: A sample data-acquisition routine using the IEEE-488 interface.

10 REM IEEE-488 PROGRAM FOR HEAT OF SUBLIMATION OF SOLID ARGON. PROGRAM SHOULD BE MERGED WITH TECMAR IEEE-488 SOFTWARE VER. 3.
20 REM PROGRAM BY THOMAS CLUNE, BRANDEIS UNIVERSITY CHEMISTRY DEPARTMENT
30 REM DMM #19 READS THE THERMOCOUPLE, DMM #17 READS THE PRESSURE TRANSDUCER. INITIALIZE IEEE-488 BUFFER LOCATION, DIMENSION ARRAYS
40 BD.ADDR%=&H310:DIM PRES(250):DIM TEMP(250)
50 REM SPECIFY COMPUTER DEVICE NUMBER, INITIALIZE DATA POINTER
60 MY.ADDR%=1:DPT=1
70 REM WAIT UNTIL READY TO BEGIN RUN. PRESSURE READINGS MUST BE POSITIVE AND THERMAL EQUILIBRIUM MUST BE REACHED BEFORE THE RUN BEGINS.
80 CLS:PRINT "PRESS ANY KEY WHEN YOU ARE READY TO BEGIN YOUR RUN"
90 A$=INKEY$:IF A$="" THEN 90
100 REM INITIALIZE BOARD WITH COMPUTER AS CONTROLLER
110 PARAM$="INIT.C:/";GOSUB 10000
120 REM SET BOTH DMM'S FOR REMOTE CONTROL BY COMPUTER
130 PARAM$="ADTR:";GOSUB 10000
140 REM SET INTERRUPT REGISTERS OF DMM'S FOR SYNTAX ERROR AND FRONT PANEL SRO.
150 DATA.Strings$="KM24D2PRESSURE"
160 PARAM$="WR.STR/17/14///":GOSUB 10000
170 DATA.Strings$="KM24D2TEMPERATURE"
180 PARAM$="WR.STR/19/17///":GOSUB 10000
190 REM ENTER DATA,STRINGS AND WRITE PROGRAMMING INFORMATION TO DMM #17. ADD <CR> FOR EOS.
200 CLS:INPUT "ENTER COMMAND STRING FOR PRES. DMM (#17)";DATA.Strings$
210 DATA.Strings$=DATA.Strings$+CHR$(13)
220 REM OUTPUT DATA,STRINGS TO DMM
230 PARAM$="WR.STR/17/13/EOS:";GOSUB 10000

(continued)
```
BASF QUALIMETRIC™ FLEXYDISKS: A GUARANTEED LIFETIME OF OUTSTANDING PERFORMANCE.

BASF Qualimetric FlexyDisks feature a unique lifetime warranty,* firm assurance that the vital information you enter on BASF FlexyDisks today will be secure and unchanged tomorrow. Key to this extraordinary warranted performance is the BASF Qualimetric standard... a totally new set of criteria against which all other magnetic media will be judged.

You can count on BASF FlexyDisks because the Qualimetric standard reflects a continuing BASF commitment to perfection in magnetic media. One example is the unique two-piece liner in our FlexyDisk jacket. This BASF feature traps damaging debris away from the disk's surface and creates extra space in the head access area for optimum media-head alignment. The result is a guaranteed lifetime of outstanding performance.

For information security that bridges the gap between today and tomorrow, look for the distinctive BASF package with the Qualimetric seal. Call 800-343-4600 for the name of your nearest supplier.

Inquiry 344

*Contact BASF for warranty details.
INTERFACING

240 REM CHECK FOR SYNTAX ERROR IN DATA.STRINGS$. IF YES, LOOP BACK TO REENTER DATA.STRINGS$.
250 PARAM$ = "RBST/".GOSUB 10000
260 IF SRO%= 1 THEN PARAM$ = "SER.POLL/17/".GOSUB 10000:IF POL$= 0 AND 4 = 4 THEN PRINT "SYNTAX ERROR IN COMMAND" :SRO% = 0:GOTO 200
270 REM IF ERROR<>SYNTAX ERROR, LIST ERROR MESSAGE IN OCTAL AND END.
280 IF SRO%= 1 THEN PRINT "ERROR. STATUS REGISTER (IN OCTAL) = (".OCT$(POLL.RESP%):END
290 REM ENTER DATA.STRINGS AND WRITE PROGRAMMING INFORMATION TO DMM #19, ADD <CR> FOR EOS.
300 INPUT "ENTER COMMAND STRING FOR TEMP. DMM (#19);" DATA .STRING$
310 DATA .STRING$= DATA .STRING$+ CHR$(13)
320 REM OUTPUT DATA .STRING$ TO DMM
330 PARAM$="WR.STR/19//13/EOS/" :GOSUB 10000
340 REM CHECK FOR SYNTAX ERROR IN DATA.STRINGS$. IF YES, LOOP BACK TO REENTER DATA.STRINGS$.
350 PARAM$ = "RBST/".GOSUB 10000
360 REM IF ERROR<>SYNTAX ERROR, LIST ERROR MESSAGE IN OCTAL AND END.
370 IF SRO%= 1 THEN PARAM$ = "SER.POLL/19/".GOSUB 10000:IF POL$= 0 AND 4 = 4 THEN PRINT "SYNTAX ERROR IN COMMAND" :SRO% = 0:GOTO 300
380 IF SRO%= 1 THEN PRINT "ERROR. STATUS REGISTER = (IN OCTAL) = (".OCT$(POLL.RESP%):END
390 REM BEGINNING OF DATA-AQCUISION LOOP. INITIATE A GROUP-EXECUTE TRIGGER TO RECORD THERMOCOUPLE AND PRESSURE TRANSDUCER READINGS SIMULTANEOUSLY.
400 PARAM$ = "GET/17,19/".GOSUB 10000
410 REM READ THE DMM VALUES INTO THE COMPUTER
420 PARAM$ = "RD.STR/17//10/EOS/".GOSUB 10000
430 REM STORE THE READING IN THE PRESSURE ARRAY.
440 PRES(DPT) = VAL(DATA.STRING$) * 100
450 REM NOTE THAT THE LINE FEED IS USED TO SIGNAL THE END OF DATA INSTEAD OF THE LENGTH OF COUNT. LENGTH OF COUNT CAUSES AN ERROR CONDITION HERE WITH V.3
460 PARAM$ = "RD.STR/19//10/EOS/".GOSUB 10000
470 REM STORE THE READING IN THE TEMPERATURE ARRAY. IF TEMP>77K GO TO CALCULATION ROUTINE
480 TEMP(DPT)= VAL(DATA.STRING$) * 1000:IF TEMP(DPT)> -5.539 THEN 630
490 REM CHECK FOR FRONT PANEL SRO. IF YES, GO TO CALCULATION ROUTINE
500 PARAM$ = "RBST/".GOSUB 10000
510 IF SRO%<> 1 THEN 550
520 PARAM$ = "SER.POLL/17/".GOSUB 10000:IF POL$= 0 AND 4 = 4 THEN PRINT "SYNTAX ERROR IN COMMAND" :SRO% = 0:GOTO 500
530 PARAM$ = "SER.POLL/19/".GOSUB 10000:IF POL$= 0 AND 4 = 4 THEN PRINT "SYNTAX ERROR IN COMMAND" :SRO% = 0:GOTO 500
540 REM READ NEW TIME, CHECK ELAPSED TIME
550 REM TIMES IS RESET TO 0 WHEN RBST CHECKS FOR TIMEOUT FAULTS
560 ENDClk = VAL(RIGHT$(TIMES$)) PRINT ENDClk
570 REM IF AT LEAST 30 SEC HAVE ELAPSED, GET NEW READING
580 IF ENDClk< 30 THEN 560
590 REM CHECK FOR END OF ARRAY. IF YES, JUMP TO CALCULATION ROUTINE. OTHERWISE INCREMENT DPT AND COLLECT NEXT POINT
600 IF DPT> 249 THEN 630
610 DPT = DPT + 1:GOTO 400
620 REM PRINT DATA AND DO SEMILOG REGRESSION GOES HERE.
(continued)
"I was very impressed with its overall performance and features... excellent interactive and data quality assurance capabilities... relatively easy to master..."

Bill Jacobson
From a feature article in
BYTE, October 1984
The cost of adding an IEEE-488 interface is nominal and the added flexibility is not available from any other source.
The PC Plotter:
It will change the way business looks at graphics.

The lowest-priced professional plotter on the market today is Houston Instrument's new four-pen PC Plotter. It is designed to produce the crisp graphics you need to compete — and communicate — in business. Just what makes this plotter so competitive? Let's take a look:

Price — A multi-pen, compact, single-sheet plotter at $595* isn't just a low price — it's an unbelievably low price. What an affordable way to link the power of graphics communication to your personal computer.

Performance — Yours and Ours — Until the PC Plotter was born, it was too expensive to let the pictures do the talking. Now that's no longer true. So, the next time the boss walks into the office needing some "nice charts and graphs," you can quickly fill the request with clean, colorful, wonderful graphics. Who knows, you might even get a raise!

As to our performance, we're the only plotter manufacturer offering you hundreds of graphics software packages which are compatible with the PC Plotter. That means you can produce any type of drawing you require.

Flexibility — Depending on your needs, you can select from two PC Plotter models. One (PC Plotter Model 595 for $595.00*) allows you to produce graphics or overhead transparencies on 8½" x 11" paper or film; the other (PC Plotter Model 695 for $695.00*) permits either 8½" x 11" or 11" x 17" graphics. And we didn't forget the OEM. Houston Instrument will work with you to configure a plotter that's perfect for your particular application.

For the name of your closest PC Plotter distributor or dealer, contact Houston Instrument, P.O. Box 15720, Austin, Texas, 78761 or call (512)835-0900. Outside Texas call 800-531-5205. In Europe, contact Houston Instrument, Belgium NV., Rochesterlaan 6, 8240 Gistel, Belgium. Tel. 059-27-74-45, Tlx. 846-81399.
For as long as anyone can remember, the world has trusted Kodak film to capture its memories. Now the world can trust legendary Kodak quality to capture its computer data.

Introducing Kodak diskettes. And the beginning of a new legend.

We know you expect nothing less than extraordinary performance from a Kodak product. We didn’t disappoint you.

These remarkable new diskettes are so thoroughly tested, they’re certified error-free.

Every Kodak diskette has a highly burnished head surface for optimum read-write accuracy. And every standard diskette is made to withstand 4½ million passes before significant wear occurs.

With accuracy and durability like that, we can offer this no-questions-asked replacement policy:

This KODAK Diskette will be free from manufacturing defects, or we will replace it.

Kodak diskettes for home and business PC use are available in standard 8- and 5½-inch formats, high-density 5¼-inch diskettes, and 3½-inch micro diskettes in our HD 600 Series.

New Kodak diskettes. Because the only thing that can follow a legend is another legend.
EVEN WITH ITS MULTIPLE-KEYSTROKE FUNCTIONS and non-mnemonic commands, WordStar has retained its reputation as a powerful and popular word processor. Now some of the people who developed WordStar have gotten together and written a package designed to capitalize on WordStar's strengths while addressing its weaknesses. Called NewWord, this program from NewStar Software has strengths and weaknesses of its own. In our first review this month, John Heilborn and Nanci Reel take a close look at whether it fails or succeeds in its objectives.

Next, Mark Welch gives us his investigations of Janus/Ada. A nonstandard subset of Ada for MS-DOS and CP/M-80, Janus/Ada lacks a lot of features that give Ada its special character and utility. On the other hand, its fundamental structure is that of Ada's, and it can give you a definite head start in your attempts to pick up a new and complex programming language.

The Geneva PX-8 is Epson's lap-size computer. These small machines look now to be a permanent feature of the microcomputing landscape. The PX-8's credentials are impressive: a CMOS Z80, 96K bytes of two kinds of memory, an 8 by 80 LCD, and a comprehensive list of bundled software for less (just less) than $1000. Still, what we've seen for some time are systems that do very similar things with their major difference being price. How well can one of these briefcase computers help you work? Rich Malloy has taken a hard look at the PX-8. His review this month shows you what you can expect.

When confronted with a choice between two products designed to do the same thing, do you ever find yourself asking why one costs more than 10 times as much as the other—and is it worth it? A case in point is demonstrated in this month's review of "Two Modula-2 Compilers for the IBM PC." Both are adaptations of the original Swiss compiler and neither is a trivial implementation. Why then does one cost $40 and the other $495? Is the more expensive product necessarily the better product? While not primarily a comparison on a cost basis, Kevin Bowyer's review provides good evidence about what each compiler can do.

Another comparative review is offered by Wayne Rash Jr. in his look at MCI Mail and EasyLink. In theory, electronic-mail services have a lot to recommend them. Why haven't they caught on as well as their advance billing a few years ago would lead us to expect? Both of these packages are full services, and each has been heavily promoted. Do you want one to call your own? If so, do you want either of these? Good questions. Mr. Rash provides some good answers.

Closing out this month's review section, Mark Welch provides a straightforward look at a straightforward product. Mannesmann Tally's latest printer, the MT160, has a variety of print modes, speeds, configuration capabilities, and programmable features. Mark Welch details the MT 160 and gives you as good an idea as anyone could about what this machine will and won't do.

—Glenn Hartwig, Technical Editor, Reviews
Whether used in video display mode or in its high-performance graphics mode, Human Designed Systems' GVT+™ Graphics Display Terminal offers more user friendliness, more design features, and more advanced functionality to optimize productivity — and encourage creativity — for the terminal operator, interactive user, and applications developer than any other terminal available today.

Atlanta - (404) 391-7766; Boston - (617) 449-6446; Chicago - (312) 825-2940; Dallas - (214) 437-1888; Denver - (303) 469-1553; Detroit - (313) 471-2607; Hawaii - Gray Associates: (808) 261-3757; Houston - (713) 952-1404; Los Angeles - (213) 410-7062; New York City - (212) 689-8833; New York State - NACE Executives: Rochester: (716) 223-4490; Syracuse: (315) 602-1840; San Francisco - (415) 692-4184; Washington, DC - International Systems Marketing: (301) 279-5775; Argentina - Itron SA: (011) 734-544; Australia - Computer Clarity Pty. Ltd.: (02) 241-3355; Belgium - BELCOMP: 091-31-52-22; Canada - CAIL Systems: Toronto: (416) 362-1063; Denmark - ADCOMP Data Aps.: 1-9 46 66, Finland - Valutecic Oy: 0742-051; France - Walton: (1) 328-60-06; Japan - Ampro: (3) 356-0850; Portugal - Soc. Com. Crocker. Delatorce Ltd.: 1-4601-41; Singapore - DTS Singapore: 33-49-506; South Africa - Palace (Pty) Ltd.: (11) 646-0000; Switzerland - Mitec AG: 01-469-23-50; United Kingdom - Sharpe Systems Ltd.: 2047-2027; Venezuela - H Blohm SA: 2541-21-22; West Germany - COMCO Computer systems: 1-705-24-30. INTERNATIONAL DISTRIBUTION INQUIRIES INVITED.
Two software packages for laboratory data acquisition tie in with this month's theme, computing in the sciences. Up for further review are Labtech Notebook, from Laboratory Technologies Corp., 328 Broadway, Cambridge, MA 02139, (617) 497-1010; and Asyst, from Macmillan Software Co., 866 Third Ave., New York, NY 10022, (212) 702-3241. Also slated for closer scrutiny in upcoming issues is the software provided by various A/D (analog-to-digital) board manufacturers. Those companies include Tecmar, 6225 Cochran Rd., Cleveland, OH 44139, (216) 349-0600, maker of the Labmaster board; and Data Translation, 100 Locke Dr., Marlboro, MA 01752, (617) 481-3700. While the A/D board makers seem to concentrate on producing driver software, the two packages first mentioned are integrated data-acquisition and data-analysis software.

Beginning with hardware requirements, there are key differences between the two main packages. The Labtech Notebook (which Data Translation also markets, under the name DT Notebook) can use the Intel 8087 math coprocessor chip; the Asyst package requires it. There are other differences between the two. Asyst supports complex number types, while Labtech Notebook does not. Asyst includes a wide variety of statistical-analysis options, while Labtech Notebook is more limited. Asyst includes routines to calculate polynomials, to operate on vectors and matrices (including matrix inversions), to determine the eigenvalues and eigenvectors of a matrix, to fit data to curves using least-squares approximations and multilinear regression, and to do fast Fourier transforms (including two-dimensional forward and inverse transforms). Labtech Notebook lacks these sophisticated mathematical functions. Arguing on behalf of Labtech Notebook is its ability to continuously stream input data to disk up to the limit of mass-storage space. Additionally, Labtech Notebook (written in FORTH-like MAGIC/L) is menu-driven and easy to use, while Asyst is a FORTH extension and requires the use of FORTH syntax, making it more difficult for some people to use. Finally, Labtech Notebook supports a wider variety of A/D boards. Both packages, however, support curve fitting.

Labtech Notebook uses Lotus 1-2-3 or similar products to do its graphing (except for real-time graphing, which is built in) and requires a spreadsheet or user-written program to perform data analysis. What is good about this is that the data files are written in comma-delimited ASCII (American Standard Code for Information Interchange), which could be transported into most other software packages that include a user-written analysis routine. What is not so good is that we don't know many scientists who can so easily write good graphing routines that they actually want to spend time doing it. Further, Lotus 1-2-3 has been characterized as inappropriate for creating sophisticated analysis programs. You'll need to take a serious look at this Labtech Notebook/Lotus 1-2-3 interdependency if you're considering it for your application. Right now, being tied into Lotus's graphing capabilities strikes a number of people around here as providing less functionality than needed for serious laboratory data analysis.

Nor is Asyst a likely "white knight" for the scientist. True, it has everything you could want except continuous data acquisition, but it is so hard to use that some of the company's own demonstrators seemed to have learned their presentations by rote. At a recent demonstration in Washington, DC, they wouldn't vary the input data at the suggestion of the audience.

Neither of these packages is cheap. Asyst comes in three separate modules and is priced at $1695 when all three are bundled together. The first module contains the system/graphics/statistics routines, is required to run the other two modules, and costs $795. The second module handles data analysis and costs $495. The third takes care of data acquisition and sets you back another $495.

Labtech Notebook is a single package and is less expensive in strictly relative terms—$795. The catch is that you have to provide your own Lotus 1-2-3.

Reporters are slowly realizing that system crackers cannot magically break into any computer. They are more likely invited in by poorly designed security measures. One of the devices that has arisen from this purported problem is the call-back modem, a device that allows access only from a group of specially selected phone numbers. And the first to arrive here at BYTE is the GTX-100 secure modem, from Lockheed-GETEX, 86 South Cobb Dr., Marietta, GA 30063. This modem, which sells for about $1000, can be set up so that nobody can call in to the system directly. You merely give it a password and the modem will then call you back after referring to a list of phone numbers in its memory. Unfortunately, the modem is not completely compatible with the Hayes modem, so some software may not work with it, but it seems to be a pretty interesting idea.

—Glenn Hartwig, Technical Editor, Reviews
The new fast mover from Hayes. The telecomputing leader. When it comes to communications products for personal computers, we're the leader! Hayes Smartmodem 1200™ set the industry standards for quality, reliability and performance.

Now our new, faster Smartmodem 2400 goes even further to lower telephone line costs and improve user productivity. So, at twice the speed of a 1200 bps modem, it quickly pays for itself in any high-volume communications operation.

Smartmodem 2400 provides a quick link to minis and mainframes. Both synchronous and asynchronous transmissions are supported by an advanced version of the well-known Hayes "AT" command set. You can download from the IBM mainframe at the home office. Send data to the mini upstairs. And guarantee accurate transmission with information services.

With worldwide communications in mind, Smartmodem 2400 was designed to meet CCITT international standards. It provides a fast, cost-effective way to transmit data between approved countries.

New version of Hayes Smartcom II™ communications software creates a complete telecomputing system with Smartmodem 2400. Our new Smartcom II, Version 2.1, is available for the IBM® PC and many popular compatibles. Smartcom II makes the most of Smartmodem's exceptional features, at the same time it makes communicating easy for you. And, if you're currently using an earlier version of Smartcom II, Hayes offers a $25 upgrade to Version 2.1.

So if you're looking for ways to streamline your communications, see your authorized Hayes dealer right away. For a hands-on demonstration of Smartcom II and our new Smartmodem 2400. Guaranteed to get you moving fast!


Smartmodem 2400
- Direct connect
- Asynchronous and synchronous communications
- Accommodates Hayes-compatible modems of slower speeds
- Meets CCITT worldwide standards
- Keyboard control of all communications parameters
- High speed indicator
- Voice/data capabilities
- Call progress monitoring
- Two-year limited warranty with optional four-year extended warranty available.

Smartcom II
- Hayes Verification and XMODEM protocols
- Emulates DEC* VT52 and VT100/102
- Totally unattended operation
- Voice/data capabilities.

Hayes
Software Review

NewWord

A WordStar clone with significant improvements

BY JOHN HEILBORN AND NANCY REEL

WordStar, the archetypal word-manipulating tool, is a versatile text-manipulating tool, but it can be difficult to master. NewWord, developed by NewStar Software, retains the strengths that have made WordStar popular while addressing most of WordStar's shortcomings.

NewWord, available for the IBM PC, PC-compatibles, and CP/M-80 systems, is priced at $249. Functionally, NewWord is similar to WordStar—it was, in fact, designed by some of the same people—but it is not merely a WordStar clone. And although it is not perfect, NewWord offers some significant advantages over WordStar.

WordStar's delete commands (Control-G, Control-T, Control-Y) are permanently destructive; when you delete something, it's gone forever. If you change your mind (or if you erase accidentally), you need to retype. To make matters worse, Control-Y (delete line) is right next to Control-T (delete word), so you can easily delete an entire line by mistake.

NewWord has an undo command (Control-U) and an "unerase" buffer. This command will usually undo whatever the last command did. For example, it will unerase a block that you erased with the command Control-KY. You can set the size of the unerase buffer during installation. Its original setting is 255 characters, or about 10 words.

When you request a document to edit, WordStar does not check to make sure that you typed the name correctly. If you misspell a document name, WordStar assumes that you want to create a new document. You have to abandon your misspelled file with Control-KO. On the other hand, NewWord looks for the document and asks for verification if the entered name does not match a file in the disk directory. This eliminates abandoning empty files inadvertently created when you try to retrieve an existing document for editing.

When WordStar saves a file during editing (Control-KS), the cursor returns to the top of the document, not to where you were editing. You must then use Control-OP to move the cursor back. NewWord returns the cursor to your editing location without extra keystrokes.

Print Features

In general, WordStar displays a document on the screen that looks exactly the way the printed page will look. Unfortunately, it also displays the control commands that you have to insert before and after text to turn boldface, underline, and other print features on and off. WordStar does have a special command that hides these commands, but it prevents you from seeing the control codes. You might forget where they are or leave out a trailing command and, for example, italicize the remainder of your document.

NewWord can display special print options such as boldface, underline, and strikeover on the screen if your terminal supports this capability. And NewWord's search function recognizes these embedded print control characters. For example, you can find all the boldfaced words and change them to underlined words: with WordStar, you have to conduct such a search visually without program support.

Another feature WordStar lacks is the ability to print more than one copy of a document at a time unless you buy the MailMerge program at extra cost. NewWord, however, includes the option of printing multiple copies of a document via a selection from the print menu. Also, you do not need an extra program to create form letters and perform other merge-printing tasks. NewWord has a merge-print function with features and commands similar to MicroPro's MailMerge, and advanced features such as conditional merge-print commands.

Rulers and Headers

WordStar has other shortcomings that might be visible only to advanced users. For (continued)
### AT A GLANCE

<table>
<thead>
<tr>
<th>Name</th>
<th>NewWord</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Word-processing software</td>
</tr>
<tr>
<td>Manufacturer</td>
<td>NewStar Software Inc. 1601 Oak Park Blvd., Pleasant Hill, CA 94523 (415) 932-2278</td>
</tr>
<tr>
<td>Price</td>
<td>$249</td>
</tr>
<tr>
<td>Format</td>
<td>5¼-inch floppy disk, PC-DOS (MS-DOS) and CP/M</td>
</tr>
</tbody>
</table>

#### Language
- 8080 machine language or 8086/8088 machine language

#### Computer
- MS-DOS- and CP/M-80-based microcomputers

#### Documentation
- 420-page manual, *Read Me First* (23 pages), Pocket Reference flyer, and disk tutorial

#### Audience
- Business and home users of microcomputer word-processing software who require advanced features

### REVIEW: NEWWORD

**Example:** In WordStar a “ruler” indicates left and right margins and tab stops. If you use several rulers within a document, you must embed each ruler in the text of your document. Each time you edit a document with several rulers, you must use a special command to turn on the new rulers as you encounter them.

NewWord allows more flexible use of multiple rulers. When you edit, NewWord automatically changes the ruler line every time it encounters a new ruler (when moving either forward or backward through a file). The command Control-@ inserts a copy of the current ruler into your text, and the factory setting lets you use up to six rulers per file, although you can increase the number during installation.

NewWord also lets you use up to three lines in page headings and footings, where WordStar limits you to single lines.

### PRINTER INSTALLATION

WordStar operates with a wide variety of printers but usually does not take advantage of their most sophisticated capabilities, such as proportional spacing (with microjustification) and italics, without assembly-language patches to the printer drivers. Also, if you have more than one printer hooked up to your system (for example, a dot-matrix printer for drafts and a letter-quality printer for final copies), you need to customize a WordStar disk for each printer and load the appropriate one.

NewWord lets you attach more than one printer to your computer and select the right one when you are ready to print. NewWord accomplishes this with multiple printer drivers, including dot-matrix, letter-quality, and electronic typewriter drivers, which are available as overlays. This package uses the advanced capabilities of the printers supported, including microjustification, variable character width and line height, and alternate pitches on the same line.

### OTHER FEATURES

NewWord’s IBM PC version (with DOS 2.0 or higher) protects a document...
when you use the opening menu’s C command. You cannot edit or delete a protected document.

NewWord also lets you find a particular page using Control-OP.

The Control-T command (delete word) works differently in NewWord than in WordStar. WordStar treats a punctuation mark as part of a word; if you use Control-T to delete the word “end,” the trailing period is deleted with the word. NewWord deletes the word but not the period.

A minor difference between NewWord and WordStar is that NewWord’s left-arrow key is a destructive backspace (WordStar’s is nondestructive).

Finally, in NewWord you can set the right margin to 255 (WordStar’s limit is 240). The wider margin is not significant for most applications, but it might be important in yours.

**DISADVANTAGES**

You have to give up some WordStar features for NewWord’s improvements. For example, you can’t print a document while editing (Control-KP). This is NewWord’s most serious flaw. Even when you use a print spooler, printing a long document requires a fair amount of time before the program accepts additional input.

You can change logged disks while editing, but NewWord can’t turn on the file directory (Control-KF in WordStar), so you can’t see what’s on your disk. For a way around this, issue the command Control-K1 (delete file), NewWord will display the directory of the currently logged disk and prompt you for the name of the file to delete. You can check the directory of the currently logged disk and cancel the command with Control-U; NewWord won’t delete anything.

The R command, which temporarily returns you to DOS and runs a program, is missing from NewWord, and NewStar Software has no plans to add it to NewWord’s vocabulary. If you want to format a blank disk from within NewWord, you’re out of luck.

Another missing command is WordStar’s “repeat this key” (Control-Q Control-Q+). Also, NewWord doesn’t separate program messages and text clearly, which often makes the screen display confusing.

**USING NEWWORD**

Like WordStar, NewWord uses a multiple-menu-oriented command structure, but because NewWord’s menus are less cluttered, they are easier to read (see photo 1).

When you begin program execution, NewWord presents an opening menu (continued)
menu (older versions of WordStar call this a no-file menu). You select one of the activities listed by typing a single character.

If you select D or N, you enter edit mode (see photo 2). Once you are in the edit mode, the edit menu (called the main menu in WordStar) appears on the screen. From this menu, you access commands by pressing the Control key and entering a character. The four commands labeled EXTENSIONS (Control-O, Control-K, Control-P, and Control-Q) are for submenus. Pressing these commands calls submenus that let you select the third character required for each command sequence. If you are familiar with NewWord, you can enter the commands without waiting for the submenus.

Fortunately, NewWord can read and edit WordStar files without conversion or translation. The program can also use some of the same auxiliary programs; for example, we use the same print spooler we use with WordStar.

**Performance**

We tested NewWord version 1.29, which is available for the IBM PC and compatibles (we used a PC, PCjr, and Compaq) and for CP/M-80 systems (we used a Morrow MD-I I). Some improved versions are available: version 1.40 for the IBM PC and compatibles is slightly faster than 1.29 and contains some minor program changes, and version 2.0 for CP/M-80 systems contains the column block-move feature, which NewStar reports will be available soon (two to three weeks) for IBM PC users. [Editor's note: We used NewWord version 1.43 to perform our benchmark tests.]

Unlike WordStar, NewWord uses no overlays except the printer driver. In cases where WordStar must load an overlay to perform a function, NewWord's performance is faster. Overall, we judge WordStar to be faster than NewWord on the IBM PC and compatibles and slightly slower on the CP/M computers. See Table 1 for data on the IBM PC, and John Heilborn's article "The Morrow MD-I I" (September 1984 BYTE, page 325) for benchmarks using CP/M systems (in Table 2, page 334).

**Installation**

The NewWord installation procedure is long (13 pages of step-by-step instructions) and critical, because the custom installation procedure is also the copy-protection scheme. Prior to this installation (called "unlocking") the software won't run on any computer. In order to unlock the software, you have to call a special 800 number maintained by NewStar. After unlocking, the software runs only on the machine on which it was installed.

The unlocking procedure is described in Read Me First, a 13-step instruction guide accompanying NewWord. The steps are clearly stated and even an inexperienced novice could follow the guidelines.

To customize NewWord to fit your own needs, NewStar has included a utility called NWINSTALL, a customization program. Like NewWord, NWINSTALL is menu-driven. Some users will need to use the utility to install special terminals and printers (the default terminal is a TeleVideo 925). The program is easy to use and well documented; the menus are comprehensive but not intimidating. NewWord's many customization options are described in the manual's Nuts and Bolts section. The organization of this section could use work (and there are several typographical errors) but, in general, the guidelines for using NWINSTALL are clear.

NewWord includes another utility program called NWCOLOR that lets you customize the screen display for a color monitor. You can select any one of eight colors for the foreground and background of text display, as well as high intensity (boldface), blinking, and blinking boldface mode for the foreground. You can display text in seven different ways and change any or all of them. NWCOLOR makes it easy to play with possibilities.

**Documentation**

NewWord's documentation includes a 420-page manual divided into three major sections: Do It Yourself, a tutorial that is organized into 12 sections, each covering important word-processing tasks: Nuts and Bolts, a customization guide; and NewWord Encyclopedia, a reference manual. The manual was written for the CP/M version and has not been updated for the MS-DOS version, so it does not include the information required to make full use of some of NewWord's enhancements (such as built-in special printer drivers and programmable function keys).

NewWord also includes the aforementioned Read Me First, a disk tutorial for word-processing novices, a Pocket Reference flyer, and a Do-It-Yourself Supplement that describes conditional merge-print dot commands.

**Conclusions**

NewWord has some features WordStar users have longed for (such as sophisticated yet flexible printer control and the undo command, which reverses whatever you just did). However, NewWord is not perfect. It can be slower than WordStar and it doesn't have some of the capabilities you might be dependent on if you've used WordStar more than casually. But at $249, NewWord is useful enough so that the lack of a few features is tolerable.
Janus/Ada

A useful nonstandard tool for learning Ada

BY MARK J. WELCH

Ada is the U.S. Department of Defense's "Language of the Future." Although the DOD ordered that all defense contractors use Ada this year, a lack of available proven compilers has delayed its wide use. Whether or not you agree with the DOD that Ada is the best language, it will soon be the language of preference for government work. The DOD hopes that using a single standardized language will reduce maintenance costs for software.

Microcomputer owners seeking to learn Ada will likely feel a sense of despair, since the compilers available for microcomputers are either partial implementations or nonstandard subsets of the full Ada language.

RR Software's Janus/Ada (version 1.4.7) is a nonstandard subset of Ada for MS-DOS and CP/M-80. Janus lacks most of the features that distinguish Ada from other highlevel languages, and it includes a number of nonstandard features.

However, Janus is a useful tool for learning about a complex programming language; those who have tried realize how hard it is to learn any programming language by reading even the best books or magazines. For a written overview of Ada, see Sabina H. Saib's two-part tutorial, "An Ada Language Primer," in June 1984 BYTE, page 131, and July 1984, page 139.

I used the MS-DOS version of Janus for the IBM PC. I am not an experienced Ada programmer; most Janus/Ada buyers will probably be in the same situation.

Ada was originally designed for real-time applications like guiding missiles or processing radar data. I don't have access to guided missiles and Janus doesn't implement Ada's concurrent tasking, so I wrote sample programs exercising Ada's usefulness as a general-purpose language. Since Janus doesn't have built-in graphics libraries, I wrote a simple text-based adventure game.

I had written a similar adventure game in BASIC in about 10 hours. Programming the game in Janus/Ada took quite a bit longer, perhaps due to my lack of experience. However, the resulting code was more structured and easier to understand and update later.

I am familiar with Pascal, the language Ada most resembles. Pascal programmers should have an easier time learning Ada than those experienced in other, less structured languages. A warning, though: the similarity between the languages is also confusing. I was often slow to locate an error because the illegal Janus/Ada line resembled valid Pascal code.

Included with the compiler are several sample Janus/Ada programs translated from Pascal. While none of the programs are noteworthy, they show how some functions are implemented.

After compiling several of the included packages, I wrote a simple program of my own to print a message, read a line of text, and echo it. It took four hours and a phone call to RR Software before I could compile the program.

Janus is not ADA

Janus is not an entirely accurate subset of Ada. The problem I battled for hours involved parameter calls. Standard Ada lets you call any function or procedure that assumes default parameter values by invoking its name. Janus—like an earlier version of Ada—requires that you add an empty set of parentheses so the use of default parameters is explicitly stated.

Because Janus doesn't use standard Ada strings, it does not have a simple way to read in a string with the valid Ada procedure:

\[ \text{get}(word); \]
\[ \text{get}_{-}\text{line}(word); \]

Instead, Janus excludes strings from the get procedure. You must use the get_{_}line function instead of the get procedure. This

(continued)
Price
$300 for CP/M-80 (not reviewed)
$700 for MS-DOS with tools disk
$500 for MS-DOS with tools disk

Manufacturer
RR Software Inc.
2718 Dryden Dr.
POB 1512
Madison, WI 53701
(608) 244-6436

Documentation
237-page loose-leaf manual in three-ring binder

Audience
Applications software developers, Ada programmers, aspiring Ada programmers

makes any program that uses I/O (input/output) nonstandard Ada. To read a string, you must call the get_line function:

word := get_line();

Note the required parentheses.

To make finished code look more like standard Ada, I created simple procedures to hide these nonstandard calls; if you compile such a program with a more complete Ada compiler, you need to change only these procedures.

Janus's nonstandard array handling also creates problems. You can create patches to cover some missing features, but some of Ada's elegance is lost. For example, the valid Ada array assignment:

\[ y(1..10) := x(1..10); \]

copy each element of \( x(i) \) into the corresponding \( y(i) \) element. This won't work in Janus because Janus doesn't implement array or string "slicing." That is, it cannot access groups of array elements. If \( x \) and \( y \) are non-string arrays, the following replaces the above code:

\[
\begin{align*}
\text{for } i \text{ in } 1..10 \text{ loop} \\
y(i) := x(i); \\
\text{end loop; -- for } i
\end{align*}
\]

If \( x \) and \( y \) are strings, the job is tougher. An appendix to the manual explains several nonstandard substring functions and procedures. To do exactly the same as the original, I'd have to use:

\[
y := \text{extract}(y,11,\text{length}(y)); \\
\text{insert}(\text{extract}(x,1,10),1);
\]

where the first line removes the first 10 characters of \( y \) and the second inserts the first 10 characters of \( x \) into the beginning of \( y \). Somehow this lacks the simple elegance of the valid Ada array assignment.

SEPARATE COMPIATION

Any Ada or Janus code can easily be bundled off in a separate segment and separately compiled. By doing this, several programmers can develop code independently, each knowing only the names and parameters of the subprograms the others are developing. Any changes made to the subprograms later will require only that dependent segments be recompiled and the program relinked with a minimum of debugging.

THE COMPILER

The compiler makes four separate passes; I've only experienced errors on the first three. Much information is echoed to the screen, most of it useless to the typical user; during each pass of the source or intermediate code, screen symbols show that the compiler is working.

When the compiler finds an error, it displays the guilty line and the line preceding it along with the line number; it points out the error and displays a fairly helpful error message.

Run-time errors are more confusing. When an error occurs during run time, the system merely displays the error message and line number. Since my text editor isn't line-oriented, I had to count lines to find the error—not an easy task when the error is in line 675.

Each compilation takes from two to five minutes, depending on the length of the file and on whether the file being compiled is merely a specification or includes executable code. Long files can be broken into segments for separate compilation; this is helpful when a single procedure must be recompiled many times during debugging. After all segments are compiled, you can link the main program and generate a .COM file. Like most compilers, Janus/Ada generates .COM files that are longer than the source code because library subprograms are linked into the file as well.

BENCHMARK PERFORMANCE

Janus/Ada is not an optimized compiler, nor does it optimize the code it generates. This is forgivable given its price and the speed with which it was brought to market. Still, it needs substantial performance improvements before I would use it for commercial software development.

The Sieve program in Ada compiled in 184.7 seconds, linked in 15.1 seconds, and ran in 29.4 seconds. Most, if not all, other language compilers on the IBM PC generate faster code more quickly. (RR Software includes with the compiler a version of the Sieve program translated from Pascal to Ada that is different from the BYTE Ada Sieve benchmark.)

The floating-point benchmark (listing 1) compiled in 184 seconds, linked in 15.8 seconds, and ran in 2.6 seconds. In this case, execution time was faster than the speed of several C compilers, although compilation speed was slow by comparison. Note that an 8087 coprocessor was used and that Janus can use floating-point numbers on the IBM PC only if it is equipped with this math coprocessor; no provision is made for floating-point arithmetic in software.

A benchmark that computes Fibonacci numbers wouldn't run when translated because Janus/Ada doesn't support 16-bit unsigned integers; they
cause a run-time error when the highest value is computed. When rewritten to use Janus's long_integer type, a stack/heap overflow occurs because Janus uses only 64K bytes of memory for data. (It uses another 64K bytes for code.) The Quicksort and Iofile programs used in benchmarking compilers also use long integers but were not benchmarked.

Janus's long_integer type was not easy to figure out, even after several calls to RR Software. The manual notes that long_integer is a standard type, but in fact you must use a separate library package called LONGOPS. Copies of the library packages are included on disk, a fact I discovered only after calling the company several times.

- Janus long_integers can't be manipulated like integers, since they're essentially user-defined types; addition or type conversion has to be done using one of the functions in LONGOPS. As a result, a program using long_integers in Janus looks radically different from one using integers in a more standard compiler.

Listing 2 shows the Fibonacci program in standard Ada; an overflow error is generated because the 24th Fibonacci number is a 16-bit unsigned number and Janus supports only 15-bit unsigned or 16-bit signed integers. Listing 3 shows the program converted to use the type long_integer in Janus: a heap overflow occurs because of the deep recursion and large data space required.

DOCUMENTATION
The Janus/Ada manual follows the format of Ada's military standard reference manual: each section mimics the reference manual and discusses any differences between Janus and Ada. The manual warns that it is not a complete guide and suggests that you have a copy of the Ada reference manual and an Ada textbook.

The Janus manual refers to the Ada reference manual of 1980, which is no longer accurate, changes were made during the ANSI (American National Standards Institute) review process.

(continued)

```ada
with longops;
package body fibo is
  use longops;
  ntimes : constant integer := 10; -- # of times to compute fibonacci value
  number: constant long_integer := lint(24); -- biggest we can compute
  one : constant long_integer := lint(1);
  two : constant long_integer := lint(2);
  value : long_integer;

  function fib(x: in long_integer) return long_integer is
    begin
      if Lgt(x,two) then
        return Ladd(fib(Lsub(x,one)),fib(Lsub(x,two)));
      else
        return one;
      end if;
    end; -- function fib

  begin -- fibo
    put(ntimes);
    put(" iterations: ");
    new_line;
    for i in 1..ntimes loop
      value : = fib(number);
    end loop; -- for i
    put ("fibonacci( ");
    put (L_to_lnt(number));
    put(" ) = ");
    put (Lto_lnt(value));
    new_line;
  end; -- fibo
```

Table 1: A partial list of unimplemented or nonstandard features of Janus/Ada.

<table>
<thead>
<tr>
<th>Item</th>
<th>Purpose/Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slices</td>
<td>Allows references to sections of arrays or strings</td>
</tr>
<tr>
<td>Strings</td>
<td>Not Ada standard (dynamic length)</td>
</tr>
<tr>
<td>Named/default</td>
<td>Allows default input parameters or named parameters in subprogram call</td>
</tr>
<tr>
<td>parameters</td>
<td>Examples: <code>attack(enemy =&gt; sam, weapon =&gt; knife);</code></td>
</tr>
<tr>
<td></td>
<td><code>attack(enemy =&gt; fred);</code></td>
</tr>
<tr>
<td></td>
<td><code>procedure attack (enemy: IN person := dave; weapon: IN tools := gun);</code></td>
</tr>
<tr>
<td>Tasks</td>
<td>Ada's multitasking facilities</td>
</tr>
<tr>
<td>Exceptions</td>
<td>Exception/error-handling facilities</td>
</tr>
<tr>
<td>Generics</td>
<td>Subprograms can be easily redefined for new data types</td>
</tr>
<tr>
<td></td>
<td>Example: <code>procedure EXCHANGE (u,v: in out ELEM ) is</code></td>
</tr>
<tr>
<td></td>
<td><code>t: ELEM;</code></td>
</tr>
<tr>
<td></td>
<td><code>begin</code></td>
</tr>
<tr>
<td></td>
<td><code>t := u; u := v; v := t;</code></td>
</tr>
<tr>
<td></td>
<td><code>end EXCHANGE;</code></td>
</tr>
<tr>
<td></td>
<td><code>procedure swap is new EXCHANGE (character);</code></td>
</tr>
<tr>
<td></td>
<td><code>procedure swap is new EXCHANGE (ELEM =&gt; integer);</code></td>
</tr>
</tbody>
</table>

You need to rewrite Janus programs to run on an Ada compiler.

and the true Ada is now reflected in the reference manual of January 1983. (Like its manual, Janus conforms to the earlier version of Ada.)

A fairly complete index is included in the manual, but some items are omitted. When I tried to learn about string-handling routines, for example, I found that section 15—which includes the list of string functions—was not in the index under "string".

As noted above, the manual says that long_integer is a standard type, although it isn't. RR Software admits that the manual (version 3.2) is behind the compiler.

**SUMMARY**

The Ada Joint Program Office (AJPO) insists that any partial implementation of Ada be so marked and all missing features be clearly identified. RR Software includes a list of implemented and unimplemented features in its brochure and its documentation. Some of the most significant missing features are listed in table I.

While missing Ada features make experience with Janus less helpful to programmers, its nonstandard implementations of other features can be downright confusing. String and file handling are nonstandard, which means that you will need to rewrite almost all Janus programs in order to run them on a valid Ada compiler.

RR Software expected the next version of Janus/Ada to be available in the fall of 1984 and said that many extensions and changes would be made to the compiler. The new version might be available by the time you read this article.

While Janus is not a true implementation and lacks many of Ada's features, it is a useful, inexpensive tool for those wishing to learn the language before true Ada compilers are available for microcomputers.
It's the buzz of the industry—our new letter-quality printer that zips along at 40 characters per second and sells for less than a thousand dollars! Its 13" print line will handle your spreadsheets and every imaginable kind of correspondence—plus graphics! Quiet, too—less than 60 dbA. And the 3K buffer memory (expandable to 15K) lets you use your computer for other purposes while the JUKI is printing. Compatible with most computers. (You can even get an optional tractor feed and cut-sheet feeder for it!) Now you know why JUKI printers are humming in offices all over the world!
C Is The Language.
Lifeboat Is The Source.

Lifeboat.™
The Leading Source And Authority For Serious Software.
1-800-847-7078.
In NY State: 212-860-0300
Serious Software For The C Programmer From Lifeboat

Lattice® C Compiler: The serious software developer’s first choice.

Selected for use by IBM®, Texas Instruments, Wang®, MicroPro®, Ashton-Tate™, IUS/Sorcim®, Microsoft® and Lotus™ to name a few of the many. Why?

Lattice C is clearly the finest 16 bit C compiler available today.
—Renowned for speed and code quality.
—Fully compatible with the C standards set forth by Kernighan and Ritchie.
—Four memory model options offer you unsurpassed control and versatility.
—Superior quality documentation.
—Now includes automatic sensing and use of the 8087 chip.
—Widest selection of supporting add-on packages.

Halo™: A graphics development package rapidly emerging as the industry standard.
—140 graphics commands including plot, line, arc, box circle and ellipse primitives, bar and pie charts; pattern fill and dithering commands.
—New: multiple viewports and “stroke text” for angling, scaling and filling text.

C Food Smorgasbord™: This beautifully written collection of C functions is a valuable time saver.
—Library includes a binary coded decimal arithmetic package, level 0 I/O functions, a terminal independence package, IBM PC ROM BIOS access functions and much more.

Pmate™: The premier editor for the programming professional.
Pmate is a full screen editor with its own powerful macro command language:
—Perform on screen row and column arithmetic, alphabetize lists, translate code from one language to another, call up other macros.
—Customize Pmate almost any way you like.
—Contains 10 auxiliary buffers for storage of macros, text, subroutines.
—An “undo” feature allows the programmer to retrieve whole series of deleted items.

Additional C Tools

Available From Lifeboat:
Panel™: Screen formatter and data entry aid.
Lattice Windows™: Windowing utility; create “Virtual Screens.”
Plink-86™: The popular linker; includes extensive overlay capabilities.
Pfix86™: Dynamic debugging utility.
Pfix86 Plus™: Symbolic debugger with capacity to debug overlays.
Btrieve™: Database record access/retrieval library.
Phact: Multikeyed ISAM C-Function library.
Fabs: Fast access B-tree database function library.
Autosort: Fast sort/merge utility.
ES/P: 'C' program entry with automatic syntax checking and formatting.
Greenleaf Functions™: Library of over 200 popular C functions.
And much more.

YES! Please rush me the latest FREE Lifeboat™ catalog of C products.

Company
Name
Title
Phone
Address
City State Zip

Please check the category where Lifeboat can best help you:

☐ Software development ☐ Corporate ☐ Education
☐ Dealer/distributor ☐ Government ☐ Other

Call Direct: 1-800-847-7078 (In NY State: 212-860-0300)
Return coupon to: Lifeboat Associates™
1651 Third Avenue, New York, NY 10128.

© 1984 INTERSOFT CORPORATION

Inquiry 181

FEBRUARY 1985 • BYTE 301
The Epson Geneva PX-8

The Epson Geneva PX-8 (see photo 1) has a low-power CMOS (complementary metal-oxide semiconductor) version of the Z80 processor. 64K bytes of CMOS memory, 32K bytes of permanent ROM (read-only memory), an 8-line by 80-character LCD (liquid-crystal display), a rechargeable battery, a full-size keyboard, and a microcassette drive. In addition, the PX-8 comes with a full complement of software: the CP/M operating system (version 2.2), WordStar, CalcStar, BASIC, a scheduling program, and a communications program. This package ($995), in combination with a healthy supply of expansion hardware, makes the PX-8 a good second computer, especially for people with CP/M systems.

HARDWARE
At five pounds and with physical dimensions just slightly larger than a heavily packed three-ring binder, the PX-8 is quite at home in a briefcase. With its LCD folded tightly and a plastic cover over its keyboard, it is fairly well protected for the ordeals of the road. There is even a large plastic handle that slides out near the keyboard. When you want to use it, the cover quickly slides off and the display unfolds to the desired angle, revealing a speaker and microcassette drive.

On the rear panel of the PX-8 are several ports: an RS-232C DIN (Deutsche Institut fur Normung, the German standards organization) connector, a serial DIN connector (for an optional floppy-disk drive), a connector for a bar-code reader, an external speaker connector, and a 50-pin expansion connector covered by a plastic strip. The power switch is conveniently placed on the right side of the unit.

DISPLAY
The size of the Geneva's LCD is acceptable, but it is a little hard to read (see photo 2). You can adjust the display to whatever angle gives you the least glare and the most contrast, and you can adjust the screen contrast further by sliding a switch that's below the screen.

The PX-8 can display 8 lines of 80 characters each. (The characters are composed on a 5- by 7-pixel matrix inside a 6- by 8-pixel matrix.) However, lowercase letters such as g and y do not have descenders, and you can't display in reverse video (i.e., light character on dark background). The characters are much smaller and thinner than those on the TRS-80 Model 100, and the screen is slower, but the Epson does display twice as many characters.

The screen displays all 96 standard ASCII (American Standard Code for Information Interchange) characters plus 32 common graphics symbols (codes 128–159 decimal), which are compatible with some Epson printers but not with the IBM-compatible ones. Character sets are available for France, Germany, U.K., Denmark, Sweden, Italy, Spain, and Norway.

The PX-8's keyboard is similar to but better than the HX-20's (see photo 3). It has four cursor keys above the Return key and a Help key plus five function keys in the upper left. And there are indicators for caps-lock and num-lock features.

MEMORY
The PX-8 uses a low-power CMOS version of the Z80 microprocessor with a clock rate of 2.45 MHz. In tests with BASIC and Calc-Star, it appeared slower than most other office computers at calculating. The PX-8 also uses two slave processors. A 6303 controls access to the display, the external disk drive, and the application ROM chips, among other things. A 7508 works with the system clock and keyboard and controls the Geneva's alarm features.

The Geneva comes with 64K bytes of CMOS memory that is always on; even if the main battery fails, a small backup battery keeps the memory chips powered on for a week or so until you can recharge it. The only event that should clear memory is if
you press a special hidden reset button on the bottom of the machine and do a cold reboot. You can set part of the memory up as a RAM disk with a size of 2K to 24K bytes.

The operating system is held in 32K bytes of ROM. When you turn on the system, it replaces (bank-switches) the lower 32K bytes of RAM (random-access read/write memory) with this ROM. When you run an application, the system bank-switches the RAM back into this location. The net result is a virtual 96K-byte machine.

The machine has two sockets for ROM chips hidden under a panel on the bottom of the computer. The software bundled with the PX-8 comes on four 32K-byte ROM chips: one each for CP/M system utilities, WordStar, BASIC, and a combination of CalcStar and a scheduling program. Only two of these chips can be resident in the machine at one time.

Epson has done a good job of implementing a microcassette drive in the Geneva. Even though it looks and acts like a tape drive, the operating system sees it as a disk drive, albeit a slow one. It even has its own directory and drive specification (H:). However, it has some quirks. To save time, the system doesn't write the directory onto the cassette until you tell it that you are going to remove the tape. If you forget to tell the system, some data stored on the cassette will be lost.

A 60-minute cassette (30 minutes per side) stores up to 12 files and up to 60K bytes per side.

You can also use the microcassette drive much like a regular audio-tape drive. Under certain conditions, the programmable function keys can simulate the control keys on a cassette tape player. You can even use it to listen to your audio cassettes, but the volume is very low.

The PX-8 is powered by an internal nicad (nickel-cadmium) battery, which can supply full power for about 15 hours. (Use of the microcassette drive or serial port shortens this time.) You can recharge the battery with a small transformer that plugs into any power outlet. A full recharge takes about 8 hours, longer if you use the machine during the process.

**INTERFACES**

The Geneva has a number of interfaces for external peripherals. The most useful is probably the RS-232C serial port configured as a round eight-pin DIN jack. It has pins for all the most commonly used signals—GND, TD, RD, RTS, CTS, DSR, DTR, DCD, and FG (frame ground)—and a maximum speed of 19,200 bps (bits per second). You can use two protocols: SI/SO (shift in/shift out), which can transmit a full 256 characters over a 7-bit communications link, and XON/XOFF.

To use the RS-232C port you need to purchase a DIN/DB-25 converter cable (approximately $25). Although we didn't test a large number of serial devices, we found the Geneva worked well with an Epson acoustic modem and with an IBM Personal Computer (PC) using a null modem adapter.

(continued)
The PX-8 has another similar connector labeled serial, which you can use to connect an external disk drive (at 38,400 bps) or a serial printer (at 4800 bps). It also has three other ports: an external speaker jack (in addition to the internal speaker), an analog input jack (which connects to an internal analog-to-digital (A/D) converter, 0–2 volts, 6 bits of resolution), and a connector for a bar-code reader.

One interface noticeably absent is a parallel printer interface. Another desirable connection would be for a full-size 80-by-24-character display. The PF-10 portable 3½-inch disk drive (see photo 1) is available for $599. Powered by an internal battery, it is rechargeable by the same transformer that recharges the Geneva. The disk drive can store about 320K bytes on a 3½-inch microfloppy disk and connects to the PX-8 with a short cable through the serial port. You can connect two disk drives in daisy-chain fashion. The data-transmission rate is 38,400 bps, slower than the parallel connections most disk drives use. When you purchase the disk drive, you also get the following familiar CP/M utilities: FORMAT, DISKCOPY, ED, DDT, ASM, LOAD, and DUMP.

**Expansion**

The Geneva has some other interesting accessories. All are wedge-shaped modules that attach to the bottom of the computer and connect through the 50-pin expansion bus. These modules add little to the size and weight of the unit and elevate the keyboard to a comfortable typing angle.

The first of these are memory-expansion modules (see photo 4), which come in two flavors: 60K bytes ($329) and 120K bytes ($460). Since the Z80 microprocessor can address only the basic 64K bytes of memory, the second and third 60K-byte segments are set up as a RAM drive.

A second add-on module is a direct-connect, 300-bps modem ($180). A third module combines that modem with 60K bytes of memory for $360. We did not test either of these modules.

These expansion units all connect through the 50-pin expansion-bus connector on the back of the computer. This connector was not designed for easy access, but once you attach an accessory you probably won't have to touch it again.

**Software**

The Geneva comes equipped with 128K bytes of software on ROM chips—four 32K-byte chips. The first one contains the BASIC interpreter; the second, some CP/M utilities; the third, Portable WordStar; and the fourth, a combination of Portable Calc (CalcStar) and Portable Scheduler. Only two of these chips can be present in the system at one time (see photo 5).

The Geneva’s operating system has some interesting features. First, it all resides on yet another ROM chip,
AT A GLANCE

Name
Geneva PX-8

Manufacturer
Epson America
2780 Lomita Blvd.
Torrance, CA 90505
(213) 539-9140

Size
11.7 by 8.5 by 1.9 inches
(29.7 by 21.6 by 4.8 cm),
5.1 pounds (2.3 kg)

Components
Display: 80-character by
8-line LCD, 480- by 64-pixel
graphics
Keyboard: 72 keys, 4 cursor
keys, 5 programmable
function keys
Processor: Z80-compatible,
low-power CMOS version,
2.45-MHz clock speed
Memory: 64K RAM; 6K RAM
for display; 32K ROM
(system); 64K ROM
(applications)
Power: Nicad battery rated
at 15 hours, small
transformer/recharger
Options: 320K, 3½-inch disk
drive ($599); 60K memory
expansion ($329); 120K
memory expansion ($460);
300-bps, direct-connect
modem ($180); combination
60K memory plus modem
($360)

Software
CP/M 2.2, BASIC (Microsoft),
Portable WordStar, Portable
Calc, Portable Scheduler,
TERM (communications)

Documentation
Five manuals

Price
$995

The Memory Size graph shows the standard
and optional memory available for the com­
puters under comparison. The graph of Disk
Storage capacity shows the highest capacity
of one and two floppy-disk drives for each
system. The Bundled Software Packages graph
shows the number of software packages in­
cluded 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 for 8-bit systems); and the stan­
dard operating system and standard BASIC in­
terpreter for each system. Note that the price
of the Epson does not include a disk drive.
The rear panel reveals (among other things) a speaker jack, an expansion bus, and an RS-232C port.

A look inside the PX-8 shows the processor chips (left) and the ROM chips (lower center).

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 June 1984 BYTE, page 327, and October 1984, page 33.) The Sieve column shows how long it takes to run one iteration of the Sieve of Eratosthenes prime-number benchmark. Note that the Epson could not run the Sieve test because of insufficient available memory. The Calculations column 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). The file-copy test involved copying a file from one part of a floppy disk to another. 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 programs used were Portable Calc for the Epson and Microsoft Multiplan for the others. The tests for the Apple IIe were done with the ProDOS operating system. The IIe Multiplan test was done with DOS 3.3, the IBM with PC-DOS 2.0.
REVIEW: EPSON GENEVA PX-8

which is permanently installed in the system. Second, when you turn the machine on for the first time, the system asks you how much memory you want in your RAM disk—from 2K to 24K bytes. Thereafter when you turn on the system, you see a menu of all the files on a particular drive. (By drive I refer to any device: a disk, a RAM drive, a microcassette tape. The operating system treats them all alike.) You then move the cursor to the program or document you want and press the Enter key. This loads the selected program into RAM and executes it.

If you press Control-Help, you see the System Display, which includes information on various operating-system parameters. The display contains the date and time, the size of the RAM disk, whether or not a password is in effect, which drives are listed on the menu, and which data files are linked to which programs. The password feature on this machine is pretty secure. If you set a password, the machine won't do anything until you give it the correct one. The only way around it is to do a cold reboot and lose all your data.

You can turn the menu on or off and choose which drives are to be listed on the menu and in which order.

The System Display also lets you control the cassette drive manually. The function keys become like the controls on a tape recorder.

In practice, the menu is quite useful, but sometimes it gets in the way. For example, it is hard to enter a command such as STAT A:*.*—how many files are on the A drive and how large are they. To do this you must leave the menu by hitting Escape. Fortunately, you can turn the menu on or off.

The most significant piece of software in the Geneva is the ROM-based version of WordStar. Despite its small size, this version seems to contain most of the features of the larger version. The only features lacking are certain printing capabilities.

The spreadsheet supplied with the PX-8 is Portable Calc, a ROM-based version of CalcStar. Portable Calc performed our standard recalculation

$$\text{Table 1: Word-processing benchmarks for Portable WordStar on the Epson Geneva PX-8 (times in seconds). In many tests the Epson with a RAM disk performs as fast or faster than a floppy-disk-based IBM PC. There are two glaring exceptions, however: the scroll test and any test involving the Epson's floppy disk. All tests were done using a standard BYTE 4000-word test file (21K bytes). The RAM disk used was a 128K-byte external memory-expansion module. The data for the IBM PC was obtained using an IBM PC with WordStar version 3.3, DOS 2.0, two floppy-disk drives, and a monochrome monitor and adapter.}$$

<table>
<thead>
<tr>
<th></th>
<th>Geneva PX-8</th>
<th>Floppy disk</th>
<th>IBM PC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load text file</td>
<td>8.3</td>
<td>17.3</td>
<td>9.9</td>
</tr>
<tr>
<td>Save text file</td>
<td>15.6</td>
<td>80.0</td>
<td>24.2</td>
</tr>
<tr>
<td>Search</td>
<td>12.5</td>
<td>37.6</td>
<td>10.5</td>
</tr>
<tr>
<td>Scroll</td>
<td>287.0</td>
<td>n.a.</td>
<td>41.2</td>
</tr>
</tbody>
</table>

(continued)
test as fast as Multiplan did on the Apple IIe, and it was much faster than the CalcStar version that comes with the 16-bit Sanyo MBC 550.

Portable Scheduler runs rings around the SCHED program on the Radio Shack Model 100 and approaches the usefulness of the scheduler features on the HP 75 portable. You can set an alarm, and you can have the computer remind you of a series of appointments.

**BASIC and CP/M**

The BASIC interpreter on the Geneva takes up about 32K bytes of memory, compared to about 16K bytes used by the Model 100's BASIC. The Geneva version lets you do quite a few more things: for example, you can access the alarm features directly from BASIC. It also includes AUTO (automatic line numbering) and WHILE... WEND. Both BASICS were created by Microsoft, and they are fairly compatible.

In terms of performance, the Geneva's BASIC does not compare well with desktop-machine versions. The results of our single-precision calculation test were significantly slower on the Epson than on the IBM PC and the Apple IIe. Also, we could not get our Sieve of Eratosthenes test to run. Of course, anything that involved disk accesses was significantly slower.

Finally, we come to the utility programs of CP/M version 2.2, such as copy files (PIP), check disk or RAM-drive status (STAT), and perform several different programs in sequence (SUBMIT). To these programs, Epson has added a configuration utility and two communications programs.

**TERM** is a general-purpose program for communicating with other computers via phone or direct connection. It doesn't support automatic dialing or logging on, but it is quite easy to use. FILINK is for file transfer to and from an Epson QX-10. We didn't test this program.

The practicality of these application programs is somewhat limited by the fact that only two ROM chips can be present in the PX-8 at one time. If, however, you have one of the optional memory-expansion modules, you can load some of the more useful utilities into the RAM drive, then remove the CP/M utility chip and use that socket for another ROM chip.

One advantage of owning a CP/M system is that you potentially have a wide selection of available software. The Geneva display and keyboard emulate a Soric IQ-120 terminal, and, theoretically, the Epson can run any CP/M software that is compatible with the Soric. In actuality, the Geneva doesn't support features such as high-intensity or inverse-video characters, and although it has a virtual screen of 24 lines, its physical screen has only 8. According to Bob Diaz of Epson, most of the simple CP/M utility programs such as DU and CATALOG run on the Geneva. More complex CP/M programs, such as Peachflex, will run but with some minor problems. And CP/M programs customized for a particular terminal or computer probably won't run at all.

**DOCUMENTATION**

The documentation for the Geneva and its software is, on the whole, good. The manuals are typeset, well written, accurate, and practically devoid of typographical errors. I was particularly impressed with the easy-to-read Portable WordStar manual, which included a reference card and stick-on labels for certain keys.

The main manual lists the entry addresses and functions of all the BIOS (basic input/output system) and BDOS (basic disk operating system) routines of the Geneva's version of CP/M.

**SUMMARY**

After the disappointment of the Epson HX-20, the Geneva PX-8 represents a giant improvement. It is, at this time, the most powerful 8-bit portable available. And its price of $995 makes it fairly affordable. With the CP/M 2.2 operating system, the Geneva is an ideal second computer for CP/M system owners. It is also a good second computer for people who use WordStar on a desktop system.
THE WORLD OF PC UPGRADES

MT10 10 Mbyte Micro Tape Backup "add it to your XT" $895
XT01 Micro Tape Backup and 1/2 High Floppy "add it to your XT" $895
IS10 10 Mbyte Hard Disk with Controller $795
IS10R 10 Mbyte Removable Hard Disk/Controller $1295
IS20 20 Mbyte Hard Disk with Controller $1095
IS33 33 Mbyte Hard Disk/Controller & Power Supply $1995
ISPS Power Supply "Internal" (140 watts) $295
CC01 Floppy/Hard Disk/Controller Card (1.6 Meg Floppy Compatible) $405
when included in any of above Hard Disk Systems add $185

NOTE: The above pricing is for internal units. External units are available. Micro Design International has been serving the Computer Industry for over 8 years and all our products carry a one year warranty with a 30-day money back guarantee.

MAGNETIC MEMORY PRODUCTS FOR THE IBM XT/PC AND COMPATIBLES...

FROM $695

FREE WITH THE PURCHASE OF ANY HARD DISK

COMMAND ASSIST $49.95
(DOS manual on disk)

CACHE ASSIST $49.95
(Fast faster disk access)

TO ORDER CALL COLLECT (305) 677-8333
MasterCard/Visa/Check/or Money Order

Micro Design International Inc.
6566 University Blvd., Winter Park, Florida 32792
(305) 677-8333
Say hello to the Datasouth Personal Printer—an office-quality dot matrix printer that makes itself right at home next to your personal computer.

Technically speaking, the Personal Printer is "Epson compatible." But it's better than the competing Epson because it also does near-letter-quality printing.

Personally speaking, the Personal Printer is "checkbook compatible." So you don't have to sacrifice the money you need to get the printer you want. And it comes in two models—one with a 10-inch and one with a 17-inch carriage.

Make a personal visit to your local computer store, and bring home legendary Datasouth performance for an affordably personal price. The Personal Printer. Only from Datasouth.

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

Datasouth Computer Corporation
Box 240947 · Charlotte, NC 28224
704/523-8500 · Telex 6843018 DASOU UW
Inquiry 87
Two Modula-2 Compilers for the IBM PC

Kevin Bowyer

Kevin Bowyer is on the faculty of Computer Science and Engineering at the University of South Florida in Tampa. He was previously on the faculty of the Swiss Federal Institute of Technology in Zürich. He received his Ph.D. in Computer Science from Duke University. Among several books he has written are An Introduction to Modula-2 (Reston Publishing, available early 1985), co-authored with Warren Jones of the University of Alabama at Birmingham) and Pascal for the IBM PC (Robert I. Brady Co.).

Two Modula-2 compilers are available for the IBM PC and run under PC-DOS. Both are adaptations of the original Modula-2 compiler developed at the ETH (Federal Institute of Technology, Zürich, Switzerland) to run on the Lilith personal workstation. One is the Modula Research Institute (MRI) Modula-2 compiler, version 1.35, available for $40 from the Modula Research Institute in Provo, Utah. The other is the Logitech Modula-2/86 compiler, version 1.0, available for $495 from Logitech Inc. in Redwood City, California. The one other Modula-2 compiler for the IBM PC is marketed by Votlition Systems of Del Mar, California. However, this compiler runs under the UCSD p-System and so is not directly comparable to the two I discuss here.

[Editor's note: A PC-DOS version of this compiler has recently become available.]

The MRI and Logitech compilers have many similarities traceable to their common ancestor. The essential difference between them is that the MRI compiler generates Meade, the machine language developed at ETH for the Lilith workstations, whereas the Logitech compiler generates 8088 machine language. The noticeable differences in compilation and program execution speed are a result of this difference.

REQUIRED RESOURCES

The Logitech compiler requires an IBM PC equipped with an 8087 numeric coprocessor chip, two double-sided disk drives, and at least 170K bytes of RAM (random-access read/write memory) in addition to whatever space the operating system uses. It runs under PC-DOS 1.1 or 2.0. A practical minimum for using the Logitech Modula-2 compiler with PC-DOS 2.0 is 256K bytes of memory. The MRI compiler might function on a system of two single-sided disk drives and 128K bytes of RAM, but a practical minimum is two double-sided drives and 196K bytes of RAM.

I did all the testing for this comparison on a PC XT with 256K bytes of RAM. Judging by the number of disk accesses made by either system, enough extra internal memory to create an "electronic disk" would greatly increase speed.

EASE OF USE

Both the MRI and Logitech systems require some care in setting up the original configuration. You have to decide where to put the many files that make up either system, and your CONFIG.SYS file at the root level of the file system must have certain options. All this is well described in the documentation and should present no problem.

Neither the MRI nor the Logitech compiler runs directly from PC-DOS. Nor do they produce standard EXE or COM format files, so the programs created with the compilers cannot be executed directly from PC-DOS. The MRI system runs its own "shell" or command interpreter, on top of PC-DOS. The compiler and any programs that you write are run from this shell. The Logitech system is similar. While it doesn't have a shell that stays resident on top of PC-DOS, it does have a "run-time system" that you have to invoke for running the compiler or programs created with the compiler.

Since neither the Logitech nor MRI system includes a text editor, you must use your own (or EDLIN) to prepare a standard PC-DOS text file that contains the program's source code. Assume that you have already prepared a source program in the file SAMPLE.MOD. You can start up the MRI shell with the command interp. The MRI shell then displays the copyright notice and an asterisk prompt. You can now run the compiler by entering the command modula. You can run the resulting compiled program by entering its name. When you want to leave the MRI shell, you type Control-C.

In the case of the Logitech system, you invoke the compiler from PC-DOS with the command m2 comp. The m2 is the name of the Logitech run-time system, so any Logitech program running under PC-DOS (continued)
The escape-to-DOS feature works quite well and is much faster than the alternative most of the time. However, if you change directories while in DOS and forget to change back before returning to the MRI shell, things get hopelessly confused and you have to reboot the system. If you want to use the escape-to-DOS feature and have the MRI software in a subdirectory of the file system, you need to place a copy of COMMAND.COM in the same directory as the MRI software.

**SPEED**

After running lots of small test programs, I am convinced that Logitech's compiler is substantially slower than the one from MRI. However, the Logitech compiler can produce programs that execute much faster than those produced with the MRI compiler. A program that does nothing but write “Hello, World!” to the display (listing 1) compiles in a little less than 40 seconds with the MRI compiler and about 65 seconds under the Logitech system. This does not include time for the link step required by the Logitech system, which takes another minute or so.

An equivalent IBM PC-DOS Pascal program could be compiled and linked in under 30 seconds—even though it involves entering three separate commands to PC-DOS (PAS1, PAS2, and LINK). Neither Modula-2 system could be called speedy as far as compile time is concerned.

If program execution speed is what you are after, Logitech's compile time might be worth waiting for. The Logitech compiler can produce programs that are many times faster than those produced by the MRI system. Another trivial example program (listing 2), using nested loops and integer arithmetic, takes about 20 seconds for the MRI system to compile and something over 60 seconds to execute. The Logitech system takes 55 seconds to compile the same program, again not counting the required link step. (The link step would be quick here because there are no IMPORTs from separately compiled modules.) However,
the Logitech program executes in about 8 seconds—which is less than one-sixth the time of the MRI program.

Both systems compile this second example more quickly than the first one, even though the executable part is more complex. This is because the first example imports a procedure from a separate module. Nearly any useful Modula-2 program will import procedures from at least one module, if for no other reason than to do input/output (I/O). Importing objects from separate modules takes time because the compiler must read the definition of the module and check it against the IMPORT clause.

For one more comparison on compiler and execution speed, I ran the Sieve of Eratosthenes prime-number generator used as a benchmark in previous BYTE articles (see reference 1). The Logitech compiler took about 65 seconds to process the program, 25 seconds to link, and about 17 seconds to execute. The MRI compiler took about 55 seconds to process the program and nearly 3 minutes to execute it. (The definition of "execution time" here is the same as that used in the article referenced above: the time between seeing the messages from the two output statements in the benchmark program.)

REAL NUMBERS
The MRI and Logitech compilers are similar in how they represent all the standard data types except real. The MRI system implements real values as 32-bit quantities, and arithmetic operations on these values are performed in software. The Logitech system uses 64-bit real numbers and can generate code for the 8087 numeric coprocessor. For a PC with the 8087 installed, this can be a great advantage. Consider the program in listing 3. The MRI compiler took just under 30 seconds to compile this program, and the resulting program took about 25 seconds to execute. The Logitech compiler took just over 60 seconds to compile the program, but the resulting program executed in about 3 sec-

(continued)
REVIEW: COMPILERS

Compiler Directives

Compiler directives in Modula-2 are specified much the same as in Pascal. The directive letter and setting are given inside a comment. The Logitech compiler has three directives:

- \((\texttt{*R} + \texttt{)})\) code generation for subrange and type checking
- \((\texttt{*S} + \texttt{)})\) index testing (arrays, case statements)
- \((\texttt{*S} + \texttt{)})\) stack overflow

The directives can be turned off by using a minus sign instead of a plus sign, or an equal sign can be used to change the setting back to the previous value.

Directives work the same way in the MRI system, but only the first two of the three options above are available. Both systems also allow several possible options on the command line that invokes the compiler. Among these are a listing file and prompting for the names of symbol files.

Language Extensions

Both compilers claim to accept the same Modula-2 language as defined by the Modula-2 report (see reference 2). However, the Logitech system has the advantage of some extra PC-specific routines available in the System module. Technically, these don't count as extensions to the language, but most users will think of them that way. Among the extensions are routines to read and set the values of 8088 registers: enable, disable, and initiate interrupts; read and write to the 8088 I/O ports; and generate a call to the DOS system interrupt.

The MRI System module contains only procedures defined in the Modula-2 report. It might be easier to write processor and operating-system-specific programs with Logitech Modula-2.

To test whether these compilers might be useful to owners of PC-compatibles, I checked them out on a Compaq portable equipped with two floppy-disk drives and 256K bytes of memory. Both compilers ran several small examples properly. Both also seemed painfully slow—with all the file I/O, a hard-disk drive is almost a necessity for using one of these compilers.

Summary

The compilation/execution speed comparisons between the two compilers are not surprising. The MRI system compiles programs into M-code, which was designed with the goal of efficient Modula-2 compilation. Given this background, it makes sense that the MRI compiler is faster than the Logitech compiler. But the MRI programs pay for this advantage with their slower execution. The MRI software executes programs by interpreting the compiled M-code, but the Logitech programs' 8088 machine code doesn't need interpretation.

If you just want to learn Modula-2 and write some programs for your own use, the MRI software is probably for you. You will appreciate the faster compile time with small programs, in which execution speed probably depends on user input anyway. And the MRI software is much cheaper.

On the other hand, if you want to write software to distribute or sell, the Logitech system is probably right for you. This is especially true if Logitech comes out with a linker to produce COM or EXE format files.

If you are one of the relatively few PC owners who operates the UCSD p-System, you should look into the Modula-2 compiler available from Voltion Systems. However, better compilers are likely to become available at any time, from these companies as well as others. Professor Wirth and Jurg Gutknecht of ETH have created a fast one-pass Modula-2 compiler for the Lilith; a compiler for the IBM PC derived from this one is likely to show up in the future.

References

Microsoft® Premium SoftCard™ IIe is the high-performance CP/M® board that really juices the Apple® IIe.

**Hard facts on SoftCard.**

It has a high speed (6MHz) Z-80 that runs CP/M up to three times faster than lesser boards. Plus 64K memory and 80-column display that fits the IIe auxiliary slot and acts like Apple's own Extended 80-column Card. So it works with CP/M, Apple DOS and ProDOS programs, too.

Microsoft BASIC is built-in, so it's compatible with more Apple CP/M software than any other board on the market: Thousands of the juiciest business programs including dBase II®, WordStar® and sophisticated Microsoft languages like FORTRAN-80, COBOL and BASIC Compiler.

It also has a new low price.

Juicing up the performance of computers is nothing new for us. We invented the SoftCard and make versions for the entire Apple family. We wrote Applesoft for the Apple II.

**MICROSOFT.** In fact, our The High Performance Software BASIC is the language spoken by nine out of ten microcomputers worldwide.

Get the Apple juicer from Washington. Call 800-426-9400 (in Washington State call 206-828-8088) for the name of your nearest Microsoft dealer.
"It’s easy to spot the difference between our IBM PC™-based frame grabber and the others."

High performance and affordable cost, just $1495 for a single plug-in board.

Unlike other video I/O systems, the new DT2803 provides real-time image capture capabilities, digitizing a 6-bit video field every 1/30 second. An on-board, memory-mapped, dual-ported frame store memory (256 × 256 × 8) makes it ideal for the IBM PC's 64K buffer size. And for real number crunching, the DT2803's external ports interface to high speed co-processors.

With our software package, VIDEOLAB, the DT2803 is easy to use for image operations like averages, histograms, and convolutions.

So, if your application is manufacturing/automatic inspection, robotics, or medical research, our new high performance video I/O board will really open your eyes—at an unbeatable price.

Call (617) 481-3700

**DATA TRANSATION**

---

**SPECIFICATIONS: DT2803**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>A/D Input</td>
<td>RS-170 (CCIR), 6-bits at 5MHz</td>
</tr>
<tr>
<td>Frame Grab</td>
<td>V/H (125) second per field</td>
</tr>
<tr>
<td>LUT's</td>
<td>8, 64 × 8 input; 4, 256 × 12 output</td>
</tr>
<tr>
<td>D/A Output</td>
<td>64 colors × 64 intensities, R-G-B, 64 grey levels, monochrome</td>
</tr>
<tr>
<td>Frame Memory</td>
<td>256 × 256 × 8 (2-bits for graphic overlays)</td>
</tr>
</tbody>
</table>

---

*Call for our new 576 pg. catalog/handbook or see it in Gold Book 1985.*

---

World Headquarters: Data Translation, Inc., 100 Locke Dr., Marlboro, MA 01752 (617) 481-3700 Tlx 951 646.

European Headquarters: Data Translation, Ltd., 430 Bath Rd., Slough, Berkshire SL1 6BB England (06286) 3412 Tlx 849 862.

In Canada: (416) 625-1907.

IBM PC is a registered trademark of IBM. VIDEOLAB is a registered trademark of Data Translation, Inc.
Two giants of the telecommunications industry have started electronic mail services. MCI Telecommunications Corporation's MCI Mail and Western Union Telegraph Company's EasyLink offer the services to individual consumers and businesses. Both services are heavily advertised, and both promise to open the world of easy and inexpensive instant communications to nearly anyone. Only one fully delivers on this promise.

**MCI Mail**

MCI Mail is part of the same corporation that provides MCI telephone communications. MCI has expanded its operations to include electronic mail, billing itself as the "nation's new postal system.

You can access MCI Mail with a local phone call in 64 cities around the country and with a toll-free number to its Washington, D.C., headquarters. You can use these numbers with your computer to transmit letters and documents to other MCI Mail subscribers in the U.S. and Canada or to Telex addresses anywhere in the world. If your recipient does not have access to MCI Mail or Telex, you can have a paper copy of the communication mailed or delivered. As of January 1, 1985, MCI Mail service was available in 41 countries.

MCI Mail's hard-copy communications are prepared using a laser printer at 18 locations in the U.S. Courier delivery is available within four hours in some locations, and overnight courier delivery is available in most major metropolitan areas. Delivery by mail usually takes two business days. Because they are prepared on a laser printer, the MCI letters look like they were done on a letter-quality printer and then photocopied. You can have your letterhead and signature placed on file with MCI so they can appear on your letters. Otherwise, the MCI Mail letterhead will appear on the first page of your letter.

You can log on to MCI Mail with either a 300- or 1200-bps (bit per second) modem. After you enter your user name and password, you will read some announcements and get a couple of news headlines before the main menu appears. Every function of MCI Mail is menu operated, and the service has extensive help files for every function. You can use the built-in text editor to prepare your document, or you can transmit a document you have already prepared. Once you finish, you can edit the document or reformat it before sending it. There is no limit to the length of the document you can send, but longer documents cost more.

You can read incoming messages or refer to messages you sent out earlier. MCI Mail also offers you access to Dow Jones News/Retrieval or lets you order discount merchandise from on-line advertisers.

**EasyLink**

Western Union apparently designed EasyLink for experienced users who already understand how the system works. You can access EasyLink with either a 300- or 1200-bps modem. You will find no descriptive prompts or menus to lead you through the system. You log on at the ID? prompt by giving a terminal description, your ID number, your user name, and your password. You enter these on a single line, separated by spaces and a period. You will not see what you are typing if you are operating in full duplex.

Once you gain access to EasyLink, the cryptic PTS prompt greets you. You can find out what your options are by using the on-line help facility or by reading the package's User Guide or quick-reference guide. Essentially, your choices are: send one of several types of messages, read messages waiting for you, or use the help facility. An information database called FYI is also available to EasyLink subscribers, but not from within EasyLink.

EasyLink gives you a wide variety of ways to send a communication to others. You can send a message directly to another sub-
REVIEW: E-MAIL

to subscriber's mailbox, just as you can with MCI Mail, and you can have a message mailed to a nonsubscriber using what Western Union calls a “computer letter.” Computer letters are mailed from Western Union's facility in the Washington, DC, area, which means that delivery can take a while for some sections of the country. Unlike MCI's laser-printed letters, the EasyLink computer letter is printed on what appears to be a Teletype printer using only uppercase letters.

Like MCI Mail, EasyLink lets you send messages to Telex addresses and gives you a Telex address for replies. Since you are using Western Union, you can use EasyLink to send telegrams, mailgrams, and cablegrams. Western Union also has an arrangement with the U.S. Postal Service that lets you send messages through the E-COM system, although the long-term existence of that service is questionable.

USING MCI MAIL

Working with MCI Mail, especially for the inexperienced, casual, or infrequent user, is a pleasant experience. About the only information you have to remember is your password. As you enter the system, every possible command is listed for you (see photo 1). The help files are extensive and detailed, and you can specify the command or function for which you need help. Since the on-line time on MCI Mail is free, you don't feel the need to rush the process unless you're using the 15-cents-per-minute 800 number.

Creating a message is easy. Following the directions on the main menu, you type the word CREATE and enter the text editor. The next prompt asks for the addressee. After you type in the name, MCI Mail checks to see whether it matches the name of a subscriber. If one or more names match, you are shown a list of names and asked to pick the proper one. If the person you want is on the list, you choose him; otherwise, you will be asked to enter his address so the message can be mailed. You can name any number of addressees since the TO: prompt will appear until you enter a blank line. You will be prompted to enter the mailing address of the recipient and the subject of the message. Then MCI Mail prompts you to enter the text of the message.

The basic rate for an MCI Mail message is $1 for an “MCI ounce” transmitted electronically. An ounce equals 7500 characters. Short messages of 500 characters or less cost 45 cents. The cost for the first ounce is $2 if the letter is mailed. In areas where courier service is available, you can have a letter hand-delivered overnight for $8 and within four hours for $30. In each case the cost for an additional ounce is $1, although for courier delivery the second ounce is free. If you are sending to a Telex address, the ounce is quite a bit less, about 400 characters, due to a limit set by Telex. International rates are higher than domestic rates, but still within reason. MCI gives you a Telex number so your correspondents can answer you by Telex. If you use the toll-free number, you are charged an extra 15 cents per minute.

Once you complete your message, you can read it. If you want to make changes, an MCI editing mode has its own menus, prompts, and help files. You can also see what your document will look like when it's printed, complete with spaces reserved for the letterhead and the page breaks. You can use the edit mode to reformat the letter. Once you are satisfied, you tell MCI to send your document by typing SEND followed by any optional delivery methods. Once you send the message, a copy is placed in your Out box for a day or two. This makes it easy to refer to messages later.

Checking for messages is also easy. MCI Mail tells you that your In box has a message. You might also be told that an unfinished draft is on your desk, in the event that you terminated an earlier session for some reason before sending a message. This is one of the nice features of MCI Mail. Once you start creating a message, it stays in the MCI system. If your computer or phone goes dead or your modem explodes, the draft of your message...
REVIEW: E-MAIL

will be waiting when you return.
As I mentioned earlier, you can do a lot besides send and receive messages. MCI Mail has an advertising section where you can order anything from gifts and travel services to fanfold paper and floppy disks. You also have access to Dow Jones News/Retrieval at regular Dow Jones rates. Off-peak rates are 20 cents a minute for 300-bps connections or 40 cents for 1200-bps service. Incidentally, Dow Jones customers also have access to MCI Mail as part of their subscription.

USING EASYLINK

My first impression of EasyLink is that it isn't very easy. As I've already discussed, logging on to the system is complicated and tedious.

Logging on wouldn't be such a problem if you were given the necessary information to enter. For example, the terminal ID is necessary if you are using a personal computer and a modem, since EasyLink's default mode does not seem to work with that type of equipment. The terminal codes are listed in Appendix E in the User Guide, but the differences between the 24 terminal codes aren't explained. Many users will have little luck deciphering them. The first time I used EasyLink it took me four tries to log on.

Once you get past the log-on sequence, you are faced with the PTS prompt (see photo 2). At this point you have to enter a slash followed by a command. Since EasyLink has no menu, you will have to look up all the commands in the documentation or read the on-line help file. If you don't have a local-access phone number, looking at the help file is going to cost you 15 cents per minute. Fortunately, Western Union has over 400 local-access phone numbers in the U.S.

Since the charges for EasyLink are based on the actual connect time, you will save yourself money if you prepare your messages ahead of time and transmit them to EasyLink. You can also save money if you minimize use of the on-line help by using the manual instead.

You are also charged by the minute for the time it takes you to send messages. The normal charge for a 1200-bps connection is 45 cents per minute. If you like to compose on line or if your modem program can't transmit easily, this can run into money. You can save 40 percent by calling during off-peak hours (12:01 a.m. to 7 a.m. local time).

EasyLink has a number of charges besides the connect time. For example, a computer letter costs you $1.25 for the first page and 40 cents for each additional page. A three-page letter that costs you $2 to send on MCI Mail will cost you $3.30 on EasyLink, assuming the total connect time was two minutes, the time required to send the document was one minute, and you called using the EasyLink toll-free number. Using a local-access number would reduce the cost by 45 cents.

Sending messages to other EasyLink subscribers is less expensive. The basic charge is only 45 cents per minute for 1200-bps service, plus 15 cents per address. A short message could go out for less than the equivalent message on MCI Mail, but a longer one could cost somewhat more. If you have to use the WATS line to call EasyLink, your costs are almost certain to be higher.

If you are a low-volume user of electronic mail, EasyLink will be a substantially more expensive service. Even though it has no sign-up fee, EasyLink has a $2.5-per-month minimum charge. Depending on the type of electronic mail you use, you might have to send one piece of mail per day just to break even.

DOCUMENTATION

EasyLink definitely has the more complete and attractive documentation. When you sign up for EasyLink, Western Union sends you a bookshelf-size binder. Sections of the book are marked by tab dividers, and the pages are attractively typeset and easy to read. This is an advantage because you're probably going to spend lots of time reading this manual.

A disadvantage is that the manual is not well organized. The process of calling EasyLink, logging on, creating (continued)
REVIEW: E-MAIL

AT A GLANCE

Name
EasyLink

Service Supplier
Western Union Telegraph Company
One Lake St.
Upper Saddle River, NJ 07458
(800) 336-3797 ext. 908

Requirements
Personal computer, modem, and telecommunications software, or dedicated communications terminal

Special Features
Messages can also be sent via Telex, telexgrams, cablegrams, mailgrams, and through the U.S. Postal Service E-COM system

Optional Software
EasyLink Instant Mail Manager program ($95) requires IBM PC or compatible computer with one disk drive, 256K bytes of RAM, and asynchronous communications modem

Price
Minimum monthly charge: $25
EasyLink mailbox message (maximum 20,000 characters):
30 cents/minute (300 bps)
45 cents/minute (1200 bps)
EasyLink to Telex (maximum 200,000 characters):
43 cents/minute (300 and 1200 bps)
Mailgram message overnight letter (maximum 15,000 characters):
First page (2700 characters) $3
Each additional page (3500 characters) 75 cents
Computer letter service (maximum 25,000 characters):
First page (2700 characters) $1.25
Each additional page (3500 characters) 35 cents

Name
MCI Mail

Service Supplier
MCI Telecommunications Corporation
900 M St. NW
Washington, DC 20036
(800) 424-6677

Requirements
Personal computer, modem, and telecommunications software, or dedicated communications terminal

Special Features
Messages can also be sent via Telex, via mail delivery, or via overnight or four-hour hand delivery

Optional Software
MCI Mail Access program ($49.95) requires IBM PC or compatible computer with one disk drive, 256K bytes of RAM, and asynchronous communications modem

Price
Instant letter
500 characters or less $0.45
7500 characters $1
MCI letter (mail delivery) $2
Overnight letter $8
Four-hour letter $30
Each additional 7500 characters $1
Annual mailbox fee $18

and sending a message, and getting off again requires a great deal of flipping through the manual. All the time you're looking up what to do next, the connect charges are mounting if you're calling on the WATS line or are in the midst of creating a message.

(Editor's note: EasyLink has since issued a new User Manual Release 1.3 that appears to be rewritten and better organized.)

The MCI Mail manuals are shorter, less fancy, and paper-bound. They include the Welcome Kit and Service Guide, which gives an overview of the service, contains some basic information on performing routine functions, and explains the services available; and the Basic User's Guide, which gives detailed information on the use of MCI Mail. The manuals skip some of the functions of MCI Mail (for example, sending a Telex message).

The manuals are much less important for the routine use of MCI Mail, however, since the menus lead you through most functions quite well. The help files are also excellent and do not have a connect charge.

CUSTOMER SUPPORT
I had occasion to call customer support at MCI Mail twice, and at Western Union three times. The personnel at MCI Mail were helpful and familiar with the service. I received accurate, complete answers to both questions. Unfortunately, MCI Mail customer support is not open on weekends.

Western Union's customer service is nearly a total contrast. The customer-service lines are open on weekends, but they might as well be closed. Regardless of the time I called, the support representatives showed little familiarity with EasyLink. Once I was told that no one knew anything about it, but that the representatives were trying to learn. In another case, the representative had never heard of a computer letter and could offer no information on how to send one or on how long it would take to deliver.

CONCLUSIONS
Both EasyLink and MCI Mail offer communications packages to make
Despite the recent press notices, multiuser microcomputers aren't anything new!

This is the first in a series of discussions with Rod Coleman, President of Stride Micro (formerly Sage Computer) on the 68000 multiuser market and its current environment.

Q: Why do you do that?
RC: "The technology to build a high performance multiuser system has been around for five years. And while some of the leaders in this industry have been pretending that micro multiuser didn't exist, we've been shipping complete systems for nearly three years. The benefits of multiuser are undeniable; it is more cost effective, and offers greater flexibility and utility. But until just recently, the marketing pressure to be compatible instead of being better, has blinded the industry."
Q: What do you mean?
RC: "Well, for example, the Motorola 68000 processor introduced 16/32-bit technology to the personal computer world a long time ago. It was fully capable of meeting high performance and multiuser design requirements in 1980. Instead of this trend taking off, most energy was spent promoting 8088/8086 products that were clearly inferior from a technical point of view. This phenomenon leads me to believe that they will soon rewrite the old proverb: 'Build a better mousetrap and the world will beat a path to your door,' but only if they can find the way through the marketing fog."
Q: Are things changing now?
RC: "Yes and no. With the business world starting to take more and more interest in microcomputer solutions, the advantages of a solid multiuser system couldn't be kept hidden forever; companies like ours and a few others were beginning to make a dent. Instead of taking a fresh approach, some of the newest multiuser offerings will probably only give the technology an undeserved black eye! Multiuser is far more than the ability to plug in more terminals. It involves things like machine compatibility, fast processors, adequate memory, large storage capacities, backup features, networking, and operating system flexibility."
Q: Is this what makes the new Stride 400 Series different?
RC: "Exactly. That sounds self-serving, but it's true. Today a number of companies are introducing their first multiuser system. We've been building and shipping multiuser machines for almost three years. We know the pitfalls, we've fallen into some of them. But we have learned from our mistakes."
Q: Give me some examples.
RC: "A hard disk is almost mandatory in any large multiuser installation. Yet, backing up a hard disk can be a nightmare if you only have floppies to work with. That's why we've added a tape backup option to all the larger Stride 400 Series machines. It's impossible for a manufacturer to market a multiuser system without such backup. Another good lesson was bus design. We started with one of our own designs, but learned that it's important not only to find a bus that is powerful, but also one that has good support and a strong future to serve tomorrow's needs. We think the VMEbus is the only design that meets both criteria and thus have made it a standard feature of every Stride 400 Series machine."
Q: What are some of the other unique features of the 400 Series?
RC: "A surprising feature is compatibility. Everybody talks about it, but nobody does anything about it. Our systems are completely compatible with each other from the 420 model starting at $2900, through the 440, on to the powerful 460 which tops out near $60,000. Each system can talk to the others via the standard built-in local area network. Go ahead and compare this with others in the industry. You'll find their little machines don't talk to their big ones, or that the networking and multiuser are incompatible, or that they have different processors or operating systems, and so on."
Q: When you were still known as Sage Computer, you had a reputation for performance, is that still the case with the new Stride 400 Series?
RC: "Certainly, that's our calling card. Performance By Design. Our new systems are actually faster; our standard processor is a 10 MHz 68000 running with no wait states. That gives us a 25% increase over the Sage models. And, we have a 12 MHz processor as an option. Let me add that speed isn't the only way to judge performance. I think it is also measured in our flexibility. We support a dozen different operating systems, not just one. And our systems service a wide variety of applications from the garage software developer to the corporate consumer running high volume business applications."
Q: Isn't that the same thing all manufacturers say in their ads?
RC: "Sure it is. But to use another over-used-term, 'shop around.' We like to think of our systems as 'full service 68000 supermicrocomputers.' Take a look at everyone else's literature and then compare. When you examine cost, performance, flexibility, and utility, we don't think there's anyone else in the race. Maybe that's why we've shipped and installed more 68000 systems than anyone else."

"A surprising feature is compatibility. Everybody talks about it, but nobody does anything about it."

For more information on Stride or the location of the nearest Stride Dealer call or write us today.
We'll also send you a free copy of our 32 page product catalog.
**REVIEW: E-MAIL**

**EasyLink is slow in sending printed material and can be “user-hostile.”**

Using their services easier. I have not had the opportunity to test them, but the information I have about them indicates that they are functionally equivalent. Both systems run on the IBM PC or close compatibles and both make logging on and sending messages almost automatic. I would consider such a package essential for the use of EasyLink.

I found the difference between these two services to be substantial. MCI Mail was easy to use and fairly inexpensive for the low-volume user, and it presented a much more attractive product when messages were delivered on paper. Overnight or four-hour delivery of printed material can be critically important in some circumstances.

On the other hand, EasyLink was anything but easy. For the low-volume user it can be very expensive, and a printed computer letter is not particularly attractive. In addition, EasyLink is slow in sending printed material and can be "user-hostile" in the process. Twice I tried to send myself a computer letter in order to compare delivery time and appearance. The first try was canceled two days after I sent it because a line was too long. The second try took eight days to arrive. I should add that Western Union has plans to implement two-hour and overnight courier delivery in 1985.

EasyLink might be easy if you have the communications software sold by Western Union, and it might be relatively inexpensive if you send large volumes of electronic mail. This is especially true if you need the ability to send telegrams or use the Postal Service's E-COM system. Otherwise, MCI Mail appears to be the electronic mail service of choice.
The Computer Chronicles, a half-hour weekly television series brings you an in-depth look at the latest developments in the computer world.

Correspondent Stewart Cheifet and Gary Kildall, creator of CP/M provide interviews with industry leaders plus news and information from Silicon Valley and around the world.

The Computer Chronicles, every week on a public television station near you.

( Check local listings for time and channel.)
To safeguard your computer against mysterious errors and costly servicing, not just any surge and noise suppressor will do. Serious computer problems demand serious computer protection... DATAGARD® by SL WABER.

For more information about DATAGARD and our complete line of Computer Accessories, call or write today.

Nobody does it better. Nobody can.
Mannesmann Tally's MT 160 is a small, high-speed, dot-matrix printer. You can configure the printer using front-panel buttons and a printer-generated menu. The printer features high-speed, draft-quality printing; a slower correspondence-quality mode; and a wide range of character sets and printing formats.

The MT 160 is compact—considerably more compact than, for example, Epson's MX-80—but surprisingly heavy at 18 pounds. It includes both serial and parallel interfaces, so it can be connected to virtually any computer.

Mannesmann Tally advertises the MT 160 as printing at 160 characters per second (cps) in draft-quality mode, or 40 cps in correspondence-quality mode. In actual use, the MT 160 is faster in draft mode than the Epson FX-80, also advertised as a 160-cps printer. In its higher-quality correspondence mode, however, the MT 160 slows down severely, lagging behind the FX-80.

A wide variety of print modes are supported by the MT 160, including underlining, emphasized (bold), superscript, and subscript (see figure 1). In draft-quality mode it can print 5, 6, 8.3, 10, 12, 16.7, and 20 characters per inch (cpi). In correspondence-quality mode, it can print 10 or 12.5 cpi or proportional spacing.

In draft mode, the MT 160 prints characters in a 7- by 9-dot matrix. Uppercase characters use the top 7 by 7 matrix, with lowercase descendents using the bottom of the matrix. In correspondence mode characters look almost like typewriter quality. A line is printed in two passes. The paper is advanced a fraction of a line between passes, so characters are printed in a 7 by 18 matrix. In emphasized mode, characters are again printed twice; the second impression is slightly offset to the side. When the correspondence and emphasized modes are combined, it's almost impossible to distinguish any dots.

The printer can be reconfigured to recognize control codes used for other printers. This is especially helpful since very little software supports the MT 160's standard control codes. WordStar text and Lotus 1-2-3 graphs were printed accurately by the MT 160 using this mode. Mannesmann Tally also offers a configuration program for Lotus 1-2-3.

The MT 160 doesn't support italic characters even when Epson control codes are used. The lack of italics is a serious handicap, although emphasized characters or underlining could be used instead.

PROGRAMMABLE FEATURES

One of the most convenient features of the MT 160 is that configuration details can be selected using the front-panel buttons and printed menus, so no DIP (dual-inline package) switches or jumpers are involved in configuring the printer for your computer (see listing 1). The current configuration is stored when the printer is turned off.

Many of the print features available through software control can be set as default parameters (see listing 2). Any of the seven character sets available can be chosen. If the printer is usually used for printing documents in another language, a European or other character set can be selected as the default. Likewise, form-length, print-format, and communications parameters can be reset.

To reconfigure the printer for my serial interface, for example, I simply pressed the Yes and No buttons to activate the menu, answered Yes to the CHANGE COMM CONFIG? prompt, and again to SERIAL prompt. While responding to prompts, I had to press No quite a few times, but this is far simpler than removing the cover to move jumpers and reset DIP switches.

There are six control buttons on the front panel of the MT 160. The on-line, form-feed, line-feed, and test buttons do what you'd expect. Two additional buttons labeled Yes and No allow you to answer the questions (continued)
You'll have to go out of your way to build a special cable to hook the MT 160 in the reconfiguration mode and also combine with other buttons for special functions. For example, pressing the Yes and the line-feed buttons causes the printer to toggle from correspondence to draft mode.

I dislike loud, nonstop fault alarms, so I appreciate that the MT 160 makes no noise when a fault occurs. A red light indicates a problem. While this is better than the endless whine some printers produce when the paper runs out, I wish it would give a little beep so I'd know something was wrong right away.

The MT 160 is not a standard serial printer. Its RS-232C connector uses pins 11 and 19 to send a busy signal, something most computers don't expect. As a result, you'll almost certainly have to buy or build a special cable to connect the MT 160 to your computer. For my older CP/M system, I switched pins 19 and 20. For the IBM Personal Computer (PC), Mannesmann Tally's service department says pin 5 must be swapped with either pin 11 or 19. Since the MT 160 is configured as data-terminal equipment (DTE), IBM PC users will also have to swap the connections to pins 2 and 3 (printer cables are readily available that way). The use of pins 11 and 19 was a surprise to me. You'll have to go out of your way to hook up the MT 160 to your system by either paying a premium to have a cable built your way or spending the extra time building your own.

Another problem I often find with printers is that the paper feeding out can feed right back into the printer. You'd almost have to work at it to get that to happen with the MT 160.

Power and interface cables often seem to need the same path as the paper. The MT 160's power cable has a right-angle connector at the printer end and feeds through a slot in the back of the left side of the printer, so there's no interference with the paper feed.

The parallel and serial connectors, however, feed straight out through the path the paper needs when it feeds from below. This problem was aggravated when, rather than rewire the printer cable, I used an adapter that also extended the printer's serial port. The right side of the paper dragged against this adapter and tore several times: there seems to be no solution except to wire a new cable especially for the MT 160. The parallel port is closer to the center of the back of the printer, so the cable would have to be routed underneath the printer.

There's never been a standard printer ribbon and Mannesmann Tally hasn't tried to change that. When my first ribbon faded, I tried to buy a replacement at several local computer stores. No one at any of the stores had seen this kind of ribbon before and delivery estimates ranged from two days to two weeks. The ribbons cost about $13 each—well above an average price for other types. If you buy an MT 160, you should probably (continued)

Figure 1: Print samples from the Mannesmann Tally MT 160 printer.
AT A GLANCE

Name
MT 160

Manufacturer
Mannesmann Tally
8301 South 180th St.
Kent, WA 98032
(206) 251-5500

Type
High-speed, 80-column dot-matrix printer

Size
14¼ by 9¼ by 6¾ inches

Weight
18 pounds

Equipment Needed
Computer with parallel or serial interface, cable

Features
Six front-panel buttons; reprogrammable configuration; high-speed draft quality or slower correspondence quality; international character sets; graphics

Documentation
Operator's manual, 64 pages

Price
$798

PRINT SPEED (CHARACTERS/SEC) LIST PRICE ($100)

<table>
<thead>
<tr>
<th></th>
<th>MT 160</th>
<th>GEMINI 10-X</th>
<th>EPSON FX-80</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>75</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This is the Mannesmann Tally MT-160 printer.
This is the Epson FX-80, draft mode. This
This is the Star Gemini-10X. This is the St

The output from the Mannesmann Tally MT 160
dot-matrix printer in draft mode is compared
with the Epson FX-80 and the Star Micronics
Gemini 10-X, both in draft mode. The pitch for
all printers is 10 cpi. The print speeds were
determined by dividing 3000 characters (50
lines of 60 As each) by the time required to pro-
duce the output. (See "The Art of Benchmark-
ing Printers" by Sergio Mello-Grand, February
1984 BYTE, page 193.) Prices shown are list.
**REVIEW: MT 160**

**Listing 1:** An example of the interactive way of changing the configuration of the MT 160 printer. The printer prints out a short question to which you might respond by pressing either a Yes or No button on the printer's control panel.

<table>
<thead>
<tr>
<th>Question</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESTORE DEFAULTS ?</td>
<td>NO</td>
</tr>
<tr>
<td>CHANGE FORM LENGTH ?</td>
<td>NO</td>
</tr>
<tr>
<td>CHANGE PRINT FORMAT ?</td>
<td>YES</td>
</tr>
<tr>
<td>CHANGE LPI ?</td>
<td>NO</td>
</tr>
<tr>
<td>CHANGE CPI ?</td>
<td>YES</td>
</tr>
<tr>
<td>10 ?</td>
<td>NO</td>
</tr>
<tr>
<td>12 ?</td>
<td>NO</td>
</tr>
<tr>
<td>16 ?</td>
<td>NO</td>
</tr>
<tr>
<td>20 ?</td>
<td>NO</td>
</tr>
<tr>
<td>CORR.QUAL. 10 ?</td>
<td>NO</td>
</tr>
<tr>
<td>CORR.QUAL. 12 ?</td>
<td>YES</td>
</tr>
<tr>
<td>CR IMPLIES LF ?</td>
<td>NO</td>
</tr>
<tr>
<td>LF AT FULL LINE ?</td>
<td>YES</td>
</tr>
<tr>
<td>POPC ?</td>
<td>NO</td>
</tr>
<tr>
<td>CHANGE CHAR SET ?</td>
<td>YES</td>
</tr>
<tr>
<td>USA ?</td>
<td>NO</td>
</tr>
<tr>
<td>UK ?</td>
<td>NO</td>
</tr>
<tr>
<td>NOR/DAN ?</td>
<td>NO</td>
</tr>
<tr>
<td>SWE/FIN ?</td>
<td>NO</td>
</tr>
<tr>
<td>GER ?</td>
<td>NO</td>
</tr>
<tr>
<td>FREN ?</td>
<td>NO</td>
</tr>
<tr>
<td>SPAN ?</td>
<td>YES</td>
</tr>
<tr>
<td>SLASH ZERO ?</td>
<td>NO</td>
</tr>
<tr>
<td>CHANGE AUX CODE SET ?</td>
<td>YES</td>
</tr>
<tr>
<td>NONE ?</td>
<td>NO</td>
</tr>
<tr>
<td>E CODES ?</td>
<td>NO</td>
</tr>
<tr>
<td>D CODES ?</td>
<td>YES</td>
</tr>
<tr>
<td>CHANGE COMM CONFIG ?</td>
<td>YES</td>
</tr>
<tr>
<td>CHANGE BUFFER SIZE ?</td>
<td>NO</td>
</tr>
<tr>
<td>PARALLEL ?</td>
<td>NO</td>
</tr>
<tr>
<td>SERIAL ?</td>
<td>YES</td>
</tr>
<tr>
<td>CHANGE BAUD ?</td>
<td>YES</td>
</tr>
<tr>
<td>9600 ?</td>
<td>NO</td>
</tr>
<tr>
<td>4800 ?</td>
<td>NO</td>
</tr>
<tr>
<td>2400 ?</td>
<td>YES</td>
</tr>
<tr>
<td>CHANGE NO. DATA BITS ?</td>
<td>NO</td>
</tr>
<tr>
<td>CHANGE NO. STOP BITS ?</td>
<td>NO</td>
</tr>
<tr>
<td>CHANGE PARTY ?</td>
<td>NO</td>
</tr>
<tr>
<td>CHANGE BUSY ?</td>
<td>NO</td>
</tr>
<tr>
<td>CHANGE COMM PROTOCOL ?</td>
<td>NO</td>
</tr>
</tbody>
</table>

**END OF MENU**

buy spare ribbons and reorder when you install the last one.

**DOCUMENTATION**

I've never seen a printer manual that I liked. I found myself flipping through the MT 160 manual hunting for simple details I wish were included in a one-page appendix. To its credit, the manual does include a careful description of most (not all) of the configuration menu, as well as brief explanations for each print command with examples in BASIC.

However, the explanations were too short, while the four-page control-code appendix was too long to be useful as a quick-reference guide. Several control-code commands weren't explained enough and left me wondering exactly what they did. I'm not sure a novice would understand the MT 160 manual, but anyone who has used another printer should be able to figure it out fairly quickly. There is enough information in both manuals for a programmer to use most of the printer's features, though some experimenting may be necessary.

Mannesmann Tally doesn't have a toll-free number, but I called the company several times while configuring the printer and looking for a new ribbon. Each time I was put through to the service department quickly and the person I spoke with answered my questions competently.

**CONCLUSIONS**

The Mannesmann Tally MT 160 is a fast, high-quality, dot-matrix printer, but its price led me to expect more. Particularly irritating was the lack of italic characters, the unusual serial cable configuration, and the nonstandard printer ribbon. Even though the printer is well designed, small and quiet, I had problems using an adapter with the serial port.

This machine is probably not as suited for the home user as some other printers, notably the Epson FX-80. However, its speed, print quality, and diverse print modes might make it appropriate for office use.
WHY IS OUR WORKSTATION DATA ACQUISITION SYSTEM THE COMPLETE SOLUTION?

Keithley DAS' Series 500 workstation data acquisition system is the complete solution to your control and measurement needs, present and future. Even a basic configuration provides enough power and capacity for most lab and test bench applications. As your needs become greater, you can set it up to perform more complex or varied operations later on. The key is: you configure it for your needs, whenever you need to.

A CHOICE OF PCs.
First of all, the Series 500 supports the PCs most commonly used in lab and R&D work: the IBM PC, PC-XT and Portable PC; the Apple II+ and IIe; and the Compaq Portable. We even support the 8087 coprocessor.

A CHOICE OF SOFTWARE.
Our Soft500 package was written to give beginners the accessibility and ease of use they need to get results, yet it also offers more experienced users the depth and extra facilities necessary for more complex applications. Facilities like high-speed sampling, data storage, graphics, statistical analyses and memory-mapped I/O for high-speed data transfer. Our unique interrupt-driven architecture allows data acquisition in the background and simultaneous real-time analysis, control and display in the foreground. What's more, with our new Plus500 interface, you can also connect IEEE-488 instruments to your PC and put the same software environment in charge of both interfaces. For special needs, there's our Chem500 analytical chemistry software package for chromatography, spectroscopy, thermal analysis and colorimetry. And the Series 500 is also supported by the Macmillan ASYST™ and Lab Notebook™ software packages.

A CHOICE OF FUNCTIONS.
With the Series 500, you can choose from a larger library of plug-in function cards than any other company offers. Choose from 18 analog and digital I/O modules; isolated and non-isolated analog input; direct connection of transducers: thermocouples, strain gauges and RTDs; pulse counting; 4-20 mA current loop input and output; direct switching and sensing of AC and DC power lines; and programmable excitation for transducers. All with full software support.

A ALL THIS, BACKED BY KEITHLEY QUALITY.
Behind the Series 500 is Keithley's 40-year reputation for engineering excellence and low-level measurement expertise. We designed it to provide the least noise, the highest accuracy and the greatest thermal stability of any PC-based data acquisition system.

A SUPPORT, TOO.
We haven't provided a complete solution unless we provide complete support. And we do. Your Series 500 comes with a one-year full warranty and 90 days' free software counseling. Most important, Keithley DAS provides you with a toll-free applications hot line, for the times you need a helping hand.

For a demonstration or more information, call us toll-free at 1-800-552-1115. In Massachusetts call 617-423-7780. Or write us at Keithley DAS, 349 Congress Street, Boston, MA 02210. For literature on the Series 500, circle Reader Service Number 168.

Series 500

© 1984 by Keithley DAS, Boston, Massachusetts

FEBRUARY 1985 • BYTE 329
SuperSoft Languages
When Performance Counts

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 excellent compilers: SuperSoft FORTRAN, SuperSoft C, and SuperSoft BASIC. They answer the programmer's need for rock solid, dependable performance on microcomputers.

SuperSoft FORTRAN
With large code and data.
SuperSoft FORTRAN version 2.0 with large code and data space is now available under MS DOS and PC DOS. It gives you the power to compile extremely large FORTRAN programs on micros. It allows double precision and complex numbers, full IEEE floating point, and a full range of other important features for the serious FORTRAN programmer. Both 8087 support and a RATFOR preprocessor are optionally available.

FORTRAN (CP/M-80 & 86, MS DOS, PC DOS): $325
8087 support: $50  RATFOR: $100

SuperSoft C
SuperSoft C is a high-powered, full-featured C compiler designed for serious C applications. It is fast—both in compilation and execution, and it is packed with more than 135 library functions (all delivered in source code form). SuperSoft C produces optimized assembly code, and object code can be ROMed.

SuperSoft C (for CP/M-80, CP/M-86, MS DOS, PC DOS): $350

SuperSoft BASIC
The SuperSoft BASIC compiler lets you get serious with business and financial programs. It uses BCD math to give you highly accurate results for demanding applications. SuperSoft BASIC is a true native code compiler that is generally compatible with Microsoft's BASIC interpreter. And an additional bonus—no run time license fee is required.

SuperSoft BASIC Compiler (for MS DOS, PC DOS, and CP/M-86): $300

Also available for programmers:
Star-Edit, a full-featured programmer's text editor: $225.00
Disk-Edit, an invaluable programmer's disk data editor: $100.00

To order call: 800-762-6629
In Illinois call 217-359-2112

SuperSoft, Inc., 1713 S. Neil St., P.O. Box 1628, Champaign, IL 61820

In conjunction with SuperSoft, Supersoft FORTRAN was developed by Small Systems Services, Urbana, IL, a leader in FORTRAN development.


*Ada is a trademark of the Department of Defense
PC DOS is a trademark of International Business Machines.
MS DOS is a trademark of Microsoft.
CP/M-80 and CP/M-86 are trademarks of Digital Research, Inc.
SAGE II AND IV

I was pleased to see the review by Allen Munro of the Sage II and Sage IV in your July 1984 issue (page 235). I agree with the author's conclusion that the Sages are fast, powerful, and reliable machines. I've owned a Sage IV for almost a year now and I'm extremely pleased with it. Not one single glitch so far.

After getting used to the power and speed of the Sage it's hard to imagine going back to a slower machine. The amount of Sage software in terms of operating systems, languages, utilities, and applications may cover the broadest range in the industry. (How many computers offer 10 operating systems and languages such as Ada and APL/J) I do have some problems with Mr. Munro's review, however. I find several misleading and simply incorrect items.

First, the graphs are terribly misleading. The price graph states that the comparison is for systems with "two high-capacity floppy-disk drives," yet the Sage line lists the Sage IV at $7300, which includes a hard disk. By the way, the price shown for the IBM PC XT is considerably lower than we've paid for that machine.

The spreadsheet comparison reaches the point of being ridiculous. The graph is labeled "Multiplan." Yet we read in the fine print that the Sage run was actually on Timberline, a p-System spreadsheet with many more bells and whistles than Multiplan that is consequently much slower. This is NOT a benchmark.

The BASIC calculation comparison is not valid. Even though the Sage's power is shown to be an advantage here, the comparison is still against the Sage. The procedure states that the calculation test involved 10,000 multiplication and division operations. Later, in the fine print, we find that the Sage runs were using 64-bit real arithmetic.

There are also minor discrepancies in the system standard configurations. For instance, both the II and IV come equipped with the IEEE-488 interface as standard equipment, not just the IV. Also, the picture of the computer shown in "At a Glance" is a Sage II, not a Sage IV. True, Sage did try for a short time to market all machines as the IV, but soon returned to the II/IV separation. As many Sage ads as you've run, I'm sure you could have obtained the right pictures.

Incidentally, Mr. Munro failed to note some of the more exotic standard features of the Sage, such as the fact that its multiuser capacity is not operating-system-dependent, which means that different operating systems with multiscanners on each can operate simultaneously. Or that multiusers can be assigned to the same terminal, thus producing concurrency with any operating system.

I'm a professional engineer with over 20 years of experience in the computer industry. I currently direct a large staff of scientific programmers using everything from PCs, HPs, 3033s, and 3081s up to the CRAY. I'm convinced that the Sage is by far the best computer value in today's market. It outperforms many upper-end "business oriented" machines, including several minicomputers, at a fraction of the price.

BILL BRUMMETT
Dhahran, Saudi Arabia

We thank Mr. Brummett for noting an error in our Sage review. The prices listed for the Sage II/IV on the "At a Glance" page were incorrect. The prices were listed as $3200 and $7300. The prices for the BYTE standard configuration (including terminal, two drives, and BASIC) should have been $4790 and $8190. The prices of the IBM PC, not the XT, was given in the graph and was labeled as such.

For our Spreadsheet test we usually use Multiplan. For the Sage, we used the BASIC spreadsheet available, Timberline. The purpose of our spreadsheet test is to determine how fast a given system/software combination can perform a given task. In this case, the Sage/Timberline combination is twice as slow as the IBM PC/Multiplan combination. Incidentally, bells and whistles do not always slow down a program: for example, Lotus 1-2-3 runs three times faster than Multiplan on the IBM PC.

As for the BASIC calculation test, again we wanted to time how long it took a given system to do a given task. Most calculations only require seven significant digits. If a system cannot efficiently support this type of arithmetic, then in this test that system is penalized slightly and justifiably.

Finally, there was what looked to be a discrepancy in the photograph of the Sage. The machine in the picture, which we received directly from Sage, was configured as a Sage II but was marked as a Sage IV. We were aware of the discrepancy at the time, but we can only photograph what we receive. We do not change or alter products to put them in a better light. We are, however, glad to hear that Sage is now labeling their products more logically.

—Rich Malloy
Senior Technical Editor

SANYO MBC 550

Bill Sudbrink was generally fair in his review of the Sanyo MBC 550 (August 1984, page 270). However, there were obvious errors in the article that do a disservice to an excellent product. To begin with, the comparison of execution time between the IBM and Apple running Multiplan to the Sanyo running CalcStar was misleading and irresponsible. Only the fine print at the bottom of the page explained the untruth of the spreadsheet (Multiplan) caption. The fine print further stated that "Sanyo BASIC apparently cannot access other disk drives." This is incorrect. The author apparently was not aware that the catch here is that the drive specifier must be in uppercase, such as LOAD "filename". Granted, the documentation did not point this out, and I agree that it was an unfortunate oversight.

James G. Droppo Jr. feels that the Sanyo BASIC screen editor is limited in comparison to the IBM Personal Computer (PC) BASIC screen editor (see "The Double-Drive MBC-555," August 1984, page 278). Maybe so. However, I find it much more convenient than that which comes with some of the PC-compatibles. The Sanyo's feature of being able to suspend and resume scrolling during a list is super. Entering changes during program debugging is also far superior. I can make
changes all over the screen, then with one touch of the Break key I can be assured that every change has, in fact, been entered into the program. Try that in IBM's BASICA!

After having used a Columbia professionally and a Sanyo recreationally on a daily basis for several months, I find that I prefer to use the Sanyo, if possible, because of its superior keyboard arrangement. Its large Return key, a better key "feel," its handy reset switch, and the dedicated asterisk key.

**ORRIN B. ISEMINGER**  
*Colton, WA*

### REVISING THE SIEVE

Mark Bridger's article, "Four Logos for the IBM PC" (August 1984, page 287), includes two benchmark programs using the Sieve of Eratosthenes—one iterative and one recursive. They execute in about the same amount of time but differ in how each change has in fact been executed on a 128-byte IBM PC. MacMillan's program runs about as fast as the other two. Its main feature is efficient use of tail recursion.

The version in listing I uses Logo's property lists to increase simplicity. It might not use stack space as efficiently, but it seems to execute on a 128-byte IBM PC.

It also seems to execute faster. For example, the Zenith Z-150 takes over 35 minutes for the primes through 1500 using MacMillan's version but only 15 minutes for the version in listing I.

**FURMAN SMITH**  
*Montgomery, AL*

### PEACHTEXT 5000

In the September 1984 Review Feedback (page 355), A. Stanbury reported problems with the PROP ON and PROP OFF commands for Peach'Iext 5000. We had similar problems, and after about two months of talking to our dealer I was allowed to talk directly to people at Peachtree. They told me about the following patch that corrected the problem.

Use the Debug (under PC-DOS 2.0) utility to patch the PRINT.PGM portion of Peach'Iext. When you are done the screen should look like the following:

```
DEBUG PRINT.PGM
```

**Listing I: Revised recursive version of the Sieve program.**

```
TO SIMPLE.SIEVE :LIMIT
MAKE "PRIME 2
CARRY.ON
END

TO CARRY.ON
IF :PRIME > :LIMIT (TONE 300 3 STOP)
PRINT :PRIME
MAKE "FOOT.PRINT :PRIME
CROSS.OUT
MAKE "PRIME PRIME.AFTER :PRIME
CARRY.ON
END

TO CROSS.OUT
IF :FOOT.PRINT > :LIMIT (STOP)
MAKE "FOOT.PRINT :FOOT.PRINT + :PRIME
PPROP :FOOT.PRINT "? "N
CROSS.OUT
END

TO PRIME.AFTER :NUMBER
MAKE "NUMBER :NUMBER + 1
IF NOT GPROP :NUMBER "? = "N (OUTPUT :NUMBER)
OUTPUT PRIME.AFTER :NUMBER
END
```

**Rod Hallen**  
*Medan, Indonesia*

### LEADING EDGE PC

Jeffrey Mazur did a good job in the review of the Leading Edge PC (September 1984, page 312). However, I want to bring up a couple of points.

First, the fan was not correctly designed. It draws air from outside the system unit and expels it out the back. This air is drawn through such convenient openings as the disk-drive doors. This results in dust deposits on the inside of the disk drive and other boards.

The second item concerns the Leading Edge word processor, which is excellent. However, the program came with very few printer drivers. After all, many users own...
Okidatas and the newer Epsons. What caused my concern was that my MX-80 (type 3) is capable of solid underlining, italics, and super-and subscripting, but the word processor does not support these features. My dealer told me that Leading Edge will provide additional printer drivers in the future.

I feel that I have made the right decision in buying the Leading Edge PC. The only alternative is an IBM PC; if purchased locally with similar software, it would cost almost $14,000.

RAMESH INDHIVAT
Bangkok, Thailand

LEADING EDGE
WORD PROCESSING

The software review entitled "Leading Edge and MultiMate" (November 1984, page 287) is strewn with bias and inaccuracies. Our documentation is being rewritten, the latest 1.2 version of the software has increased speed, and at no point in time could it be considered inefficient. If during the reviewing process the reviewer had called us to find out something about the future of our package, that could have been reported.

We are, if anything, faster than MultiMate in just about everything and give WordStar a run for the money in almost all categories. We also provide easy-to-use and easy-to-learn word processing that we feel is leagues ahead of WordStar. How does the reviewer know that "Programs like MultiMate and Leading Edge might be easy to teach because they are designed for correspondence and short reports, projects that require few commands"? Both Leading Edge and MultiMate have many similarities to the Wang word processor. Surely the reviewer doesn't intend to make us believe that the original Wang word processor was designed solely for short reports and correspondence.

Finally, this is the only reviewer to date who did not like Leading Edge Word Processing or see it as a great value for the money. It is not wrong to be different or to state opposing points of view, as long as one has done the research correctly, thoroughly, and fairly. In comparing our 1.1 version with the current version of MultiMate and WordStar, the author has done a grave disservice to BYTE's readers.

J. B. ROYAL
Senior Vice President
Word Processing R&D
Leading Edge Products Inc.
Canton, MA

SANYO CUSTOMER SUPPORT

I would like to share Harvey J. Cooper's complaint in Review Feedback (November 1984, page 357) about Sanyo's poor response to owner's problems. I bought the Sanyo 1250 and had difficulty booting up the Calculating program.

I forwarded to Sanyo the error messages, original disks, warranty, and original purchase receipt with instructions written in large letters to return the receipt for my income tax records. Sanyo returned the original disks with a scribbled note stating I was pleased to see Mark Welch's review of the Mannesmann Balli spirit 80 printer. (November 1984, page 335). I agree with your conclusions that it represents a fine combination of improved print quality and lower price. I've experienced the occasional paper jamming that Welch mentioned, but only when I tried to print from the top of a cut sheet of paper. What seems to happen is that the paper is hampered as it first goes through the paper bail rollers and jams either against them or against the removable cover. The remedy is to have about a half-inch of paper past the print head when starting printing or a full sheet if beginning precisely at the top of the form is essential. For an adjustment, the top of the form is desirable you can ask the printer to pause at the end of the first page. Using these procedures, I've had no jamming.

Two points Welch does not mention might be of importance to some users. The cassette ribbons used by the Spirit 80 are specific to it and list for about $12, though I've found them for $7 at a discount house. Second, the replaceable print head is rated at 30 million characters, significantly less than some other dot-matrix printers; for medium use, I still consider it adequate (at 1.6K bytes per page, that represents about 19,000 double-spaced pages).
that its testing equipment found no problems. The booting problem remained, and Sanyo offered no explanations for the error messages. Moreover, the company by PIPping the components of CalcStar between the two disks.

Maxim W. Mikulak
Nesconset, NY

Gifford Update

Since my recent review ("Gifford's MP/M 8-16," January, page 303) Gifford Computer Systems (2446 Verna Court, San Leandro, CA 94577, (415) 895-0798) has started shipping MC-DOS, the multiuser concurrent disk operating system. This operating system is one of the first implementations of Digital Research Inc.'s Concurrent CP/M 3.1 to be available for non-IBM hardware. MC-DOS resembles MP/M 8-16 at the user-interface level, so the user who is already familiar with the older Gifford offering needs little training. Upgrades include a simple update guide for converting from MP/M 8-16 to MC-DOS.

MC-DOS has several advantages, including increased speed. Concurrent CP/M is basically an outgrowth of MP/M-86 and uses disk buffering, directory buffering, hashing, etc., to allow faster operation. The M-Drive/H 512KB-byte board is no longer used as a disk emulator but serves as a large hard-disk buffer. A utility locks any files into this buffer, so they are unaffected by the LRU (least recently used) technique of buffer flushing. This provides an MC-DOS user with the advantages of a large buffer and a solid-state disk emulator.

Gifford incorporated local-area networking into its new operating system. Optional Arcnet hardware is available for Gifford's S-100 systems and IBM PCs, and all appropriate utilities in the MC-DOS package have been modified. Also new from Gifford is the Macrotech Mi-286 dual-processor board, now supported and shipped in most Gifford systems. This board was designed as a plug-compatible replacement for the Compaq Pro 8085/8086 board. It comes in its standard configuration with a 6-MHz 80286, an 8-MHz Z80H, and a socket for an optional 5.33-MHz 80287 numeric processor. Operating in an 8086-compatible mode, the Mi-286 offers as much as two-and-a-half times more throughput under ideal circumstances.

MC-DOS lists for $695, and you must order it for a specific hardware configuration. MP/M 8-16 is listed in the price guide for $1345. The networking software and a single board cost $895. A networking package for the IBM PC XT and compatibles is available. Passive hubs (connecting up to four nodes, 200-foot maximum) are $95, while an active hub (eight nodes, 2000-foot maximum) is $795. The Macrotech Mi-286 processor board with the standard Gifford two-year replacement warranty is $1595, and the 80287 numeric processor is $690.

Charles H. Strom
New York, NY

The Compaq DeskPro

I noticed with interest in the November 1984 Reviewer's Notebook (page 261) that you have been using a Compaq DeskPro. The DeskPro is not compatible with the 384K-byte Quadram Quadboards; I have tried three in my DeskPro and each makes the screen go into outer space when the machine tries to switch resolutions on the monochrome monitor. Compaq claims on the telephone that this board is compatible with the machine, and people at Quadram have discussed it for the past six weeks or so, but I think it is clear that the board is not usable with this computer. Dealing with Quadram about this has soured me on them as a source of peripherals for IBM-type machines—their support is weak.

A couple of additional points: Compaq's documentation is helpful in setting up the machine, but it doesn't include much technical information (like a memory map), and Compaq's customer-support telephone number will only answer real questions from dealers, not end-users.

George Carey
Marietta, GA

Tough Local Network Problem:

"How can our department get our six computers and three printers to work together efficiently? We also want to be able to access outside data services and our future company LAN."

Simple Network Solution: NetCommander

NetCommander is a smart, small Local Area Network manager. It lets you link from four to 40 computers and peripherals—in any mix of models and makes. A 50K buffer (expandable to 250K) makes sure that productivity is high—keeping fewer printers humming—while computer and PC users do their thing, without waiting for a printer, modem, or shared disk. Those devices can be specified with names defined by users—and allocated on the basis of availability and capability. And NetCommander handles multiple protocols and different baud rates simultaneously—without modifications to hardware or software. It will also tie into your company's LAN. The latest in a family of products in use since 1979 NetCommander is a smart, small, efficient network manager.

For more information, call or write:

NetCommander
Digital Products Inc. • The Simple Network Solution Company
600 Pleasant Street • Watertown, MA • 02172
(617) 924-1680 • Outside Mass., call 1-800-243-2333
And check out our 30-day trial evaluation.
Inside Outside

Why pay more for a 300/1200 baud modem than you have to? Through the use of four low-cost, state-of-the-art microprocessors, we can now offer two versions of our full featured modems at prices, hundreds less than the competition. PC212A/1200 is available for $299, the 212A/1200E for $329.

Our modems are fully compatible with all Hayes software commands. Software packages like Crosstalk™, Sidekick™ and SmartcomIT™ will work with our modems.

Our internal modem card, PC212A/1200, is designed specifically for the IBM PC, PC/XT or other PC-compatible units.* The board occupies only one slot, since it is just 6/10" in thickness. The optional asynchronous port, available for $40, can be used for other peripherals when the modem is not being used. The modem comes complete with PC-TALK IT™, modular phone cable, card edge guide, and user’s guide.

Our external standalone modem, 212A/1200E, can be used with any computer or terminal that has an -232C serial port. The modem is housed in an attractive gold anodized case and fits comfortably under a standard telephone.

An easily accessible volume control knob adjusts the modem speaker’s output. The modem comes complete with modular phone cable, serial connector cable, and user’s guide.

Both modems are Bell 103/212A compatible. Both feature auto-dial and can be accessed remotely through an auto-answer mode.

Good service starts with answering your questions before and after you buy. It continues with same or next day shipment of your order. Since we only sell a few selected products, we have the information and inventory to help you fast.

We perform repairs in our own service department within 48 hours, should you ever need service during the one year warranty period.

Our price is the whole price. All prices include UPS surface charges and insurance. In a hurry? Two day UPS air service is just $5.

Corporations, dealers and institutions, call for volume purchase price information.

Inquiry 266

*Call for information.

No Risk Guarantee
If you are not completely satisfied with your purchase, you may return it within 30 days for a full refund, including the cost to send it back. If you can get any of our competitors to give you the same guarantee, buy both and return the one you don’t like.

Order Today, Shipped Tomorrow!
For fastest delivery, send cashier’s check, money order, or order by credit card. Personal checks, allow 10 days to clear. California residents, add 6% sales tax.
Hours: Mon.-Fri. 8:00 a.m.-6:00 p.m. PST
Sat. 9:00 a.m.-1:00 p.m. PST
(800) 821-4479
Toll Free Outside California
(805) 987-9741
Inside California

© Qubie' 1984

PC212A/1200 $299
212A/1200E $329
Now, You Can Buy an IBM-PC™ and OPTOMUX from Opto 22.

(Industrial Control has never been Easier!)

Opto 22, an IBM-PC Value Added Dealer, combines OPTOMUX and the IBM-PC to provide a powerful general purpose industrial control or data acquisition system. Optically isolated analog and digital I/O modules plug into a variety of mounting racks which communicate to the IBM-PC over a simple pair of twisted wires.

Opto 22 provides the software to program the PC in a high level language, commanding OPTOMUX to perform:  • Process Control  • Energy Management  • Machine Control  • Data Acquisition or any combination of analog or digital control.

Our application engineers are ready to answer any questions you may have regarding the use of the IBM-PC and OPTOMUX. Call us at 1-800-854-8851.

15461 Springdale Street  •  Huntington Beach  •  California  •  (714) 891-5861

*In California use our direct line.  Inquiry 217 for Dealers.  Inquiry 238 for End-users.
TROUBLES HAVE WE ALL, and this month Jerry Pournelle mentions some space problems at Chaos Manor, talks about the problem of choosing computer books, and still finds time to look at some interesting goodies.

In BYTE Japan, columnist Bill Raike's trip to the 1984 Data Show provides some information on disk-drive storage technology and laser printers.

From California, BYTE West Coast looks at a high-resolution digitizer for the Mac, some new workstations, and the windowing game.

Dick Pountain, our U.K. contributing editor, appears to have found the system that he's always wanted—and this time it's affordable.

We introduce a new column this month—Computers and Law. Attorneys Robert Greene Sterne and Perry J. Saidman begin with the legal issues of copying software.

Also this month, Steve Ciarcia again finds time to answer readers' questions about his projects in Circuit Cellar Feedback.

Computing at Chaos Manor: Troubles by Jerry Pournelle ............. 339
Chaos Manor Mail conducted by Jerry Pournelle ..................... 339
BYTE Japan: Disks and Printers by William M. Raike ............. 367
BYTE West Coast: What Next? by John Markoff, Phillip Robinson, and Ezra Shapiro ............. 371
BYTE U.K.: Realizing a Dream by Dick Pountain ............. 379
Circuit Cellar Feedback conducted by Steve Ciarcia ............. 393
Don't buy a disk/tape system that can't grow with you.

Get the Sysgen™ XL™ expandable hard disk and tape back-up system.

Most popular disk/tape systems offer 20 Megabytes of hard disk, plus a 20-Megabyte tape back-up.

That may seem ample now, but do you know whether, a year down the road, 20 Megabytes will give you enough storage?

You don't. So it makes sense to get the only disk/tape system that gives you room for expansion later on.

And that doesn't cost you any more now.

The new Sysgen XL comes with 20 Megabytes of fast, reliable hard disk storage, a built-in 60-Megabyte tape for fast, reliable back-up, plus room for an additional hard disk drive.

What happens if you later need more hard disk storage?

With the XL, you simply add a second 5¼" disk drive. It fits inside the cabinet, and plugs right into the XL controller.

You can add an additional 20 Megabytes, and back-up with a single pass of the 60-Megabyte tape.

Or add up to 100, and back-up with two tapes.

With the low cost of hard disk drives, expansion is much more economical than buying a whole new $3,000 system. Plus, you save desktop space by expanding inside the cabinet.

The XL sells for $3,295, including cabling, adaptor, and utility software. You get everything.

(Watch out. Some companies charge extra for cabling and the host adaptor.)

Installation? Just snap in the controller, plug in the system, install the system software, and you're running.

Compare before you buy.

You'll find the XL to be the outstanding disk/tape system for your PC, XT, AT™, or compatible today. And the only system that can expand for your needs for tomorrow.

Trademarks: Sysgen, XL — Sysgen, Inc.; AT™ International Business Machines, Inc.

SYSGEN INCORPORATED

47853 Warm Springs Blvd.,
Fremont, CA 94539
(415) 490-6770 Telex 4990843
I have problems. My office, its extension, the back room, and indeed my whole house are filled with software, books, computers, and computer components.

I've foreseen the crisis. We have plans for rebuilding Chaos Manor, adding a large new library, office, and workshop as a second story. If I can get that up, I'll last awhile longer. Alas, my real problem is with the city of Los Angeles, which has taken nearly a year to process my application to let me build that second story. If I have any friends in the appropriate departments—it's a yard variance I need—to let me build out even with the existing office extension—HELP!

BOOKS AHOY
I've just sent in the final version of my Adventures in MicroLand (Baen Books, spring 1985). Like The Users Guide to Small Computers (Baen Books, 1984), it's a collection of my BYTE and Popular Computing columns with considerable updating. I don't change the columns, but I do add information and comments to make them up-to-the-minute timely. Indeed, Adventures will contain columns that haven't been published as I write this.

After I finished the book I called my publisher, Jim Baen: what he told me is very disturbing.

It also gives me a problem. I want to enlist your help in what I think is a cause important to all of us. So far, so good, but I'm hardly a disinterested party.

THE BOOK EXPLOSION
The problem is real: there's been an enormous explosion of computer books. Publishers Weekly estimated the total 1985 sales of computer books to be comparable to fiction. However, there are so many computer books that no one of them does very well. Moreover, many of those books are pure schlock. Many publishers, seeing the rapid expansion of the computer-book category, simply flooded the market with books regardless of their quality. Quick in, quick profit, quick out. The result is that the field will soon be awash in dreck; and by a kind of Gresham's law, the bad books drive out the good ones. Publishers who take their time, bringing out carefully edited books of high quality—publishers like Que—are already being forced out, leaving the field to the schlockmeisters and hypesters.

The problem is curable but complicated. What's happening is that book buyers—the book-chain and book-distributor officials charged with actually ordering the books—do not know the difference between the good and the bad. How could they? A year ago these same people were buying romances. Romances are down, computer books are up, so their assignments changed. They didn't read the romances they used to buy, and they aren't reading the computer books they buy now.

My books sell fine once they get to the bookstores—but the only reason they get to the store in the first place is that the salespeople remember me as a science-fiction writer. Frank Herbert wrote a computer book. So did Pournelle. Neither the book buyers nor the publisher's sales force ever heard of this column, or indeed of BYTE magazine; magazine sales are handled by entirely different people. Since buyers don't know the difference between good and bad computer books, they order "some of each." If the salespeople insist that a particular book is hot, the buyer may order twice as many of that one; still not enough to make any sales.

THE REMEDY
The only cure for this is consumer organization, and the only relevant organized consumer groups I know of are the enthusiasts and hobbyists. The largest block of those are BYTE readers. There was a time when we enthusiasts were the computer revolution. We're still the largest organized part of it. We're also the people who lose the most (continued)
if computer-book publishing is abandoned to drecksters and schlockmeisters. We need good books.

It's time for us to do something about the situation. If we don't, no one will.

Several things must happen. First, most of us are accustomed to buying computer books in specialty stores. That's not the way to influence what's published. The impact is made in regular bookstores, and particularly in the big book chains: which means books you want at your local B. Dalton and Waldenbooks, say something to the manager. Better yet, put in a special order. The only way the book buyers will know which are the best computer books is for store managers to tell them—and the only information source the managers have is us. Most of their customers don't know a good computer book from a bad one. The average computer-book buyer is so used to being ripped off that yet another overhyped horror isn't even noticed.

It isn't enough to praise the good books. You must also condemn the bad. Now do understand what I mean by a bad book. I'm not talking about books that I disagree with or say "bad things," as for example the silly books that try to claim that computers are bad for poor people. I am thoroughly uninterested in censorship of ideas. No; by "bad books" I mean those that are poorly edited, filled with typos and misspelled words, crammed with jargon; books with neither index nor analytical table of contents; books written so poorly that you don't know whether or not you disagree with the authors because you can't understand what they said. Books with programs that can't possibly run. Books filled with obsolete materials.

There are plenty of such books, and if you discover that a particular publisher seems to bring out a lot of them—you won't have any trouble finding them if you look on the shelves of your local B. Dalton—then take them to the bookstore manager. Show her why these are bad books. Make sure she notices which publisher put them out.

There's another odd phenomenon: newcomers to the computer field are desperate for books, so much so that they pay little attention to price. It's strange; but a book will sell about as well at $19.95 as it does at $9.95. Publishers notice this sort of thing. If it keeps up, pretty soon there aren't going to be any low-cost books. Incidentally, my own Pournelle Users Guide books, including both The Users Guide to Small Computers and Adventures in Microland, sell for $9.95. They'd sell for even less if there were the slightest evidence that lowering the price would sell significantly more books.

If a certain publishing line consistently puts out overpriced schlock, complain loudly and often. If you find a publisher who consistently puts out good books at decent prices, tell your store manager that.

Baen tells me that he can make five times the profit publishing science fiction—quality science fiction—than computer books. It's true for me, too: my advances for computer books are a pretty small fraction of what I can get for science fiction. So far, the love of the field—I really like writing about little computers—keeps me putting out the books, while hope that the market will settle into something reasonable keeps quality outfits like Baen Books publishing them, but it's a strain. The real computer enthusiasts, led by BYTE readers, could make things a lot easier for the good guys.

SEMI_DISK

Speaking of good guys, SemiDisk Systems of Beaverton, Oregon, continues to develop a high-quality line of RAM-disks products for S-100 machines, IBM PCs and PC clones, and the Epson QX-10. They've now got SemiDisk boards with up to 2 megabytes on board, and I believe their costs are now the lowest per megabyte in the industry. A RAM (random-access read/write memory) disk, for those few who tuned in late, is a method of fooling your computer into believing that a block of memory is a very fast disk; indeed, the computer can't tell the difference. In CP/M systems, we generally designate the RAM disk as M: (for memory drive); once installed, you use it as you would any other disk drive, copying files to and from it (use COPY in MS-DOS and PIP in CP/M), renaming files, erasing them, marking them read-only, etc.

The time saved can be quite significant. For instance, my accounting system begins with a journal, which is a report in chronological order, of every financial transaction: income from my agent, or BYTE, or speaking engagements; travel expenses, computer supplies, salaries to my assistants, etc. From time to time, these must be posted into the general ledger. Since the files are quite large, each page of my ledger is a random-access disk file. There are about 200 ledger pages, and each month's journal has a couple of hundred entries.

Due to sloth, I seldom post all these until year's end. That can take time. With 8-inch floppy disks, it takes about three hours. With my CompuPro (Quantum) hard disk, it takes about 50 minutes. With a RAM disk, it takes just under 11 minutes to do a year's posting. Now true: in my CompuPro system I'm using a CompuPro Medium Drive/H RAM disk; but we've done speed comparisons between SemiDisk's S-100 boards and the CompuPro, and they're nearly identical. We've had a SemiDisk board running in Helen, Alex's CCS S-100 computer, for nearly three years with no problems at all.

Except for power failures, RAM disks are much more reliable than physical disk drives. There are no moving parts and no door latches to break (Barry Workman reports that he's still doing a brisk business in 'Anddon drive-door latches'). There's no maintenance and no problems with disks lunched by cats, tobacco, or stray magnetic fields. SemiDisk makes a battery backup unit: you can plug it into the wall, so that if you turn off your computer, the memory stored on SemiDisk doesn't go away; and if there is a power failure, the files are protected for up to six hours.

That six-hour limit does bother me
somewhat, but in actual fact the longest power failure we’ve endured in 20 years here at Chaos Manor was only about four hours, and it happened in the middle of the night. In fact, that data on my RAM disks is safer than the rest of what I’m doing since, although I’ve intended to get one for years, I blush to confess I am not using an uninterruptible power supply. I intend to get one Real Soon Now.

As I said above, SemiDisk makes RAM-disk boards for the Epson OX-10; they’ve done that for years, and therein lies a tale.

VALDOCS COMES FORTH AGAIN
The Epson OX-10 story is very odd. Back in mid-1982 Chris Rutkowski, president of Rising Star Industries, secretly showed the upcoming Epson computer to a number of writers. Rutkowski had been heavily involved in marketing the Epson printers (he once told me that he had made them the success they were) and was given a contract to develop unique software for the OX-10; he seemed to be involved with marketing the OX-10 at that time.

The Epson OX-10 was yet another Z80 in a market flooded with new Z80 machines, but it did have some special features. First, it had a bit-mapped screen, meaning that it was capable of better graphics than almost anything then on the market. Second, it could hook into an Epson dot-matrix printer, so that the on-screen graphics could be translated into hard copy.

Third, the OX-10 would come out with Rutkowski’s own keyboard design, which he called the HASCII; the acronym stood for human applications standard computer interface. Rutkowski predicted a great future for that design: so great that he was going to license it and charge 50 cents a copy, the money to go to a research institute that would improve human/machine interface designs. The HASCII keyboard had a good feel and was intended for newcomers. Rutkowski
try to make it like a typewriter by, for example, putting the Escape key well off to one side and labeling it "Margin Release." There were some other special-function keys with labels like "Edit" and "Copy" and "Delete Line."

The OX-I0's really big feature, though, was to be the integrated software known as Valdocs; this was going to be so wonderful that Epson would stop the IBM flood, save the Z80 computer, and, while they were at it, wipe out CP/M. Epson pinned so many hopes on Valdocs that the company didn't even have a CP/M version of the machine. Valdocs ran under TP/M, which is a kind of CP/M work-alike different enough from CP/M that CP/M hackers have real problems with it.

More: the whole Valdocs/TP/M software package was developed in STOIC, which is an offshoot of FORTH. The machine itself used a hardware bus developed by Epson America and employed by no one else. The result was that there were essentially no independent software or hardware developers interested in the Epson OX-10.

Freezing out independent developers has been the formula for financial disaster for every computer company that has tried it so far. Epson was going to bring it off, though, because of Chris Rutkowski, Rising Star industries, and Valdocs. Valdocs would do everything. It made charts, wrote documents, kept track of calendars, did calculations, and employed by no one else. The company that has tried it so far. Epson America believed him and began a big advertising campaign.

Alas, Valdocs wasn't ready in January of 1983. The first versions were sent to test sites. I got one. I really wanted it to succeed, but it was a disaster. Valdocs was slow, sent without documents, easy to learn but
Today it seems that everybody’s trying to sell you on their software.

So how do you locate the best programs for your needs at the best price?

Send for a copy of Vanloves 1985 Software Directory for your Apple, IBM or CP/M-system micro.

Each system-specific Directory gives you complete, reliable, up-to-date information on approximately 3,000 different programs in more than 60 different categories.

And it’s objective information from the most-trusted name in the information business, not advertising copy from the software supplier.

You’ll find out the package name, the publisher, the memory requirements, operating system and cost of each program.

You can look up and compare programs by the precise application you have in mind. Locate programs by their titles. Or check for all the offerings from a particular publisher.

You can even use our electronic bulletin board and club lists for free access to valuable information and independent advice from users like yourself.

So before you spend another dollar or another hour searching for software that might not do the trick, send for the Vanloves Software Directory of your choice and get all the information you need before making a buying decision.

For a free 10-day examination, call toll-free or clip and mail the coupon.

Vanloves 1985 Software Directories
from R.R. Bowker, The Information Company
hard to use, and quite capable of losing your files without warning. It could take up to a full minute simply to erase an unwanted file, and it took about 15 minutes to use Valdocs to create a one-paragraph letter. As to TP/M, the only documentation was some photocopied sheets so dim that I couldn't read them in strong light with a powerful glass; and it blew up if you tried to use standard CP/M utilities such as SWEEP.

Over the course of 1983, version after version of Valdocs (and, I suppose, of TP/M) emerged from Rising Star. All were improvements, but none were very good. In the September 1983 BYTE (Valdocs Revisited, page 480), Rutkowski promised that Valdocs 2.0 would fix everything and that it would be available soon (italics his). My answer was that I hoped he was right, but I didn't believe it: in my view, Valdocs was too ambitious for the Z80 chip. To do what Rutkowski wanted his software to do, you'd need a great deal more memory (8-bit computer chips such as the Z80 can address only 64K bytes of memory directly; to have access to more requires kludges).

ONE POSSIBLE FIX
There was, though, one obvious improvement that could be made to Valdocs: a RAM disk could probably take the software well past tolerable. The Epson used a very conservative—and slow—disk-control system, and Valdocs is heavily dependent on disk operations, making it painful; but with a RAM disk it might become a pleasure to use.

Apparently the people at SemiDisk thought so. In any event, they developed a SemiDisk for the Epson OX-10. In the meantime, Epson had brought out a CP/M version of the OX-10. The CP/M Epson was a nice little machine, well made and handsome, but not particularly distinguished among Z80 machines except for its extremely nice screen and graphics. The SemiDisk worked splendidly with the CP/M Epson—but of course that wasn't the system that needed the RAM disk. Alas, they never did get the software to connect up the SemiDisk to Valdocs.

I don't blame them, understand. Working with an operating system written in FORTH and intended to ape CP/M is my idea of purgatory. The fact remains that even with plenty of cooperation from Rising Star, they never were able to tie SemiDisk to Valdocs: so we were never able to see whether the speed improvements would make Valdocs tolerable.

A RAM disk would certainly have helped Valdocs. The trouble is that it's not really an integrated software package. It's not even call-on demand. It's only a set of chained programs.

That is: when you invoke Sidekick on your IBM PC, the program is already in memory and so is your own work in progress. Whatever you were doing stays where it was, while Sidekick operates with its own section of the PC's memory cells. If Sidekick needs to call in a file from disk—such as the calendar or the help file—it does it, but it still hasn't disturbed what you were doing. The result is that when you exit Sidekick, you're right back where you were when you brought it in.

Valdocs doesn't work that way. When you change functions in Valdocs, it must first save your current work to disk, then bring the new job in off the disk. When you return to your previous work, that process is reversed. Disk operations are slow. Five-inch floppies are very slow. If Valdocs could have been hooked up with a good RAM disk, the slowest and worst part would be speeded by a factor of at least 10, and Valdocs might have been tolerable. Alas, that didn't happen.

REAL SOON NOW
In October 1984 Rutkowski announced the imminent release of Valdocs 2.0 in a big press conference. Computer writers who were present—didn't go: it was in the Bay Area and I live in Hollywood—had mixed reactions. The BYTE staff wasn't very impressed, especially when they were told that certain features promised for 2.0 would be implemented in "the next version."

Valdocs 2.0 was developed with a new language: according to Rising Star, a greatly improved version of FORTH. It will employ a new operating system, TP/M 3. It was developed under a radical new organizational structure: many programmers, working individually in locations from New Hampshire to Hollywood, linked by electronic mail, each working on a small part of the system. I wasn't told whether the documents were developed that way: perhaps it doesn't matter, since Rutkowski once told me that he didn't consider documents necessary anyway. The program ought to teach itself.

The people at SemiDisk have been told by Rising Star that the software drivers for using a SemiDisk RAM disk with Valdocs 2.0 and TP/M 3 are "already written and installed directly into the operating system." Moreover, they actually have a copy of TP/M; they do not have Valdocs.

My advice to OX-10 owners is not to hold your breath. The Valdocs 2.0 release date is said to be January of 1985. At the moment (December 12, 1984), the software technicians inside Epson America do not have copies of Valdocs 2.0.

Valdocs was a valiant effort. In my judgment, it was doomed from the beginning: 8-bit machinery just isn't powerful enough for what Valdocs attempted even if you don't further handicap it by trying to do it in FORTH. It's a kind of moot question anyway, now that the 16-bit integrated software packages are beginning to deliver what Valdocs promised.

I've never understood the people at Epson America. They had everything going for them, but somehow they hitched themselves irrevocably to Rising Star and Rutkowski's obsession with proving that you can write good, fast, compact, usable software in FORTH. Epson's loyalty to Rising Star is touching. I guess they can afford it.

MORE ORCHIDS
Last month I reviewed Orchard Technology's PCturbo 186 board ("Orchids
to You," page 363), which speeds up your IBM PC something wonderful. We've been running it for nearly two months now: no glitches, no problems, and it's fast, FAST, FAST.

The Orchid board uses its own onboard memory, allowing the original memory in your PC to become one or more RAM disks. Last month there was a problem: the Orchid manuals weren't clear enough on how to install the RAM disks. That's been fixed. Orchid now has an Options program that runs fine and lets you configure your PC in a particular good for power supplies, either.

Deep Blue, my source inside IBM, has told me why there's no hardware reset key on the IBM PC. (There isn't one on the PC AT either.) The lack of such a key can be pretty serious, as for instance when your machine locks up and won't listen to the keyboard at all, and you have to turn it off to get it going again. This is not good for hard disks. It isn't particularly good for power supplies, either.

Of course, all the IBM people at Boca Raton use an expensive hardware addition called PC Trace that contains, among other things, a hardware reset. That's a pretty costly way out.

Fortunately, there's a less expensive remedy. Security Microsystems, the manufacturer of Quickon, the nifty little switch that lets you dispense with the PC's memory test on power-on, now makes PC Reset, a combination gadget that will disable the memory test and also do a hardware reset. There's a version for the PC and another for the PC XT; so far none for the AT, although I wouldn't be surprised if one is in the works.

I've had Security's memory-disabler in Lucy Van Pelt, our fussbudget PC and I don't think you'll have trouble with it now.

So THAT'S IT...

I've often wondered why there's no hardware reset key on the IBM PC. (There isn't one on the PC AT either.)

The lack of such a key can be pretty serious, as for instance when your machine locks up and won't listen to the keyboard at all, and you have to turn it off to get it going again. This is not good for hard disks. It isn't particularly good for power supplies, either.

Deep Blue, my source inside IBM, has told me why there's no hardware reset: Microsoft didn't want IBM to put one on. It seems that if you can reset the machine it's easier to pirate software. IBM, for reasons not known to my source, went along with this nonsense. It didn't even put a hardware reset on the AT.

(continued)
PC with the memory test. We'd forgotten how long that takes: 90 seconds, if you have your system chock-full of memory. That's a long time.

We've just put in the reset switch with the PCturbo 186 board installed; it works: push the button and I don't know whether or not it forces reset. To install it you have the 186 to reset. That board has its own hardware reset button on the back, and if I ever lock up the 186, I'll probably use both reset buttons just to be sure.

With an S-100 system, the contents of a RAM disk will survive a reset; at least they do with my Compupro, which won't reformat a RAM disk that's already formatted. Alas, the Orchid PCturbo 186 RAM-disk files do not survive resetting the PC, whether that's done by the Security Microsystems button or by Ctrl-Alt-Del. I suspect that's a function of the Orchid Software, but it may be inherent in the way Security Microsystems forces system reset.

The Security Microsystems reset comes out the back of the machine to a big button reminiscent of the pickle switch on the old Norden bombsight. The company has thoughtfully included some sticky-back Velcro so that you can attach the button to the side of your PC at any convenient place. Alas, the Orchid PCturbo 186 button remains on the back where it's hard to get at.

Anyway, you can now have hardware reset for your PC: gee, if this keeps up, the machine will have most of the features the Altair did.

**PC AT RUMORS**

Knowledgeable sources are ordering their PC AT for delivery in six to nine months; it seems there are some hairy power-supply problems on many of the ATs recently delivered. This comes from a company that orders IBM PC equipment by the pallet load.

Deep Blue tells me there are about 80,000 PC ATs sitting in warehouses waiting for Intel to deliver 80286 chips. The production yields on those chips are much lower than expected. There's also some concern that the power supplies in many of those warehoused machines will have to be replaced or at least reworked. By the time you read this, you can be sure that IBM will have done something about the problem. Big Blue does not intend to ship equipment that frustrates users.

I've further information on the AT: according to a friend in an independent laboratory, the AT is set up for
When the going gets tough, Optimizing C86 comes through time and time again. C86 is a highly dependable C compiler that has been optimized through the years to provide the best combination of reliability, speed, and performance.

FAST, IN-LINE 8087/80287 SUPPORT
Now you can take full advantage of 8087/80287 capabilities, allowing your programs to run many times faster than possible with other C compilers. Plus the source code to all routines is included, so you have complete control over all functions.

MORE OF THE FEATURES YOU WANT
- **SOURCE** is provided to all libraries for total programming control. The source includes a set of standard UNIX routines plus many DOS specific functions.
- **SPECIAL IBM-PC LIBRARY** including communication, screen, and keyboard handling functions.
- **COMPATIBLE WITH WIDELY AVAILABLE LIBRARIES** such as HALO screen graphics and many, many others (call for list).
- **TOPVIEW SUPPORT LIBRARY** provides windowing capabilities.
- **SPEED OPTIMIZATION** — there's always room to tighten your code, and Computer Innovations has the tools to help. For example, PROFILER-86 helps identify key areas for optimization.
- **TECHNICAL SUPPORT, NOBODY DOES IT BETTER**
  Computer Innovations has earned a reputation for providing customer support that is unequalled in the industry. This includes a user's group, an on-line bulletin board, and a user's newsletter.

JOIN THE THOUSANDS OF PROGRAMMERS WHO TRUST AND RELY ON C86
For Further Information Call 800-922-0169. Technical Assistance Call (201) 542-5920.

Computer Innovations features a full line of C products including C-to-dBase (dBase development tool) and Introducing C (C Interpreter Language Learning System). Call or write for a product profile.

For Further Information Call
800-922-0169
Technical Assistance Call (201) 542-5920

Inquiry 66
REAL MEN DON'T USE MENUS. I WANT TO KNOW HOW TO USE POWER COMMANDS.
HERE'S HOW:
FRAMEWORK SOFTWARE

Framework™ has elegant menus that are handy for beginners and occasional users, but are easily bypassed once you know your way around the program.

We're going to show you the simplicity and speed of using power commands to create and use our unique automatic outline.

This fancy keyword is typical of the power commands for all of the powerful integrated functions of Framework: word processing, spreadsheet, graphics, data management, and telecommunications, as well as running other sophisticated software such as dBASE III™ within Framework. And for writing macros or creating custom programs with FRED, the built-in programming language, power commands are the only way to go.

Boot Framework, and you've created the Framework desktop.

CTRL C S Press the Ctrl and C keys together, then press the S key. A spreadsheet frame is created as the second subhead.

CTRL F9 Press the F9 key. There's the spreadsheet you created, full screen.

CTRL F9 again. Back to the outline.

CTRL D C Press the Ctrl and D keys together, then the C key. Your desktop is cleaned up.

Now, how's that for a power trip. And you did it by following a few simple directions. Amazing. In just seconds you were in control of a powerful creative tool. Which is the way we think software should work.

For a dealer near you call (800) 437-4329, ext. 222. In Colorado, (303) 799-4900, ext. 222.

Software from
ASHTON-TATE™
We'll put you in control.

©Ashton-Tate 1984. All rights reserved.
Subscription Problems?

We want to help!

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

BYTE Subscriber Service
P.O. Box 328
Hancock, NH 03449

multiprocessing—there are signals on the extra bus for it. (The "extra bus" is another strip of connectors that make the AT's bus 16 bits wide.) The extra bus seems to run all of the current PC cards just fine but also will run "wider" cards.

Another thing: the AT's crystal is socketed, just as if IBM were planning for faster 80286s already.

SYNCHRONICITY

Talking with Jim Baen reminds me that he has a new software line. It includes a number of games, many based on the works of authors he's published—the most notable is Fred Saberhagen's Berserker series, and of course I'll finish the game based on Niven and Pournelle's Inferno Real Soon Now. I've mentioned Baen's Magic Keyboard several times before.

There's also The Electric Dragon.

The I Ching or Book of Changes has been around a long time; Confucius thought it was old at the time of Christ. It is supposed to have been composed about the time of the Trojan War. Scholars including Confucius and Jung have thought it worth a great deal of study. Many science-fiction readers first heard of it through the late Philip K. Dick's masterful The Man in the High Castle, which, according to Dick, was largely written through the aid of the oracle.

One uses the I Ching by tossing joss sticks to generate random numbers. The theory is that all events in the universe are connected, and thus the study of any event will lead to understanding of events (and total situations) existing simultaneously; and thus the total pattern of the universe will be brought to bear on the fall of the yarrow stalks.

You can also generate the I Ching hexagrams by tossing coins: Chinese coins were supposed to be preferable, but I used to use silver dollars. Whatever method you use generates a hexagram of six lines. Each possible hexagram has a name and considerable text concerning it. Study of that text is supposed to give you sage advice on what to do at this particular moment.

Modern science, particularly the general theory of relativity, holds that the concept of simultaneity is meaningless; and it isn't necessary to believe in the theory of the I Ching to be fascinated with it. You can also believe that its author was a very astute judge of human nature and wrote a number of mind-concentrating passages designed to focus an individual's powers of thought.

In any event, the standard way to consult the I Ching involves hand washing, lighting incense, taking the book down from a high shelf, and unwrapping it from its silk cover with great respect; laying it on a south-facing table in the middle of the room; and, after suitably composing one's mind, tossing the yarrow stalks in a precisely defined manner.

With The Electric Dragon you merely put a floppy disk into an IBM PC and type ICHING <return>. The system will prompt you from there. The manual tells you that you may, if you like, treat your floppy disk with the proper reverence, place your computer facing south on a table in the middle of the room, and use incense. Somehow it's not quite the same.

However, the program does all that the yarrow stalks could do. Instead of tossing the sticks (or coins), you press any key whenever you feel that the time is propitious; this generates one line of the six-line I Ching hexagram. Lines are either yin or yang and can be either fixed or moving; if any of the lines is a "moving line" (the odds are good that at least one will be), you have actually generated two hexagrams, and their meaning, modified by the meaning of the moving line or lines, must also be considered. The odds for generating each kind of line (as generated by tossing yarrow stalks) are easily calculated: one supposes that The Electric Dragon program duplicates those odds as closely as possible.

The manual was written by Steve Rasnic Tem. I've not read a lot of his poetry, but I have twice included poems by Tem in anthologies I've edited. The I Ching implemented in the
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.
program is the 1950 Richard Wilhelm translation rendered into English by Cary F. Baynes from Princeton University Press. I'm no authority on versions of the I Ching; I assume this is a good one mostly because I've known Jim Baen a long time, and he's always pretty careful to do things right—and I also know he's been intrigued by the I Ching for many years. Certainly the messages read poetically—and enigmatically—enough.

The Electric Dragon program contains what amounts to a log book. You can type in your question, and after receiving an answer from the oracle, type in a comment; after which you can save the whole thing. The file is time- and date-stamped, so that it can become a kind of diary of your problems and your thoughts about them. Alas, I've found no way to make hard copy to paste into my regular log book.

You can also review previous sessions or study an individual hexagram.

If you've ever wondered about the I Ching, this is a reasonably painless way to consult it. At worst, it's an expensive electronic log book.

**SMALL DISKS!**

Everyone has moved to 5¼-inch disks; everyone, that is, except me. Eight-inch disks are still the main workhorses here at Chaos Manor. The CompuPro 8-inch double-sided format holds 1.1 megabytes per disk: that's 180,000 English words, more than enough for a novel. I can copy all that in about two minutes flat. It's easy to keep lots of backup copies. Eight-inch drives are much faster than 5¼ and significantly more reliable; I almost never get 'retry' errors on the 8-inch drives, and there's at least one a week with 5¼.

However, most software now comes on the small disks, and it's a pain to have to get Peter to use the Disk Maker I to transfer it over to 8-inch format so that I can get it into the Golem, my big CompuPro 8/16 system. For some time now I've been promised small disks for the Golem; when the CompuPro hard disk arrived, it had a blank spot with a piece of yellow stick-on saying "5¼ drive goes here"; but nothing happened.

Last week that got fixed. CompuPro sent down a big box that contained a new power supply and two Mitsubishi 96-tpi (tracks per inch) 5¼-inch drives. There was also a CompuPro Disk One-A controller that will handle both the 5¼-inch and 8-inch drives.

We took the hard disk out of the old box and put it in the new; the old power-supply box went back up to Hayward, where CompuPro intends to take it apart to see how it has held up under nearly a year of intense use. Then 'Toby Pietsch came over to set things up. In the course of the installation, we discovered one mode of board failure that the CompuPro quality-assurance people hadn't tested for. A quick phone call took care of that; they've now changed their test procedure.

One of the main reasons I get so much attention from the people at CompuPro is that nearly everything they put out gets set up and used here before it gets to the public; and I often find problems that did not show up in other tests, precisely because I do not "test" equipment and software. I use it; and since we do almost everything here, from writing books to running accounting software to writing programs, it gets "tested" a great deal more thoroughly than most test sites can manage.

I generally find some problems. That's why I have more than one computer, including one I don't touch; when we get a problem with the experimental system, I leave it alone until 'Toby can look at it. He finds the problem, consults with CompuPro, and they modify the design, change software, or do what it takes to make things work properly.

The result can be impressive. Take the Golem as an example. He's often torn apart and filled with experimental equipment. We work him hard. Yet he hasn't been off duty for two weeks cumulatively in the more than two years we've had him.

Anyway, the board glitch was fixed, as was a minor software problem; and I can now run my 5¼-inch drives as well as 8-inch. They run under Toby's Newmedia program. Newmedia tells your system that any one of about 40 different disk formats (he's adding to them all the time) is native. Once that's done, you can read, write to, and format 5¼-inch disks in the format you chose. Possible formats include both 48- and 96-tpi, IBM, Epson, Kaypro, and a whole bunch of others.

Changing native formats with Newmedia takes about 30 seconds, after which you can use COPY or PIP to move files to the new format from the hard disk, 8-inch drive, or RAM disk. Like all of Toby's recent programs, it contains its own instructions; type NEWMEDIA? <return> and it tells you all you want to know about using it. Newmedia with the CompuPro Disk One-A is going to save Peter and the Disk Makers a lot of work. Incidentally, all of 'Toby Pietsch's software uses that convention: type the program name, space, and a question mark and the program explains itself. Nifty.

'Toby also brought the new very fast Copy and Format programs that cut disk-copy time in about half.

My system was installed by 'Toby; but CompuPro has been working on making its stuff easier to get running, and installation of the new BIOS (basic input/output system) software can now be accomplished by running a single Submit file, which assembles the BIOS (you get the source code) and does the system installation. Pournelle's law still obtains though: if you don't know what you're doing, deal with people who do. In CompuPro's case, that translates to "work with Systems Centers unless you're pretty familiar with S-100 bus systems."

**THAT VIDEO BOARD AND THE SPUZ**

'Toby also brought over a copy of the new CompuPro PC-compatible S-100 video board. Alas, he couldn't leave it; as of now there are only five of them in existence. CompuPro is making more next week, and I ought to have mine Real Soon Now. I can hard-
Your Career Is Our Business—Catch Our Magazine

Grab the brass ring through McGraw-Hill's COMPUTER CAREERS

McGraw-Hill's COMPUTER CAREERS magazine will be published in May 1985. This McGraw-Hill publication, focusing on career development, will be edited for computer specialists working in leading edge areas such as computer graphics, communications and robotics, as well as mainstream design and application of computer technology.

subscription if you

graduated between 1978-1985 with a:

Computer Engineering/Science major or Electrical Engineering major with computer related curriculum,

and/or

Are actively involved in computer technology in your job function.

To receive this free subscription to COMPUTER CAREERS, fill in one of the attached postcards which will trigger an application form for you to complete. We must have your home address only. If both cards are missing, send your request to: Violet Frey, Circulation Manager, McGraw-Hill's COMPUTER CAREERS, McGraw-Hill Publications Company, 1221 Avenue of the Americas, New York, NY 10020.

COMPUTER CAREERS editorial content will focus on interests and concerns of the computer science/engineering specialist. Articles will sift through the maze of computer-related jobs to show you what and where the opportunities are...tell you how to weigh them now and in the future...offer expert advice that will help you move successfully ahead in your career...identify areas where you can build your personal attributes to enrich your career. In addition, the reader has available a Resume Forwarding Service in each issue.
C Preprocessor

If you have ever found yourself wishing that C had a more sophisticated preprocessor, you will appreciate this stand-alone preprocessor from Hyperon Software.

- Supports Harbison & Steele Preprocessor
- Preprocessor Variables & Expressions
- #While & #Do Loops
- Full Macros
- One Pass
- C Source & Documentation Provided

Designed for portability. Presently PC-DOS diskettes are available; please inquire about other formats.

Price: $39.95 (California residents add 6%)

Hyperon Software
PO Box 3349
Costa Mesa CA 92628

CPCOMPUTING
2068 Ventura Blvd.
Camarillo, CA 93010

Expand! For the NEC PC 8201:
SIDECAR/$349. 32K Memory Cartridge, expandable to 128K.
32KROM SPREADSHEET/$88.
For the NEC PC 8201, TRS 80 Model 100.
8K MEMORY MODULE/$44.95 each
- Simple installation instructions included.
- 30 day satisfaction guarantee or your money back.
- 1 year warranty.
- Prompt shipment via UPS.

Shipping: free UPS service 2 day air, add $4.00 Continental USA, add $7.00 Canada. Payment: Visa, MC. American Express. Checks held 14 days: COD add $5.00

Pro also has UNIX System V for the 80286 chip. It shouldn't take the company all that long to bring UNIX into the United States.

FLOWCHARTS

Mrs. Pournelle is doing a book plus computer program that will allow any child with access to a computer to learn to read. She can do that because she has for years been the reading teacher of last resort for the Los Angeles County juvenile justice system. Her students are teenage illiterates in a lockup. They mostly come with pound after pound of psychological mumbo jumbo that "proves" the kid can't possibly learn to read; it wasn't the school system's fault.

She ignores that junk and teaches the kids to read. She hasn't failed yet. Now she's doing a book on methods. With the book will come a computer program. Alex and I are working on it. Her contract specifies that part of the advance will be paid when we turn in a flowchart of the computer program. By coincidence, we got that contract the same day that Flow Charting, a program by Patton and Patton, arrived.

This looks as if it would be an easy system for producing flowcharts. It adheres to UNIX: it goes to sweep through the computer world like wildfire and be the unifying influence we all need. After all, Digital Research is supposed to be working on ways to make Concurrent DOS run under UNIX; and since PC-DOS runs under Concurrent DOS, that will go a long way toward integrating the micro world into one happy family.

On Tuesdays and Thursdays I recall that UNIX is enormous, too big and too slow, changes all the time, and generally requires a UNIX wizard to maintain; there's no way it's going to be popular outside large computer establishments. Give vanilla UNIX to business users and hear the screams of agony.

For those interested, though, these rumors out of CompuPro: the European branch of the firm has shipped a beta-test version of UNIX for the 68000 chip to CompuPro-Canada. This is supposed to be the full Berkeley UNIX plus System V. Compu-
ly found an excellent CP/M program that makes it considerably easier.

Free Filer from Tellion Software was designed to work with WordStar files, but it works fine with WRITE text files, too. Free Filer is a "free form information retrieval system" that will let you keep card files, search through them on single or multiple keys, and make sorted files of the kind you see in the Items Discussed box.

His example: suppose you had the following card entries:

-Cats
furry, sneaky, warm, smart, small, edible (although eating them is not socially acceptable), semidomesticated, cheap to expensive

-Sheep
woolly, medium-sized, warm, edible, domesticated, expensive

-Toads
small, wet, cold, beautiful [it's Peter's file, not mine], inedible [as far as I'm concerned], cheap

Free Filer could be used to search for all animals that are small (toads and cats) or warm and expensive (cats and sheep) or cheap and edible (cats). Each time a record is found that contains the word or words searched for, it is displayed by itself on the screen. You then have the option to print it or add it to the search file.

There are a number of ways to sort your data once you retrieve it.

The program is not copy-protected and indeed urges you to make a backup copy before using it. It can be run from within WordStar as an information utility to generate specialized files that can then be included in the text you're working on.

The instructions are simple, in English, and easy to use. There are plenty of examples. Free Filer is one of those wonderful little general-purpose text utilities that simplify life with computers.

Recommended.

WINDING DOWN

Tony just called. He's got a CompuPro 80286 board and SPUD intended for me; first they go into his system for checkout. COMDUX is coming up in two weeks; just after that I ought to have the new stuff aboard.

I could say the book of the month was mine; certainly that was the book I put the most time and effort into. However, the real book of the month is The World of Digital Typesetting by John W. Seybold (1984; Seybold Publications, POB 644, Media, PA 19063; no price shown). This book will tell you a lot about typesetting equipment, software, and interfaces. It is not complete. There's more to the story; but this is a good introduction and history. Like Skillin and Gay's Words Into Print, Seybold's book belongs on the reference shelf of any serious professional writer. It's not easy reading, but it's stuff that professional wordsmiths had better know.

There hasn't been enough time for games, so there is no game of the month. However, I have been promoted to Vice Admiral in the Cygnus Star Fleet 1 game.

We've ordered 512K-byte upgrades for our Macintosh computers, but they haven't come yet. Our dealer says Real Soon Now.

Finally, I just got a call from AT&T, and it looks as if I'm going to get one of the UNIX-running 3B2 systems to play with; hopefully, in a couple of months I'll know what to think about UNIX on Fridays and weekends.

Jerry Pournelle welcomes comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, do 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.
**KnowledgeMan™ and You.**

The possibilities are endless.

To succeed in business, you need a partner that is fast, flexible, intelligent and easy to work with. A partner that can help turn your big ideas into well-conceived reality. One that gives you the support you need to make critical decisions confidently.

No partner can give you more of what you need than KnowledgeMan, the knowledge management software from MDBS.

**A powerful partner.**

KnowledgeMan helps you manage more knowledge, in more ways, than ordinary software. It can help you make better decisions on just about everything from production scheduling to financial planning to market forecasting. KnowledgeMan and its optional components offer data management, spreadsheet analysis, statistical analysis, text processing, forms management, business graphics, programming and more.

The key to KnowledgeMan's versatility is its exclusive synergetic integration, allowing you to accomplish your computing needs within one program. Unlike other software, there's no need to exit one function before entering another. The result: different kinds of processing can be intermingled. Quickly and easily.

**A partner that speaks your language.**

For all of its power and sophistication, KnowledgeMan is remarkably simple to understand. Even a beginner can start putting KnowledgeMan to work in minutes. With a single query, you can obtain related data from unlimited multiple tables. You can even teach KnowledgeMan to understand your own jargon.

**A partner that helps you along.**

The on-line HELP facility allows you to draw on 6800 lines of helpful information organized into 380 screens. If you have a problem or question, KnowledgeMan allows you to access the pertinent HELP screen immediately. Each screen is carefully designed to provide a quick reference guide to KnowledgeMan commands.

**A partner that gives you room to grow.**

Ordinary software packages can be frustratingly easy to outgrow. Not KnowledgeMan. Each KnowledgeMan component has more power than you'll probably ever need—far more than conventional integrated programs. With KnowledgeMan, you don't sacrifice capability, capacity or convenience. So with KnowledgeMan, you spend your time solving problems—not trying to overcome software limitations.

**A partner that protects your interests.**

KnowledgeMan offers sophisticated security features. Unauthorized access to data is next to impossible, thanks to password checking, thousands of access code combinations and data encryption.

So your secrets are safe with KnowledgeMan.

**A partner you can build on.**

To add yet another dimension to KnowledgeMan's capabilities, you can get fully-integrated options like K-Graph, an extensive business graphics facility that lets you plot information in a variety of colorful graphs, charts and diagrams. For text processing, the K-Text option lets you incorporate data into written documents quickly and easily. Or, create highly-polished, full-color customized forms with K-Paint, our forms painting option. To short-cut the keyboard, put the K-Mouse option to work.

**A partner you should get to know better.**

To see KnowledgeMan in action, visit your dealer. Or contact Micro Data Base Systems, Inc., P.O. Box 248, Lafayette, IN 47902, (317) 463-2581, Telex: 209147 ISE UR.

It may be the beginning of a long, successful partnership.
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.
CORVUS PROBLEMS

Dear Jerry,

I was very interested to see your comments on the Corvus hard disk. We've been using one for almost two years. Our experience has been frustrating, different enough from yours, and, I hope, relevant to enough people that you might decide to look into it further.

After researching hard disks for several months, our ultimate reason for going with Corvus was that the finance company we use for our computer deals said it was the only brand it wanted to finance because it was the only one with a reasonable service record. After five firmware and hardware crashes, I wish I knew then what I know now.

More distressing than having to baby the beast has been the response of Corvus itself. Our first crash was due to a bug in Corvus's firmware. I got on the phone with Corvus's technical people, who told me they knew about the problem and how to fix it. The strange part was that they also told me they hadn't bothered to notify dealers or users about the problem. Corvus has also failed to answer my letters to network everything. Not just the biggies. We hear good things about their competitors, they're trying to network everything, not just the biggies.

NET PC-8201A

Dear Jerry,

Recently I purchased an NEC PC-8201A lap-size portable computer. Partly because you had nice things to say about it and partly because I couldn't resist the sale price. In general, I've been quite pleased with it (although I'll need to add more memory before I'll be really happy). I also own a Kaypro 2, and I have been using Microfot Labs' MITE communications package along with the Telcom program in the NEC to transmit text files between the two. However, according to the way I read the NEC manuals, it should be possible to use the NEC SAVE command to transmit text files from the NEC through the RS-232C port to the Kaypro. This feature would be potentially useful in saving BASIC programs from the NEC to the Kaypro's disk drives. The useful feature is that the NEC tries to convert a BASIC file (BA) from internal format to ASCII format as it transmits. Thus, using the SAVE command would prevent you from having to first save a BASIC program in ASCII format on the NEC and then calling up Telcom to send it to the Kaypro.

Unfortunately, the SAVE command does not work very well in my setup. I have both computers set to agree on communications protocol and whatnot, but when I save a text file to the RS-232C port on the NEC, the Kaypro gets only about half a screen and then gets hung up. When I try this procedure with a .BA file, the same thing happens, but the Kaypro drops a few characters as well (notably line numbers). This seems to happen regardless of how slow I set the transmission rate. I was wondering if you have tried the NEC SAVE command to send things out the communications port to a Kaypro or other computer.

The NEC Telcom program has worked fine for my setup (as long as one is aware that because of the Kaypro's software, screen scrolling, any communication that echoes to the screen has to be no faster than 1200 bps for the scrolling to keep up and no characters to be lost). At any rate, I would like to hear about any experience you have had with the SAVE command. Thanks.

MARK E. CORNELL
Tucson, AZ

I've never used the SAVE command. Indeed, I only use Percy, my NEC PC-8201A, as a lapboard typewriter when I'm on aircraft. When I get to my hotel, I use Telcom and the PIP command to send the resulting text to Adeline, my Orona. When I get home, I use Telcom to send the text to my CompuPro 8/16. Both work perfectly at 9600 bps.

I've tried this with the Kaypro 10 and it all works fine at 9600 bps; just don't echo to the screen. Use PIP to collect the files onto the Kaypro. Alas, I think you have no choice but to save your programs in ASCII and use Telcom.

I still like Percy a lot. So does Mrs. Pournelle.—Jerry

COPY PROTECTION

Dear Jerry,

I can empathize with your gripes about copy-protected source disks: I had such a
utility disk self-destruct on me six months ago. I have no children or animals underfoot and am reasonably fastidious about disk care. Even with the best-laid plans, part of the copy-protection scheme is an (usually abortive) attempt to reformat the disk. Fair enough, except when the switch on your drive slips slightly and the underside of the write-protect flap caves in just enough, leaving you with a rather expensive blank disk. In defense of the manufacturer, the program is very reasonably priced, does exactly what it claims, and one backup disk is available to registered owners at a reduced price. I was still rather miffed at having my disk destroyed through no real fault of my own.

The distributor was no help (buy the backup—but what if that one goes?). I began snooping around in my DOS and discovered the nature of the copy-protection, where certain information is returned to the DOS buffers with certain types of read errors. I then wrote a couple of utilities to read and write these irregular formats track by track. I now have backups for my own use that in a better world I should have had in the first place. I'm no real pirating threat, since I don't know anyone who can use this program who doesn't have it already (an essential part of my system is no longer manufactured), yet these copies are not entirely on the up-and-up (maybe one, since I paid for one). Serial numbers are a good idea, but the numbers on this package are not hidden very well even though the code itself is gibberish.

I don't know if an equitable and sensible solution is on the horizon. Just look at what a mess "fair use" turned out to be when certain publishers decided to play hardball with photocopying. Inflating software costs to anticipate piracy could very well even though the code itself is gibberish.

I don't know if an equitable and sensible solution is on the horizon. Just look at what a mess "fair use" turned out to be when certain publishers decided to play hardball with photocopying. Inflating software costs to anticipate piracy could easily price some packages out of the market. Improved copy protection is just more of a challenge in the escalating war of copy-protection/subversion schemes. I agree that cheap, reliable software usually isn't worth trying to steal, but I don't think we'll be flooded with exemplars any time soon.

LAWRENCE L. CRAWFORD
Philadelphia, PA

Another good letter on copy protection. The issue is not going away.—Jerry

THE USERS STRIKE BACK

Dear Jerry,

The time has come for the computer users of the world to unite and to make the following declaration to the software suppliers of the world.

Dear Software Supplier/Copy Protector:

I understand that you perceive the unauthorized and illegal copying of your software to be a huge and critical problem. There are many people who criticize your position and logic, but that is neither here nor there. To you, this copying is seen as a problem, and I doubt that any arguments or evidence will change your mind. So I am not writing you about piracy, its economic effects, or any of this. Instead, I ask you to consider for a moment the forgotten person in this debate: the ordinary user.

The means you have chosen to solve this problem of illegal copying, copy protection, are completely inappropriate from the viewpoint of the user of your software. You should be able to recognize this without long and tedious argument; you should be able to recognize that you owe everything to the user, that you owe to the user the duty of utmost care, that you are a trustee of the user's information needs. You should, in short, be able to recognize the tremendous responsibility you have toward the user.

But you don't. Instead, you treat the user with the utmost contempt and disrespect. You deliver unintelligible manuals, full of jargon and convoluted syntax, when you should be trying desperately to communicate clearly. You disclaim all legal responsibility for the correctness of your software; you spend millions in advertising and then refuse to even commit yourself to the proper working of your product. But you show your greatest contempt by instituting copy-protection schemes, which create new dangers for those who have foolishly placed their trust in your ability to help them. No copy-protection scheme will ever help any user, and usually the scheme will only serve to injure and frustrate the user. Are the concepts of pride and professionalism really so foreign to you?

Maybe you are protected by these schemes; but they serve me poorly. Can't you see that your duty is to me, your customer, instead of to your perception of your own injury? You can't balance the perceived cost to yourself against the injury to me and then say your interest is the greater and should prevail; you are morally responsible to consider and protect my own information welfare, and I demand that you attend to this duty.

Maybe your product is truly wonderful, but I am not interested in any copy-protected software, no matter how wonderful. I can see that your only interest is what you can get from me and not what you can do for me. So I will avoid your product. I will not buy it, so you will not have my money. More important, I will not use it, so you will not have my trust and respect: for these are what I give when I use a piece of software. Needless to say, I will not waste my time trying to copy a piece of software that I am committed not to use. I will advise everyone I know to do the same. I will choose my software vendors as I do my friends, my physician, and my attorney. And I will hold you in the same contempt as you, perhaps unknowingly, hold me.

Should you learn to temper your greed with wisdom, let me know. I'm always ready to make a new friend.

Sincerely,
Software User

Boycott is the only effective answer to this problem. The vendors will somehow have to be coerced into being fair and reasonable, since they have no inclination to take this step on their own.

EDMUND B. BURKE
Atlanta, GA

Maybe yours is the only way, Alas, computer users are not all that well organized. Still, a few thousand such letters...—Jerry

A FANTASY?

Dear Jerry,

A while back, I was part of a commercial programming effort. The question of copy protection came up. We came to the following conclusions:

If customers cannot back it up, then:

We would have to maintain full customer records; We would have a higher number of disks returned because the disk needed very accurate drive-speed adjustment; it would involve another entire job/position/department; it would have to be a nonprofit endeavor.

All locks can be picked:

The only people we had to stop could copy and sell it anyway. If they give away only one to three copies, we still have a large number of paying clients (free advertising, tool).

We would either have to:

Write the lock ourselves (time = $);

Hire someone to write it (ditto). Pay (continued)
Statpro* data analysis software was specifically created to give professionals of all kinds the analytical tools they need on the job. It's for corporate planners and marketing specialists, engineers and lab technicians, scientists and educators. In fact, Statpro is for every professional who does data analysis but can't afford to waste time.

Mainframe statistics on your PC.
As a practical tool for professionals, Statpro was specially designed for the personal computer. It's not a scaled-down mainframe program or one of those packages that can only handle a few basic analyses. Instead, it brings a full repertoire of statistical techniques to your IBM PC or PC/XT. From basic descriptive statistics and linear regressions to unequal size ANOVA and discriminant function analysis.

And despite its impressive power, Statpro is easy to use. You just respond to simple menus and screen prompts with single keystrokes. No programmers, complex commands or long lines come between you and the job.

A powerful database.
Because you'll want to set up your analyses according to your needs, we've equipped Statpro with a remarkably flexible database. You can range check, verify data entries and keep track of missing data. Analyze any subset of your data base. Transform variables according to virtually any formula. And add, edit, delete, sort or move data wherever you want.

Lots of graphics.
Nothing makes complex data clearer and easier to present than pictures. So Statpro lets you create graphics and charts in the best format for each job, from pie charts, scatter and regression plots to bar, box and multivariate vector plots. What's more, Statpro graphics can be customized—with scaling, labels and colors—to emphasize important aspects of your analyses.

Call for a demo.
Statpro Professionals get more done, faster. But don't take our word for it. Call and ask about our demonstration package, or order Statpro for only $795.

Don't wait! Become a Statpro

800-322-2266
In Massachusetts, call (617) 423-0420. Call us for the dealer nearest you.
a higher duplication cost. We would find ourselves with a large custom-programming job:
  - Patches to fit/use all printers
  - Patches for all 80-column (Apple) cards
  - Patches for several disk operating systems.

The market would be more than halved because it would not fit many specific systems (hardware).

The market would be reduced further because it could not fit into a menu-driven, userproof, black box with many functions.

It would please the programmer because no one would see the faults. But then he had already been paid. I would not have bought it because I think programs should be unlocked: people lend/borrow your books don’t they?

At this point we ended the discussion and sold it unprotected.

William M. Reed
New Orleans, LA

I wish all the publishers would come to the same conclusion.—Jerry

ETHICS

Dear Jerry,

Re your September 1984 column on Tom Timpidis and his RCBS being busted at the behest of one of Ma Bell’s offspring:

Of course. it’s always the little guy who gets hung out to dry. This same sort of stuff must certainly go on (even if only on a one-on-one basis) via CompuServe and the Source. Can you imagine how many lawyers the Reader’s Digest, Control Data Corp., and H & R Block would have barring the doorway if a phone company tried to impound the computers at their two subsidiaries?

You seemed to think that your supermarket analogy was a bit off-the-wall, but if you’ve ever read the tortured logic and mind-boggling conclusions that some judges hand down every day, you wouldn’t be quite so quick to dismiss the idea. Some more theoretical cases:

The Washington Post runs a car dealer’s ad. I respond, get bait-and-switched, and buy a lemon from him. Can I impound the Post presses? What if the Post had received previous complaints about the dealer? Even if the Post later yanked the ad, the damage is done. It seems to me that the argument for joint tort-feasance is just as strong here as it is in Timpidis’s case.

If I get ripped off by a con-artist advertisement, can I have the magazine’s Second Class Postage permit yanked?

Suppose you print in your column (notice how we’re getting closer and closer to home?) my casual comment to you that “the Bytecrunch-99 computer stinks,” along with my name and address. Some irate Bytecrunch-99 owner firesbombs my house. Can I send your local sheriff over to impound your 32 computers?

As a “reader service,” I print your phone number in our Eagle users group newsletter, with the suggestion that you can be reached between the hours of 2–4 a.m. PST. Is your unpublished phone number “owned” by you and/or Ma Bell?

Regarding your comments (same column) that electronic bulletin boards publish ways to defeat copy-protection schemes—there’s an obvious connection here to the Timpidis case. If Timpidis is guilty of some crime, then what do we do about those who publish these other hacker goodies? Or are they safe because they only published ways to defeat copy-protection schemes and not the proprietary information itself?

How ethical is it to hit a buyer for one or two weeks’ take-home pay for a copy-protected program? While awaiting a replacement for the program disk you accidentally trashed, you make the next VISA payment on a worthless disk and loose-leaf binder, the project deadline has come and gone, and you’ve lost bucks, grades, or a job. What are the ethics of arrogant licensing agreements, hyped product descriptions with product disclaimers packed inside the box, refusal to fix bugs, user nonsupport, and other problems you’ve talked about?

Yes. I read program reviews by the bucketful. My eyes glaze over and skip to the next product review as soon as they encounter the phrase “copy-protected.” I absolutely refuse to buy copy-protected programs. But let’s be realistic—what percentage of home computer software produced today gets a thorough magazine review so you can be forewarned? And how many interested buyers are going to dig up, say, a March 1983 BYTE to see what you said about their intended purchase? What makes it really bad is that fighting a battle against copy-protected programs can be heartbreakingly when you have to pass up an otherwise luscious piece of software. There’s got to be a better way.

John Mazor
Clinton, MD

Yeah. I get so coldly furious about the Timpidis situation that I’m tempted to cry havoc. One thing I note that Pacific Telephone has done: by acting as its people have, they’ve opened what ought to have been a closed ethical debate, thus causing a lot of bright kids to seriously consider becoming phone phreaks.

It is statistically improbable that the forbidden phone codes have not been sent through The Source and CompuServe: equal justice demands that Ma Bell try to confiscate their equipment. Perhaps they’re not so eager to take on the Reader’s Digest?

As to copy protection: I don’t know the answer. One of my readers counsels me to “let loose the demons”: that is, any copy-protection scheme can be defeated, usually by a program called a “demon” that sits in high memory, watches what the copy-protection scheme does, and then begins to do it. My reader wants me to publish the source and installation procedures for various demons.

A number of them are already available on computer bulletin boards. I’m thinking what to do.—Jerry

THE TRUTH ABOUT ALEX

Dear Jerry,

A friend of mine and his wife are taking a systems course at UCSD. As part of this course they develop software in C on the UNIX system there. While browsing through the system after a long night of programming, my friend’s wife came across an adventure game. As any self-respecting hacker would do, she began playing the game. At the end of the game, after being killed several times, the program listed the top ten players. It turns out your son has more talents besides the business end of computer systems. His name was at the top of the list.

Andrew H. Bushnell
San Diego, CA

So that’s what he’s doing down there! I understand the game was Rogue. Alas.

—Jerry

USERS GROUP CORNER

MIddWEST CONNECTION (NEC systems)
6200 Prince Dr.
High Ridge, MO 63049

NORTH ORANGE COUNTY COMPUTER CLUB
POB 3616
Orange, CA 92665-0616
Engineering Excellence

CROSSTALK™

XVI

THE STATE OF THE ART IN DATA COMMUNICATIONS SOFTWARE

DESIGNED BY

MICROSTUF®

CROSSTALK IS A TRADEMARK OF MICROSTUF, INC., ATLANTA, GEORGIA

CROSSTALK IS AVAILABLE FOR MOST SMALL BUSINESS COMPUTERS

DATE 2/16/84
Any modem can send and receive information. But what good is a modem if you can't communicate with it? In plain English, The Maxwell Modems and George™, our communications software, let you do just that. In fact, learning to use them is as easy as reading a menu. Instead of a manual. All the features make sense. Like auto-dialing directories. Automatic log-on. Auto-answer. Automatic error-checking. And complete unattended operation. Which means you can send and receive files late at night when the phone rates are lower. And you're asleep. Plus, with single keystroke dialing, you can call a database faster than you can say Racal-Vadic. While the handy mes-
FINALLY, A MODEM YOU CAN COMMUNICATE WITH.

The Maxwell Modems are available in two versions, internal* or desktop. And, now, in three different speeds. 300, 1200 or 2400 bits-per-second. So there's bound to be one just right for you. And your personal computer.

Best of all, they're from Racal-Vadic—the world's leading supplier of switched-network modems. The kind of modems data networks use to take calls from modems like yours.

Just as soon as you get one.

And the easiest way to do that is to call 800-4-VADICS for the name of the Maxwell Modem dealer nearest you.

Racal-Vadic—connect today.
Viasyn (vī' uh sin) n. [L., via, a way or road; Gr., syn, together or integrated], formerly CompuPro. 1. n. a twelve year old manufacturer of microprocessor systems, subsystems and components, notably multi-user computers used in business, science and industry. 2. adj. related to Viasyn, formerly CompuPro, quality, i.e., possessing extraordinary reliability, performance, modularity and ruggedness. See CompuPro (previous name).
The 1984 Data Show was held from September 26 to 29 at the International Trade Center Exhibition Site at Harumi, near the Tokyo waterfront. The fastest way to get there is by ferryboat; a pleasant 5-minute ride replaces the usual 15-minute taxi or bus trip through some of the least impressive neighborhoods in Tokyo. In this case, the boat trip was one of the more interesting events of the afternoon; the show itself was only so-so in terms of noteworthy new computer products. The most important exhibits at this show were peripheral devices, especially optical disks and laser printers.

One of the high points of the show was Hitachi’s OC-301 optical-disk cartridge system, which looks like a practical solution to on-line storage requirements for large databases. You can put 2.6 gigabytes on one double-sided disk and still have room left over. The disks look like ordinary videodiscs. While a disk spins at 600 rpm (revolutions per minute) within its cartridge, microscopic pits are laser-scanned to read the data. Data can also be written in random-access mode to any track and any sector on the disk.

According to Hitachi, the maximum data-transfer rate is 440K bits per second; this limitation is apparently due to the drive itself, since the built-in controller/formatter is capable of more than twice that rate. The disk is organized into over 40,000 tracks per side (both single- and double-sided cartridges are available), but the average seek time is only 200 milliseconds. That means that it takes less than 1/4 second, on the average, to access any part of a 2.6-gigabyte disk, and a single controller can handle up to four disks. No information about prices of either the cartridges or the optical-disk drive was available during the show, but the system is now available to OEMs (original equipment manufacturers). It will probably be adopted first by minicomputer vendors, but the supermicro market won’t be far behind.

Hitachi floppy-disk drives were featured earlier in BYTE Japan (see “Show Time,” September 1984, page 407) when I reported on the 9.6-megabyte 8-inch floppy-disk drive that was announced at the Tokyo Microcomputer Show. After that announcement, it seemed almost anticlimactic when Hitachi displayed its 6.5-megabyte 5¼-inch FDD541 floppy-disk drive at this show. Even though the new DK 512 (photo 1), a 171-megabyte 5-inch hard-disk drive, was displayed right next to it, the new floppy-disk drive stole the show: its data-transfer rate is 3 million bits per second. That’s more than twice as fast as the transfer rates of most hard-disk drives and means really fast access, even for big files. Right now the FDD541 (and the DK 512) are available to OEMs, but it won’t be long until we see consumer products that use them.

For people who want something in between the sizes of the new optical-disk and floppy-disk systems, Hitachi also displayed a compact 8-inch hard-disk drive. The DK 815 holds 525 megabytes unformatted (435 megabytes formatted), and two of them will fit into a standard 19-inch equipment rack.

Printers were very much in the spotlight at the show, among them laser printers by Canon, Fuji Xerox, Konica, and TEC. (TEC printers are marketed in the U.S. by the C. Itoh trading company.) All four laser printers have similar characteristics: they print with very high resolution (typically about 300 dots per inch), offer a large variety of character fonts with sharp, magazine-quality printing, and have printing speeds in the 8- to 10-page-per-minute range. All are tabletop machines. Some models have RS-232C serial interfaces, while others require a special video interface. Although no prices were available as of this writing, it looks as if laser printers will eventually become standard for high-quality word-processing and office applications.

Laser printers use the same principle as an electrostatic copying machine. A drum... (continued)
Conventional printers are getting better and cheaper.

Coated with a material like selenium is given a static charge. When light (in this case, laser light) touches the drum, the drum material becomes conductive and the charge leaks away from the area exposed to light. A dark powder (the toner) charged with the same polarity is then applied to the drum; since like charges repel, the toner adheres only to the parts of the drum that were exposed to the light. The laser beam is extremely narrow and is bounced off a multifaceted (typically 8 or 12 facets) spinning mirror, so that the beam sweeps across the surface of the drum as the mirror spins. Regulation of the mirror-rotation speed is simplified because the beam can be synchronized using a simple photodetector arrangement. The beam is simply turned on and off to form the desired image, much the same as the electron gun in a cathode-ray-tube screen. No “vertical deflection” of the beam is necessary because of the rotation of the selenium drum.

The Casio LCD (liquid-crystal display) shutter printer I mentioned in last month’s BYTE Japan (“The New and the Old,” page 429), the LCS-2400, uses a similar principle, except that the laser and the scanning mechanism are replaced by a simpler combination of a light source and a liquid-crystal shutter to expose the image on the drum. Casio has announced a Japanese price for the printer equivalent to $1650.

Conventional printers, both the dot-matrix type and the daisy-wheel type, are getting better and cheaper. A number of 18-dot and 24-dot near-letter-quality (or better) printers have been on the market for some time, at prices ranging from $800 to $1000, for both Japanese-language word-processing and graphics applications. Now TEC has introduced the M1570, which prints kanji characters using a 24-dot font and letter-quality alphanumeric characters using an 18-dot font. In draft mode it produces near letter-quality printing at 200 characters per second (cps) and has a four-color ribbon so that it can produce graphics and/or characters in any of seven colors.

Citizen, better known for its electronic wristwatches, is a newcomer to the computer peripheral-equipment market. Citizen’s new MSP-10K printer (see photo 2) is an 18-dot, 21-cps kanji printer and near letter-quality alpha-
numeric printer that prints in draft mode at 160 cps. It will retail for about $520.

Two low-speed, relatively low-cost daisy-wheel printers are worth mentioning. C. Itoh is selling its Y-10 daisy-wheel printer, which weighs only 17 pounds, at a list price of only about $525. It has a cassette-interface feature that lets you change between serial and parallel interfaces: you swap print wheels using a "slide-in-and-snap" loading method. The other printer is an original-equipment model that's sold here in Japan as the Aurora 650. You can buy one for only about $360, discounted, which is just about the best deal I've seen. It uses a film-type ribbon cartridge and prints clearly and evenly at 13 cps. It includes built-in parallel and RS-232C serial interfaces.

**NEW TOSHIBA MSX COMPUTER CAN COMMUNICATE**

In the December 1984 BYTE Japan I discussed the MSX computer phenomenon. MSX is the name of a set of standards, developed by Microsoft Corporation, for low-cost computers based on Z80 or equivalent microprocessors that have Microsoft BASIC in ROM (read-only memory). About two dozen models of MSX computers are available in Japan from all the major Japanese computer manufacturers.

Until now they have been sold almost exclusively for playing video games. Prices generally range from about $200, or even less, up to about $400 for models with 64K bytes of RAM (random-access read/write memory). In addition to built-in sound generators and joystick interfaces, MSX machines all have one or more slots that can accept standardized RAM/ROM cartridges. Hundreds of game cartridges are available: most sell for about $10 to $20.

There is little MSX software for any purpose other than entertainment, and with the computer-game market quickly becoming saturated, the MSX phenomenon here has been more of a curiosity than a force for steady growth.

All of that may change soon, however. I had a chance to try out Toshiba's newest MSX machine, the HX-22, the other day. Due to be released in about a week, it's a 64K-byte computer that has a list price of only about $360, is supplied with useful Japanese-language word-processing software, and includes a standard RS-232C serial interface and terminal software. A 500K-byte 3½-inch floppy-disk drive is optional, supported by the MSX-DOS operating system. (See the December 1984 BYTE Japan, "Hand-held Computers and MSX Standards," page 365.) The standard display is only 40 characters wide, but an inexpensive 80-column adapter will be available soon.

The HX-22's serial interface, which can operate at speeds up to 19,200 bits per second, may cause major changes in the low-priced computer market in Japan. Until now, personal computer users here have lagged behind their American counterparts in terms of communication services like bulletin boards, conferencing systems, and wide-ranging information services like The Source and CompuServe. Although The Source is available in Japan, there aren't yet any widely available analogous Japanese services. My guess is that the introduction of the HX-22 (and its inevitable competitors) will be a powerful stimulus for people to start developing them. Also, because the HX-22 includes a sizable Japanese-language (kanji) character set in ROM, the road is now open for developing information and communication services in the Japanese language, which is an absolute necessity for acceptance of this kind of technology by the Japanese general public.

The market for MSX machines is fiercely competitive, and other major producers like Sony, Canon, Pioneer, and Mitsubishi are certain to introduce their own versions of MSX machines with communications and kanji display capabilities; prices in the $275 (continued)
The First "Intelligent" Chair. FORMERLY $89.95! Now on sale for $29.95. REDUCE THE EFFECT OF GRAVITY ON YOUR BACK. Sitting regularly in a conventional chair your lower back is supporting the TOTAL WEIGHT of your body, plus additional weight due to the downward effect of gravity. Unfortunately most chairs are designed for appearance, not for comfort.

THE BACK CHAIR SOLUTION—Sitting on the Back Chair relieves your back from supporting the total weight of your body by distributing your weight between your lower back and legs. Your legs support you when standing, your lower back supports you when sitting. Combine them both in a comfortable sitting posture and you relieve the unnecessary stress on your back. When sitting on the Back Chair you'll feel more relaxed and sit up perfectly straight.

Standard Chair made of hardwood layers with final layer of Genuine Oak. Adjustable Chair made from solid hardwood with Oak finish. Both come with padded seat and knee pads upholstered in Chocolate Brown.

SHOPT FASTER BY PHONE

1-805-966-7187

Or send a check or your credit card # (Diner's Club, VISA, MasterCard, American Express) for THE BACK CHAIR (Standard Model, $29.95 ea.; Adjustable Model, $49.95 ea.—please indicate below) plus $9.95 shipping (Canadian orders, $13.00 shipping). CA residents add 8% sales tax. Sony no C.O.D. If not satisfied return within 15 days for refund (less shipping).

BYTE JAPAN

Especially in the last few years, integrated-circuit designs have been moving more and more toward CMOS (complementary metal-oxide semiconductor) technology. The biggest advantage CMOS has to offer is its very low power consumption. Although the speeds of CMOS integrated circuits have been increasing, they generally can't match the speeds obtainable with the older bipolar technology. Hitachi has just announced that it has come up with a way to combine both bipolar and CMOS elements on the same chip and claims that a gate array based on the new process has a gate delay, or operating speed, of only 0.8 nanosecond. That's comparable to the fastest ECL (emitter-coupled logic) chips. Its power consumption is only about 0.15 milliwatt per gate, similar to CMOS.

Optical-disk technology is moving fast, too. Sony has just developed a magneto-optical-disk system for delivery to the Japanese international telephone company this month. The significance of the Sony development is that the disks are erasable, in contrast to other optical-disk systems like the one Hitachi introduced at the Data Show. The capacity of the disk is 1 gigabyte, and a single controller can handle up to four disk drives. No information about the speed of the new system was available, and so far Sony hasn't announced that it will market the system commercially.

COMING UP

Next month I'll cover the IBM JX, WordStar 2000, the new Toshiba 1-megabit RAM chip, and the growing popularity of UNIX in Japan, and I'll compare the Japanese PC-9801F3 personal computer with the NEC APC-III.
What Next?

Thunderscan, the ins and outs of the windowing game, new workstations, and more

BY JOHN MARKOFF, PHILLIP ROBINSON, AND EZRA SHAPIRO

Apple Computer's president, John Sculley, has a habit of publicly referring to Macintosh graphics as "super graphics." However, although the Mac may be impressive when compared to the Apple II and the IBM PC, we've always been a little irritated by the supergraphics claim. Shouldn't the superlatives be reserved for the new generation of personal computers with 1024-by-1024-pixel (picture element) bit-mapped screens and hardware coprocessing support for animation and other sophisticated graphics operations? By those standards, the Mac seems primitive indeed.

Yet, over the course of the past few months, as new applications have been introduced, the Macintosh has proven to be consistently surprising in the quality of its graphics. Despite its relatively low number of pixels, the Macintosh display is crisp, partly because of its small screen size.

THUNDERSCAN

Recently, a demonstration given to us by Macintosh designer Andy Hertzfeld and Tom Petrie of Thunderware provided convincing evidence that if Macintosh graphics aren't "super," they're at least a clear step above anything else currently available in that price range.

Thunderware, previously known as a manufacturer of clocks for the Apple II and III, drew a lot of attention when its new Macintosh product, Thunderscan, was introduced at this year's National Computer Conference. Thunderscan is a high-resolution digitizer that enables the Macintosh to capture and later reprocess virtually any image that can be rolled under the platen of the Apple Imagewriter dot-matrix printer. The process is deceptively simple. Thunderscan consists of a palm-size optical sensor that snaps into the Imagewriter in place of the ribbon cartridge. When a document or picture is rolled through the printer, software written by Hertzfeld controls the sensor as it slides back and forth over an image.

Petrie says that Thunderware is sensitive about discussing the exact nature of the scanning technology used in the device. However, he will say that the scanner is able to extract analog information from the image and transmit it to one of the Macintosh serial ports without having to use traditional A/D (analog-to-digital) conversion techniques.

It's an intriguing process. For example, it's possible to increase the resolution of the image being scanned by increasing the scanning rate. The result of the proprietary technology is a low-cost scanning device (initially $229) that permits the Macintosh to store and manipulate images with a resolution in excess of 200 dots per inch.

According to Petrie, there are a number of difficulties in getting graphics images into the Macintosh. The greatest problem is that high-resolution graphic images require a relatively large bit map. Until now, the only way of stuffing this information into the Mac has been to use a video camera. and video cameras are relatively high cost and low resolution. (At the same time, it should be noted that cameras have the advantage of being fast. Because essentially only one row of pixels is scanned at a time, it takes Thunderscan as long as 15 minutes to digitize an entire 8½-by-11-inch document.)

Once Thunderscan has transmitted an image to the Macintosh, software designed by programmer Hertzfeld (who has left Apple and is now working on his own) can do a remarkable job of enhancing or manipulating it. Not only can you rescale images, you can also alter brightness and contrast to create halftones or high-contrast images (see figure 1). Additionally, the Thunderscan software contains a number of graphics tools familiar to those who have used the MacPaint program on the Mac. There is also a special "express" option that lets you go directly to MacPaint to further enhance an image.

The Thunderscan software operates on a
bit map that is stored in the Macintosh RAM (random-access read/write memory). The bit map has a size limit of 48K bytes on the 128K-byte machine. This is just about a full page at 72 dots per inch. On the 512K-byte Macintosh, a bit map as large as 300K bytes can be stored. With this amount of information you can store a full 8½-by-11-inch document at up to a 300 percent magnification. You can use this expanded storage space for image enlargement or to extract gray-scale information on up to 64 levels of intensity. On the 128K-byte Macintosh, both the magnification and the halftoning features are available, but only for smaller regions of a scanned document (a document can be scaled four times linearly, yielding a magnification of up to 16 times by area).

To use the equipment, first select a page-map option from the scanner's menu. From within the page-map screen you can choose to scan the area of your original by changing the size of a selection rectangle. The system prompts you with warning messages if the area you select is either too large to store gray-scale information or too large to scan. This feature also lets you scan just a portion of a larger document to make certain that you have gray scale and magnification set correctly.

After you've completed the scanning phase, you can play with the image in memory. You can work with a document in the same way you use MacPaint, with a special image window. But Hertzfeld has added a series of features to the Thunderscan software that give it functions that MacPaint doesn't have. You can use a special hand icon to move large documents around in the image window (unlike the first release of MacPaint, which stored image information outside of memory on disk, Thunderscan allows the document to slide freely).

You also can use the hand icon to impart inertia. For example, if you push the mouse in one direction, the image will continue to slide after you have stopped, much like a piece of paper slides along a table. In addition to being intuitive, this feature lets you move slowly or quickly around an image.

Other MacPaint icon tools, such as the pencil, FatBits, and cutting and pasting, as well as inversion (changing black pixels to white pixels and vice versa), are also available within Thunderscan.

Documents created by Thunderscan can be saved in one of two formats. One is a special MacPaint format yielding a 720- by 756-pixel document with 1 bit of information per pixel. The second is a less-restricted scan format that permits multiple bits of information to be stored for each pixel.

The range of possibilities that Thunderscan creates is fascinating. For example, Hertzfeld thinks that it might put an end to the burgeoning market for Macintosh predrawn images because you can copy virtually any image into the Macintosh memory.

A future project for Hertzfeld is a Macintosh desk accessory (a small program that runs in the background under the Mac operating system) that will permit Thunderscan to send scanning information out through the Macintosh modem port while you work in another program. This would convert the Macintosh into a low-cost (and multitasking) digital-facsimile machine. Hertzfeld is also working on a protocol that would enable the Macintosh to print software code in a format that could be scanned using Thunderscan. Paper would then be the medium for software distribution. Hertzfeld believes that he could get close to 40K bytes per sheet of paper.

**MORE DELAYS FOR MICROSOFT WINDOWS**

In early October 1984, Microsoft Corporation announced that it was postponing the introduction of its long-awaited Windows software-integration package until June 1985. Leo Nikora, Windows product-marketing manager at Microsoft, said that the company was undertaking "a major redesign," in part because Windows' code cur-
rently takes up too much space and also because several functions are not running fast enough.

As recently as this spring, Microsoft was hoping to achieve a minimum recommended system size of 192K bytes. The most current technical information available on Windows states that Windows together with the operating system occupies 156K bytes of memory; thus the currently recommended 256K bytes leaves only about 100K bytes for applications software—not much by today's standards.

Nikora said that almost all of Windows is now written in the C language and that Microsoft plans to rewrite as much as half of the program in 8088 assembly language. Apparently Microsoft is happy with the window-management functions of the program but feels that text management is inadequate. Nikora said that Microsoft expects a twofold increase in text performance after the code is rewritten, although he feels that the performance of the product is already satisfactory on the IBM PC AT.

Microsoft is clearly worried that its decision to delay Windows will lead to a negative attitude in the marketplace. "We have to be careful that Microsoft doesn't get the reputation of giving up in the face of TopView," claims Nikora, referring to IBM's entry in the window-management fray.

He also maintains that Microsoft's decision to delay the product introduction hasn't led to mass desertions on the part of companies developing applications software for Windows. On the contrary, he said that there was a general feeling of relief that they were being given more time to get their applications ready for market.

Microsoft is also looking for a way to differentiate Windows from TopView, and the company appears to have found one because the current version of TopView is designed for a character-based display. This will, at least temporarily, be a selling point for Windows, which functions only in a bit-mapped environment.

Will Windows face the same fate that befell Visi On? Nikora says that he is certain that it won't—his evidence is the fact that a number of the manufacturers of IBM PC-compatible computers appear to have a sizable stake in the success of Windows. Still, Microsoft is starting over again after investing more than a year in attempting to develop a user interface for the IBM PC.

**CONVERGENT'S FAST NGEN**

Although criticism of the IBM PC AT hasn't been nearly as fevered as that leveled at the PCjr, there are some doubters emerging. Why, some experts have asked, does the 80286 microprocessor in the PC AT have an artificially lowered clock speed? And why is the bus speed even slower than the bus speed for the IBM PC? A number of companies are already comparing their systems to the PC AT to demonstrate their systems' performance.

Convergent Technologies Inc., a Santa Clara, California, company is selling its NGEN "modular" workstation based on the Intel 80186 microprocessor to a variety of OEM suppliers. Last year the NGEN got off to a slow start because of the scarcity of the 80186, but now Convergent claims to have shipped 50,000 systems. The NGEN is built around a collector...
the closest thing to
perfect is WordPerfect
by SSI.

When it comes to
software, nobody's perfect.
But according to many of the
experts, one word processing
program is as close as you can
get. No wonder it's called
WordPerfect.

What are all the critics
raving about?

Simplicity. Most
WordPerfect functions
require only one keystroke, a
simple press of a finger. So
you can concentrate on
writing, not programming.

Speed. Because it is
document-oriented
instead of
page-oriented, WordPerfect
won't make you
wait
between
pages. No
matter
how fast
you type,
WordPerfect won't slow you
down.

Features. From writers to
doctors, accountants to
lawyers, WordPerfect has
built-in special functions to
meet a wide variety of specific
needs. And at SSI, every day
is spent upgrading and
improving WordPerfect —
reaching for
perfection.

It's the closest
thing to perfection.
For more
information, see your dealer.

Or call or write:
SSI Software
288 West Center Street
Orem, Utah 84057
Information: (801) 224-4000
Toll-free

WordPerfect isn't flawless
word processing software,
but it comes very close.

- Digital Review
The NGEN is a quick machine, and it has an "X-Bus" that allows 16-bit DMA transfers at speeds up to 4 megabytes per second.

tion of components; a separate video display and keyboard connect to a shoebox-size central processor. A variety of add-ons such as RAM, floppy- and fixed-disk drives, and graphics components can be simply plugged into the processor module to expand the system. Convergent Technologies' own multitasking multiprogrammed operating system (CTOS) permits users to run MS-DOS, CP/M-86, and Convergent's own flavor of UNIX System V called Distrix.

It's a quick machine; the 80186 runs at 8 MHz, and it comes equipped with 120-nanosecond RAM. The NGEN has a proprietary "X-Bus" that allows 16-bit DMA (direct memory access) transfers at speeds up to 4 megabytes per second.

To show off the performance of the NGEN, Convergent sets it next to an IBM PC AT and then has both systems recalculate a series of Fibonacci numbers in 2400 cells of a Multiplan spreadsheet. It takes the NGEN 4.9 seconds to recalculate the series while the PC AT finishes it in 11.8 seconds. This performance comparison may not be entirely fair, given that Multiplan on the NGEN has been ported to run under CTOS and in the process its performance has been considerably improved. However, the demonstration gives ample evidence that it won't be hard to improve on the performance of the PC AT.

EXPLOSIVE COMPATIBLES

Tandem is known for its NonStop systems, such as the new TXP 32-bit, transaction-processing computer. Parallel processors and special software protect these systems from breakdowns, which endears Tandem computers to on-line users such as airlines and banks.

The new Tandem 654x family of workstations provides the same features as the 653x family of on-line terminals but adds both 3270 emulation and personal computer features. The Tandem is built around the 8086 and can, it is claimed, run most IBM PC software.

The two Tandem workstations (which will be built in Austin, Texas) differ in mass-storage capacity and price. The 6541 has two 360K-byte floppy-disk drives and costs $2995. The 6546 has one 360K-byte floppy-disk drive and a 10-megabyte hard-disk drive and will cost $3995.

Both the 6541 and the 6546 have 12-inch green screens (for both text and graphics) and 256K bytes of RAM. The current options include bit-mapped graphics and memory expansion to 640K bytes of RAM. The Tandem terminals interface directly with Tandem's 5340 and 5341 printers.

Tandem terminals come with MS-DOS and GW-BASIC. The new Tandem software includes IXF and PCformat. IXF (and associated information exchange facilities) can transfer data from files on a Tandem NonStop system to a Tandem workstation. PCformat converts such files into MS-DOS-compatible files.

Is Dynamite just another "compatible"? Tandem says it isn't because, while the Dynamite can run most IBM PC software, it isn't supposed to be an IBM PC competitor: it's designed (continued)
Presenting Travelshopper™
...new from CompuServe and TWA.

Now you can save time and money by getting information and reservations on virtually any flight on any airline—worldwide—from one source. It's TWA's new Travelshopper, available now through CompuServe's Information Service.

With Travelshopper, you can scan flight availabilities, discover airfare bargains and order tickets...on your own personal computer...at home or in the office.

You also receive automatic membership in TWA's Frequent Flight Bonus™ program. And you can build bonus points by staying at Marriott and Hilton hotels and by using Hertz Rent-A-Car.

Besides Travelshopper, CompuServe offers an ever-growing list of other travel-oriented on-line services.

The Official Airline Guide Electronic Edition lists direct and connecting flight schedules for over 700 airlines worldwide plus over 500,000 North American fares.

Firstworld Travel offers worldwide travel advice and service.

Discover Orlando provides complete prices, hours and features on all of Central Florida's attractions and accommodations.

West Coast Travel offers travel information for the western states.

Pan Am's Travel Guide contains up-to-date information on immigration and health requirements for most foreign countries.

And TravelVision® provides complete automotive information, including road maps and an expert, personalized routing service.

Let your travel plans really take off. Use Travelshopper and lots, lots more from CompuServe.

To buy a CompuServe Starter Kit, see your nearest computer dealer. To receive our informative brochure, or to order direct, call or write:

CompuServe
P.O. Box 20912, 5000 Arlington Centre Blvd.,
Columbus, Ohio 43220
1-800-848-8199
In Ohio, Call 1-614-467-5002

TravShopper and Frequent Flight Bonus are Service marks of TWA
specifically to work with Tandem's bigger transaction machines.

**REMEMBER BUBBLES?**

Intel's Non-Volatile Memory Division—one of the few companies still in the bubble-memory game—has a couple of new removable bubble-memory cassette kits: the BCK-10 and the BCK-12. Both provide a 1-megabit cassette. The BCK-12 prototype kit costs $495 and has a limited temperature range (10 to 55 degrees Celsius). The BCK-10 production kit costs $605 and can survive a greater range of temperatures (0 to 65 degrees Celsius). The kits include the necessary support chips for the bubble memories and an SBC-258 board interface with a ribbon-cable output so you can just hook the kit up and start writing software. Intel is proud of the simplicity of these kits; they use only six support chips where earlier bubble systems required many more.

The Intel facility in Folsom, California, is getting a new fabrication line to make 4-megabit bubble chips; the standard 1-megabit chips will now probably be phased out in 1985 or 1986. Moving from 4 to 16 megabits on a chip (by shrinking the loops) will be difficult and should take several years—the 4-megabit chips already depend on the advanced, expensive technique of X-ray lithography.

Bubble memories aren't found in many personal computers; the expense just can't be justified for routine volatility of the bubble chips. While both the Grid and the Sharp products use Intel bubbles, the Sharp portable uses Japanese bubble chips. If fabrication costs can be brought down to a reasonable level, bubbles could be the storage device of the future, though early hopes have long since faded.

**A BLUE NOTE**

Rolm—the telecommunications equipment maker—has frequently been used as an example of the Silicon Valley workstyle because it offers such employee benefits as flextime, sabbaticals, and a multimillion-dollar recreation center. Two senior IBM officials appeared at Rolm to quell speculation that the famous workstyle would be threatened by the IBM buyout. Said one of the officials, "Contrary to what the press has said, we're not here to drain the pool."
In the beginning there was Dow Jones Straight Talk™

All across the country, Macintosh™ computers – and their owners – are getting smart with just the information they need: an electronic encyclopedia, business news and information, the latest stock quotes, sports and weather reports, airline schedules and fares. Point, click, Dow Jones News/Retrieval® and other leading electronic information services are at your fingertips.

In fact so many Macintosh computers are getting smart that Straight Talk is a best seller.

Now there's more.

Introducing Dow Jones Spreadsheet Link™ and Dow Jones Market Manager PLUS™ – new software for the Macintosh computer.

Dow Jones Spreadsheet Link adds brainpower to your Multiplan® spreadsheet. Just collect the financial information you need from News/Retrieval and – click – Spreadsheet Link automatically downloads it into your spreadsheet.

Dow Jones Market Manager PLUS makes portfolio management as easy as using a mouse. With current stock price information from News/Retrieval, the Market Manager PLUS saves time in record keeping, giving you more time to make smart investment decisions.

Call for more information on Dow Jones Software™ for the Macintosh computer:

1-800-345-8500 ext. 100
(Alaska, Hawaii, and foreign, call 1-215-789-7008 ext. 100)
In previous columns I've documented some of the activity in British low-cost home computer design. Don't run away with the idea that we can only make home computers, though. This month I've been looking at a 32-bit graphics workstation that provides power roughly equivalent to a VAX 11/750 at a starting price of £5500.

The machine is called the Whitechapel Computer Works MG-I (see photo 1), and it is the first product from this start-up company (let's call them WCW from now on). WCW was founded in April 1983 by Managing Director Timothy Eccles (a physicist turned computer engineer who has worked at Bell Laboratories, Logica, and Rank Xerox) and Technical Director Bob Newman (a computer science lecturer at Queen Mary College in London). The company is located in a new complex called Whitechapel Technology Centre, which was created with assistance from the city council to attract high-technology industries back into the de-industrialized center of London: it seems to be working. Design of the MG-I was begun in August 1983 and carried through to production in barely a year, with the first units shipped in September of 1984.

PERSONAL WORKSTATIONS

For several years I've permitted myself the occasional daydream about what my (realizable) dream computer might be. It goes something like this: a 68000 or 16032 (this was before National Semiconductor decided that 32016 sounded sexier) processor in a desktop box, a "clean" architecture with lots of memory and straightforward in-memory bit-mapped graphics (but very high resolution), an on-board Winchester drive, and above all, hardware assistance for raster-graphics operations. In other words, my dream computer would be a personal computer (à la Apple II) fed with anabolic steroids, or alternatively, the Xerox Alto at a personal computer price. I kept watching, but it didn't quite happen. The Sage (now Stride) looked interesting, but what's this—a serial terminal? The Corvus Concept showed us that even a 68000 runs out of steam if asked to run the screen as well as crunching numbers, but the Lisa and Macintosh continue to try.

The MG-I fits the bill exactly except that it isn't quite in my price range. It isn't meant to be, of course. WCW has single-mindedly targeted it at the CAD/CAM (computer-aided design/computer-aided manufacturing) personal workstation market, competing with machines like Sun, Apollo, and Pec, which typically cost over four times as much as the MG-I. These dedicated minicomputers are called "personal workstations" because only one person uses the machine at a time (i.e., they're not multiuser), but at upwards of £20,000 all but the richest firms would require several designers or engineers to share one machine on a rota.

Bob Newman, principal designer of the MG-I, reasoned that if he adopted personal computer rather than minicomputer design techniques (no multiboard bit-slice processors, no demountable hard-disk packs, no industrial fans), a colossal price reduction should be possible. He reasoned thus at the same time that VLSI (very-large-scale integration) technology had made it possible. Viewed this way, the MG-I is the first truly personal workstation: not only will it fit on a desk, but it's priced so that firms can afford one per person: it costs about the same as a full-spec IBM PC XT and less than a PC AT.

SPECIFICATIONS

The MG-I is driven by the NS32016 32-bit virtual-memory processor chip, running at 8 MHz, and mounted along with all the other Integrated-circuit (IC) components on a single personal-computer-style system board. An eight-layer board is used to give simpler routing for the conductors. This board is held in a desktop casing with a footprint slightly larger than that of an IBM (continued)
PC: the works are cooled by a single miniature silent fan.

The 32016 is complemented by its support chips, the 32082 memory manager and the 32081 floating-point processor. though the former is still suffering from bugs. and WCW currently has it on a piggyback board that contains its own hardware fixes. Standard memory is 512K bytes, expandable in 512K-byte chunks up to 8 megabytes. At least 100K bytes of this memory is devoted to the bit-mapped black-and-white display that has a resolution of 1000 by 800 pixels. A 17-inch (landscape format) monitor with a display width of 150 characters is included, and it can depict an A4 document page, albeit slightly reduced to fit the height. Mass storage is provided by a single 800K-byte floppy-disk drive and a choice of a 10-, 22-, or 45-megabyte Winchester drive built into the case.

Peripheral expansion is catered to by the bold step of adopting the IBM PC bus. The MG-1 internal expansion unit has three IBM expansion slots and IBM cards will work (with the proviso that suitable drivers have to be written). Communication is via a built-in Ethernet interface for networking MG-1s to share the expensive laser printers or plotters necessary to print on the high-resolution screen. An RS-232C port enables a local draft-quality printer or modem to be attached.

The operating system is Genix, a Berkeley 4.1 UNIX customized by WCW to support the MG-1's graphics abilities, for which optimized C FORTRAN, and Pascal compilers are offered.

**Raster Graphics**

A CAD/CAM workstation has very specific requirements (which I believe are, in the main, also the requirements for future personal computers). It is by definition an interactive system that dictates very fast response times even for the most complex operations.

It must be capable of very-high-resolution graphics. In a low-cost machine this has to be achieved by using a direct refresh bit-mapped screen. Personal computer users are quite familiar with bit-mapped graphics; it's the rule rather than the exception. However, in the CAD/CAM business it isn't yet the rule, but one technique among many: random-scan vector displays are in use, and where a raster display is used it frequently has a dedicated frame buffer separate from main memory.

WCW decided that the bit-map data should be in main memory (just like an Apple II or IBM PC) so that multiple screen buffers could be utilized; animation then can be achieved by building one screen while another is being displayed. The other advantage of having the bit map in main memory is that it simplifies the use of RasterOps as the primitive graphics operations.

RasterOp (called BitBlt, for Bit Block Transfer, at Xerox PARC [Palo Alto Research Center]) is a fast algorithm for doing bit-mapped graphics. Anyone who has written a BASIC program to draw a circle knows that it takes a long time to move that circle (by redrawing it again somewhere else); the computation of which points to plot is wastefully repeated every time the circle is drawn. RasterOp, in a nutshell, says "don't redraw the circle, move the bits that make up the first circle." Rectangular areas of the screen data (called "rasters") are directly moved about in the bit map using raster block-move operations (RasterOp). Unlike, for instance, simple Z80 block moves, with RasterOp you can do Boolean operations (AND, OR, XOR) between the destination and source rasters so you can get effects like overlapping transparent backgrounds or use mask rasters to clip shapes. Much of the theory and practice of this kind of graphics was worked out at Xerox PARC in the 1970s (by the Smalltalk people, among others), and it lives today in the Lisa and Mac. (For more information on Smalltalk, see the August 1981 BYTE.)

Display systems based on RasterOp tend to be homogeneous; there is no distinction between "text" and "graphics." All text characters are handled as rasters, and this is what makes the plethora of different type styles possible on the Macintosh. Because of this total reliance, the efficiency of RasterOp becomes critical.

There are two computation problems when using RasterOp: what to do if a raster (which is defined in bit coordinates) doesn't lie nicely on byte or word boundaries, and how to find the actual memory addresses of the
lines in a raster (don’t forget that successive lines in a rectangle on the physical screen aren't contiguous in memory). The amount of computation involved can bring even the most powerful of the new microprocessors to its knees if it has to do the computation every time it wants to write a character or scroll the screen in addition to all its other duties.

Having decided on a 1000 by 800 screen (the minimum for a serious CAD display), WCW was committed to a 100K-byte bit map. It’s often necessary to treat the whole screen as a raster (e.g., when scrolling) so you have to be able to deal with single graphic objects of up to 100K bytes in size. The main design question has now answered itself. A 32K-bit processor is necessary to efficiently manipulate objects larger than 64K bytes. When writing a program on the screen (the minimum for a serious designer), it’s often necessary to attain a flickerless 60-MHz screen-refresh rate using industry-standard 150-nanosecond memory chips. The total memory bandwidth available is 200 MHz, giving sufficient leeway for the 32016 to access memory with effectively no wait states.

The 32016’s demand-paged virtual memory means that the data for a single screen might be scattered all over physical memory in different pages. Rather than waste time reorganizing these fragments into a contiguous 100K-byte block, the video controller maintains a page map so that it always knows where its images are stored.

The result of all these design decisions is spectacularly fast graphics operation combined with easy programming in high-level languages. Rasters can be created and processed anywhere in main memory and then moved onto the screen. As many screens as memory allows can be held in memory simultaneously, and with virtual memory, “memory allows” has a broad meaning. The MG-I employs a two-level paging system similar to that on the VAX.

At a somewhat higher level, WCW has implemented the GKS (Graphical Kernel System) graphics standard, which is more suitable for CAD/CAM (continued)
applications programmers than are the raw raster-graphics primitives.

I/O HARDWARE
The adoption of virtual-memory UNIX together with the constraints imposed by the high-performance display places extraordinary demands on the hard-disk subsystem.

Again Newman broke away from minicomputer design practices and went for a solution taken from the personal computer domain: a central DMA (direct memory access) controller rather than complex multiple buses. The single-chip DMA controller can load consecutive blocks to any page in memory and works fast enough to do without buffering; there is a direct path from memory to the Winchester disk. In one rotation of the disk a whole track can be loaded, shotgun fashion, into a scattered selection of pages. Apart from performance and cost benefits, this scheme has the virtue of providing DMA service for any IBM expansion cards fitted to the expansion bus.

The Ethernet controller can't be as simple because Ethernet requires devices to receive their packets of information without warning and at very high speed. With Ethernet, buffering was found to be necessary under operating system control using a second DMA device.

OPERATING SYSTEM
Having decided upon the 32016, WCW was faced with the crucial choice of an operating system. UNIX turned out to be the only commercially widespread operating system that supported 32-bit virtual memory and had a reasonable software base. The fact that UNIX was designed for timeshared multiuser systems and has no support for graphics didn't help.

National Semiconductor already had Genix, based on UNIX System II with the BSD (Berkeley Software Distribution) extensions, available for the 32016. WCW had to do considerable work to get satisfactory performance in a single-user, interactive, graphics-based application quite unlike that for which it was designed.

One of the biggest problems with UNIX is its poor response time to interrupts. Like most modern workstations, the MG-I uses a mouse for cursor control and a mouse works by sending interrupts to the operating system to say that it's moved. If UNIX is busy elsewhere, cursor movement will start to lag noticeably behind mouse movement, thus destroying the visual illusion upon which mouse control is based. It's like driving a car with a flexible rubber steering wheel.

Newman, typically, went for a hardware solution. The cursor is not represented in the main bit map as on most other systems. Instead another coprocessor is employed to read the mouse position continuously, and the 64-pixel cursor is produced in a small separate memory, then video-mixed with the main display. UNIX and the main processor are only interrupted when some action is to be taken, i.e., a mouse button has been pressed. This same coprocessor handles the "soft" keyboard too, which makes it earn its keep.

Another problem arises with the windowing system, for which UNIX's process communication system is not ideal. WCW is working on the window manager and has decided to treat it as a user program rather than an extension to the UNIX kernel. This will permit experienced users to modify it if they wish.

One of the great dangers with UNIX is system corruption on shutdown; you can't simply switch off the power on a UNIX system as you can with CP/M or MS-DOS and expect it to come back up unscathed. Huge amounts of housekeeping and resuming need to be done before UNIX can be put to sleep. Because personal computer users are used to a more cavalier attitude toward their machines, WCW took a leaf out of Lisa's book and provided a soft power switch. When you hit the "power-off" button, power is not disconnected immediately; instead an orderly UNIX shutdown is initiated while you are on your way down the stairs to catch your bus.

(continued)
A New Age Dawns for Microcomputer Programming

**PROMAL™** is innovative. PROMAL (PROgrammer's Micro Application Language) was designed to achieve maximum performance from small computers...performance previously impossible except with machine language. And it was developed, specifically, to meet the need for a single development system for limited memory environments.

**PROMAL is complete.** It's a fast, structured programming language. It's also a true development system, complete with its own command-oriented operating system executive, fast one-pass compiler, and full- screen cursor-driven editor. In short, PROMAL is the complete set of tools that microcomputer programmers have been waiting for.

**PROMAL is fast.**

<table>
<thead>
<tr>
<th>Commodore 64 Benchmark</th>
<th>PROMAL</th>
<th>BASIC</th>
<th>COMAL</th>
<th>FORTH</th>
<th>PASCAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Execution Time (secs.)</td>
<td>30</td>
<td>630</td>
<td>490</td>
<td>51</td>
<td>55</td>
</tr>
<tr>
<td>Object Code Size (bytes)</td>
<td>198</td>
<td>955</td>
<td>399</td>
<td>181</td>
<td>415</td>
</tr>
<tr>
<td>Program Load Time (secs.)</td>
<td>3.9</td>
<td>3.8</td>
<td>6.3</td>
<td>11.9</td>
<td>92.5</td>
</tr>
<tr>
<td>Compile Time (secs.)</td>
<td>8.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>39.10</td>
</tr>
</tbody>
</table>

As the benchmark results in the table show, PROMAL is much faster than any language tested. From 70% to 2000% faster! And it generates the most compact object code. The PROMAL compiler is so fast that it can compile a 100-line source program in 10 seconds or less. And, not only is it fast in compile and run time, it also reduces programming development time.

**PROMAL is easy.** It's easier to learn than Pascal or C or FORTH. It makes use of powerful structured statements, like IF-ELSE, WHILE, REPEAT, FOR, and CHOOSE. Indentation of statements is part of the language's syntax, so all programs are neatly and logically written. There are no line numbers to complicate your programming. And comments don't take up memory space, so you can document programs completely. And with the full-screen editor, you can speed through program development with saves to memory and compilation from memory workspace.

**PROMAL is elegant.** PROMAL overcomes the performance limitations inherent in all small systems. It gives you access to the power of the machine. But it doesn't require the complexity of machine language programming. With PROMAL, you can have performance the easy way...since it was developed from the very beginning to work on small systems...elegantly.

**PROMAL may be the answer to your programming needs.** Finally, there's an answer to the need for a complete environment for simple and rapid program development. Finally, a new age has begun for microcomputer programmers. Finally, there's PROMAL.

**PROMAL Features**

- **Structured Language**
  - Structured procedural language with indentation
  - Fast, one-pass compiler
  - Simplified syntax requirements
  - No line numbering required
  - Long variable names
  - Global, Local, &Arg variables
  - Byte, Word, Integer & Real types
  - Dec or Hex number types
  - Functions w/ passed arguments
  - Procedures w/ passed arguments
  - Built-in I/O library
  - Arrays, strings, pointers
  - Control Statements: IF-ELSE, IF, WHILE, FOR, DO, ENDFOR, BREAK, REPEAT, INCLUDE, NEXT, ESCAPE, REFUSE
  - Compiler I/O from/to disk or memory

- **Executive**
  - Command oriented, w/line editing
  - Memory resident
  - Allows multiple user programs in memory at once
  - Function key definitions
  - Program abort and pause
  - User-defined resident commands
  - No limit on disk commands
  - Prior command recall
  - I/O re-direction to disk or printer

- **Editor**
  - Full-screen, cursor driven
  - Function key controlled
  - Line insert, delete, search
  - String search and replace
  - Block copy, move, delete & write to
  - Read from file
  - Auto indent, undentsupport

- **Library**
  - 43 Machine-language commands
  - Memory resident
  - Call by name with arguments
  - V/O, Edit, String, Cursor control and much more

**Order Form**

- **Programs Available For:**
  - Commodore 64 (with disk drive)
  - Apple IIe (with extended 80 column card, 128K and ProDos)
  - Apple IIc (with ProDos)

- **Prompts:**
  - Please send me my copy of PROMAL SYSTEM (check one):
    - Commodore 64
    - Apple IIe
    - Apple IIc
  - PROMAL Package Desired (check one):
    - PROMAL, 64k (for systems listed above) $49.95 plus $5.00 for shipping and handling at a total cost of $54.95. Satisfaction guaranteed.
    - PROMAL, Developer's Version $99.95 plus $5.00 for shipping and handling for a total cost of $104.95. Includes unlimited run-time distribution license, PROMAL demo diskette $100.00 for the diskette plus $25.00 for postage and handling for a total cost of $125.00. (Non-refundable.)
  - My check is enclosed. Please charge my purchase to my...
  - [ ] Visa [ ] MasterCard

- **Card Number**
- **Expiration Date**
- **Signature**
- **Name**
- **Address**
- **City, State, Zip**
- **North Carolina residents add 4 1/2% sales tax.**

**Our Guarantee**

- **Try your copy of PROMAL for 15 days.** If you are not completely satisfied, return it to us and we'll refund it to you, no questions asked. De la &Inquiries Ltd. ed.

**Systems Management Associates**

3700 CArton Drive, Dept. PB-2
Raleigh, North Carolina 27609

Inquiry 306
Hardware solutions are becoming cheaper than writing software.

Other little goodies include a battery-backed real-time clock/calendar and CMOS (complementary metal-oxide semiconductor) RAM (random-access read/write memory) area for holding system information to assist service engineers in maintenance and fault tracing.

SOFTWARE

WCW does not intend to become a supplier of CAD/CAM software. The sort of client they are aiming the MG-1 at will typically have some existing software system or will have a specification for such a system and the capability to write it. WCW will provide an operating system with graphics support (included in the machine's price), the GKS Kernel, a window manager, and three high-quality compilers for Pascal, C, and, in recognition of its huge existing software base, FORTRAN.

THE FUTURE

There's no point in pretending that the MG-1 is a personal computer in its present form. It's an extremely powerful and cost-effective tool for engineers, designers, and possibly artificial-intelligence researchers; but it requires a plotter or a laser printer to provide proper hard-copy output (hence the Ethernet). A serial dot-matrix printer could only produce text output for program listings.

As a personal computer user I am interested in the MG-1 because the design decisions embodied in it are relevant to the next generation of personal computers. In particular, Bob Newman's philosophy of "do it in hardware where you can" is at odds with current thinking in certain large corporations, where a reliance on software solutions seems to be based on highly optimistic estimates of the power of the new microprocessors.

Besides, we are entering an epoch in which hardware solutions are becoming cheaper than writing software.

At the moment, the Macintosh is by far the cheapest personal computer using advanced raster graphics. Could the functionality of an MG-1 be had for the price of a Macintosh? The 32016 chip set is still terrifyingly expensive and constitutes a significant fraction of the hardware costs, but this factor should ease in coming years as the various 32-bit chips get into volume manufacture. Similarly, the price of 256K-bit memory parts and Winchester disks is steadily falling. Custom gate arrays could do away with most of the discrete logic used in the MG-1. Perhaps most significant, though, is the new generation of graphics coprocessor chips that are on the way: for example INMOS's G213 Graphics Controller promises BitBlit at 8 million pixels per second. Laser printers are tumbling in price (witness the Canon), or perhaps one of the more potent dot-matrix printers like the Epson LQ-1500 could be persuaded, like Apple's ImageWriter, to perform as a fast graphics device.

Speculation aside, a most exciting prospect arises because the MG-1 possesses sufficient brawn to support the Xerox Smalltalk language system. Newman is enthusiastic about Smalltalk and sees it as a possible development, though the marketing people are not yet convinced that a real demand exists. Tektronix announced the HS 4404 Artificial Intelligence System with Smalltalk-80 at $14,950—the cheapest Smalltalk system so far (see What's New, October 1984 BYTE, page 39). You won't need a spreadsheet to work that out: an MG-1 should do it for about half that price with a laser printer thrown in. This would at least put Smalltalk into the hands of educational institutions, but it remains well beyond private pockets. More's the pity.

WCW should have a subsidiary in the U.S. in operation by the time this column is printed. Contact Whitechapel in the U.K. at 75 Whitechapel Rd., London E1, England. BYTE hopes to review the MG-1 in a future issue.
Only NRI teaches you to service and repair all computers as you build your own 16-bit IBM-compatible micro

As computers move into offices and homes by the millions, the demand for trained computer service technicians surges forward. The Department of Labor estimates that computer service jobs will actually double in the next ten years—a faster growth than any other occupation.

**Total System Training**

As an NRI student, you’ll get total hands-on training as you actually build your own Sanyo MBC-550-2 computer from the keyboard up. Only a person who knows all the underlying fundamentals can cope with all the significant brands of computers. And as an NRI graduate, you’ll possess the up-to-the-minute combination of theory and practical experience that will lead you to success on the job.

You learn at your own convenience, in your own home, at your own comfortable pace. Without classroom pressures, without rigid night-school schedules, without wasted time. Your own personal NRI instructor and NRI’s complete technical staff will answer your questions, give you guidance and special help whenever you may need it.

**The Exciting Sanyo MBC-550-2—Yours To Keep**

Critics hail the new Sanyo as the “most intriguing” of all the IBM-PC compatible computers. It uses the same 8088 microprocessor as the IBM-PC and the MS/DOS operating system. So, you’ll be able to choose thousands of off-the-shelf software programs to run on your completed Sanyo.

As you build the Sanyo from the keyboard up, you’ll perform demonstrations and experiments that will give you a total mastery of computer operations and servicing techniques. You’ll do programming in BASIC language. You’ll prepare interfaces for peripherals such as printers and joysticks. Using utility programs, you’ll check out 8088 functioning. NRI’s easy step-by-step directions will guide you all the way right into one of today’s fastest growing fields as a computer service technician. And the entire system, including all the bundled software and extensive data manuals, is yours to keep as part of your training.

**100-Page Free Catalog Tells More**

Send the postage-paid reply card today for NRI’s big 100-page color catalog, which gives you all the facts about NRI training in Microcomputers, Robotics, Data Communications, TV/Video/Audio Servicing, and other growing high-tech career fields. If the card is missing write to NRI at the address below.

NRI is the only home study school that trains you as you assemble a top-brand microcomputer. After building your own logic probe, you’ll assemble the “intelligent” keyboard . . . then install the computer power supply, checking all the circuits and connections with NRI’s Digital Multimeter. From there you’ll move on to install the disk drive and monitor.

NRI includes a Sanyo MBC-550-2 Computer with 128K RAM, Monitor, Disk Drive, and “Intelligent” Keyboard; The NRI Discovery Lab®, Teaching Circuit Design and Operations; a Digital Multimeter; Bundled Spread Sheet and Word Processing Software Worth $1500 at Retail—and More.

**Critics hail the new Sanyo as the “most intriguing” of all the IBM-PC compatible computers.**

**Your NRI Course Includes**

- A Sanyo MBC-550-2 Computer with 128K RAM, Monitor, Disk Drive, and “Intelligent” Keyboard
- The NRI Discovery Lab®, Teaching Circuit Design and Operations
- A Digital Multimeter
- Bundled Spread Sheet and Word Processing Software
- Worth $1500 at Retail—and More.

**100-Page Free Catalog Tells More**

Send the postage-paid reply card today for NRI’s big 100-page color catalog, which gives you all the facts about NRI training in Microcomputers, Robotics, Data Communications, TV/Video/Audio Servicing, and other growing high-tech career fields. If the card is missing write to NRI at the address below.

**NRI SCHOOLS**

McGraw-Hill Continuing Education Center
3030 Wisconsin Avenue, NW
Washington, DC 20006

We’ll Give You Tomorrow.

IBM is a Registered Trademark of International Business Machine Corporation.
Is your calculator programmed for success?

Move up to the TI-66. The easy 512 step programmable.

You're in the fast lane now, and the last thing you need is a calculator that slows you down. That's why you need the TI-66 programmable calculator from Texas Instruments. The TI-66 offers full programming power and flexibility so you can handle complex and repetitive math problems quickly, easily, and with fewer keystrokes.

Its 512 merged program steps and over 170 built-in scientific, engineering, and statistical functions make for powerful programming. And its sleek, streamlined design makes for easy use.

Its Algebraic Operating System lets you key in problems as they are written, left to right. And its 10-digit angled Liquid Crystal Display not only makes it easy on your eyes, but provides alphanumeric notation of your program steps so you can make easy modifications as you go along.

The keys are readable and large enough for your fingers. The guide book is a quick study. And at $69.95 suggested retail, the price is easy. So instead of spending extra time on routine calculations that won't get you noticed, promote yourself with the TI-66 programmable calculator.

TEXAS INSTRUMENTS
Creating useful products and services for you.

Copyright © 1984 Texas Instruments Incorporated.
Both sides of the Lotus lawsuits

BY ROBERT GREENE, STERNE AND PERRY J. SAIDMAN

This is the first of our columns on computers and law, and a few words are in order. As contributing editors, we will examine state-of-the-art computer-law issues. Since the law lags behind the technology and the technology is evolving at a rapid rate, legal systems everywhere are being confronted with such novel legal questions as legal protection of application and operating-system software, user rights against vendors for defective hardware and software, ownership rights in microcomputer technology created by independent contractors, and the right to publish protected software in user magazines. The resolution of such questions will shape the microcomputer industry in the years ahead. In our columns, we will address a given computer-law issue, present the arguments and legal precedents, if any, on either side, and let you decide which is more persuasive. This, we hope, will foster an awareness of computer-law issues.

THE LOTUS LAWSUITS

Lotus Development Corporation has started the next round in the legal prizefight between software vendors and users of mass-marketed software packages. In the winter of 1983/84, Lotus filed a lawsuit against Rixon, a maker of modems and multiplexers in Silver Spring, Maryland, alleging that Rixon personnel have made more than 10 unauthorized copies of Lotus 1-2-3 and associated documentation. The suit was quickly settled. According to the trade press, Rixon agreed to a permanent injunction against unauthorized copying and paid Lotus an undisclosed sum of money. The suit received widespread publicity and sent shock waves through corporate America.

Flush with victory, Lotus filed suit in July 1984 against Health Group Inc. (HGI). Lotus alleged that HGI had made several unauthorized copies of the Lotus 1-2-3 disks and delivered them to its hospitals and nursing homes in the southeastern United States. The suit was settled by consent decree in September 1984, a little more than two months after it was initiated. As Rixon did, HGI agreed to a permanent injunction against unauthorized copying and paid Lotus an undisclosed sum of money. This suit also has received widespread publicity.

These two lawsuits appear to be the beginning of a wave of such suits by software vendors against institutional users—manufacturers, service organizations, governmental bodies, schools—whose personnel are making unauthorized copies of mass-marketed software packages. This activity seems to be enormous and growing.

Depending on whom you talk to, estimates range from 1 to 20 unauthorized copies for each authorized copy. These unauthorized copies represent an enormous amount of money; estimates place it in the hundreds of millions of dollars.

Top executives at several large software houses have indicated to us that they are seriously thinking of following Lotus's lead. We also know from discussions with top lawyers at several large companies and governmental agencies that a massive cleanup campaign is afoot as organizations silently trash their unauthorized copies.

LEGAL ISSUES INVOLVED

All this has started a spirited, and often very heated, debate between vendors and users. Vendors see this as a market-correcting mechanism for keeping institutional users "honest." Many users grudgingly agree but wonder if the vendors might not be biting the hand that feeds them. A vocal group of users vehemently disagrees with the vendors and charges that this is nothing more than an attempt to intimidate users into paying inflated license fees. The users warn that the upshot of this will be a loss of creativity and freedom as big business tightens its grip on the microcomputer market.

In its suit against HGI, Lotus alleged six  

(continued)
Lotus claimed maximum statutory damages of $50,000 for each unauthorized copy plus court costs.

legal theories (called counts) to support the legal remedies sought, including a permanent injunction against unauthorized copying, compensatory money damages, lost profits, statutory money damages, attorneys' fees, and court costs. If the Lotus Development Corporation had been awarded relief on all counts in the amounts alleged in the complaint, HGI would have been out more than 2 million dollars.

Count one alleged that HGI had willfully infringed the Lotus copyrights on Lotus 1-2-3. Lotus stated that it owned two copyright registrations—TX 1-233-501 and TX 1-233-502—in the Lotus 1-2-3 packages, which include the user's manual and the software disks. It stated that the two registrations had effective dates prior to the date on which infringement began. This was important, since Lotus could not receive statutory damages or attorneys' fees for any infringement that occurred before the effective date of the copyright registrations. Lotus also stated that all lawful copies of Lotus 1-2-3 had carried a proper copyright notice. It alleged that since the infringement was willful, it was entitled to attorneys' fees and statutory damages of $50,000 for "each act of infringement" (i.e., each unauthorized copy!) in addition to a permanent injunction and court costs.

Court decisions have been handed down that find that application software is entitled to copyright protection and that verbatim copying constitutes copyright infringement unless it is authorized by agreement or by law. Further, the Copyright Office routinely grants copyright registrations for application software that is in compliance with the registration requirements. What is of great significance in count one is that Lotus alleged that it was entitled to statutory damages in the maximum of $50,000 for each unauthorized copy. Section 504(c) of the Copyright Act of 1976 states that the copyright owner may receive instead of actual damages and profits "an award of statutory damages for all infringements involved in the action, with respect to any one work . . . ." Statutory damages range from $100 to $50,000 depending on whether the infringement is innocent or willful. While the court has considerable latitude in the actual dollar amount, many legal experts argue that the language of Section 504 and its legislative history do not permit the court to multiply the statutory-damage dollar amount by the number of unauthorized copies. There do not appear to be any legal decisions that have addressed this precise issue.

The resolution of the statutory-damage issue will have far-reaching practical effects. If Lotus were correct in its interpretation and if the court agreed that it should receive the maximum $50,000 for each infringing copy, then Lotus would have received 1 million dollars for 10 unauthorized copies of Lotus 1-2-3 (multiplied by two since there were two copyright registrations). If Lotus were incorrect in its interpretation, then it would have received $50,000 for the 10 unauthorized copies. Compare these two amounts to $4950, which is calculated by multiplying the 10 unauthorized copies by $495 (the suggested retail price for Lotus 1-2-3).

Under the 1909 Copyright Act, the current law's predecessor, some court decisions multiplied "in lieu" damages (similar to statutory damages) by the number of infringements of a single work. Fine lines were drawn as to the number of infringements. For example, one factor was whether the unauthorized copies were made all at once or over a space of time. Essentially, courts were finding ways to justify the multiplication approach in situations where a large number of unauthorized copies had been made of a single work and they felt that only one statutory amount was insufficient. Supporters of the Lotus interpretation...
Detractors of the Lotus interpretation go straight to the language of Section 504. They see no ambiguity and argue that only one amount of statutory damages can be awarded for all infringements of a single work. They note that the legislative history of Section 504 supports this interpretation. They see the availability of actual damages and profits as the mechanism to compensate the copyright owner where there have been many unauthorized copies of a single work. Any other approach, they argue, would allow the copyright owner to effectively obtain punitive damages, which are unavailable under the copyright law.

Count two alleged that HGI committed willful trademark infringement since the unauthorized copies contained the Lotus and 1-2-3 trademarks. As pointed out in our article "Trademarking Software Packages" (March 1984 BYTE, page 393), trademarks often offer the most effective way to protect mass-marketed software packages. It is interesting to see that Lotus thought enough of its trademark rights to allege that it was entitled to not less than 1 million dollars for their infringement. It has been well documented that Lotus has spent millions of dollars advertising and promoting Lotus 1-2-3. It makes good business sense that Lotus would try to protect this investment by vigorously enforcing its rights in its trademarks and goodwill.

Count three is of interest because Lotus alleged that HGI violated the terms of the license agreement that accompanied the lawful copy of Lotus 1-2-3. This is the so-called shrink-wrap license, which you find under the clear wrapper that encases Lotus 1-2-3 before you first open it. The whole issue of shrink-wrap licenses was debated at the BYTE Computer Show in San Francisco in September 1984. (Tapes of the software piracy session (SSI) can be purchased for 58 from Professional Cassette Center, 180 East California Blvd., Pasadena, CA 91105, (818) 796-0200.)

Lotus alleged that the unauthorized copies breached the provision of the shrink-wrap license that states that the user "may not . . . make copies of the User's Manual or the 1-2-3 system disk . . . ." Vendors argue that the shrink-wrap license becomes binding on the user when the software package is opened and not returned and that contractual provisions against copying are valid. Users take the opposite view. First, they argue that a shrink-wrap license is not binding because the user never has accepted it. They also argue that even if there has been acceptance, the copying provisions are invalid because they are in conflict with the copying provisions contained in Section 117 of the 1980 Software Amendments to the 1976 Copyright Act. Section 117 states that "it is not an infringement for the owner of a copy of a computer program to make or authorize the making of another copy or adaptation of that computer program provided: (1) that such a new copy or adaptation is created as an essential step in the utilization of the computer program in conjunction with the machine and that it is used in no other manner, or (2) that such new copy or adaptation is for archival purposes only and that all archival copies are destroyed in the event that continued possession of the computer program should cease to be rightful:" Users argue that, when it is read literally, the Lotus copying prohibition is in conflict with Section 117 and thus is invalid due to preemption under Section 301 of the copyright law. Essentially, preemption means that the federal copyright law will take precedence over any state law that is in direct conflict with it.

Count four alleged that HGI unjustly enriched itself by making and using the unauthorized copies. Count five alleged that HGI committed fraud and misrepresentation. And, finally, count six alleged that HGI violated the Tennessee Consumer Protection Act. Each of these counts may have been viable, but the real teeth of the Lotus action were in counts one to three.

**WHY SETTLE?**

Lotus has been able to settle both of these suits to its satisfaction outside of court. Thus, we have no way of knowing whether a court would find one or more of the alleged legal theories valid. Cynics would argue that Lotus and other vendors will only bring lawsuits in situations with a high probability of settlement. In other words, they are deliberately avoiding a legal test of these legal theories.

There is definite merit to the argument that Lotus is picking and choosing its targets carefully. This is exactly what Apple did when it successfully went after copiers of its operating-system software. This approach was also employed by Bally, Atari, and other electronic-game manufacturers. Copyright owners have learned to be very careful in bringing lawsuits involving new computer-law theories. An unfavorable decision, even if later overruled, can have a major impact on that theory of computer law for years. A loss also generates adverse publicity for the vendor, which makes settlements in other situations more difficult to obtain.

**HOW DO THEY FIND OUT?**

We were interested in learning how vendors find out about institutional
Users argue that the root of the problem lies in inflated prices of software.

Some vendors are responding to this argument by implementing site licenses that allow multiple copies to be obtained at discounted prices. This seems to make economic sense for vendors due to the economy of scale that is present.

WHERE DOES THIS LEAVE US?

There is no doubt that the Lotus suits are having a major impact on institutional users. As time goes on, a greater percentage of mass-marketed software will be used by institutional users as microcomputers find their way onto desks and workstations throughout the country. Lotus and others intend to make sure that authorized software is used with these machines. Sooner or later, one of these users will actually be sued and will fight back. That first court case will have an impact that will cause the impact of Lotus's two out-of-court settlements to pale by comparison.
The ATtack series is designed to increase the performance of the IBM PC-XT 4 to 10 times to the functionality of the PC-AT.

The ATtack series is a tool to increase the productivity of programmers, engineers, and system houses working with CAD, CAE, LAN and DATA BASE applications.

The ATtack series, with full hardware protection, virtual memory support and 16 MB address space, makes true multi-user UNIX available to the IBM PC user.

Runs most PC DOS compatible programs without modification

Runs most software 4 to 10 times faster

Works with most PC Bus compatible expansion boards

Multi-user applications supported

Intel 80286 processor running 4, 6, 8 MHz

80287 companion math co-processor

Supports virtual memory and hardware protection

Expansion connector for future growth and OEM applications

640K memory capacity onboard, 4 meg with expansion.

The ATtack is bus compatible with the IBM PC. The hardware includes a state machine to generate 8088 timing. By replacing the 8088 with a 40 pin header the ATtack can totally take over the IBM PC's bus. This allows the ATtack to run most software without special disks or software to transfer the applications program into the 286 address space...it already resides there.

Aftek ATtack is basically a plug and play productivity machine. All the necessary firmware is provided on the board such that the ATtack will provide the fastest possible processing speed with no user intervention. No special disks are required to move software or Basic into the fast 16 Bit memory. The 80286 operation is virtually transparent, "Except for speed," to the user.

Aftek ATtack board prices with 256K Ram memory:

- 4 MHz: $2995.00
- 6 MHz: $3095.00
- Extra Memory: $300.00
- 80287 Processor: $500.00

U.S. FUNDS

To order in U.S.A. or Canada Call Toll Free:

1-800-269-5412

AFTEK BUSINESS MACHINES INC.
762 Gordon Baker Rd., Willowdale, Ont. Canada M2H 3B4
Tel.: (416) 497-0531 Telex: 06-986133
1050 Clinton St., Buffalo, New York 14206
Tel.: (716) 694-5366 Telex: 916428

PRIME DEALER DISTRIBUTOR TERRITORIES AVAILABLE. OEM CALLS INVITED.

FEBRUARY 1985 • BYTE 391
If you've been waiting for the lines of communication to open up in the international micro market, you've been wasting your time. BYTE is not only in touch with the market: *BYTE is the market.* We communicate regularly with the top microcomputing professionals and business people all over the world.

We are *the* international standard in micro publications. That's why our readers rely on our editorial *and* ads to deliver the latest in available micro products and services. And when we deliver, 94.5% of our readers take action on the ads they read.*

If you need a communications link to impact the international marketplace, or for the International or Domestic Subscriber Profile, call your BYTE sales representative now. The waiting is over.

*Source: 1984 Subscriber Profile

For advertising information, call:

- Austria: Hans Csokor 75 76 84
- Israel: Gurit Gepner 866 561 321 39
- W. Germany: Fritz Krusebecker 72 01 81
- Spain: Maria Sarmiento 45 52 891
- Sweden: Andrew Karnig 46-8-44 0005
- France: Jean Christian Acis 720 33 42
- England: Arthur Scheffer 01 493 1451
- Italy: Savio Pesavento 86 90 656
- Singapore: Seavex Ltd. 734-9790
- Hong Kong: Seavex Ltd. 5-260149
- Japan: Hiro Morita 581-9811
- U.S.A.: Peter Huestis (603) 924-9281

Conducted by Steve Ciarcia

TERM-MITE FOR VISUALLY IMPAIRED

Dear Steve,

I am looking into the possibility of assembling a word-processing system for someone who is visually impaired and can read only oversize type. My thought is to couple a terminal with oversize characters to a machine like the Morrow Micro Decision, which works with an external terminal. Could your Term-Mite ST Smart Terminal (described in January and February 1984) be configured with a character grid of 12 lines by 40 columns of double-height and double-width characters? Do you know of any other terminals that produce oversize characters?

I would greatly appreciate an answer to these questions and any other suggestions you have regarding computing for the visually impaired.

STEVEN EBSTEIN
Cambridge, MA

The Term-Mite ST Smart Terminal (described in January and February 1984) has attributes to allow double-height and double-width characters. It is therefore possible to create the 12-line by 40-column display you desire.

Several terminals on the market that feature double-height/double-width character sizes include the Ergo 301 from Micro-Term Inc., 1314 Hanley Industrial Court, St. Louis, MO 63144, (314) 968-8151; the ET80 from Tel Inc., 2727 North Fairview Ave., Tucson, AZ 85705, (602) 792-2230; and the Televideo 970 from Televideo Systems Inc., 1170 Morse Ave., Sunnyvale, CA 94086, (408) 745-7760.

Many graphics terminals are available that allow custom programming of character sizes, but they are considerably more expensive (several thousands of dollars). If double-size characters are not adequate, either a terminal of this type or a dedicated computer with graphics capability will be needed.—Steve

LINE PROTECTION

Dear Steve,

After reading your December 1983 article, I decided to install some MOVs (metal-oxide varistors) in my power strips for my computer systems. When I purchased my computer, I bought a General Electric Spike Protector from the hardware store (for $19.95—and I thought radio tubes had the highest markup in the electronics industry). I can see that this is identical to the Radio Shack model pictured in your article. However, I realized that this would not afford me the full protection you recommended.

I decided, after reading your article, to take it apart to see what it contained. I found a GE V170LA10A MOV connected in series with a Microtemp 4168A1 temperature-cutoff device. How does this device function in this circuit?

My local electronics-supply store does not carry GE parts but had the RCA equivalents. I decided upon the SK53, which is equivalent to the GE V130LA20A. This is because I have several items plugged into my power strip, and I didn't want to take the chance of underprotecting it. The SK (and the ECG) catalogs list temperature devices, but I did not know which one to get nor how to install it (one for each MOV), so I left them out for now. I would like to know if I need to install these cutoffs and how I should go about it.

I would also like to know how to build my own power strip that would filter out line noise, because my Apple IIe causes my wireless telephone to go crazy whenever graphics or flashing text is being displayed on the screen. I don't believe that the interference is RF-transmitted but that the interference is RF-transmitted because the phone is two rooms away. Also, the phone is in its cradle at the time and is supposed to be immune to outside transmissions. Would a line filter help in this instance? The Radio Shack filter, part number 273-100, doesn't seem to be available any more—none of the stores in my area have it.

I look forward to your excellent articles every month, and although some are above me (I'm an audiophile expert), I still enjoy reading them. Keep warm up there in Connecticut and keep the articles coming!

ROBERT M. DEANO
New Orleans, LA

MOVUs usually fail by shorting. The temperature-cutoff device in series with the MOV is designed to open in the event of an MOV failure. A fuse will serve the same purpose and should be installed in series with the MOV.

In either case, the protection device should function before the MOV casing ruptures. If you are in an area where lightning strikes are not too frequent, the SK53 or GE V130LA20A MOVs are suitable. Use a "slow-blow" series fuse rated at no more than 15 A.

Before applying line filters to your Apple IIe, be sure that the cause of radiation is not ungrounded leads to your monitor or disk drives. Often, these leads can act as an antenna and radiate spurious signals.

Several manufacturers supply power-line filters that are suitable for your applications. They include

Corcom Inc.
1600 Winchester Rd.
Libertyville, IL 60048
(312) 680-7400
Type 5VK1 or 5VK3

Cornell-Dubilier Electronics
150 Avenue L
Newark, NJ 07105
(201) 589-7500
Type APF511L

Delta Electronics Industry USA
1355 Yosemite Way
Hayward, CA 94545
(415) 785-5231
Type 05DBAC5

Potter Company
POB 337
Wesson, MS 39191
(601) 643-2215
Type 600A5

These filters are equivalent to the Radio Shack part number 273-100. Write the manufacturers for additional information and the address of your nearest supplier.

—Steve

SPEECH SYNTHESIS

Dear Steve,

I thoroughly enjoyed your article "Build a Third-Generation Phonetic Speech Synth..." (continued)
I also have a North Star Horizon, about four years old, on which I run BASIC programs—some under North Star DOS and some such as WordStar under CP/M. The Horizon has a Z80-A chip, and I am wondering whether the 2log Z8001 can run Z80 programs. In other words, is the 8000 or 8001 upward-compatible with the Z80 Instruction set, and does it constitute what could be considered part of a family of chips with the 8001 simply being more advanced, powerful, and able to handle 16 bits?

WOLCOTT TOLL
Newtown, CT

The Z8001 does not have the same instruction set as the Z80 and is not directly compatible with your Z80 programs. The Trump Card does, however, have a CP/M 2.2 software emulator that will run Z80 programs like WordStar, SuperCalc, and Multiplan. To use your Z80 programs, they must first be transferred to a PC-DOS or MS-DOS disk and given a filename extension of CMD to differentiate them from 8088.COM files. This can be accomplished in several ways. The easiest way to transfer your files is to connect the RS-232C ports on your computers and use communication software to send and receive the files.

The Trump Card should be compatible with your Columbia 1600-4, but if you have any questions contact Sweet Micro Systems, 50 Freeway Dr., Cranston, R.I. 02910, (401) 461-0530.—Steve

TEMPERATURE OVER POWER LINES

Dear Steve,

I read your article “Build a Power-Line Carrier-Current Modem” in the August 1983 issue. I’d like to build a data-collection network that would send temperature information over 120-V power lines to a host computer for storage. The temperature sensors would send information only when requested to do so by the host. In what form is the information best sent and which is cheapest?

NASSER AUDATALA
Cleveland, OH

Most low-cost serial-communication systems use ASCII characters to transmit information. These systems require a method of generating the ASCII character and converting it to a serial data on the transmitting end and a method of receiving the serial data on the receiving end and converting it to some useful format.

Dear Steve.

I am an engineer forced into retirement by a heart condition several years ago. However, I have been interested in electronic since about 1927 when my father got involved in that field, and it has been a hobby of mine ever since. I took several night courses at our technical school in digital electronics and computers. I invested in a Heathkit H-100, which is the 8085/8088 hybrid using the S-100 bus. I purchased a couple of 8-inch double-sided density MPI drives and did all my own interfacing.

Adapting your Trump Card looks rather challenging, as I would have to wire-wrap the board for the S-100 bus. This would not deter me, but before I start I would like to know whether there would be a lot of program adaptation required to use the software that you offer with this system. Is the BASIC compiler suitable for Microsoft BASIC or, as Heath/Zenith terms it, ZBASIC? I am not familiar with the version that IBM supplies (BASICA), and my concern is whether the compiler is specific to the IBM version or if it is general purpose. Would you venture to say how the Z8001 would compare in execution speed on mathematical programs compared to the 8087 coprocessor?

E. G. HRDLICKA
Edmonton, Alberta, Canada

With your background in interfacing, you should have little trouble in converting the Trump Card circuit to operate on the H-100 bus, and it should be an interesting project.

The software-initializing routine called
LDSYS and the device driver used by PC-DOS will probably have to be modified to run on your system. The documentation that accompanies the software does not describe these routines in any great detail, and this may be a problem area depending on your programming skills. You will also need a 5¼-inch disk drive that can read PC-DOS or MS-DOS disks, since this is the only format for which you will be able to find available software.

I am not familiar with ZBASIC syntax, but if it is close to MBASIC, written by Microsoft for standard CP/M machines, it will be highly compatible with BASICA since MBASIC is practically a subset of BASICA.

The Trump Card will have a higher throughput in most applications than the 8088/8087 combination. This is because the 8087 is used only to perform numeric computations, which usually comprise a small part of most BASIC programs. The advantages of the 8087 will be noted in programs that predominantly do number crunching.—Steve

Trump Card and CP/M-80

Dear Steve,

I currently have an IBM PC and a Xerox 820 printer. With the arrival of your Trump Card, I'd like to consolidate as much software as possible in the IBM. Question: How good is the CP/M-80 emulator accompanying your Trump Card? Also, is there a list of commercial CP/M-80 programs that can run under it? Can it handle all BDOS function calls? Thank you for any information you have.

John M. Allred
FPO Miami, FL

The CP/M-80 emulator used with the Trump Card can run many programs written for a standard CP/M-2.2 environment. Typical programs that have been tested on the Trump Card are WordStar, SuperCalc, and Multiplan.

Since the CP/M-80 emulator is really a Z8001 program that interprets Z80 code and emulates it on the Z8001, the performance of the interpreted programs suffers a little in speed of execution. This reduction may or may not be noticeable to you, depending on how fast your own CP/M system is running.

The emulator handles 28 of the 37 CP/M 2.2 function calls. The function calls not supported are 3 Reader Input, 4 Punch Output, 7 Get I/O Byte, 8 Set I/O Byte, 27 Get Alloc Addr, 28 Write Protect, 30 File Attributes, 31 Disk Param Addr, and 32 User Codes. In addition, the standard CP/M BIOS calls dealing with the disk, the reader, and the punch are not supported by the emulator.—Steve

Over the years I have presented many different projects in BYTE. As you may know, many of you have built them and are making use of them in many ways.

I am interested in hearing from any of you telling me what you've done with these projects or how you may have been influenced by the basic ideas. Write me at Circuit Cellar Feedback, POB 582, Glastonbury, CT 06033 and fill me in on your applications. All letters and photographs become the property of Steve Ciarcia and cannot be returned.

Steve Ciarcia
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 macroassembler 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.

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.

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 and override, along with assembly runtime 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 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.

Z-8000 Cross Development Package
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 and override, along with assembly runtime 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 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

<table>
<thead>
<tr>
<th>Product</th>
<th>Z-80CP/M®</th>
<th>ZLOGSYSTEM8000</th>
<th>IBM P.C. 8086/88</th>
<th>IBM P.C. 8086/88</th>
<th>OLIVETTI M-20 PCOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>8086/88ASM</td>
<td></td>
<td>$99.50</td>
<td>$199.50</td>
<td>$199.50</td>
<td>$199.50</td>
</tr>
<tr>
<td>80186XASM new</td>
<td>199.50</td>
<td>750.00</td>
<td>199.50</td>
<td>199.50</td>
<td>199.50</td>
</tr>
<tr>
<td>32000 (all)XASM new</td>
<td>299.50</td>
<td>750.00</td>
<td>299.50</td>
<td>299.50</td>
<td>299.50</td>
</tr>
<tr>
<td>68000,08,10XASM new</td>
<td>199.50</td>
<td>750.00</td>
<td>199.50</td>
<td>199.50</td>
<td>199.50</td>
</tr>
<tr>
<td>Z-8000®ASM</td>
<td></td>
<td>750.00</td>
<td></td>
<td></td>
<td>299.50</td>
</tr>
<tr>
<td>Z-8000XASM</td>
<td>199.50</td>
<td></td>
<td></td>
<td></td>
<td>299.50</td>
</tr>
<tr>
<td>Z-80XASM</td>
<td>49.50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Z-8 XASM</td>
<td>99.50</td>
<td>500.00</td>
<td>99.50</td>
<td>99.50</td>
<td></td>
</tr>
<tr>
<td>6301(CMOS) new</td>
<td>99.50</td>
<td>500.00</td>
<td>99.50</td>
<td>99.50</td>
<td></td>
</tr>
<tr>
<td>6500/11XASM new</td>
<td>99.50</td>
<td>500.00</td>
<td>99.50</td>
<td>99.50</td>
<td></td>
</tr>
<tr>
<td>6502XASM</td>
<td>99.50</td>
<td>500.00</td>
<td>99.50</td>
<td>99.50</td>
<td></td>
</tr>
<tr>
<td>65C02(CMOS)XASM new</td>
<td>99.50</td>
<td>500.00</td>
<td>99.50</td>
<td>99.50</td>
<td></td>
</tr>
<tr>
<td>6800,2,8XASM</td>
<td>99.50</td>
<td>500.00</td>
<td>99.50</td>
<td>99.50</td>
<td></td>
</tr>
<tr>
<td>6801,03XASM</td>
<td>99.50</td>
<td>500.00</td>
<td>99.50</td>
<td>99.50</td>
<td></td>
</tr>
<tr>
<td>6804XASM new</td>
<td>99.50</td>
<td>500.00</td>
<td>99.50</td>
<td>99.50</td>
<td></td>
</tr>
<tr>
<td>6805XASM</td>
<td>99.50</td>
<td>500.00</td>
<td>99.50</td>
<td>99.50</td>
<td></td>
</tr>
<tr>
<td>6809XASM</td>
<td>99.50</td>
<td>500.00</td>
<td>99.50</td>
<td>99.50</td>
<td></td>
</tr>
<tr>
<td>8748XASM</td>
<td>99.50</td>
<td>500.00</td>
<td>99.50</td>
<td>99.50</td>
<td></td>
</tr>
<tr>
<td>8051XASM</td>
<td>199.50</td>
<td>750.00</td>
<td>199.50</td>
<td>199.50</td>
<td></td>
</tr>
<tr>
<td>8080XASM</td>
<td>99.50</td>
<td>500.00</td>
<td>99.50</td>
<td>99.50</td>
<td></td>
</tr>
<tr>
<td>8085XASM</td>
<td>99.50</td>
<td>500.00</td>
<td>99.50</td>
<td>99.50</td>
<td></td>
</tr>
<tr>
<td>8096XASM new</td>
<td>199.50</td>
<td>750.00</td>
<td>199.50</td>
<td>199.50</td>
<td></td>
</tr>
<tr>
<td>1802XASM</td>
<td>99.50</td>
<td>500.00</td>
<td>99.50</td>
<td>99.50</td>
<td></td>
</tr>
<tr>
<td>F8/3870XASM</td>
<td>99.50</td>
<td>500.00</td>
<td>99.50</td>
<td>99.50</td>
<td></td>
</tr>
<tr>
<td>COP5400XASM</td>
<td>99.50</td>
<td>500.00</td>
<td>99.50</td>
<td>99.50</td>
<td></td>
</tr>
<tr>
<td>NEC7500XASM</td>
<td>99.50</td>
<td>500.00</td>
<td>99.50</td>
<td>99.50</td>
<td></td>
</tr>
<tr>
<td>NSC800</td>
<td>99.50</td>
<td>500.00</td>
<td>99.50</td>
<td>99.50</td>
<td></td>
</tr>
</tbody>
</table>

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.)
□ Apple (Softcard)
□ Kaypro DSDD
□ other formats available, please call!

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. Total $_________

Check one:
□ 8" Single Density shipping/handling
□ 5¼" Osborne Blue Label, $25.00 per unit for 1st. airmail) $_________
□ IBM P.C. Cartridge Tape
□ Apple (Softcard)
□ Kaypro DSDD
□ other formats available, please call!

Total Order $_________

CP/M is a registered trademark of Digital Research, Inc.

*52659/AD

218
<table>
<thead>
<tr>
<th>MODEL</th>
<th>IBM PC XT</th>
<th>ISA</th>
<th>CPU</th>
<th>DRIVES</th>
<th>MEMORY</th>
<th>HDD</th>
<th>RAM</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM XT</td>
<td>2 drives</td>
<td>256K</td>
<td>7864-590</td>
<td>Serial</td>
<td>8088</td>
<td>30MB</td>
<td>0MB</td>
<td>$1695</td>
</tr>
<tr>
<td>IBM XT</td>
<td>1 drive</td>
<td>128K</td>
<td>7864-590</td>
<td>Serial</td>
<td>8088</td>
<td>30MB</td>
<td>0MB</td>
<td>$1295</td>
</tr>
</tbody>
</table>

**IBM SOFTWARE**

<table>
<thead>
<tr>
<th>UNIVERSITY</th>
<th>HOME</th>
<th>SPECIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>$199</td>
<td>$149</td>
<td>$129</td>
</tr>
</tbody>
</table>

**IBM ACCESSORIES**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM KEYBOARDS</td>
<td>$75</td>
</tr>
<tr>
<td>IBM MICE</td>
<td>$50</td>
</tr>
<tr>
<td>IBM DRIVES</td>
<td>$100</td>
</tr>
</tbody>
</table>

**APPAREL**

<table>
<thead>
<tr>
<th>-models</th>
<th>price</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM T-SHIRT</td>
<td>$15</td>
</tr>
<tr>
<td>IBM HAT</td>
<td>$20</td>
</tr>
<tr>
<td>IBM GREETING CARDS</td>
<td>$5</td>
</tr>
</tbody>
</table>

**MONITORS**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM MONITOR</td>
<td>$299</td>
</tr>
<tr>
<td>VIEWSONIC</td>
<td>$299</td>
</tr>
<tr>
<td>SONY</td>
<td>$299</td>
</tr>
</tbody>
</table>

**PRINTERS**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPSON LQ-1000</td>
<td>$999</td>
</tr>
<tr>
<td>EPSON LQ-1500</td>
<td>$1299</td>
</tr>
<tr>
<td>EPSON LQ-2500</td>
<td>$1599</td>
</tr>
</tbody>
</table>

**ACCESSORIES**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM POWER SUPPLY</td>
<td>$199</td>
</tr>
<tr>
<td>IBM SURGE PROTECTOR</td>
<td>$299</td>
</tr>
<tr>
<td>IBM SERIAL PORT</td>
<td>$50</td>
</tr>
<tr>
<td>IBM PARALLEL PORT</td>
<td>$50</td>
</tr>
</tbody>
</table>

**DISCOUNT COMPUTER CENTERS**

398 BYTE • FEBRUARY 1985
SIMULTANEOUS EQUATIONS WITH LOTUS 1-2-3

by Jan-Henrik Johansson

An example from macroeconomics

SPREADSHEETS ARE amazingly useful in a number of applications. In this article, I will show how macroeconomic models can be formulated as simple spreadsheet programs as long as they can be defined using just linear simultaneous equations. I will then go on to show how to solve such equations numerically using standard spreadsheet commands.

My inspiration for this article came after reading an article by Patrick E. McGuire (see reference 3). He published a simple BASIC program that solved simultaneous equations analytically, and he therefore seemed to have solved the problem I was interested in. But programming everything in BASIC from now on seemed to me to be a step backward. Was there a more general approach? I will illustrate a different method by using only the familiar spreadsheet Lotus 1-2-3. I will use it to solve systems of simultaneous linear equations through iteration (successive recalculations) rather than through successive transformations of the equations. The technique demonstrated here is in fact quite general and can also be applied to other spreadsheets and to many other types of models.

A FAMOUS MACROECONOMIC MODEL

Before describing the solution technique in detail, let me describe the problem. An area where systems of simultaneous equations (even very large ones) have become an essential vehicle for formulating and analyzing relationships is macroeconomics. Macroeconomic models describe global economic behavior of nations and groups of nations. Many models with hundreds of equations have been developed in efforts to analyze and project the economic performance of, for example, the United States. One of the first economists to develop major macroeconomic models for the U.S., using simultaneous equations as his analytical tool, was Professor Lawrence Klein of the Wharton School of the University of Pennsylvania. His classic model of the U.S. consists of a set of 20 simultaneous equations. The work was done in the early 1950s (see reference 2).

As our example, I am using an earlier and slightly simpler version known as "Klein's model I" (see reference 1), which I will formulate and run in Lotus 1-2-3. I will then show how to solve this model through iteration, using nothing but standard Lotus 1-2-3 commands. The example is important because it represents a type of application where the need to solve simultaneous equations efficiently has continued to be a key technical problem for economists around the world. However, you do not need to be an economist to understand the technique itself. I will ignore the economics and concentrate instead on demonstrating a general method—expecting the method to be applicable to other problems as well. On the (continued)
Inquiry 69

PROGRAMMING INSIGHT

other hand, if you want to know more about macroeconomic models, reference 4 is a good book. All the models described there can be handled by the techniques described in this article.

I will first define the model by using standard college algebra and then verify that the equations are circular. The circularity is what makes this example interesting. I will then translate the equations into an equivalent set of spreadsheet formulas. Table 1 shows the equations in algebraic form. This version of the model has six equations, each defining an economic variable in terms of some other economic variables. The equations for \( C(t) \), \( I(t) \), and \( W(t) \) have previously been estimated from historical data using regression. The equations for \( Y(t) \), \( Y(t) \), and \( K(t) \) are identity relationships.

To see the circularity, notice that \( l(t) \) is defined in terms of \( K(t) \) and that \( K(t) \) is defined in terms of \( K(t-1) \) and \( l(t-1) \)—the variable we started with. The equations are therefore circular. If we take a closer look, we will find other circularities in the set of equations as well.

But there is more: not only is this set of equations circular, it is also recursive. That is, the solution to the set of equations for a particular time period depends on the solution of the same equations for preceding time periods. In this particular model, only one preceding time period is needed (referring to, for example, \( K(t-1) \)). However, it is quite common that one has to go back in time more than one time period to define the model. Of course, the recursion must stop at some point in the past. Therefore, instead of a reference to an earlier period, we need an initial numeric value to start the process.

One last point regarding the algebraic formulation of the model: the equations make use of three variables that have no equations. They are \( G(t) \), \( W'(t) \), and \( P(t) \). These variables are input data. In fact, they are constants, although they vary from one year to the next. These three input variables are said to be exogenous (external to the model), while the six variables computed by the model are endogenous (internal to the model). We now have a model and a nomenclature to describe it. Let's now translate it to Lotus 1-2-3.

The reformulation of the equations in table 1 as a spreadsheet is straightforward; table 2 displays the formulas in columns B, C, and D of the spreadsheet. The spreadsheet formulas are in fact almost identical to the ones in table 1, except that we have reserved extra rows for the exogenous variables \( G(t) \), \( W'(t) \), and \( P(t) \) as well for the time period \( YR(t) \). No typical spreadsheet coordinates are shown because I have named every cell in column D by the name of the corresponding variable. If a formula references a cell that has a name, Lotus 1-2-3 automatically replaces the normal coordinate notation by the name.

(continued)

Table 1: Klein's model 1.

<table>
<thead>
<tr>
<th>Behavioral equations:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption function: ( C(t) = B0 + B1P(t) + B2W'(t) + B3P(t) + u4 )</td>
</tr>
<tr>
<td>Investment function: ( I(t) = B4 + B5P(t) + B6P(t-1) + B7K(t-1) + u2 )</td>
</tr>
<tr>
<td>Demand for labor: ( W(t) = B8 + B9Y + T - W'(t) + B10Y + T - W'(t) + B11t + u3 )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Identities:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taxes: ( T(t) = C(t) + I(t) + G(t) - Y(t) )</td>
</tr>
<tr>
<td>Income after tax: ( Y(t) = W(t) + T(t) + P(t) )</td>
</tr>
<tr>
<td>Capital stock: ( K(t) = K(t-1) + l(t) )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exogenous data:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government expenditure (G),</td>
</tr>
<tr>
<td>Government wage bill ( W'(t) ) and</td>
</tr>
<tr>
<td>Profits ( P(t) )</td>
</tr>
<tr>
<td>Regression coefficients: ( B0, B1, B2, B3, u1, u2, u3. )</td>
</tr>
</tbody>
</table>
The new IBM Quietwriter® Printer. When letter quality should be seen and not heard.

If you're looking for a printer for your personal computer that offers quiet, letter-quality printing, look at—and listen to—the IBM "Quietwriter" Printer. It's a technological breakthrough, featuring a new and innovative system for transferring ink to paper that makes it whisper-quiet.

But more than quiet, the "Quietwriter" Printer gives your letters the crispness of an IBM typewriter along with the deep, rich gloss of a carbon ribbon. All at up to 60 quiet characters per second.

What's more, plug-in electronic modules support the full 252-character set of the IBM Personal Computer. You can easily attach the "Quietwriter" Printer to IBM personal computers and to many other microcomputers.

The "Quietwriter" Printer is just one example of the more than 70 printer models we build. But they all serve a single purpose: To make your printing as effective as your processing. To give your work the finishing touch.

Contact your IBM marketing representative or call 1-800 IBM-2468, Ext. 587/3T, for the IBM Product Center or authorized IBM dealer nearest you.

IBM PRINTERS The Finishing Touch
of the cell. This makes the formulas more readable and is a practical necessity for bigger models. As a special trick, I have given names like \( K(-1) \) to the cells in column C (corresponding to period 1).

The net result is that Lotus 1-2-3 displays all formulas in a notation that is familiar to economists and almost identical to that of Table 1. We thus have six equations with six unknowns for each period. Because formulas for subsequent periods are structurally identical to the ones in column D, it is sufficient to list only one column in order to display the logic of the model. But to solve the model, we must explicitly repeat the formulas in column D for each time period we are interested in.

Because the formulas for different periods reference each other, a solution to the model must satisfy all formulas for all periods at the same time. In fact, if we wrote down an algebraic formulation of this model in a non-recursive form, the total number of equations would equal the number of equations (six) for each period times the number of time periods minus one.

Solving a system of linear equations is not a solution because at least one unknown has been given an arbitrary value. Because of the circular nature of the equations, however, we can now compute this variable from the other variables we just computed. In so doing, we will get a better initial value to use in a second round with the other unknowns. Now repeat the process a number of times. During each iteration the values tend to change less and less. After a certain number of iterations, they do not change any more. The process has converged, and the values are stable. We have reached the solution.

Solving equations through iterations is not something one would like to do by hand, but a computer can do it. In fact, spreadsheets like Lotus 1-2-3 always store the results of the last computation (the last solution) with the formulas. When using a spreadsheet, we will always start the iterations from an approximation that is probably close to the solution. The only exception to this rule is the first time we enter the formulas. By going in small steps from solution to solution, we can explore the performance of our model in a way that is fast because we have reduced the total number of computations needed.

Fortunately, this process matches well with the way people actually use models. For example, we may be interested in how sensitive exports are to small changes in exchange rates or import tariffs. Or we may want to see

---

### Table 2: A formulation of Klein I in Lotus 1-2-3.

The exogenous variables \( G \) and \( W' \) have been given a 5 percent and 3 percent annual growth rate, respectively. Use of the information in this table is explained in the text box.

<table>
<thead>
<tr>
<th>Column B</th>
<th>Column C</th>
<th>Column D</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1: ( YR = )</td>
<td>C1: 1</td>
<td>D1: (+ YR(-1) + 1)</td>
</tr>
<tr>
<td>B2:</td>
<td>C2:</td>
<td>D2:</td>
</tr>
<tr>
<td>B3: ( C = )</td>
<td>C3: 1.5</td>
<td>D3: (- 2.0 + 0.2 \cdot P + 0.55 \cdot (W + W') + 0.26 \cdot P(-1))</td>
</tr>
<tr>
<td>B4: ( I = )</td>
<td>C4: 3.0</td>
<td>D4: (+ 1.0 + 0.7 \cdot B \cdot P - 0.05 \cdot P(-1) - 0.02 \cdot K(-1))</td>
</tr>
<tr>
<td>B5: ( G = )</td>
<td>C5: 5.0</td>
<td>D5: (+ G(-1) \cdot 1.05)</td>
</tr>
<tr>
<td>B6:</td>
<td>C6:</td>
<td>D6:</td>
</tr>
<tr>
<td>B7: ( W = )</td>
<td>C7: 3.0</td>
<td>D7: (- 1.0 + 0.24 \cdot (Y + T - W') + 0.2 \cdot (Y(-1) + T(-1) - W'(-1)) + 0.1 \cdot YR)</td>
</tr>
<tr>
<td>B8: ( W' = )</td>
<td>C8: 1.0</td>
<td>D8: (+ W'(-1) \cdot 1.03)</td>
</tr>
<tr>
<td>B9: ( P = )</td>
<td>C9: 3.0</td>
<td>D9: 3</td>
</tr>
<tr>
<td>B10:</td>
<td>C10:</td>
<td>D10:</td>
</tr>
<tr>
<td>B11: ( T = )</td>
<td>C11:</td>
<td>D11: (+ C + I + G - Y)</td>
</tr>
<tr>
<td>B12: ( Y = )</td>
<td>C12:</td>
<td>D12: (+ W + W' + P)</td>
</tr>
<tr>
<td>B13: ( K = )</td>
<td>C13: 5.0</td>
<td>D13: (+ K(-1) + I)</td>
</tr>
</tbody>
</table>
### PRINTERs
- **Anadex**
  - 9625 $1129
  - w/FCO $1200
  - DP6500 $2259
- **Brother**
  - DX 15 $569
  - HX 92 $649
  - HX 94 $875
- **Citah**
  - A-103D $479
  - 10 Parallel (Printer) $1049
  - HX 10 Parallel $315
  - HX 25 Parallel $339
  - HX 26 Parallel $459
  - A-12 Parallel $333
- **Comtex**
  - CF-2E Parallel $91
  - CF-2A $1429
  - CF-4 $210
- **Datsouh**
  - DS-180 $1149
  - DS-220 $1469
- **Diablo**
  - 420 $694
  - 630 API $1499
  - 630 CCI $1669
  - 630 UC/HM $1669
  - Series 36 $1139
  - BD 8 $689
  - FD 21C2G $539
  - FD 21C5G $739
  - FD 21C6G $839
- **Epson**
  - All Printers Mitsubishi $999
  - Infoprinter $999
  - Juki $999
  - Economy $699
  - 620, 6215, 6300 $699
  - CANON $699
  - CONTINIC $699
  - Epson $699
  - Canon $699
  - Kodak $699
- **Zenith**
  - 2150 Single Drive $25
  - 2150 Single Drive $25
  - 2150 Single Drive $25
  - 2150 Single Drive $25
  - 2150 Single Drive $25

### EVALUATION TERMINALS
- **Zenith**
  - 2150 Dual Drive $259
  - 2150 Dual Drive $259
  - 2150 Dual Drive $259
  - 2150 Dual Drive $259
  - 2150 Dual Drive $259
  - 2150 Dual Drive $259

### MODEMS
- **Anchor Automation**
  - Anchor Express $999
- **Hayes**
  - Supermodem 300 baud $1185
  - Supermodem 1200 baud $465
  - Supermodem 1200 baud (BM) $5279
  - Micromodem II AApple (Apple) $209
- **Navation**
  - 1X-11 $315
- **Rascal-Vadic**
  - All Models $315
- **US Robotics**
  - Fax Wizard $139

## DISKETTES
- **Maxwell**
  - MD-100 (80 HU) $319
  - MD-2 (80 HU) $319

## TEC MAR
- **Graphic Master**
  - Smart CAD $25
  - SuperCAD $25

## CONTROL SPECIALISTS
- **Silicon Specialties**
  - 802-939-0909
  - 802-939-0909
  - 802-939-0909

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. Other checks will delay shipping 2 weeks.
what happens to the model when it is exposed to a shock, such as quadrupling the oil price or barring all sales of grain to the Soviet Union.

THE REAL THING:
9000 UNKNOWNS
Experimenting with Klein's model shows that when changing exogenous variables we need only 3 to 9 iterations to reach a new solution from an old one. Of course, a drastic change of exogenous variables may require more iterations. For 24 years, one iteration takes less than 7 seconds on my Compaq. With an average of 5 iterations required to reach the solution, the microcomputer has solved a system of simultaneous equations that has 140 unknowns in about half a minute. A printout showing the results for the first 10 years can be found in table 3.

I have experimented with very large models with up to 450 endogenous 100 exogenous variables covering a time span of 20 years. Such a system has almost 9000 unknowns! One complete iteration still takes only about 22 seconds, and only 4 to 10 iterations are required for convergence. This is fully adequate for practical work with realistic models and makes our simple spreadsheet approach surprisingly competitive when compared even to large mainframe software packages specifically designed to solve macroeconomic models. What we have seen is a synergism. Iteration is an easy and slow method to solve equations. But because a spreadsheet by default makes a smart guess, we see a drastic improvement in efficiency, allowing us to attack much tougher problems than before.

However, a problem relates to finding a new solution to the system of equations. In the case of a small model, like Klein’s model I, there is no question whether the model has converged or not. We can simply look at the screen and see what happens when we give a calculation command. When nothing happens, we are done. However, it will not take long before we have a model that does not fit on
This is a complete step-by-step example of how to build and execute the model. First, you set up the worksheet. When entering the model, use the data in table 2.

1. Type in the variable names in cells B1 to B13.
2. Type in the initial values in cells C1 to C13.
3. Using the variable name in column B and the Lotus /RNC command, name all the corresponding cells C1 to C13 as lagged variables (i.e., "Y1-1", "X1-1", etc) and name all cells D1 to D13 simply with the variable names (i.e., "Y", "X", "C", etc).
4. Format the range C9..D13 to display three decimals.
5. Now enter the model equations into cells D1 to D13. Because cell names have been created earlier, equations can now be entered exactly as the are.
6. Copy the range D1..D13 all the way to column H. Also, copy D11 and D12 to C11 and C12, respectively. This extends the model to six annual periods.
7. Hit the Calc key (F9) several times and watch the values for year six in column H. If the model has been entered correctly, you will see the worksheet converge.
8. To run further simulations, change some of the initial values. Convergence control is still manual.

Automatic convergence control is next. We will use wages in year six (cell H7) to check for convergence.

9. Type the formula +H7 into cell A1. This will cause Lotus 1-2-3 to start every new iteration by copying the result of the preceding iteration to A1. The value of H7 is then recomputed. The difference between A1 and H7 is a measure of how close we are to a solution.
10. Using /RNC, give the cell A15 the name "\S" and enter the test for convergence: \X1@ABS(A1-H7) >0.001 ~(CALC)/XG/\S. Translated into English, this macro says: if the absolute value of the difference between two iterations for wages in year six is greater than a certain tolerance (0.001), recompute the spreadsheet and reevaluate the macro again; otherwise, you have found the solution. That is, if the condition is not met, Lotus 1-2-3 will loop over the model and continue recomputing the worksheet until changes are smaller than the tolerance.
11. To ensure that the value of A1 is computed before H7, i.e. that the value of the old iteration is stored, type \W�C.

You are now ready to run a simulation. The macro we just created will correctly automatic control the iteration process for you.
12. Change the initial value of some variable, for example, change C in C5 from 5.0 to 3.0.
13. Now execute our macro by typing ALTFS. We will see the model converging and then stop automatically when the solution is reached.

This illustrates the impressive power of the macro facility of Lotus 1-2-3.

REFERENCES
Stand-alone programs can't be made to work as a system no matter how hard you might try.

Stand-alone programs are fine. Unless, of course, you need them to work together. Because the sum of the parts will never equal a whole. That's why even the highly touted WordStar, dBase II and 1-2-3, programs don't make sense as a business system. They were designed to perform very specific application functions only, and therefore, make miserable workmates.

Fortunately, there's a smart solution. It's the new Smart Software System. Smart's unique "modular integration" is the key to productivity. It means that The Smart Word Processor, The Smart Data Manager...
The fully integrated Smart Software System is designed to make the whole office more productive.

and The Smart Spreadsheet with Graphics not only have the uncompromising power and capacity of these leading stand-alone programs, but they also have the unprecedented capability to work brilliantly together.

So you can easily transfer data and pass commands from one to another. Which means that you can compile financial data, to be included in graph-form, within the text of a printed report, that's mailed to a list drawn from the data manager automatically.

Don't short change your business by attempting to squeeze the impossible out of a makeshift software system. Get Smart, and the whole office will thank you.

Smart is available for the IBM PC, PC/XT, PC/AT, and compatibles. For information call, 800-GET-SMART.
(In Kansas call, 913-383-1089).

Smart Software from Innovative Software

*1-2-3*, WordStar™ and dBase II™ are registered trademarks of Lotus Development Corporation. Micro-Pro International Corporation and Ashton Tate respectively. © 1984 Innovative Software, Inc.
All you need to build a Small Video Terminal equiva lent to the popular ECII is the new TERM-MITE ST circuit board, scanned or parallel key board, and a monitor (36x).

- Small and light. (88x)
- 24 lines by 80 characters, 25th reverse-video status.
- Upper & lowercase. Line (block) graphics.
- Selectable data rate, parity & display options.
- Binary, half intensity, double height & width, underline, blinking and/or black character.
- Separate sync or composite video output. Soft Test.

As featured on the cover of BYTE Magazine. Also featured in Canusa's Circuit Corner, February, 1983 January, 1983

The Computer with a Split Personality

- IBM 4470 as an IBM PC look alike that directly boots IBM PC DOS 2.0 and accepts all expansion boards. 
- Measures 3" x 3 1/2".

MPX-16 MICROCOMPUTER IBM PC COMPATIBLE

As featured in Byte Magazine. Also featured in Canusa's Circuit Corner, February, 1983 January, 1983

The Microcom Sauer Rang Ramp Gs.5.4 is a high performance version of a standard range-finder. Its ultrasonic range-finding unit will fit any computer, modem, RS-232C serial or parallel interface.

- Measures 3" x 3 1/2".
- Measures 3" x 3 1/2".

IBM PC is a trademark of International Business Machines Inc.

IBM PC is a trademark of Digital Research Inc. Z8 is a trademark of Zilog Inc.

IBM PC is a trademark of International Business Machines Inc. CP/M-86 is a trademark of Digital Research Inc.

IBM PC is a trademark of International Business Machines Inc. CP/M-86 is a trademark of Digital Research Inc.

IBM PC is a trademark of International Business Machines Inc. CP/M-86 is a trademark of Digital Research Inc.
BOOKS RECEIVED


THE COMPUTER BOOK. William Bates. New York: (continued)
The best of two worlds

The MYTECH COMAL interactive programming language gives you the simplicity of Basic and the power of Pascal. Many of the concepts are influenced by ADA®, for example exception handling, packages etc.

**MYTECH COMAL features**
- Available for IBM® PC-G, PC-XT, PC-AT, PPC, WICAT etc.
- Implemented on UNIX®, CP/M®, C-CP/M®.
- MS-DOS®, PC-DOS®.
- Easily ported to 16/32-bit systems.
- The package concept makes MYTECH COMAL extensible.
- Easy to customize for foreign languages.
- Support for the 8087.
- Written in "C".
- Comal is available in 100% orthogonal.
- Support for 8086.
- In written in "C".
- Fulfills the Comal 2.00 requirements.

MYTECH COMAL is the perfect language for students as well as professional programmers. For further information please ask for a data sheet. Or why not do it the right way, order your MYTECH COMAL system today and move in to a new fascinating and powerful programming dimension.

**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

**BOOKS RECEIVED**

- **Doublenay and Co., 1984; 416 pages, 20.8 by 27.8 cm, soft-cover, ISBN 0-385-19291-6, $14.95.**
- **Computer Craziness, Paul Somerson and Stephen Manes. New York: Scholastic, 1984; 176 pages, 20.3 by 27.5 cm, soft-cover, ISBN 0-590-33177-9, $4.95.**
- **Computer Monsters, Stephen Manes and Paul Somerson. New York: Scholastic, 1984; 174 pages, 20.3 by 27.5 cm, soft-cover, ISBN 0-590-33176-0, $4.95.**
- **Computer Space Adventures, Paul Somerson and Stephen Manes. New York: Scholastic, 1984; 176 pages, 20.3 by 27.5 cm, soft-cover, ISBN 0-590-33178-7, $4.95.**
BOOKS RECEIVED


SHOULD I BUY A HOME COMPUTER? A GUIDE WITH CHECKLISTS. Lincoln Hallen. Princeton, NJ: Petrocelli Books, 1984; 412 pages. Prices include postage in the US. Please add $5.00 per copy for Canada and Mexico, and $2.00 per copy to foreign countries (surface delivery).

☐ Check enclosed

Payments from foreign countries must be made in US funds payable at a US bank.

☐ VISA    ☐ MasterCard

Card #

Exp.

Signature

Please allow 4 weeks for domestic delivery and 12 weeks for foreign delivery.

NAME

ADDRESS

CITY

STATE    ZIP

BYTE back issues for sale

| May     | $2.75 | $2.75 | $3.25 | $3.25 | $3.70 | $3.70 | $4.25 | $4.25 |
| May     | $2.00 | $2.75 | $2.75 | $3.25 | $3.70 | $3.70 | $4.25 | $4.25 |
| June    | $2.00 | $2.75 | $2.75 | $3.25 | $3.70 | $3.70 | $4.25 | $4.25 |
| July    | $2.00 | $2.75 | $2.75 | $3.25 | $3.70 | $4.25 | $4.25 | $4.25 |
| Aug.    | $2.00 | $2.75 | $2.75 | $3.25 | $3.70 | $4.25 | $4.25 | $4.25 |
| Oct.    | $2.75 | $2.75 | $3.25 | $3.25 | $3.70 | $4.25 | $4.25 | $4.25 |
| Nov.    | $3.25 | $3.25 | $3.70 | $4.25 | $4.25 | $4.25 | $4.25 | $4.25 |
| Dec.    | $2.75 | $2.75 | $3.25 | $3.25 | $3.70 | $4.25 | $4.25 | $4.25 |

Special BYTE Guide to IBM PC's — $4.75

Circle and send requests with payments to:
BYTE Back Issues
P.O. Box 328
Hancock, NH 03449

412 BYTE • FEBRUARY 1985
BOOKS RECEIVED

104 pages. 16 by 20.8, softcover. ISBN 0-89433-257-0. $8.95.


TO APPLE LOGO AND TERRAPIN LOGO, Pamela Sharp Bowie. $8.95.


INTRODUCING
Interface Technologies' Modula-2
Software Development System

The computer press is hailing Modula-2 as "the next
standard in programming languages." Modula-2
combines the strengths of Pascal with the features
that made C so popular, like independent
compilation and direct hardware control.

But until today, no company offered a
Modula-2 system that made the development
of software fast, easy and efficient. Now,
though, there's a new tool at your disposal.

The fast, powerful tool
for programmers

The breakthrough is here: Interface Technologies' new Modula-2 Software Development System for the IBM® PC, XT, AT and compatible computers to give programmers the same quantum leap in productivity spreadsheets and word processors gave to end-users. It can reduce monotonous wait time, will dramatically increase speed, help stop thoughtless mistakes, and free you to become more creative in virtually all of your programming efforts.

How to speed input and eliminate 30% of errors

Thirty percent of programming mistakes are syntax errors and simple typos in the program structure. Our "syntax-directed" Modula-2 editor does away with these time-consuming headaches once and for all.

It speeds input by cutting manual typing as much as 90%, letting you enter statements with a single keystroke. For example, if you type a capital "I" to begin a line, the editor completes the logical "IF THEN" statement automatically, so you can concentrate on what you want to program, rather than concentrate on what you're typing.

The editor locks out errors, finishing statements and procedures in perfect accord with the standardized rules of Modula-2. It also indents and formats your text automatically, making programs easy to read and maintain, an important feature on big projects.

And if you leave an undefined variable or data type, the editor detects the mistake and gives you the option of on-line "help" to correct it. No other programming text editor offers you so much innovation at any price.

How to turn "wait time"
into "work time"

The vast majority of programming time is spent waiting, and the biggest slowdown is most often with compilers.

Our compiler turns wait time to work time with a new innovation that lets you compile in the "background."

With background compilation, your program is automatically compiled into object code line by line as you work, every minute you spend writing or editing a Modula-2 program!

When you're finished editing, all that's left for the compiler is a quick mopping up job that generates optimized native code in a single pass.

How quick is "quick"?

Thanks to background compilation and the fact that the compiler itself is so fast, Interface Technologies' compiler turns 100 lines of typical Modula-2 text into optimized machine code in under five seconds.

Plus the Interface compiler produces compact code with execution speed superior to that produced by any other Modula-2 compiler on the market.

How to do two things at once

Along with the background compiler and syntax-directed editor, which can save you hours every day and make you more productive, Interface Technologies' Software Development System gives your monitor...
windows so you can refer to one file while you edit another simultaneously, saving you even more time.

Concurrent editing of two or more files is especially useful when doing programming work that's intended for separate compilation, and Interface Technologies has the only Modula-2 system on the market that provides you with this helpful benefit for developing software.

How preprogrammed modules speed development

One of the advantages of Modula-2 is that it lets you build large, reliable programs quickly, by linking together many smaller "building-block" modules. The development system's toolkit of precompiled program modules includes the standard Modula-2 library, and adds exclusive link-and-run modules for direct calls to the operating system, sound, and color graphics support. Plus you get low-cost updates from the Interface Technologies fast-growing library of new programming modules.

Increase productivity for $249

Interface Technologies' Software Development System is fast, powerful and unlimited. It works so well that it's the same tool Interface Technologies is using to write business and consumer applications in Modula-2. For $249, you get the syntax-directed editor and compiler, linker, module library and tutorial that will have even modestly experienced programmers writing in Modula-2 in days. And you have full rights to your work; there's no license fee for programs you develop with the Interface Technologies system.

You can use it on any IBM® PC, XT, compatible computer with two double-sided, double-density floppy drives and 320K RAM diskette.

You get a thoroughly indexed, comprehensive user's manual and free telephone support from Interface Technologies. But the most important thing you get is the future, and the programming language of the future is Modula-2, and now it's easier than ever.

For more information, or to order the Modula-2 Software Development System, call 1-800-922-9049 today. In Texas, call (713) 523-8422.

You can also order or request further information by mail. Just fill out the coupon below and send it in. Act today and receive your system soon.
BENCHMARKING UNIX SYSTEMS

Thanks to David F. Hinnant's excellent article, "Benchmarking UNIX Systems" (August 1984, page 132), I feel I gained an awareness of the limitations and advantages of the different UNIX/machine combinations. The results are a great reference guide. However, I was a little surprised by the lack of a System V version (the standard-to-be one), which motivated me to run all the benchmark programs specified in the article on an NCR Tower (an M68000-based computer) under UNIX System V. Table I shows my findings. For the tests I used 2 megabytes of RAM and one 30-megabyte hard disk.

The results obtained fall about midway between systems 6 and 7 when plotted on the graph in figure 1 on page 408. I was rather pleased with these results, since my Tower was, according to Hinnant's tables, among the top seven most powerful systems. I hope this small extension of Mr. Hinnant's work will be very useful to all System V users, because this version is intended to standardize the UNIX world.

MARIO DESCALZI
Columbia, SC

Table I: NCR Tower performance using UNIX benchmarks discussed in "Benchmarking UNIX Systems.

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>User</th>
<th>Sys</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe</td>
<td>6.0</td>
<td>2.8</td>
</tr>
<tr>
<td>System Call</td>
<td>13.8</td>
<td>13.2</td>
</tr>
<tr>
<td>Function Call</td>
<td>1.7</td>
<td>1.6</td>
</tr>
<tr>
<td>Sieve</td>
<td>4.5</td>
<td>0.1</td>
</tr>
<tr>
<td>Disk Write</td>
<td>3.4</td>
<td>1.3</td>
</tr>
<tr>
<td>Disk Read</td>
<td>8.8</td>
<td>2.0</td>
</tr>
<tr>
<td>Shell</td>
<td>9.1</td>
<td>2.2</td>
</tr>
<tr>
<td>Loop</td>
<td>13.4</td>
<td>12.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Concurrent Processes</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>98</td>
<td>10.0</td>
<td>22.2</td>
<td>353</td>
<td>44.2</td>
<td>52.2</td>
<td></td>
</tr>
</tbody>
</table>

A CALL FOR STANDARDS

In a computer system, dates can be kept in many different ways. If "DD" represents day, "MM" month, and "YY" year, let me define the British way as "MMDDYY", the French way as "DDMMYY", and the standard international way as "YMMDD". Despite its universality and advantages for sorting, the last one is not used by MS-DOS, dBASE, or Quickcode (to name just a few).

Let me ask both software and hardware developers to stick to international standards. Let me further suggest that they keep dates as numeric values (taking advantage of most keyboards' numeric locking feature) and automatically enforce month and day values smaller than 13 and 32, respectively. Zeros could be allowed for month and day when their values are unknown.

PAUL-ANDRE DESJARDINS
Rabat, Morocco

ENHANCING PERFECT WRITER


To anyone using Perfect Writer on a Kaypro, I recommend the inexpensive enhancements available from Plu*Perfect Systems (Box 1494, Idylwild, CA 92349). While running the word-processing program, keys can be defined, files printed or erased, disks changed, and the directory accessed. Key definitions also can be saved and automatically loaded. The swap file can be increased in size up to an entire disk.

Plu*Perfect recommends erasing Perfect Writer's menu to provide space on the disk for key definitions and other files. Everything that can be done through the menu can be done more quickly at the system level.

Documentation and user support is excellent. I have been using the enhancements for nearly a year and wouldn't do without them.

JAMES SWANSON
McBride, British Columbia, Canada

SUBSCRIBER'S LAMENT

My letter is one of caution to other readers of computer magazines. My experience with computers and the computer-magazine industry goes back only about four years, and in this period of time I have subscribed to at least eight different publications, most of which are good sources of information and education, especially yours. But something less than professional is happening within this industry.

In the past six months I have had the unfortunate experience of being a subscriber to two publications that just quit sending out their magazines: LOAD and Computer User. A third magazine that quit publishing (Basic Computing) did have the professional integrity to transfer its subscriptions to another magazine.

Maybe I have been a victim of a freak set of circumstances, but I don't think so. I believe this is the trend of the future. I hope not, but there doesn't seem to be much a consumer can do once the magazine has your money. It's obvious that bad management is ever present even in the computer-magazine industry.

STEVE HERMES
Bloomington, IL

FORTH CONFERENCE

The fifth Rochester FORTH Conference will be held at the University of Rochester, Rochester, New York, June 12-15, 1985. Sponsored by the Institute for Applied FORTH Research Inc., the focus of the conference will be on software engineering and software management.

There is a call for papers on the following topics:
- software engineering and software management practices
- FORTH applications, including, but not limited to: real-time, business, medical, space-based, laboratory and personal systems; and FORTH microchip applications
- FORTH technology, including finite-state machines, metacompilers, FORTH implementations, control structures, and hybrid hardware/software systems

Papers may be presented in either platform or poster sessions. Please submit a 200-word abstract by March 30, 1985. Papers must be received by April 30, 1985, and are limited to a maximum of four single-spaced, camera-ready pages. Longer papers may be presented at the conference but should be submitted to the refereed Journal of FORTH Application and Research.

Abstracts and papers should be sent to the conference chairman: Lawrence P. Forsley, Laboratory for Last Energetics, 250 East River Rd., Rochester, NY 14623. For more information, call or write Ms. Maria Gress, Institute for Applied FORTH Research, 70 Elmwood Ave., Rochester, NY 14611. (716) 235-0168.

ADDITIONAL DISCRIPTION

In Roy M. Matney's excellent article, "Adding a Hard Disk" (October 1984, page 203), he reiterated a common misunderstanding about my software product, The Norton Utilities. I would like to explain
what my programs can and cannot do, and why.

As many of your readers know, my Norton Utility programs provide file recovery (UnErase) and disk exploration (DiskLook) features for the IBM PC family. However, in the past they have not worked on most unconventional disks: RAM disks, quad-density disks, IFORMAT 10-sector disks, or any hard disk that wasn’t in one strict format.

Many people—including Mr. Matney—have assumed that this was because my programs worked “below the BIOS.” Actually not. All disk operations were done through conventional PC BIOS services. My programs did not work on more disk formats for a much worse reason: simply because I had coded these programs rather rigidly on the framework of five standard IBM disk formats. It was a lack of flexibility in my programming that restricted their use from wide application. I’m not leaving the experts unsatisfied, though: my beta-testers, experts all, have been giving version 3 lots of applause.

Peter Norton
Santa Monica, CA

I enjoyed Roy Matney’s informative article, “Adding a Hard Disk,” on hard-disk upgrades. However, it is incorrect to say that the Norton Utilities will not work with our controller. The Norton program is expecting 305 DOS cylinders, no more, no less. Our system gives you more than that. By using FDISK.COM to reduce the number of DOS cylinders to 305, the Norton Utilities will perform as expected.

Chris Tipton
Director of Technical Support
Maynard Electronics
Casselberry, Fl.

Cluster Analysis

Rob Spencer’s article, “Cluster Analysis” (September 1984, page 129), is a jewel. In the midst of all the recent articles on structuring BASIC by executing subroutines (continued)
Call Oryx and order by phone ...without a single hang-up!
APPLE/FRANKLIN

FRANKLIN

CARDS

APPLE

IBM/PC

AST Research

PUBLIC CARDS

Display Cards

MONITORS

DISK DRIVES

MODems

PRINTERS

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 2% for shipping, handling and insurance.

For cash prepayment of orders $200 or more, add 2% for shipping, handling and insurance.

Foreign - either add 15% handling & shipping (10% money order) or inquire.

Prices are subject to change without notice.

All items subject to availability.

APPLE/FRANKLIN

FRANKLIN

CARDS

APPLE

IBM/PC

AST Research

PUBLIC CARDS

Display Cards

MONITORS

DISK DRIVES

MODems

PRINTERS

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 2% for shipping, handling and insurance.

For cash prepayment of orders $200 or more, add 2% for shipping, handling and insurance.

Foreign - either add 15% handling & shipping (10% money order) or inquire.

Prices are subject to change without notice.

All items subject to availability.

APPLE/FRANKLIN

FRANKLIN

CARDS

APPLE

IBM/PC

AST Research

PUBLIC CARDS

Display Cards

MONITORS

DISK DRIVES

MODems

PRINTERS

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 2% for shipping, handling and insurance.

For cash prepayment of orders $200 or more, add 2% for shipping, handling and insurance.

Foreign - either add 15% handling & shipping (10% money order) or inquire.

Prices are subject to change without notice.

All items subject to availability.

APPLE/FRANKLIN

FRANKLIN

CARDS

APPLE

IBM/PC

AST Research

PUBLIC CARDS

Display Cards

MONITORS

DISK DRIVES

MODems

PRINTERS

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 2% for shipping, handling and insurance.

For cash prepayment of orders $200 or more, add 2% for shipping, handling and insurance.

Foreign - either add 15% handling & shipping (10% money order) or inquire.

Prices are subject to change without notice.

All items subject to availability.

APPLE/FRANKLIN

FRANKLIN

CARDS

APPLE

IBM/PC

AST Research

PUBLIC CARDS

Display Cards

MONITORS

DISK DRIVES

MODems

PRINTERS

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 2% for shipping, handling and insurance.

For cash prepayment of orders $200 or more, add 2% for shipping, handling and insurance.

Foreign - either add 15% handling & shipping (10% money order) or inquire.

Prices are subject to change without notice.

All items subject to availability.
each time anything is to be accomplished, his program succeeds in accomplishing its task simply and clearly with only one GOTO and only four GOSUB instructions in the body of the program, plus the two recursive GOSUB instructions in each subroutine. Only five line numbers are referenced in the entire program.

The problem with the "structured BASIC" proponents is that in general they want us to write BASIC programs as if they were really Pascal. Let's face it: It may be proper German to put a verb at the end of a sentence, but in English that is bad grammar. The goal is to write clear programs. What purpose would have been served by inserting in Mr. Spencer's program lines such as:

31 GOSUB 40 ' initialize
32 GOSUB 140 ' get data, do basic stats
33 GOSUB 240 ' do means

The goal is to write clearly with the tools given us, not to emulate one language from within another.

W. Howard Cornelsen Jr.
Houston, TX

The September issue was outstanding. Two programs presented in it—"Cluster Analysis" by Rob Spencer and "Fractals" by Peter R. Sørensen—give the micro owner a wonderful opportunity to use a program running on a computer as a way of understanding important phenomena. This aspect of computer literacy is not often stressed, and articles such as these serve such a purpose.

Benjamin W. White
Tiburon, CA

DATABASE TYPES

Every once in a while BYTE carries an article that really makes me sit up and take notice. I wish that I had seen Rich Krajewski's article, "Database Types" (October 1984, page 137), a couple of years ago. I had need of a database program to run on my Commodore 64 but really had no way to know which program to buy. Actually, none that I read about sounded right for me. So I wrote my own. Now, as I am in the middle of revising my program, I discover in your October issue that I have a "free-format database." Too bad I didn't know what to look for before. But, actually, I'm not sure that there was, or is, such a program for the Commodore 64.

I teach at Southern Arkansas University—El Dorado. Each year I need to select an outstanding student from science and math to be honored at graduation. And I need to select students for nomination to "Who's Who." Frequently I hear from a student who would like me to write a letter of recommendation. With my Database program, I can print out my records for all students that got an A for any particular semester, and in any particular course if needed. Or I can print out all the information that I have on a particular student.

Recently I have been computerizing my card file. When finished, I will be able to call up all references to databases, or to dot-matrix printers, or on using solar energy to heat pools.

If any reader of BYTE would be interested in trying "Database" on his Commodore 64, send me a disk and a check for $5. I'll return a copy of the program and documentation.

Jack Ryan
Rte. 5, Box 244
El Dorado, AR 71730

What's "Friendly"?

I wonder if you have any idea how over-used and undefined the word "friendly" is when used to describe a computer system? I have found that every user community has a different idea about that, and even the same users will feel differently about it with use.

I believe we should be simply talking to our users rather than trying to define friendly within the computer community. This kind of action requires that we get hardware and operating systems that are as flexible as possible and that we write applications to react to the needs of the users. This is hard to do when writing for a large unknown user, and perhaps this is the reason most software is deemed unfriendly.

I think the most unfriendly operating system is UNIX, but I really like that system, and many users will call it friendly because it is flexible and permits the programmer to write friendly applications. I would be interested to hear comments on this.

John L. Beal
Phoenix, AZ

PSEUDORANDOM NUMBERS

Your article by Charles A. Whitney entitled "Generating and Testing Pseudorandom Numbers" (October 1984, page 128) is a good tutorial on examining the periodicity of pseudorandom sequences used in Monte Carlo and other simulation techniques. To this end, I would like to contribute the two-line program below for IBM PC DOS 2.0 to further demonstrate the inherent periodicity of the BASIC RND (and other) pseudorandom functions.

10 RANDOMIZE TIMER: KEY OFF:
20 X = 320*RND: Y = 200*RND:
C = 4*RND: PSET (X, Y), C: GOTO 20

The program is intended to graphically demonstrate periodicity as spatial/color banding. Such banding indicates a clear recurrence of pseudorandom triplets repeatedly formed for X, Y, and color.

Other than an interesting star-like twinkling effect, this graphical technique has considerable value in visually inspecting both the periodicity and distribution (uniform, Gaussian, etc.) of other pseudorandom sequences.

H. J. Sommer III
University Park, PA

THE ORIGIN OF "FOO.BAR"

I have been working with computers for 26 years, and I still don't know the origin of the words "FOO" and "BAR" which appear in just about every language manual I've read.

Are they Ada Lovelace's boyfriend's middle names? Or perhaps they are magic words from an early adventure game. They never work for me.)

Someone out there must know.

Peter Smith
Kenmore, Australia

We believe "FOO.BAR" started out as "FUBAR," an unofficial military acronym for Fouled Up Beyond All Recognition. Perhaps often used as a test filename, FUBAR may have been altered to FOOBAR when a large computer manufacturer's file specification required six characters. We're curious too.

420 BYTE • FEBRUARY 1985

LETTERS
PC Chinese Software Bridge

The CCC-PC Chinese Character Generator Card from Multitech Industrial Corporation lets you run Chinese applications software on your IBM 5550 and IBM PC. This card plugs into an IBM expansion slot and gives you the ability to display and print out Chinese characters.

The CCC-PC card stores Chinese characters in a 2-byte international code using a technique known as the Dragon Coding Method. This method is said to reduce 17,000 characters to 24 alphabet-like symbols. The CCC-PC supports the method in two modes: one for beginners and the other for experienced Chinese encoders.

Other input/output methods on the CCC-PC include telegraphics, lightning, national phonetic alphabet, and internal code dictionary.

The CCC-PC supports IBM-compatible TTL-input monochrome monitors with a 40-character by 25-line display for Chinese characters and an 80 by 25 format for ASCII characters. The resolution uses a 16- by 16-dot character cell.

The CCC-PC is available to original equipment manufacturers and end users. Contact Mr. William Lu, Multitech Industrial Corp., 266 Sung Chiang Rd., Taipei, Taiwan, Republic of China; tel: (02) 551-1101; Telex: 19162 MULTIC. Inquiry 615.

IBM PC Color-Graphics Board for S-100

An IBM PC-compatible color-graphics display board for S-100 bus systems is available from CompuPro. The PC Video Board runs under CompuPro's Concurrent DOS 8-16 with Digital Research's IBM PC-compatibility module, and it works with Digital Research's GSX graphics software.

Built around the Motorola 6845 video-display controller, this board can be programmed to produce an assortment of timing characteristics for a variety of color and monochrome monitors. It features 16K bytes of static CMOS RAM, 24-bit memory addressing, 16-bit addressing for I/O ports, and variable wait states, which provide independent access to up to eight boards.

In its color mode, the board permits graphics screens of 160 (horizontal) by 200 pixels (vertical) in 16 colors using an alphanumeric 4- by 2-dot character box, 320 by 200 pixels in four colors, or 640 by 200 pixels in one color plus black.

The alphanumeric screen uses an 80 or 40 by 25 format and an 8- by 8-dot cell with a 7- by 7-dot character within the box. A 256-character ROM generates uppercase and lowercase characters with single-line descenders. Direct-drive outputs include horizontal sync, vertical sync, RGB TTL, and half- and full-intensity.

In its monochrome mode, the PC Video Board produces a graphics screen with a 320 or 640 by 200 resolution. Its alphanumeric screen in this mode has the same column and line sizes as in the color mode but uses a 9- by 14-dot character cell with a 9- by 12-dot character. The 256-character ROM generates character sizes in upper- and lowercase with fully formed descenders and such character attributes as underline, blanking, and reverse video. Direct-drive outputs include horizontal sync, vertical sync, video dots, and half- and full-intensity.

The PC Video Board is $495. Contact CompuPro, 3906 Breakwater Court, Hayward, CA 94545, (415) 786-0909. Inquiry 616.

2K Programmable Microcontroller

The MC-IZ is a 3- by 4-inch microcontroller with 2K bytes of RAM and 40 fully programmable I/O lines. Its resident programming language is Integer BASIC, making the MC-IZ suitable for such applications as instrumentation and process control.

This board is built around a Zilog 8671 microprocessor. It can be upgraded to 16K bytes of RAM, or it may be equipped with a 4K- or 8K-byte EPROM. Standard equipment includes a clock/calendar, two timer/counters, six interrupts, and an EPROM receptacle. With more cabling, the MC-IZ can be linked to an RS-232C terminal for applications programming. Its data rates range from 110 to 19,200 bps.

The MC-IZ comes with complete hardware and software manuals. Prices begin at less than $200. Contact Basicon Inc., 11895 Northwest Cornell Rd., Portland, OR 97229, (503) 626-1012. Inquiry 617.

(continued)
**X.25 Interface for PC**

The PC-X25 is an X.25 communications interface for the IBM Personal Computer. A plug-in board, the PC-X25 comes with supporting software that provides a menu-driven environment for accessing network services, exchanging messages, and transmitting files. Data transmission rates range up to 19,200 bps.

The PC-X25 has received PTT approval in the United Kingdom, France, Holland, Japan, and Switzerland. The manufacturer claims that approval is imminent in the United States as well as the rest of Europe and Australasia.

The single-license charge is £1000. Contact S-Com Computer Systems Engineers Inc., 509 South Rockford Dr., Tempe, Arizona, 85281-3021; (602) 966-5802; Telex: 837520 ADTRAV G. Inquiry 618.

---

**Apple IIe Video Card**

Checkmate Technology has announced the MultiView 80/160 Card, a video card that displays from 80 to 160 characters per line on a 12-MHz monitor. The MultiView 80/160's seven screen sizes are 80 characters by 24 lines, 80 by 32, 80 by 48, 96 by 24, 132 by 24, 132 by 30, and 160 by 24. Screens longer than 24 lines require a monitor with a long-persistence phosphor. The user can view each screen size in wide-angle mode for easier reading.

The MultiView 80/160 also adds up to five prompt lines to the standard screen display. The card uses an 8 by 9 matrix with true descenders to create a letter-quality character set. Characters can be displayed as bold, inverse, normal, or underlined. You can reverse-scroll up to 4096 characters.

The MultiView, you can access the extra 64K bytes by using 3 basic commands. The card is compatible with CP/M, Apple Pascal, DOS 3.3, and ProDOS.

---

**Multifunction Card for Apple IIe**

AST Research's Multi-I/O board for the Apple IIe offers a serial printer port, a communications serial port, and a ProDOS-compatible clock/calendar with battery backup. It also includes an on-disk tutorial program, clock read/set, text-file listing, graphics dump, phone dialer, modem or remote-terminal print, and screen time-display utilities package.

The price for the complete package is $235. Contact AST Research Inc., 2121 Alton Ave., Irvine, CA 92714, (714) 476-3868. Inquiry 620.

---

**Greeting Card Security**

The Greeting Card prevents unauthorized use of your Apple II, II+, or IIe. This single card has a 2Kbyte nonvolatile memory that holds a security program that gives your Apple password protection. It can be used for posting short messages, and it can hold up to eight assembly-language programs, which can be set to run when the Apple is booted up.

The Greeting Card requires 48K bytes of RAM and a disk drive. The price is $69.95. Contact Birchem disk drive. The price is $69.95. Contact Birchem Computer Products, 5728 Thames Way, Carmichael, CA 95608, (916) 489-7342. Inquiry 621.

---

**A/D Cards**

Action Instruments offers a line of plug-in, IBM PC-compatible analog and digital I/O cards for industrial process and laboratory applications.

The AICP-AI04 accepts 4 analog inputs, transmits 2 analog outputs, and provides 16 channels of configurable digital I/O, all with 12-bit resolution. The AICP-AI016, also with 12-bit resolution, accepts 16 single-ended or 8 fully differential inputs. The AICP-AI08 handles 8 single-ended, ±5-volt inputs and provides 7 channels of digital I/O.

Both the AICP-RTD15 and the TC15 are designed for temperature applications. Each accepts up to 15 input channels and provides 500-volt input-to-expansion bus signal isolation.

The AICP-SG4 enables the IBM PC to monitor and control force, strain, and pressure applications. A general-purpose, low-level analog card, the SG4 provides 8 outputs and sources its own excitation voltages for direct connection to load cells, strain gauges, and pressure transducers. Also standard are front-end filtering and individual on-board channel alarm set points.

The AICP-DIM32 has 32 input channels, and the -DOM32 has 32 output channels. Both are designed for interfacing multiple digital signals to the IBM PC and can connect with industrial, isolated high-level I/O racks. They provide positive or negative true TTL-compatible logic levels.

Prices range from $250 for the AICP-DIM32 to $1295 for the thermocouple, RTD, and strain-gauge cards. Contact Action Instruments Inc., 8601 Aero Dr., San Diego, CA 92123, (619) 279-5726. Inquiry 622.
Omninet for the Mac

Corvus Systems' Omninet local-area network can connect up to 63 Macintoshes at distances up to 4000 feet and run at 0.7 megabits per second. This card is built into the computer interface cable; you plug the cable into the modem port of the Mac.

The connections for Omninet are $200. Disk drive costs depend on amount of memory: $1795 for 5 megabytes, $2495 for 10 megabytes, $3495 for 16 megabytes, and $4995 for 45 megabytes. Contact Corvus Systems Inc., 2100 Corvus Dr., San Jose, CA 95124, (408) 559-7000. Inquiry 623.

High-Speed Printer

The OT-700 dot-matrix printer from Output Technology uses an advanced print-head technique to reach a maximum speed of 700 characters per second. It also features correspondence-quality printing at 350 cps and dot-addressable graphics capability in two modes: 50 by 69 dots per inch for high speed or 100 by 69 dpi for high resolution.

Centronics parallel and RS-232C serial interfaces and a 4K-byte buffer are standard. You use menu-driven program commands to configure the OT-700. Numerous character sets, including foreign languages, are offered.

The printer has 136-column carriage width, and paper feeds from the front or bottom of the case. The control panel features membrane switches and LED indicator lights. The OT-700 sells for $1595. Contact Output Technology Corp., Suite 203, 606 110th Ave NE, Bellevue, WA 98004. (206) 453-9794. Inquiry 624.

Multiuser Hard Disk for the IBM

A multiuser, 38-megabyte hard-disk drive for the IBM PC or PC XT is available from Adcomp. Up to 16 microcomputers can access the system, which includes a removable 6-megabyte disk drive for backup. Its modular design lets you expand it to use more computers and up to 100 megabytes of memory.

Adcomp also offers ready-made file administration for multiuser applications. One computer supervises the access administration for the others while it remains functional as a workstation.

The hard-disk system costs $3995. Contact Adcomp Datensysteme GmbH, Olgastrasse 13, D-8000 Munich 19; tel: 011 (49) 89-129-80-45; Telex: 5216271. Inquiry 625.

Graphics and Letter-Quality Print

Star Micronics has announced the Star SB-10, a letter-quality, dot-matrix printer. The Star SB-10 produces text at two speed and quality settings: letter quality at 60 cps and draft quality at 120 cps. It also can combine letter-quality text with graphics.

The printer's character fonts include pica, elite, condensed, proportional, expanded, emphasized, and double-strike. It has a standard Centronics parallel interface plus optional serial (RS-232C) and GPIB (IEEE-488) interfaces. Some of the Star SB-10's features are continuous underline, vertical and horizontal programmable tabs, self-test, left and right margin set, and bit-image column scan.

The Star SB-10 is $995. For details, contact Star Micronics Inc., 200 Park Ave., New York, NY 10166. (212) 986-6770. Inquiry 626.

(continued)
Passport Comes with Hard Disk

Anderson Jacobson's AJ Passport/PHD desktop computer gives you both floppy- and hard-disk storage. The system behind the storage has 256K bytes of dynamic RAM, on-board color, graphics, and five expansion bus slots. An MS-DOS 2.11-compatible operating system, TeleDOS controls operations.

Based around Intel's 8088 microprocessor, the Passport/PHD comes with an asynchronous RS-232C serial communications port, a parallel Centronics-type printer port, a single internal IBM PC-format bus slot, and RGB and composite-video connections. It has fifteen data rates, ranging from 50 to 9600 bps.

The slimline 5¼-inch floppy-disk drive provides 360K bytes of formatted storage, and the 3½-inch hard disk offers 10 megabytes. The floppy-disk transfer rate is 250K bits per second. The hard disk offers a 5-megabit per second transfer rate.

The Passport/PHD has a 12-inch amber display with a nonglare surface that tilts and swivels. Graphics capabilities are supported by 16K bytes of dedicated memory. The monochrome display resolution is 640 by 200 pixels. The color resolution is 320 by 300 pixels.

The IBM PC-style keyboard features 83 keys, with a numeric pad and 10 programmable function keys. The Passport/PHD is $4095, which includes integrated word-processing, spreadsheet, and database-management programs. Contact Anderson Jacobson, 521 Charcot Ave., San Jose, CA 95131, (408) 945-9030.

Datapoint Announces 32-bit Computer

The Datapoint 3200, a 32-bit computer has a UNIX-like operating system known as UNOS. The 3200 can serve as a stand-alone system and as a member of Datapoint’s ARC intelligent local-network system.

UNOS, which is said to optimize 68000 performance, provides such file-management capabilities as multi-tasking, device-independent I/O, dynamic file allocation, I/O redirection, and hierarchical directory structure.

Software options for the 3200 include C, RM/COBOL, and a business programming language. Ace Microsystem's LEX word processor and Microsoft's Multiplan are supported.

The 3200 has dual 68000 microprocessors. One 68000 has a 4K-byte cache memory for application processing at a 12.5-MHz clock rate. The second 68000 organizes I/O.

Presently, two models are available with a variety of options, including up to 8 megabytes of RAM, three types of terminals, three different printers, and a 2780/3780 communications adapter. The 3200 can support 28 Datapoint terminals.

An entry-level 3200 comes with 1 megabyte of RAM, cache memory, and four serial ports. A 1-megabyte 8-inch floppy disk and a 32-megabyte hard disk provide mass storage. The base system price is $15,430 through Datapoint’s ISO and direct sales force. UNOS is $1000, and a network adapter is $2,500. For more information, contact Datapoint Corp., 9725 Datapoint Dr., San Antonio, TX 78284, (800) 334-1122.

A Wyse Line of IBM PC-Compatibles

Wyse Technology has unveiled a line of IBM PC-compatible computers. The WYSePC Model WY-1100-1 is an entry-level system. It comes with a pair of 360K-byte double-density floppy-disk drives, 256K bytes of RAM, two serial ports, and a parallel printer port. A 14-inch tilt-and-swivel monochrome display and a 101-key keyboard are standard. Two expansion slots provide room for IBM PC-compatible options.

The IBM PC XT-compatible Model 1100-2 comes with a 10-megabyte Winchester hard-disk drive and one floppy-disk unit.

Both units are shipped with MS-DOS 2.11 and GW-BASIC and are offered with a color graphics option. Other options include 256K bytes of RAM, a real-time clock/calender, battery backup, and an expansion chassis with four IBM PC-compatible slots.

The Model 1100-1 is $1995, while the Model 1100-2 is $3495. The color graphics option is $500. Contact Wyse Technology, 3040 North First St., San Jose, CA 95134, (408) 946-3075.

Inquiry 627.
**WHAT'S NEW**

**SOFTWARE • APPLE**

**Musical Macintosh**

Even if you can't read a note of music, you can use MusicWorks to create and perform music on a Macintosh. MacroMind, developer of the software, claims the program enables anyone to compose and edit simple melodies or fully orchestrated symphonies. The compositions can then be played back with as many as four voices simultaneously over an eight-octave range, and you can assign each voice any one of eight musical instruments. You can vary the tempo, intensity, timbre, and meter.

MusicWorks features two composing options. In the first method, you place notes and rests on a conventional staff. In the second method, you place boxes on a matrix grid that resembles the keys of a piano. The program automatically updates the composition in standard notation and can print scores for one instrument or for an ensemble.

The program comes with sample songs that you can edit and rearrange. The manual includes an introduction to the basics of music.

MusicWorks for the Apple Macintosh costs $79.95 and is being marketed by Hayden Software Company Inc., 600 Suffolk St., Lowell, MA 01854. (617) 937-0200. Inquiry 630.

**MacManage Projects**

A project-management tool for the Macintosh, MacProject enables you to draw a schedule on the screen and enter beginning dates, required completion dates, resources, and fixed and variable cost data for each task. MacProject then calculates the start and finish dates.

The program features "what-if" analytical capability that lets you instantly recalculate dates, resources, and expenses when variables are introduced into a project. You can cut and paste sections of projects into other project schedules or into files created with MacWrite. You can also transfer cost data to Multiplan for further analysis. Schedules, resources, and tasks can be represented in tables.

MacProject can accommodate up to 200 jobs on the 128K-byte Macintosh and up to 2000 jobs on the Lisa 2 or the 512K-byte Macintosh. Available from authorized Apple dealers, the package has suggested retail price of $125. Contact Apple Computer Inc., 20525 Mariani Ave., Cupertino, CA 95014. (408) 996-1010. Inquiry 631.

**High-Level Language**

Based on the FORTH language model, SkyForth 1.3 is a development system for the Apple II series. According to the vendor, SkyForth can execute 10 iterations of the Sieve of Eratosthenes benchmark in 139 seconds and alphabetize 2000 five-character names in 5.2 seconds.

The language, including its source-code editor, resides in the upper 16K bytes of the computer. Since the editor/compiler is always resident, you can write, compile, and test programs quickly. SkyForth reads and writes its programs as continuous Apple DOS 3.3 files. You can save finished programs and overlays as object code.

The developer features a full assembler, utility and debugging routines, and a turnkey, run-time package. SkyForth's kernel includes words to handle floating-point math, 32-bit integers, memory moves, sorts, list structures, and windowed graphics.

A single-user license costs $99. Contact Tosch Information Management, Dept. 5, 16025 10th Ave. SW, Seattle, WA 98166. (206) 246-3839.

**Introduction to CAD**

With CADAPPLE—Entry Level, you can learn and apply the fundamentals of computer-aided design (CAD). The program features menus and single-stroke operation, built-in error recovery, and floating-point internal calculations.

The package provides lines, arcs, circles, rectangles, ellipses, polygons, and text. You can select grid spacing and divisions in both x and y axes independently. In "real world" coordinates, and change them at any time. You can input with a keyboard, joystick, mouse, or KoalaPad. Any distance can be dimensioned automatically. You can scale objects or groups of objects independently, rotate them to any degree or delete (or undelete) them. Windowing functions let you zoom in and out of a drawing or pan across it. Drawings are done on a plotter.

CADAPPLE—Entry Level costs $495 and runs on an Apple II or II+ with 64K bytes of memory and on an Apple IIc or IIe. Contact T & W Systems Inc., Suite 106, 7372 Prince Dr., Huntington Beach, CA 92647. (714) 847-9960.

**System Helps You Search Information Databases**

Searchware has developed a software system that enables an Apple computer to access and search information databases. The system emphasizes a knowledge of the subject you are investigating rather than familiarity with the search procedures of each database.

According to the company, you don't need to know the syntax of search commands. The program asks you to identify key words in the subject of interest; the search strategy is then developed off-line, which can reduce search-time charges. When the strategy is complete, the computer automatically dials the phone number of the database, logs on, transmits the search strategy, records the results of the search either on paper or on floppy disk, and then logs off and disconnects.

You can search at three levels. The first level takes care of commands, syntax, and logic. At the second level, the software develops and transmits the search commands, but you create the logic. The third level lets you search online.

Searchware bills monthly for search-time charges. There is no minimum monthly charge.

The company is offering an automated demonstration program for $15. No modem is required to run this program. Complete software packages start at $290. A version for the IBM PC is also available. Contact Searchware Inc., Suite E, 22458 Ventura Blvd., Woodland Hills, CA 91364. (818) 992-4325. Inquiry 634.

(continued)
WordStar Commands Placed on Function Keys

Keys Please! with instant install gives WordStar users the convenience of single-keystroke operation. This enhancement package, published by Precision Software Products, places all 140 WordStar commands onto function keys and automatically activates all WordStar's printer capabilities, including condensed, bold, and italics. Commands are grouped by function, and an on-screen command summary line eliminates the need for rote memorization of key combinations.

Hardware modifications or optional boards are not required. Keys Please! with Instant Install runs on CP/M 2.2, CP/M-80, CP/M 3.0, TurboDOS, CDOS, and Cromix systems with 56K bytes of RAM. It also works with MS-DOS and PC-DOS version 1.x or 2.x computers with 128K bytes of RAM. Two disk drives are required. A variety of printers are supported. The suggested list price is $69.95. For more information, contact Precision Software Products, Suite 204, 360 17th St., Oakland, CA 94612, (415) 839-5780.

Hard-Disk Backup Traps Errors in CP/M-86

BackRest 2.0 is a hard-disk drive backup program for such operating systems as CP/M-86. MS-DOS, and MP/M. When used with CP/M-86, BackRest will trap hard system errors, even though that operating system does not support error trapping.

BackRest: can interrupt a backup at any time to perform a priority task or to format additional floppy disks. After the interruption, it can resume the backup procedure from where it left off. It looks out bad sectors on the hard disk, and it supports backups to most file-oriented tape devices. Standard features include optional restoration to an alternate drive, automatic restoration, the ability to split large files over several floppy disks, backup of sparse files, and local-area network support.

Other DOSes supported include PC-DOS. Concurrent CP/M, CP/M 2.2, CP/M Plus, MP/M-86, and TurboDOS. The suggested retail price is $180. Contact Stok Software Inc., 17 West 17th St., New York, NY 10011, (212) 243-1444.

Integrated Package Grows with You

TymIV is an integrated software package that can be expanded as your needs increase. The basic package, known as Anthology, comes with word-processing, spreadsheet, analysis, and database-management capabilities. For more sophisticated data management, there's Six, a universal database package that lets you save, recall, and edit large quantities of information and print standard or custom-designed reports, forms, and labels.

At the heart of this package is a native C code master program called Execu/Bus. Execu/Bus serves as a common environment by generating uniform commands and screen presentations for all applications. These commands control the start-up and completion of a task as well as provide an interface for data swapping among applications. Operating system utilities can be accessed through Execu/Bus. Utility functions include file backup and copy; rename, delete, and print file; and display directory. A common help facility supports all applications.

Presently, the manufacturer has 18 vertical and horizontal applications in the TymIV series, including financial application templates, plotting software, banking packages, and communications. The TymIV series runs on MS-DOS, PC-DOS, and UNIX System V systems. Anthology is $495, and the suggested price for Six is $395. Specialized applications range from $195 to $1500. For details, contact TymIV Marketing, 20705 Valley Green Dr., Cupertino, CA 95014, (408) 446-7406.

Product Generation Utility Eases Rebuilding Process

Lattice has announced the availability of an automated product generation utility for MS-DOS. Called LMK, this product functions like a UNIX MAKE facility. LMK is designed to facilitate the making of alterations in a variety of source files. It eliminates the manual reconstruction of a product's source files and scope in constructing software documentation, or file systems is limitless.

Here's what LMK does: Once you have specified the relationships between various pieces of a system, such as source modules, object modules, or chapters of a manuscript, in a "dependency file," you can invoke a single LMK command to automatically rebuild the system. LMK's actions can be any executable command, such as invoking a batch text editor to make replacements in a file, applying a file comparator to new and old files, updating a database, or running utilities.

Minimum system requirements are 320K bytes of floppy-disk capacity, 128K bytes of RAM, and MS-DOS 2.0 or 3.0. It runs on computers based on 8086, 8088, 80186, or 80286 microprocessors. The suggested retail price for LMK with full documentation is $195. For further information, contact Lattice Inc., POB 3072, Glen Ellyn, IL 60138, (312) 838-7950.

Software Connections Supports Networks 1.0

Software Connections has announced a line of network applications software that works with Microsoft's Networks 1.0 network-operating system extension. Products available include a relational database-management system, a relational database-development tool, and a store-and-forward electronic-mail file-transfer system.

Contact Software Connections, 2041 Mission College Blvd., Santa Clara, CA 95054, (408) 988-0300.

Inquiry 638.
Equation Processor

Equate is an equation processor for the IBM PC and compatibles using DOS 1.1 through 2.1. It lets you enter up to 799 equations anywhere on screen in standard algebraic notation. A full-screen text editor facilitates equation and explanatory-text entry, and an interactive Constants Window gives you more than 400 physical constants and measurement conversions to insert into equations. Equations or other constants can be added to the window.

Equate evaluates your equations, prompts for undefined variables, and produces 16-bit (double-precision) results at the press of a function key. A forms feature helps you devise application worksheets that prompt for data or arrange results into tables. Data cells can be sited at any spot on screen; rows or columns are not mandatory.

Equations, results, and tables can be stored as worksheets. Worksheets may be printed or transferred to a word processor that accepts ASCII files.

The General Worksheet Series Disk 1 comes with Equate. It provides worksheets for solving simultaneous equations and for calculating standard deviation, variance, and the area and moments of inertia for principal shapes.

Equate comes with an evaluation version that's good for 30 uses. The master disk and related materials can be returned to the manufacturer within 30 days for a full refund. Equate is $195. Contact Ban-yan Systems Corp., 5632 East Third St., Tucson, AZ 85711, (602) 745-8086. Inquiry 640.

Soft Winchester: Inexpensive, Alternative Hard Disk

The BYSO Soft Winchester program from Levien Instrument Company stores your most frequently used data in RAM so that you can access it quickly. The manufacturer says that with Soft Winchester such programs as WordStar and dBASE II will load or sort hundreds of times faster than from a floppy.

Soft Winchester lets you use 1440K bytes of data. If you have data that cannot be accessed from RAM or disk, it prompts you for the disk with the data. It automatically backs up your data to disk, and, once loaded, its operation is transparent. A simple key combination lets you use new 1440K-byte sets of data.

The BYSO Soft Winchester runs on 128K-byte IBM Personal Computers, including the PCJr, and true IBM compatibles. A monochrome or graphics adapter is required. It costs $60. For more information, contact Levien Instrument Co., POB 31, McDowell, VA 24458, (703) 396-3345. Inquiry 641.

FORTRAN and UNIX for AT

Unisource Software Corporation has introduced a UNIX-based FORTRAN-77 compiler for the IBM PC XT and PC AT. In a related development, the Massachusetts-based publisher and distributor of UNIX software also announced an implementation of UNIX for the IBM PC AT.

The FORTRAN compiler runs under VENIX on such machines as the IBM's AT&T 6300, Compaq Plus, Eagle Turbo, MAD 1, and DEC Professional 350. It costs $395. Its UNIX operating system, claims Unisource, is the first licensed implementation of AT&T UNIX for the the IBM PC AT. This version is delivered with a System V UNIX license. A full implementation for one or two users retails for $875. For up to eight users, it's $1075.

For further information, contact Unisource Software Corp., 71 Bent St., Cambridge, MA 02141, (617) 491-1264. Inquiry 642.

IBM Fits the Curves

A curve-fitting program for the IBM PC, Curve Fitter-PC is available directly from Interactive Microware. Curve Fitter-PC fits curves to experimental or business data. Curve types include polynomial, cubic spline, or Stineman interpolation methods. If you want least-squares fitting can produce the standard curve using a polynomial (degree 1 to 6), geometric, or exponential least-squares method. Any or all fitting models can be used to select the best fit.

Some statistical measures of the accuracy of the fitted curve provided are standard error of estimates and percent deviation for calculated versus observed values.

Features include curve-fitting demonstrations, high-resolution (i.e., 320 by 200) graphics, choice of plotting symbols on the same graph for distinguishing multiple superimposed curves, the ability to enter data as x-y pairs or as values at fixed intervals, and four text-label locations. Working files can be saved and transferred to programs that accept ASCII data.

Minimum requirements are 128K bytes of RAM, color graphics board, a disk drive, and PC-DOS 1.1, 2.0, or 2.1. The manual alone is $15; the complete package is $95. Contact Interactive Microware Inc., POB 139, State College, PA 16804-0139, (814) 238-8294. Inquiry 643.

WHERE DO NEW PRODUCT ITEMS COME FROM?

The new products listed in this section of BYTE are chosen from the thousands of press releases, letters, and telephone calls we receive each month from manufacturers, distributors, designers, and readers. The basic criteria for selection for publication are: (a) does a product match our readers' interests? and (b) is it new or is it simply a reintroduction of an old item? Because of the volume of submissions we must sort through every month, the items we publish are based on vendors' statements and are not individually verified. If you want your product to considered for publication (a no charge), send full information about it. Including its price and an address and telephone number where a reader can get further information, to New Products Editor, BYTE, POB 372, Hancock, NH 03449.
Inquiry 302

SUNTRONICS CO., INC.
12621 Crenshaw Blvd., Hawthorne, CA 90250

NEW BRANCH STORE IN ORANGE COUNTY, CALIFORNIA: 17552 BEACH BLVD., #C, HUNTINGTON BEACH, CA 92647 (714) 842-1948

1-800-421-5775 (Order Only)
(213) 644-1140 (CA. Order & Info.)
STORE HOURS: Mon.-Fri. 9 a.m. to 6 p.m.
Sat. 10 a.m. to 5 p.m.

TERMS: VISA, MASTER Card.
In 50 States or on ordering check No.
Toshiba 3624 W 110th St, Los Angeles, CA 90047.

IBM & Apple are registered trade
marks of IBM & Apple.

Inquiry 302

XT Compatible Products

| 16K RAM Card | $49.00 |
| 50 Card (w/o software) | $55.00 |
| 80 Column Card (w/soft switch) | $85.00 |
| Power Supply (5 Amp) | $59.95 |
| Cooling Fan | $42.00 |
| Parallel Printer | $55.00 |
| Floppy Disk Controller | $47.00 |
| EPROM Programmer (2176, 32, 64) | $75.00 |
| Apple Disk Drive | $160.00 |
| APARTER PROM Blaster | $119.00 |
| Apple Prototype Board (SUN-722) | $5.95 |

SAW WO HIGH RESOLUTION MONITOR

Features:
- 22 MHz Bandwidth
- Composite Video
- Anti-glare Screen
- Passes FCC & UL Approved
- 1000 Lines or 132 Characters Across

12" AMBER or GREEN | $99.00

TAXAN RGB-III Monitor | $420.00

12" Green TTL Monitor
(For IBM, 20 MHz) | $135.00

S-100 Products

40K Static Memory Board (21616) with /RAM A & T | $155.00
40K Dynamic Memory Board (21616) with /RAM A & T | $295.00
Uses 21616 CMOS RAMS, 1/2 Amp Max, w/SAK extended addressing, Bank
Select 4-16K Blocks, 21616 EPROM can replace any 21616 RAM, 8 Bit IEEE 696.
UFDC-1 5/4 and 8 Floppy Disk Controller
(BIOS available) A & T | $225.00
Clock/Calendar A & T | $115.00
Mother Board/Card Cages
(6, 8 & 12 Slots) are available | CALL

SPECIAL SALE ITEMS

* 1MB Hard Disk Drive (Internal)
  with Controller for IBM PC | $749.00
* IBM Prototype Board (SUN-208) | $9.50
* IBM PC Mouse | $147.00
* Diskette DDSQ 5/4 | $16.00/10
* Koala Graphics Table w/Software for Apple
  Price: $89.00 for IBM
  Price: $105.00
* Quad Board II | $249.00
* Quad S12 (64K) | $259.00
* RAM 4146 (150ns) | $3.55

TTI IC, RAM, & CPU CHIPS, CONNECTORS & IC SOCKETS ARE AVAILABLE.

HAY REL ★ SWITCHING POWER SUPPLIES ★ LOW COST

SW40W

<table>
<thead>
<tr>
<th>ITEM</th>
<th>FOR</th>
<th>+5V</th>
<th>-5V</th>
<th>+12V</th>
<th>+12V</th>
<th>-12V</th>
<th>+24V</th>
<th>+8V</th>
<th>+16V</th>
<th>W x D x H in.</th>
<th>TERMINALS</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW40W</td>
<td>TERM &amp; 2 ALPS DRIVES</td>
<td>2.5A</td>
<td>-2.5A pk.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>6.3 x 3.9 x 1.9</td>
<td>MOLEX 5051</td>
<td>$54.95</td>
</tr>
<tr>
<td>SW40W</td>
<td>APPLE III, IBM PC-I, II</td>
<td>2A</td>
<td>2A</td>
<td>2.5A/5A pk.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>MOLEX 126-P1</td>
<td>$49.95</td>
</tr>
<tr>
<td>SWBOW</td>
<td>IBM PC with SOFT DRIVES</td>
<td>2A</td>
<td>2A</td>
<td>3A/4A pk.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>MOLEX 5051</td>
<td>$64.95</td>
</tr>
<tr>
<td>SW138</td>
<td>IBM PC-XT w/128K RAM</td>
<td>2A</td>
<td>2A</td>
<td>4A/5A pk.</td>
<td>10A</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>MOLEX 5051</td>
</tr>
<tr>
<td>SW150</td>
<td>IBM PC with HARD DRIVES</td>
<td>2A</td>
<td>2A</td>
<td>4A/5A pk.</td>
<td>2.5A</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

SPECS. OF ABOVE SWITCHERS: 117/220 VAC SELECTABLE, INPUT 90-122 VAC/180-275 VAC, EFTIC. 75%, TYPICAL, LINE REGUL. 1%, LOAD REGUL. 1% ON +5V, 5% ON OTHER VOLTAGES, 220V SETTING ON +5V, OVERLOAD & SHORT CIRCUIT PROTECT, LOW OUTPUT RIPPLE & NOISE. 1% MAX, 50,000 HRS MTBF RELIABILITY, UL, FCC & VDE SAFETY & NOISE STANDARDS.

S3 for S-100, 6 SLOTS | 5A | 1A | - | 5/5A pk. | 3A | 10 x 3 x 1.2 | SOLDER POST | $105.95
S4 for S-100, 6 SLOTS | 4A | 1A | - | 4/4A pk. | 2A | 8 x 3 x 1.3 | SOLDER POST | $89.95
R1 for 2 FLOPPY DRIVE | 3A | 3A | - | 3A/4A pk. | - | 8 x 4 x 1.3 | SOLDER POST | $44.95
R1A for 3 PC | 3A | 3A | 3A/4A pk. | - | - | 8 x 4 x 1.3 | SOLDER POST | $30.95
C64 for COMMODORE (C64+C4) | 8A | 2A | 4A/8A pk. | 2A | 4A/8A pk. | 10 x 4 x 1.2 | SOLDER POST | $19.95

POWER TRANSFORMERS: WITH MOUNTING BRACKET (ON SALE)

<table>
<thead>
<tr>
<th>ITEM</th>
<th>PRIMARY</th>
<th>SECOND. #1</th>
<th>SECOND. #2</th>
<th>SECOND. #3</th>
<th>W x D x H in.</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>11/120 VAC</td>
<td>2 x 8 VAC/7A</td>
<td>28 VAC, CT, 2A</td>
<td>-</td>
<td>3 x 3 x 2.7</td>
<td>$15.95</td>
</tr>
<tr>
<td>T2</td>
<td>11/120 VAC</td>
<td>2 x 8 VAC/12A</td>
<td>28 VAC, CT, 2A</td>
<td>-</td>
<td>3 x 3 x 2.7</td>
<td>$15.95</td>
</tr>
<tr>
<td>T3</td>
<td>11/120 VAC</td>
<td>2 x 8 VAC/6A</td>
<td>28 VAC, CT, 2A</td>
<td>-</td>
<td>3 x 3 x 2.7</td>
<td>$15.95</td>
</tr>
<tr>
<td>T4</td>
<td>11/120 VAC</td>
<td>16 VAC, CT, 4A</td>
<td>28 VAC, CT, 1A</td>
<td>-</td>
<td>3 x 3 x 2.7</td>
<td>$15.95</td>
</tr>
<tr>
<td>T4-1</td>
<td>11/120 VAC</td>
<td>16 VAC, CT, 4A</td>
<td>28 VAC, CT, 1A</td>
<td>-</td>
<td>3 x 3 x 2.7</td>
<td>$15.95</td>
</tr>
<tr>
<td>T5</td>
<td>11/120 VAC</td>
<td>16 VAC, CT, 4A</td>
<td>28 VAC, CT, 2A</td>
<td>-</td>
<td>3 x 3 x 2.7</td>
<td>$15.95</td>
</tr>
</tbody>
</table>

IBM PCPC-XTX, APPLE III & COMMODORE C64+C4 ARE TRADEMARKS OF IBM CORPORATION, APPLI COMPUTER INC. & COMMODORE BUSINESS MACHINES, RESPECTIVELY.

MAILING ADDRESS:
P.O. BOX 4296
TORRANCE, CA 90510

SUNNY INTERNATIONAL
IN BUSINESS SINCE 1975
(213) 328-2425 MON-FRI 8:30-5:30

SHIPPING ADDRESS:
22129 S. VERMONT AVE.
TORRANCE, CA 90502

428 BYTE • FEBRUARY 1985

Inquiry 301
### 1985 Mail Order Pricing Only

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANTENNAS 14 DBI 90° Wide</td>
<td>$39.95</td>
</tr>
<tr>
<td>APPLE I/O BOARD</td>
<td>$94.95</td>
</tr>
<tr>
<td>APPLE MOUSE</td>
<td>$39.95</td>
</tr>
<tr>
<td>APPLE TERMINAL BLOCKS</td>
<td>$34.95</td>
</tr>
<tr>
<td>APPLE TERMINAL BLOCKS</td>
<td>$34.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB CARTRIDGE</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
<tr>
<td>APPLEGATE 10MB DISK</td>
<td>$59.95</td>
</tr>
</tbody>
</table>
When's the last time you saw "digging a well" on someone's résumé? Working in the Peace Corps is not your average everyday job.

Whatever it takes to be Peace Corps volunteers, it's a way of working that develops a resourcefulness and a degree of self-reliance that volunteers use long after they've come home. Anyplace they work. On any job they're given.

Hire a former Peace Corps volunteer, and put that experience to work on your "toughest job." Call Peace Corps toll-free, 800-424-8580 (ext. 76) to tell them about job possibilities for returned volunteers. Or if you know of those who might like to volunteer, use the same phone number (ext. 93) to put their experience to work where it can do a world of good.

Peace Corps
The toughest job you'll ever love.
The Computer Parts Merchant is a leading nationwide supplier of wholesale I.C.'s. We have just about every I.C. made in stock today. Plus, we offer these special services:

Guaranteed parts—every part guaranteed for 60 days—and pre-tested before shipment.

Guaranteed fast—same day—shipping.

Guaranteed low prices.

Guaranteed satisfaction or purchase price cheerfully refunded.

How to order.
Call toll free. We accept Visa, Mastercard or American Express. Or we can ship UPS C.O.D.
National 800-235-4900
California 800-238-4900
Local Orange County (714) 474-1033.

A few samples from our million part inventory:

<table>
<thead>
<tr>
<th>74LSX</th>
</tr>
</thead>
<tbody>
<tr>
<td>74L200 $3.80</td>
</tr>
<tr>
<td>74L203 $3.80</td>
</tr>
<tr>
<td>74L204 $4.00</td>
</tr>
<tr>
<td>74L207 $4.45</td>
</tr>
<tr>
<td>74L208 $4.99</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>74SXX</th>
</tr>
</thead>
<tbody>
<tr>
<td>74000 $4.50</td>
</tr>
<tr>
<td>74001 $4.50</td>
</tr>
<tr>
<td>74002 $4.50</td>
</tr>
<tr>
<td>74004 $4.50</td>
</tr>
<tr>
<td>74005 $4.50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DYNAMIC RAMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMS4060 $1.99</td>
</tr>
<tr>
<td>TMS4060 $1.99</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>74X</th>
</tr>
</thead>
<tbody>
<tr>
<td>7400 5 3.50</td>
</tr>
<tr>
<td>7401 5 3.50</td>
</tr>
<tr>
<td>7402 5 3.50</td>
</tr>
<tr>
<td>7404 5 3.50</td>
</tr>
<tr>
<td>7405 5 3.50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STATIC RAMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4001 $1.75</td>
</tr>
<tr>
<td>4002 $1.75</td>
</tr>
<tr>
<td>4003 $1.75</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CMOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4001 $1.75</td>
</tr>
<tr>
<td>4002 $1.75</td>
</tr>
<tr>
<td>4003 $1.75</td>
</tr>
</tbody>
</table>

Visit our retail store:
The Computer Parts Merchant, Inc.
17777 Main Street, Suite D
Irvine, CA 92714

Terms: minimum order $10. For shipping and handling, include $2.50 UPS Ground, or $3.50 for UPS Air. California residents must include 6% sales tax. All prices are subject to change without notice. We are not responsible for typographical errors. All merchandise subject to prior sale.

Search service. If we don’t have the I.C. you need in stock, we can find it for you. (There is a $25 minimum charge for I.C.’s found through a search.)

A few samples from our million part inventory:

<table>
<thead>
<tr>
<th>PARTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>74000 5.00</td>
</tr>
<tr>
<td>74001 5.00</td>
</tr>
<tr>
<td>74002 5.00</td>
</tr>
<tr>
<td>74004 5.00</td>
</tr>
<tr>
<td>74005 5.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CMOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4001 $4.99</td>
</tr>
<tr>
<td>4002 $4.99</td>
</tr>
<tr>
<td>4003 $4.99</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CMOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4001 $4.99</td>
</tr>
<tr>
<td>4002 $4.99</td>
</tr>
<tr>
<td>4003 $4.99</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Memory EPROMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2708 $3.95</td>
</tr>
<tr>
<td>2708 $3.95</td>
</tr>
<tr>
<td>2708 $3.95</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MEMORY EPROMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2708 $3.95</td>
</tr>
<tr>
<td>2708 $3.95</td>
</tr>
<tr>
<td>2708 $3.95</td>
</tr>
</tbody>
</table>

The Computer Parts Merchant, Inc.
This series in the CCT line exploits the speed and power of the Intel 80286 and Zilog Z-80(8MHz), on the 286Z CPU board. This combination, along with CompuPro DMA controllers and I/O boards, yields a dramatic improvement in system throughput speeds, from basic CP/M operation, up to large powerful multi-user/multi-tasking machines. The CCT-4 represents the most advanced hardware presently available in a microcomputer to run the thousands of CP/M type software programs on the market, and with CONCURRENT DOS 8-16 and the CompuPro PC Graphics board (when available), all software written for the IBM PC machines. This series is for the serious business/scientific user.

**CCT-4A**
State-of-the-art power in its basic form. Consists of CCT-286Z CPU board and CCT-M256 (256K), along with CompuPro Enclosure 2 Desk, Floppy Drive System, Interfacer 4, and Surgefree SF-200 surge suppressor system. 

**CCT-4B**
Single-user/hard disk power. As the 4A, except priced without the CCT-2-4, to add in your choice of CCT hard/floppy combination drive subsystem, at the published price.

**CCT-4C**
Multi-user/hard disk power. As the 4B, with the CCT-M512 (512K static RAM board) instead of M256; Interfacer 3 instead of Interfacer 4; Surgefree SF-400 instead of SF-200, plus MPU/MPM 8-16 operating system. (6 user system)

The latest CCT implementation of the new generation Intel 16-Bit Processor technology. This means extreme speed, unequaled power, and the ultimate in reliability, and of course, the innovators at CCT behind it.

**CCT BONUS ON 4C: FREE CONCURRENT DOS UPDATE!**
The above systems include all necessary cabling, assembly, testing, minimum 20 hour burn-in, and the CCT unconditional 12 month direct warranty.

**CCT-M512**
CCT introduces its 512K static RAM board. IEEE Standard 12MHz, 512K in one slot! 

**CCT-M256**
256K version of M512 upgradeable to full 512K. Perfect 256K RAM board for any CompuPro system.

SOMEBODY Has To Have The Lowest Prices!

**MONITORS**

- AMDEK 300 $135.00
- PGS MX-12 $475.00
- PGS MX-25 $450.00
- PGS SX-12 $625.00
- TAXAN GREEN COMPOSITE $125.00
- TAXAN AMBER COMPOSITE $135.00
- TAXAN GREEN W/TTLPLUS $149.00
- TAXAN AMBER W/TTLPLUS $159.00
- IBM MONOCHROME DISPLAY $260.00
- IBM COLOR DISPLAY $290.00

**PRINTERS**

- EPSON FX-80 $425.00
- EPSON FX-100 $425.00
- EPSON FX-80FT $395.00
- OKIDATA 62A $299.00
- OKIDATA 83A $569.00
- OKIDATA 82P $399.00
- OKIDATA 83P $625.00
- OKIDATA 84P $795.00
- OKIDATA 2493P $1699.00
- TOSHIBA P2515 $1395.00
- NEC PINWRITER 3500 $1895.00
- NEC PINWRITER 80 COL $899.00
- NEC PINWRITER 136 COL $899.00
- BROTHER HR-25 $999.00
- BROTHER HR-35 $925.00

**HARD DISKS**

- IBM PC, 528K, Modular 320K Disk Drive DS/DD, Persyst Color Card, Taxan Green Monitor, DOS 2.1, 120 Watt Power Supply, IBM Hard Disk Sub System PLUS 10MB Tape Back Up System all for:
  
  **$2590.00**

- IBM PC, 256K, Two Half Height Drives DS/DD, Persyst Color Card, Taxan Green Monitor, DOS 2.1, 120 Watt Power Supply PLUS a 10MB Hard Disk Sub System all for:
  
  **$2380.00**

- IBM PC, 256K, Two Half Height Drives DS/DD, Persyst Color Card, Taxan Green Monitor, DOS 2.1, 120 Watt Power Supply PLUS 10MB Tape Back Up System all for:
  
  **$3575.00**

- IBM PC, 256K, Two Half Height Drives DS/DD, Persyst Color Card, Taxan Green Monitor, DOS 2.1, 120 Watt Power Supply, 20MB Hard Disk Sub System all for:
  
  **$3380.00**

- IBM PC, 256K, Two Half Height Drives DS/DD, Persyst Color Card, Taxan Green Monitor, DOS 2.1, 120 Watt Power Supply, 20MB Hard Disk Sub System PLUS 10MB Tape Back Up System all for:
  
  **$3979.00**

**DRIVES**

- TANDON TM-100-2 $179.00
- SLIMLINE TOSHIBA $155.00
- SLIMLINE - TAC 550 $155.00

**MULTIFUNCTION BOARDS**

- AST I/O+4 SER & 1 PAR $179.00
- AST SIX PACK 64K, 1 SER & 1 PAR $269.00
- QUADBOARD 64K $299.00
- IBM COLOR GRAPHIC ADAPTER $225.00

**SOMEBODY Has To Have The Lowest Prices!**

**MONITORS**

- IBM 8086 PLUG IN $225.00
- IBM 8087 SURGE FREE $590.00

**PRINTERS**

- IBM MONO PRINTER ADAPTER $230.00
- PERSYST COLOR ADAPTER $190.00
- PERSYST MONOPRINT ADAPTER $210.00
- HERCULES GRAPHIC ADAPTER $340.00
- HERCULES COLOR CARD $210.00
- STB GRAPHIC PLUS $375.00

**MODEMS**

- HAYES SMART MODEM 1200 $499.00
- HAYES SMART MODEM 300 $379.00
- HAYES 1200B PLUG IN CARD $429.00
- QUBE PC 212A/200 INT $275.00
- QUBE PC 212E/1200 EXT $299.00

**HARD DISKS**

- 10MB SUB SYSTEM INT $999.00
- 10MB SUB SYSTEM EXT $1025.00
- 10MB TAPE BACK UP $599.00

**GENERAL**

- CONTROL DATA DISKETTES $25.00
- KEYTRONIC KB951 $189.00
- PARALLEL CABLE $25.00
- 64K RAM UPGRADE KIT $50.00
- 128K RAM UPGRADE KIT (FOR AT) $190.00
- IBM PC POWER SUPPLY (Original) $65.00
- IBM KEYBOARD FOR PC (Original) $105.00

**PRINTER CARTRIDGES**

- EPSON FX100 $24.00
- EPSON FX200 $24.00
- EPSON FX 100 $24.00
- IBM MONOCHROME $25.00
- IBM COLOR DISPLAY $25.00

**COMPUTER ACCESORIES**

- IBM PC, 256K, One Half Height 320K Disk Drive DS/DD, Persyst Color Card, Taxan Green Monitor, DOS 2.1, 120 Watt Power Supply PLUS a 10MB Hard Disk Sub System all for:
  
  **$2690.00**

**COMPUTER ACCESORIES**

- IBM PC, 256K, Two Half Height Drives DS/DD, Persyst Color Card, Taxan Green Monitor, DOS 2.1, 120 Watt Power Supply, 10MB Hard Disk Sub System, PLUS 10MB Tape Back Up System all for:
  
  **$2980.00**

**COMPUTER ACCESORIES**

- IBM PC, 256K, Two Half Height Drives DS/DD, Persyst Color Card, Taxan Green Monitor, DOS 2.1, 120 Watt Power Supply, IBM Hard Disk Sub System PLUS 10MB Tape Back Up System all for:
  
  **$3575.00**

**COMPUTER ACCESORIES**

- IBM PC, 256K, Two Half Height Drives DS/DD, Persyst Color Card, Taxan Green Monitor, DOS 2.1, 120 Watt Power Supply, 20MB Hard Disk Sub System all for:
  
  **$3380.00**

**COMPUTER ACCESORIES**

- IBM PC, 256K, Two Half Height Drives DS/DD, Persyst Color Card, Taxan Green Monitor, DOS 2.1, 120 Watt Power Supply, 20MB Hard Disk Sub System PLUS 10MB Tape Back Up System all for:
  
  **$3979.00**

(We configure and test the system for you at no extra cost.)

Inquiry 216
TOLL-FREE ORDERING:
800-222-8686
FOR TECHNICAL SUPPORT/ SERVICE / IN ARIZONA:
602-282-6299

CUSTOM COMPUTER TECHNOLOGY
1 CCT PLAZA — P.O. BOX 4160 — SEDONA, ARIZONA 86340

Purchase your Hardware and Software directly from an OEM / Systems Integrator. Take advantage of our buying power! We stock a full line of Board Level Components, Software and Peripherals. Call for your needs. We'll give you the lowest Prices, and the Technical Support and Know-How we are quickly becoming well-known for. Satisfied Customers Nationwide. The Nation's Custom Systems House for Business, Education and Science. Call for a system quote. CCT implements tomorrow's technology today!

• FOREMOST QUALITY • ADVANCED SUPPORT • REASONABLE COST •

80286 NOW!
\( \square \) CCT-286Z is our model designation for the Intel 286 dual processor board from Macrotech. It features the super high speed combination of Z-80H and 80286, with provision for the 80287 math chip. Directly replaces 8085/88 and 8086 CPUs running CP/M, MP/M, Concurrent DOS, and MS-DOS, at throughput increases of 3X to 5X!

SPECIAL PRICE - $1099
80287 Option - Installed - $395

SEE THE CCT-4 SERIES USING THIS BOARD
DETAILED ON THE FACING PAGE

• 8" CP/M SOFTWARE SPECIALS •
\( \square \) dBase II - Latest Version 2.4 - $349
Supercalc 66 - $990/680 - $259
Wordstar - $279/286- $449
DRI CBASIC Compiler 80 - $389/86 - $449
DRI Pascal Compiler 80 - $279/86 - $449
DRI Assembler 80 - $279/86 - $449
Microsoft BASIC - $299/86 - $339
Supersoft FORTRAN IV - $399/86 - $399

• TOP SELLING PERIPHERALS •
Wyse Terminals - $30/68 - $649

LIBERTY TERMINALS
• Superior Reliability •
100-12" GREEN-25x80 - $399
110-14" GREEN-80x120 - $499
200-14" GREEN-80x120 Super Deluxe - $599
220-14" GREEN DEC Compatible - $659

CCT RECOMMENDS-
AMBER Screen Options - $20

OKIDATA PRINTERs - Top Quality
82-60 Col. - $329
83-132 Col. - $599
92-80 Col. - $429
132 Col. - $659
84 - 132 Col/200cps-Top of the Line - $799
For Serial Interfaces - $100

DIABLO—Letter Quality Series
Model 620 - $999
Model 630 - $1799

INDUSTRIAL GRADE CCT DISK DRIVE SYSTEMS ROLLS ROYCES OF THE INDUSTRY

S-100 HARD DISK SUBSYSTEMS

CCT-2.4 • Dual 8" DDS
CCT-5 • 5 1/4" DDS

IBM Compatible Tandon 320K. Extra Heavy Cabinet accommodates two drives, hard or floppy, Alcabling, A&T, Burned-in. Perfect for our MS-DOS Package - $999

SUPER PRICES

CCT-2.4 • Dual 8" DDS

Mitsubishi 2.4Megabyte in Extra Heavy horizontal enclosure, removable filter air system, all cabling, A&T, Burned-in. The fastest system available. - $1229

CCT-2 • $6799
CCT-3 - $6699
CCT-4 - $6599
CCT-5 - $6599
CCT-6 - $6499
CCT-7 - $6399
CCT-8 - $6299
CCT-9 - $6199
CCT-10 - $6099
CCT-11 - $5999
CCT-12 - $5899
CCT-13 - $5799
CCT-14 - $5699
CCT-15 - $5599
CCT-16 - $5499
CCT-17 - $5399
CCT-18 - $5299
CCT-19 - $5199
CCT-20 - $5099
CCT-21 - $4999
CCT-22 - $4899
CCT-23 - $4799
CCT-24 - $4699
CCT-25 - $4599
CCT-26 - $4499
CCT-27 - $4399
CCT-28 - $4299
CCT-29 - $4199
CCT-30 - $4099
CCT-31 - $3999
CCT-32 - $3899
CCT-33 - $3799
CCT-34 - $3699
CCT-35 - $3599
CCT-36 - $3499
CCT-37 - $3399
CCT-38 - $3299
CCT-39 - $3199
CCT-40 - $3099
CCT-41 - $2999
CCT-42 - $2899
CCT-43 - $2799
CCT-44 - $2699
CCT-45 - $2599
CCT-46 - $2499
CCT-47 - $2399
CCT-48 - $2299
CCT-49 - $2199
CCT-50 - $2099
CCT-51 - $1999
CCT-52 - $1899
CCT-53 - $1799
CCT-54 - $1699
CCT-55 - $1599
CCT-56 - $1499
CCT-57 - $1399
CCT-58 - $1299
CCT-59 - $1199
CCT-60 - $1099
CCT-61 - $999
CCT-62 - $899
CCT-63 - $799
CCT-64 - $699
CCT-65 - $599
CCT-66 - $499
CCT-67 - $399
CCT-68 - $299
CCT-69 - $199
CCT-70 - $99

FLOPPY SYSTEMS

IBM Compatible Tandon 320K. Extra Heavy Cabinet accommodates two drives, hard or floppy, Alcabling, A&T, Burned-in. Perfect for our MS-DOS Package - $999

SUPER PRICES

CCT-2.4 • Dual 8" DDS

Mitsubishi 2.4Megabyte in Extra Heavy horizontal enclosure, removable filter air system, all cabling, A&T, Burned-in. The fastest system available. - $1229

CCT-2 • $6799
CCT-3 - $6699
CCT-4 - $6599
CCT-5 - $6599
CCT-6 - $6499
CCT-7 - $6399
CCT-8 - $6299
CCT-9 - $6199
CCT-10 - $6099
CCT-11 - $5999
CCT-12 - $5899
CCT-13 - $5799
CCT-14 - $5699
CCT-15 - $5599
CCT-16 - $5499
CCT-17 - $5399
CCT-18 - $5299
CCT-19 - $5199
CCT-20 - $5099
CCT-21 - $4999
CCT-22 - $4899
CCT-23 - $4799
CCT-24 - $4699
CCT-25 - $4599
CCT-26 - $4499
CCT-27 - $4399
CCT-28 - $4299
CCT-29 - $4199
CCT-30 - $4099
CCT-31 - $3999
CCT-32 - $3899
CCT-33 - $3799
CCT-34 - $3699
CCT-35 - $3599
CCT-36 - $3499
CCT-37 - $3399
CCT-38 - $3299
CCT-39 - $3199
CCT-40 - $3099
CCT-41 - $2999
CCT-42 - $2899
CCT-43 - $2799
CCT-44 - $2699
CCT-45 - $2599
CCT-46 - $2499
CCT-47 - $2399
CCT-48 - $2299
CCT-49 - $2199
CCT-50 - $2099
CCT-51 - $1999
CCT-52 - $1899
CCT-53 - $1799
CCT-54 - $1699
CCT-55 - $1599
CCT-56 - $1499
CCT-57 - $1399
CCT-58 - $1299
CCT-59 - $1199
CCT-60 - $1099
CCT-61 - $999
CCT-62 - $899
CCT-63 - $799
CCT-64 - $699
CCT-65 - $599
CCT-66 - $499
CCT-67 - $399
CCT-68 - $299
CCT-69 - $199
CCT-70 - $99

SYSTEMS UPDATES/REMARKS - $30

• FREE CONCURRENT DOS 8-16 UPGRADE (WHEN AVAILABLE) WITH PURCHASE OF MP/M 8-16 •

CCT-1 — ENTRY LEVEL S-100 BUSINESS SYSTEM

SPECIAL PRICE
$3,559

Prices & availability subject to change. All products new, and carry full manufacturer’s warranties. Call for catalog. Free technical help to anyone. All products we sell are CCT individually tested and set up for your system - plug-and-go! Arizona residents add sales tax. CCT® Trademark - Custom Computer Technology; MS-DOS® Trademark - Microsoft; IBM® Trademark - International Business Machines; CompuPro® Trademark - W.J. Godbout; CP/M® MP/M® Trademarks - Digital Research

Inquiry 79

FEBRUARY 1985 • BYTE 433
IBM type Case only

Use this Driveless workstation for low-cost Networking.

We think of this System as a Driveless System. Start by choosing

MacIntyres he following are considered Trademarks and their COO:

MSDOS, PC-DOS, Microsoft

port Flight School record Keeping
tory Program for Video Tape Rental
Machine Route

with his own components to satisfy the needs of his

Systems in service and working satisfactorily.

This is OUR Junior! DOS

* 14611 Leahy Ave. * Bellflower, CA * 213 / 866-8608 *

February Dealer Honors

Dick Culbertson says ,

Dick buys Basic Systems and then customizes them

for their reliability and

Micro Products is ready

serve your needs in several countries. Each Office

has Sales Literature, Pricing, Inventory and Technical Service available to

support your needs. There are no problems with U.S. Export Forms.

This one is loaded! Features:

Real-Time Chronograph

Back-up. Parallel Port, RS232-D Serial Port. • 64K to 256K of Parity-verified

Memory, Printer Spooling, RAM Disk Software.

IBM AT

1.2M Floppy

In Stock - For
your XPC!

Can Read
3.0 or 2.1

DOS Formats!

$1245

* $1245

* $1245

NEW

Complete System! XPC by XOR

10 Meg H.D. Complete System

$1895

* 20 Meg Color Complete System

$2375

* 40 Meg w/ TAPe

$2845

Check These Standard Features:

• Full-Sized Touch-Tactile, Capacitive Keyboard with 10 Function Keys and Calculator Type Numeric Keypad •

• Comes Standard with Parallel and Serial I/O •

• IBM compatible expansion slots •

• Game Port •

• 2-Slot 5.25" Disk Drive (D1030 Drive) •

• Real Time Clock •

• Video-Color Card •

• 68K (64-bit) CPU •

• OEM Size, XPC 300 watt Power Supply •

Add-On H.D. & Tape

Add-On Hard Disk

Two ways to go. The internal system is cheaper because it does not need a Power Supply. The external

system is ready to use with our ready-to-use 10 Megabyte or 20 Megabyte. The external system includes

an interface card for your XPC to use. The internal system includes the power supply and the interface card.

Add-On 10 Meg Tape

If your IBM XT needs a little help to back-up your data, you won’t be able to beat this price! Cables, software and
everything!

February Dealer Honors

* * Culbertson & Assoc. * *

Dick Culbertson says, ‘I have been writing application programs with dbase II since

it’s introduction. I recommend Micro Product’s XPC

because we have found them so reliable and

their application programs.

Among these is a very extensive

Chiroptic Billing System, a Point-of-Sale Inventory

System for Video Tape Rental Stores, a Vending

Machine Route Service Collection System and an

Airport Flight School record keeping system.”

Dick buys Basic Systems and then customizes them with his own components to satisfy the needs of his

customers. To date he has over 27 Micro Computer Systems in service and working satisfactorily.

** 14611 Leahy Ave. * Bellflower, CA * 213 / 866-8608 *
**STOP, LOOK & SAVE!**

For Lowest Prices Call (800) 732-0304

---

### PRINTERS

- **OKI DATA**
  - ML96K, 15" Para. & Ser. ... $299

- **MICROFAX**
  - E3, 150 cps, 80 char. ... $349

- **STAR MICRONICS**
  - Cables
    - Gemini 15X PC (IBM Compal.) ... $369
    - IBM AT Enhanced ... $365
    - Delta 10 PC ... $359

- **QUME**
  - OKIOATA
    - 8510 BPI (IBM Compatible) ... $335
    - BIZCOMP MSC 550 w/160K Drive & Software ... $895
    - Starwriter F10·40PU, 40 cps ... $929

- **SWEET**
  - Color600 ... $429

- **BROTHER**
  - 100cps, does graphics ... $1229

- **OYNAX**
  - DX15 By Brother, Same as HR15 ... $129

- **LOTUS DEVELOPMENT CORP.**
  - Lotus Card (CPIM) ... $265

### MODEMS

- **Microsoft Word MODEMS**
  - Premium Lotus Card ... $115

### ACCESORIES

- **IBM PC ACCESSORIES**
  - IBM 64K Memory Upgrade ... $249

- **APPLE & FRANKLIN ACCESSORIES**
  - Apple Super Serial Card ... $139

### PERSONAL SYSTEMS

- **APPLE**
  - Apple IIe Starter System incl. Apple IIe, Tilt Screen, 300Baud Smart Modem ... $129

### DISK DRIVES

- **DISK DRIVES**
  - 25Kw, 320KD (Drives) ... $2150

### SOFTWARE

- **SOFTWARE**
  - 64K MEMORY UPGRADE ... $249

### ORDER LINE

(800) 732-0304

---

**MAIL ORDER**

12841 S. Hawthorne Blvd., No. 589
Hawthorne, California 90250

---

GIVE US A CHANCE TO BEAT THE COMPETITION’S ADVERTISED PRICE.

IF YOU SEE IT ADVERTISED FOR LESS, CALL COMPUTER CONNECTION FIRST FOR LOWEST QUOTE!
Announcing 4 New Collector Edition

BYTE COVERS

The 4 Bylc covers shown below are the newest additions to the Collector Edition Byte Cover series. Each full color print is 11" x 14", including a 1½" border, and is part of an edition strictly limited to 1,000 prints. Each print is a faithful reproduction of the original Byte painting, printed on museum quality acid free paper, and is personally inspected, signed and numbered by the artist, Robert Tinney. A Certificate of Authenticity accompanies each print.

Collector Edition Prints are carefully packaged flat to avoid bending, and are shipped first class within one week of receipt of order. The price of each print is $30. All 4 prints are available for only $120.

Other Collector Edition Byte Covers are also available from Robert Tinney Graphics. For a color brochure, or to order one or more of the prints shown, please check the appropriate box in the coupon below.

#25 Computers and the Handicapped $30
#26 Graduation Memories $30
#27 The Keys to Education $30
#28 Simulation $30

Mail this coupon to:
Robert Tinney Graphics
1864 N. Pamela Drive
Baton Rouge, LA 70815

FOR VISA OR MASTERCARD ORDERS or for more information
CALL 1-504-272-7266
Daytime or Evenings

Please send me the following prints ($30 each). All 4 only $120.

<table>
<thead>
<tr>
<th>QTY</th>
<th>TITLE &amp; PRINT NO.</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$</td>
</tr>
</tbody>
</table>

postage & handling $3.00 (Overseas $8.00) $4.00

SHIPPING COST: $4.00

TOTAL $ ________

I have enclosed check or money order.

Visa MasterCard

Card No: Exp. Date: _____________

SHIP MY PRINTS (OR BROCHURE) TO:

Name: ____________________________
Address: __________________________
City: ___________________ State: ______

TOTAL ________

Please send me your color brochure.
FC 135-40 Features:

- Full Replacement to your regular IBM® PC
- 65 W. Power Supply
- 4 Disk Drives Connectors
- Built-in High Air Flow
- High Quality Cooling Fan
- File #E82453
- Schematics included
- One year Warranty
- +5V/15A, +12V/4.2-8.5A (peak)
- +12V/1A, -5V/1A. (max. outputs)
- Up to 2 Hard Disk Drives
- Fully Buffered 1/0 Bus
- Built-in ECC
- Accepts 5 to 20 MB Hard Disk

IDEAL FOR:
• Upgrade IBM® PC
• OEM Manufacturer
• Do it yourself an IBM® PCXT Compatible

Quality That You Can Trust
140 W.(max) Power Switcher
#FC 135-40

For “Build Your Own Computer” and OEM’s Convenience, we also carry:

FC 427 Keyboard
• For IBM® PC or IBM® compatible products
• 50 Million Life Cycle
• Light on Num and Caps Lock Keys

FC 630A-2 Cabinet
• IBM identical
• Use FORTRON FC 135-40 power supply
• Good for Faraday and other compatible level CPU boards.

FC 427 Keyboard

FC-330 Hard Disk Controller
• Up to 2 Hard Disk Drives
• Fully Buffered I/O Bus
• Built-in ECC
• Accepts 5 to 20 MB Hard Disk

FC-630 Cabinet
• On-off switch to be on back side
• Use FORTRON HSC-130-40 power supply

FC-530 Monochrome Card
• 8 x 5 Screen
• 9 x 14 Character Box
• TTL Level of output

FC-530 Monochrome Card

FC-930 512K RAM Card
• From 64K to 512K
• Boundary and Total Memory

FC-940 RS232C/Clock Calendar Card
• One RS-232C Port, One Clock Calendar, Battery Back-up

HSC 130-40 130 Watt Switching Power Supply
• Good For Faraday, DTC Mega-board, Colby Computer and Other Compatible Level CPU boards.
• Backside On-Off Switch
• Use Cabinet FC-630

Monochrome/Graphic/Printer Card CT-6040
• 80 x 25 Text Mode (Default)
• 720 x 348 Graphic Mode
• Can Run Lotus 1-2-3
• 64K Graphic Display Memory
• 18 KHz Monitor and Printer Interface

Color/Graphic/Printer Card CT-6020
• RGB Color Port and Parallel Port For Printer
• Light Pen Interface
• Graphic Mode:
  - 320 Dots x 200 Lines Color
  - 640 Dots x 200 Lines B/W
• Text Mode:
  - 40 Columns x 25 Rows Color / B/W
  - 80 Columns x 25 Rows Color / B/W

Hard Disk Drives
769.00
(with cable & controller)
Half Height, Top Brands, 10-32 MB Available

Cable For IBM PC/AT
89.00
RS-232 (D Type 9 Pin to D Type 25 Pin)
All prices include free shipping in USA.
These prices current as of December 21, 1984. Call for latest prices.

**TEAC**
10 Meg Half Height Drive
$129

**PANASONIC**
10 Meg Half Height Drive
$109

**IRWIN**

**TAPE BACKUP SYSTEM**
- Full Height
- Low Power
- 160K Capacity
- Controller Card
- Desktop
$595

**IBM PC**
- 256K Floppy Drive
- 10 Meg Internal HD
$2195

**IBM PC**
- 1 Meg Floppy Drive
- 360K Internal HD
$629

**10 MEG INTERNAL HARD DISK SYSTEM**
10, 20, 33, and 42 Meg Internal and External Hard Disk Systems

**10 MEG INTERNAL HARD DISK SYSTEM**

**SOFTWARE**
- dBase III—$375
- Norton Utilities—Version 3.0, $59
- Borland Gift Pack—$69
- Wordstar 2000—$399
- Wordstar 2000+—$359

**IBM PC**
- 1 Meg Drive
- 360K Internal HD
$1595

**64K RAM**
- Set of 9 chips, 200 or 50 Nanoseconds
- Quantity of Slot Type
$25

**64K RAM**
- Set of 9 chips, 200 or 50 Nanoseconds
- Quantity of Slot Type
$19 per sec.

**COMPAQ**
- 256K, 1/360K Drive, 10 Meg Internal
- $2995

**COMPACT**
- Functional equivalent to a Compaq Plus
- 10 Meg Internal
- $629

**IBM PC**
- 1 Meg Drive
- 360K Internal HD
$629

**SOFTWARE**
- Multimark
- $259
- PFS/Graph
- $189
- PFS/Plan
- $189
- PFS/Proof
- $189
- PFS/Write
- $189
- PFS/Access
- $189
- PFS/File
- $189
- PFS/Report
- $189

**PC'S LIMITED**

**ORDERS ONLY, CALL 1-800-IBM-5150**
7801 N. Lamar, #E-200, Austin, Texas 78752
All other inquiries, call (512) 452-0323
Now, the lowest prices ever on 3M Scotch® DISKETTES!

$153
5¼" SSDD
$206
5" SSDD
5¼" SSDT
$2.29 ea.
5½" SSDT-360
$2.89 ea.

SOFT SECTOR ONLY! MINIMUM ORDER: 20 DISKETTES

These are factory fresh 3M diskettes packed in boxes of 10 with Tyvek sleeves, reinforced hubs, user identification labels and write-protect tabs.

3½" MICRO-DISKETTES-SS-135 TPI- $2.89 ea.

LIFETIME WARRANTY ON ALL 3M SCOTCH DISKETTES!

FOR ORDERS ONLY:
INFORMATION & INQUIRIES:
1-800-621-6827
(In Illinois: 1-312-944-2788)
HOURS: 8:00-5:00 Central Time, Monday-Friday
WE WILL BEAT ANY NATIONALLY ADVERTISED PRICE ON THE SAME PRODUCTS AND QUANTITIES!

DISK WORLD!, Inc.
Suite 4806 • 30 East Huron Street • Chicago, Illinois 60611

INFORMATION & INQUIRIES:
1-312-944-2788
(In Illinois: 1-312-944-2788)
HOURS: 8:00-5:00 Central Time, Monday-Friday
WE WILL BEAT ANY NATIONALLY ADVERTISED PRICE ON THE SAME PRODUCTS AND QUANTITIES!

DISK WORLD!, Inc.
Suite 4806 • 30 East Huron Street • Chicago, Illinois 60611

INFORMATION & INQUIRIES:
1-312-944-2788
(In Illinois: 1-312-944-2788)
HOURS: 8:00-5:00 Central Time, Monday-Friday
WE WILL BEAT ANY NATIONALLY ADVERTISED PRICE ON THE SAME PRODUCTS AND QUANTITIES!

DISK WORKS!, Inc.
Suite 406 • 30 East Huron Street • Chicago, Illinois 60611

INFORMATION & INQUIRIES:
1-312-944-2788
(In Illinois: 1-312-944-2788)
HOURS: 8:00-5:00 Central Time, Monday-Friday
WE WILL BEAT ANY NATIONALLY ADVERTISED PRICE ON THE SAME PRODUCTS AND QUANTITIES!

DISK WORLD!, Inc.
Suite 4806 • 30 East Huron Street • Chicago, Illinois 60611

INFORMATION & INQUIRIES:
1-312-944-2788
(In Illinois: 1-312-944-2788)
HOURS: 8:00-5:00 Central Time, Monday-Friday
WE WILL BEAT ANY NATIONALLY ADVERTISED PRICE ON THE SAME PRODUCTS AND QUANTITIES!

ATHANA DISKETTES
The great unknown!

99¢
5¼" SSDD
$1.09
5" SSDD

You've used these diskettes hundreds of times...as copy-protected originals on some of the most popular software packages. They're packed in poly-bags of 25 with Tyvek sleeves, reinforced hubs, user identification labels and write-protect tabs.

LIFETIME WARRANTY!
SOFT SECTOR ONLY! Sold in multiples of 50 only.

FOR ORDERS ONLY:
INFORMATION & INQUIRIES:
1-312-944-2788
(In Illinois: 1-312-944-2788)
HOURS: 8:00-5:00 Central Time, Monday-Friday
WE WILL BEAT ANY NATIONALLY ADVERTISED PRICE ON THE SAME PRODUCTS AND QUANTITIES!

ATHANA DISKETTES
The great unknown!

99¢
5¼" SSDD
$1.09
5" SSDD

You've used these diskettes hundreds of times...as copy-protected originals on some of the most popular software packages. They're packed in poly-bags of 25 with Tyvek sleeves, reinforced hubs, user identification labels and write-protect tabs.

LIFETIME WARRANTY!
SOFT SECTOR ONLY! Sold in multiples of 50 only.

FOR ORDERS ONLY:
INFORMATION & INQUIRIES:
1-312-944-2788
(In Illinois: 1-312-944-2788)
HOURS: 8:00-5:00 Central Time, Monday-Friday
WE WILL BEAT ANY NATIONALLY ADVERTISED PRICE ON THE SAME PRODUCTS AND QUANTITIES!

DISK WORLD!, Inc.
Suite 4806 • 30 East Huron Street • Chicago, Illinois 60611

INFORMATION & INQUIRIES:
1-312-944-2788
(In Illinois: 1-312-944-2788)
HOURS: 8:00-5:00 Central Time, Monday-Friday
WE WILL BEAT ANY NATIONALLY ADVERTISED PRICE ON THE SAME PRODUCTS AND QUANTITIES!

DISK WORLD!, Inc.
Suite 4806 • 30 East Huron Street • Chicago, Illinois 60611

INFORMATION & INQUIRIES:
1-312-944-2788
(In Illinois: 1-312-944-2788)
HOURS: 8:00-5:00 Central Time, Monday-Friday
WE WILL BEAT ANY NATIONALLY ADVERTISED PRICE ON THE SAME PRODUCTS AND QUANTITIES!

DISK WORKS!, Inc.
Suite 4806 • 30 East Huron Street • Chicago, Illinois 60611

INFORMATION & INQUIRIES:
1-312-944-2788
(In Illinois: 1-312-944-2788)
HOURS: 8:00-5:00 Central Time, Monday-Friday
WE WILL BEAT ANY NATIONALLY ADVERTISED PRICE ON THE SAME PRODUCTS AND QUANTITIES!

DISK WORLD!, Inc.
Suite 4806 • 30 East Huron Street • Chicago, Illinois 60611

INFORMATION & INQUIRIES:
1-312-944-2788
(In Illinois: 1-312-944-2788)
HOURS: 8:00-5:00 Central Time, Monday-Friday
WE WILL BEAT ANY NATIONALLY ADVERTISED PRICE ON THE SAME PRODUCTS AND QUANTITIES!
**CompuPro**

**SYSTEM 816/B TWO-USER** $4,899
**SYSTEM 816/10 H40 40Mb H.D.** $6,995
**FOR 40Mb H.D. OR 50Mb H.D.** $1,900
**TO HAVE 2ND 8" FLPY W/ H.D.** $395

**5½" H.D. SUBSYSTEMS**

- **W/ CONTROLLER, CP/M 8088 DRIVERS. CABLES, CABINET, FAN, P.S., ETC.**
- **RODIME QUANTUM**
- **MICROPOLIS**
- **Majtor**
- **Majtor**
- **Majtor**
- **Majtor**
- **Majtor**

**CPU 286 A/T & W/ 287 MATHE MATH** $1,496
**CPU 32016/WMU 8MHz** $689
**HUSON 8087 PIGGY BACK FOR 8088/88** $335
**RAM 22 260K STATIC 816 A/T** $1,075

**DISK 2 & 8" H.D. CTRL/SET**
**Fujitsu 23028 20M8 ADD-ON H.D.** $1,995

**SMD-200 DU/IAL DRIV. 5V/6 CONTROL BD.** $6,000
**DGC-100 CTRL BD./6W" H.D., ST-6081/F 2/3 F**

**Electrologic**

**EXPANDAM 4** $825
**EXPANDAM 4 W/ EDC** $1,435
**SO 300 CHASSIS W/ 8 SLOT** $399

**Morrow**

- **PM/PORTABLE W/ DUAL 6V BUS. BATT.**
- **268K, MODOS, MDOS, NEWWORD**
- CALL
- **M03 W/TERMINAL & EPSON FX100** $1,999
- **M03 W/TERMINAL & EPSON FX100** $1,999
- **M01 W/TERMINAL & HPX100** $2,995

**CPZ 4808 68M8 MASTER** $739
**CPZ 16 268K 8MHz 8086 SLV** $839
**CPZ-840 48K RAM SLAVE 6MHz** $389
**CPZ-86A 128K RAM SLAVE 6MHz** $629
**MUT-6 E 280 MULTICARD** $588

**PC-SLAVE/16-256K 68M8**
- **2 SERIAL PORTS - TURN YOUR**
- **PC INTO A HIGH SPEED MULTI-USER**
- **MACHINE W/ TODAY'S TECHNOLOGY** $750
- **SPECIAL 256K-6MHz** $739
- **SPECIAL 2568 6MHz** $525
- **SUPER TR 2568 MSTR- SLAVE-4 USERS** $1,295
- **CP/M 3.0** $300
- **TURBODOS VER. 1.4 8 BIT MULTI DRIVER** $450
- **MS 512 W./ PAK II** $599

**SCION**

**Votrax**

**PERSONAL SPEECH SYSTEM** $289

**Hayes**

- **COMPAT W/ LOTS OF FEATURES** $325
- **W/ MAC PAC** $389

**US ROBOTICS**

- **PASSWORD 1200 AUTO ANS./DIAL** $205
- **IBM PERSONAL MODEM W/ TELPAC** $295

**SOFTWARE**

- **8" SSD OR AS PREDEFINED SOFTWARE IS NOT RETURNABLE**
- **BDS "C" COMPILER-8 BIT** $99
- **COMPUTER INNOVATIONS C86 "C"** $299
- **COMPUTIVE VEDIT-66 "C" MS-DOS** $120
- **SORCIM SUPER CALC-3 IBM-PC** $245
- **DATALOGIC MULTIMEDIA DATABASE**
- **NEW WORLD WORD PROCESSOR** $189
- **30 DAYS MONEY BACK GUARANTEE**
- **LATTICE (CP/MS & PS-DOCS)**

**DIGITAL RESEARCH**

- **"C" LANGUAGE COMPILER 88** $229

**TERMINALS**

- **LIBERTY TERMINALS**
- **QUZE QVT 102G**
- **WYSE 50 14" 132 COLUMN**

**MONITORS**

- **AMDEK 300A AMBER MONITOR** $1,469
- **PRAXTON GRAPHICS HX-12** $649
- **ZENITH 252 A MOTHER NON-GLARE** $88
- **ZENITH 252 A MOTHER NON-GLARE** $88

**PRINTERS**

- **BROTHER DAISYWHEEL** HR-16 SER. OR PAR. 17 CPS $386
- **HR-26 SER. OR PAR. 23 CPS** $626
- **HR-36 SER. OR PAR. 36 CPS** $849

**BROTHER DOROT MATRIX**

- **20X24 PIN HEAD, GRAPHICS** $926
- **BROTHER M1000 50 CPS EBS** $1,969
- **EPSON ALL MODELS & ACCESSORIES**
- **AXIS ALL MODELS & ACCESSORIES**
- **TALLY MT1601 160 CPS S-OR-P**

**DRIVES**

- **WE SERVICE FLOPPY DRIVES**
- **5¼" OR 8 + PARTS & SHIP.** $965

**Alloy**

- **TAPE BACK-UP**
- **IDCS-100 17.6M8/5-100 BUS** $1,949
- **IDS-412 5CSI/SASI 176M8** $1,949
- **PC-GICATE 80M8-IB/M-IBU/TURBO**

**Amcodyne**

- **AMAPANE 8" SSD 25MB FIX & REMOV.** $3,995
- **OPTIONAL FAN 459 POWER SUPPLY** $289

**Mitsubishi**

- **ELECTRONICS**
- **485I ½ HT 4½ 48TH** $159
- **4853 ½ HT 4½ 96TH** $179
- **M2885 5½ 8½ 256D8D** $339
- **M2885 5½ 8½ 256D8D** $339
- **143 SSD 5½ /½ HI** $149
- **242 SSD 8½ / ½ HI** $149
- **842 SSD 8½ HI** $449

**Qume**

- **SANYO**
- **Tandon**
- **AMATEUR 8" SSD 25MB FIX & REMOV.** $3,995
- **Optional FAN 459 POWER SUPPLY** $289

**data Systems**

**Z-150 PC THE MOST COMPATIBLE PC** $2,986
**Z-150 PC (W/ 106MB H.D.)** $3,898
When it comes to Flexible Disks, nobody does it better than Wabash.

MasterCard. Visa Accepted.
Call Free (800) 235-4137

Inquiry 244

In 3 Minutes

Erases Most Eproms

Only

Solid State 2-8 Min.

Timer Version $54.95

For all 24 or 28 Pin Devices

90-DAY WARRANTY

DEALER INQUIRIES WELCOME

SHIPPING & HANDLING $2.50

AZ RESIDENTS ADD 8% TAX

Walling Co.
4401 S. Juniper • Tempe, AZ 85282 • (602) 838-1277

Inquiry 328

3M Diskettes Lifetime Warranty

Think you're getting the best price on 3M Diskettes? You're right... BUT ONLY IF...

You're buying from NORTH HILLS CORP.

We will beat any nationally advertised price or give you a 15 disk library case FREE!

Call us last--TOLL FREE—for our best shot every time.

1-800-346-3472

Formatted and hard sectored disks in stock.

Dealer inquiries invited. CODs and charge cards accepted. All orders shipped from stock within 24 hours. Why was 12 days to be shipped?

North Hills Corporation
3664 Rolling View Dr.
White Bear Lake, MN 55110
MN Call Collect: 1-612-770-0465

Inquiry 234

In 3 Minutes

Erases Most Eproms

Only

Solid State 2-8 Min.

Timer Version $54.95

For all 24 or 28 Pin Devices

90-DAY WARRANTY

DEALER INQUIRIES WELCOME

SHIPPING & HANDLING $2.50

AZ RESIDENTS ADD 8% TAX

Walling Co.
4401 S. Juniper • Tempe, AZ 85282 • (602) 838-1277

Inquiry 328

In 3 Minutes

Erases Most Eproms

Only

Solid State 2-8 Min.

Timer Version $54.95

For all 24 or 28 Pin Devices

90-DAY WARRANTY

DEALER INQUIRIES WELCOME

SHIPPING & HANDLING $2.50

AZ RESIDENTS ADD 8% TAX

Walling Co.
4401 S. Juniper • Tempe, AZ 85282 • (602) 838-1277

Inquiry 328

In 3 Minutes

Erases Most Eproms

Only

Solid State 2-8 Min.

Timer Version $54.95

For all 24 or 28 Pin Devices

90-DAY WARRANTY

DEALER INQUIRIES WELCOME

SHIPPING & HANDLING $2.50

AZ RESIDENTS ADD 8% TAX

Walling Co.
4401 S. Juniper • Tempe, AZ 85282 • (602) 838-1277

Inquiry 328

In 3 Minutes

Erases Most Eproms

Only

Solid State 2-8 Min.

Timer Version $54.95

For all 24 or 28 Pin Devices

90-DAY WARRANTY

DEALER INQUIRIES WELCOME

SHIPPING & HANDLING $2.50

AZ RESIDENTS ADD 8% TAX

Walling Co.
4401 S. Juniper • Tempe, AZ 85282 • (602) 838-1277

Inquiry 328

In 3 Minutes

Erases Most Eproms

Only

Solid State 2-8 Min.

Timer Version $54.95

For all 24 or 28 Pin Devices

90-DAY WARRANTY

DEALER INQUIRIES WELCOME

SHIPPING & HANDLING $2.50

AZ RESIDENTS ADD 8% TAX

Walling Co.
4401 S. Juniper • Tempe, AZ 85282 • (602) 838-1277

Inquiry 328
**REMEX**

5 1/4" 40 TRACK DOUBLE SIDED/ DENSITY 3/4-HEIGHT FLOPPY DRIVES

Tested up to 2mS Track-to-Track Access

<table>
<thead>
<tr>
<th>ブランド</th>
<th>EACH</th>
<th>$59.95</th>
<th>毎枚</th>
<th>$49.95</th>
<th>EACH</th>
<th>$45.00</th>
</tr>
</thead>
</table>

**SINGLE & DUAL 3/4-HEIGHT FLOPPY DRIVE CABINETS**

<table>
<thead>
<tr>
<th>型号</th>
<th>单价</th>
<th>单位</th>
</tr>
</thead>
<tbody>
<tr>
<td>BNJNR253</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**5MBYTE HARD DISK DRIVE**

SHUGART 604

$7506 Compatible - In Factory Cartons

60 DAY WARRANTY!

<table>
<thead>
<tr>
<th>单位</th>
<th>单价</th>
<th>单位</th>
</tr>
</thead>
<tbody>
<tr>
<td>EACH</td>
<td>$199</td>
<td>$175</td>
</tr>
</tbody>
</table>

**SINGLE & DUAL 5 1/4" HARD DRIVE CABINETS**

<table>
<thead>
<tr>
<th>型号</th>
<th>单价</th>
<th>单位</th>
</tr>
</thead>
<tbody>
<tr>
<td>BNHND501</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**COMPUTER SYSTEMS**

MORROW DESIGNS

**PRINTER ADS**

<table>
<thead>
<tr>
<th>品牌</th>
<th>型号</th>
<th>型号</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPSON</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOSHIBA**

<table>
<thead>
<tr>
<th>型号</th>
<th>型号</th>
<th>型号</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**S-100 CPU BOARDS**

<table>
<thead>
<tr>
<th>品牌</th>
<th>型号</th>
<th>型号</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**S-100 RAM BOARDS**

<table>
<thead>
<tr>
<th>品牌</th>
<th>型号</th>
<th>型号</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**S-100 I/O BOARDS**

<table>
<thead>
<tr>
<th>品牌</th>
<th>型号</th>
<th>型号</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DISK DRIVE ENCLOSURES**

<table>
<thead>
<tr>
<th>品牌</th>
<th>型号</th>
<th>型号</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**5" DOUBLE SIDED DOUBLE DENSITY DISKETTES**

<table>
<thead>
<tr>
<th>型号</th>
<th>型号</th>
<th>型号</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**S-100 CONTROLLER BOARDS FOR FLOPPY DISK**

<table>
<thead>
<tr>
<th>品牌</th>
<th>型号</th>
<th>型号</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TORCH ORDER TOLL FREE**

(800) 423-5922 - CA, AK, HI CALL (818) 709-5111

Minimum Prewire Orders $15.00. Terms U.S.A. MC, BS, Check, Money Order, F.D.U.S. Only. CA Residents add 6.25% Sales Tax. Minimum Shipping & Handling of $3.00 for the first 3 lbs., plus 50¢ for each additional pound (204 [Ohion California]). Orders over 70 lbs. sent freight collect. In such case, include your phone number. Prices subject to change without notice. We will bill your best source to process through February 1983. Credit card orders with a charged appropriate freight. We are not responsible for typographical errors. Sale prices are for prepaid orders only.}

**PREFERRED ELECTRONIC**

19161 Deering Ave., Chatsworth, CA 91311
**Used Software**

*Low Prices!*

We buy and sell used software. All makes of computers supported.

**Software Exchange Inc.**

Box 485, Hales Corners, WI 53130

---

**EPROM Programmer**

APRIL 1000

**Only**

$249.95

Complete with personality and module

**174 AC Power RS-232**

- 6 baud rates - handshake to host

Allows read, write, verify & copy

Program Listings for most small micros

**Full 1 Year Warranty**

Programs the following: 5 volt 32.4 or 28 pin devices. 27.2 times through 27.256

Specify personality module desired with order. Additional personality modules only $15.00 ea.

To order: call or write

APPROPOS TECHNOLOGY

1071 Avenida Acasia

Camarillo, CA 93010

94.00 shipping USA

**ICs Prompt Delivery!!!**

SAME DAY SHIPPING (USUALLY)

**Outsiders Oklahoma. No Sales Tax**

**8087-3**

$124.97

**Dynamic RAM**

256K
256Kx1
150 ns $13.47

128K
128Kx1
150 ns $6.73

64K
64Kx1
200 ns $4.44

4K
4Kx1
200 ns $2.59

**EPROM**

27256
32Kx8
300 ns $36.25

27128
16Kx8
250 ns $13.12

2764
8Kx8
200 ns $11.87

2764
8Kx8
200 ns $5.31

27232
4Kx8
250 ns $9.99

2716
2Kx8
450 ns $3.21

**Static RAM**

6064L-16
64Kx1
150 ns $18.75

616P-3
2Kx150 ns $4.06

Open 6 days. We can ship via FedEx on Sat.

MasterCard/Visa/U.S. Cash COD

Factory New, Price Limited

**Microprocessors Unlimited**

24 South Percy Ave.

Bergen, N.J. (914) 267-4961

Prices shown above are for January 7, 1985

Please call for current prices.

---

**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

(805) 544-1337

---

**PromoTech**

815 Doral Ave.

San Mateo, CA 94401

(415) 382-3360

---

**Data Switches**

Share computers, printers, any parallel or serial device. Eliminate cable swapping. Inexpensive way to network any number of computers. Businesses, Schools, Homes. We also offer: Data buffer, line drivers, parallel, serial converters, parallel or serial converters, computers, printers, disk drives, and more.

**Automatic - Caretaker**

Is ideal for a business or school to share a printer or modem among many computers. Operation is fully automatic with no software required.

**Remote - Telepath**

Connects multiple computers to multiple peripherals. A selector at each computer or terminal chooses up to 4 peripherals and displays busy status.

**Manual - Hardswitch**

Is operated with the flip of a switch. 2, 2 and 24 models allow simultaneous communication.

**Code Activated - Porterm**

Connects one computer to multiple peripherals. A selector at each computer or terminal chooses up to 4 peripherals and displays busy status.

**Data Flex 2.0**

Choice up to 4 peripherals and displays busy status.

---

**TeleVideo Users**

Fast Dump/Restore CPM, TurboDOS. Over 600 per disk, $345.

BasicZ with Graphics from $300.

TurboDOS for CPM! From $300.

LYNC Communications Package. $195.

F Disk Drive for 802 and BOA.

Drive, board and software. $1000.

ROM/COBS Systems. $250.

DataFlex 2.

$395.

Bois, Bois 3T-1 and GRAPHIC programs:

Drew.

$90.

Games Pak 3.

$34.95

816 and Bois Tape Backup. From $175.

Salt Standby Power Systems.

$200.

Anti-Static Products. From $39.95.

**PC and COMPATIBLE USERS!**

Run your PC as a slave to your 8-Bit TurboDOS System. Also see our ad on Page 459. Available soon: Backup for TELEBEEF PM & 1600. Plus other good stuff.

**Cognitive, Incorporated**

Specialists in unique software.

24000 Telegraph Road, Southfield, MI 48034

(313) 812-2285

Telex 8386551

**Distributors Accepted**

---

**Turbo + PC Tools = Programs**

Tools for Turbo Pascal™ on the IBM™ PC

**Window Management** = menus, help files...

- Unlimited windows
- Window overlay & recall
- Cursor save & jump
- Access all colors & chars
- Window Complier/Library manager manager window files
- Graphics Drawing = Hilite plotting power!
- Ellipses, polygons, Region fill and clear & more

**String Formula Evaluator = easy calculation**

- 2D functions with nesting and implicit multiplication
- Won't bomb on overflow or division by zero

**System Check and Control = max flexibility!**

- Time & date access
- Get disk types & room
- Get & set default
- VID information
- Drive

**All this for only $39.95 . . . . . Incredible!**

You get 32K of source code on a double-sided disk and a 35 page manual. For single-sided drives add $2. Works with DOS 2.0, Turbo 2.0.

*Please include $2.00 for shipping & handling ($4 if outside of USA). Californians add 6%.

Paragon Courseware

4954 Sun Valley Road

Del Mar, CA, 92014

(619) 481-1477

Turbo Pascal is a trademark of Borland International

IBM is a trademark of the IBM Corporation

---

**Data Acquisition to Go Interface for Any Computer**


**Specialists in Portable Applications**

(201) 299-1615

PO. Box 246, Morris Plains, NJ 07950

ELEXOR

---

**Electronic Circuit Analysis**

- New release
- Transient, AC, DC analysis
- Full nonlinear
- Over 200 nodes
- Full editing
- Macro circuits
- Worst case, Monte-Carlo
- Temperature effects
- Frequency dependent parts
- Time dependent parts

For MS-DOS. 128k minimum.

$395.00

**Tatum Labs**

P.O. Box 698

Sandy Hook, CT 06482

(203) 426-2184

---

**COGITE, INCORPORATED**

Specialists in Portable Applications

24000 Telegraph Road, Southfield, MI 48034

(313) 812-2285

Telex 8386551

**Distributors Accepted**

---

**ROM ELECTRONICS**

(713) 240-7673

P.O. 803

PC & VAX Accepted

Houston, TX 77004

Dealer inquiries invited

CALL US FOR ALL YOUR INTERFACE NEEDS

---

**Data Video**

- TeleVideo USERS

- Fast Dump/Restore CPM, TurboDOS.

**Retail**

- TurboDOS over 600 per disk, $345.

**BasicZ with Graphics from $300.

**LYNC Communications Package. $195.

**F Disk Drive for 802 and BOA.

**Drive, board and software. $1000.

**ROM/COBS Systems. $250.

**DataFlex 2.

**Bois, Bois 3T-1 and GRAPHIC programs:

**Drew.

**Games Pak 3.

**816 and Bois Tape Backup. From $175.

**Salt Standby Power Systems.

**Anti-Static Products. From $39.95.

**PC and COMPATIBLE USERS!**

Run your PC as a slave to your 8-Bit TurboDOS System. Also see our ad on Page 459. Available soon: Backup for TELEBEEF PM & 1600. Plus other good stuff.

**Cognitive, Incorporated**

Specialists in unique software.

24000 Telegraph Road, Southfield, MI 48034

(313) 812-2285

Telex 8386551

**Distributors Accepted**

---

**Specialists in Portable Applications**

(201) 299-1615

PO. Box 246, Morris Plains, NJ 07950

ELEXOR

---

**Electronic Circuit Analysis**

- New release
- Transient, AC, DC analysis
- Full nonlinear
- Over 200 nodes
- Full editing
- Macro circuits
- Worst case, Monte-Carlo
- Temperature effects
- Frequency dependent parts
- Time dependent parts

For MS-DOS. 128k minimum.

$395.00

**Tatum Labs**

P.O. Box 698

Sandy Hook, CT 06482

(203) 426-2184

---

**COGITE, INCORPORATED**

Specialists in Portable Applications

24000 Telegraph Road, Southfield, MI 48034

(313) 812-2285

Telex 8386551

**Distributors Accepted**

---

**ROM ELECTRONICS**

(713) 240-7673

P.O. 803

PC & VAX Accepted

Houston, TX 77004

Dealer inquiries invited

CALL US FOR ALL YOUR INTERFACE NEEDS

---
What's New at AMERICAN DESIGN COMPONENTS?

We warehouse 60,000 items at American Design Components—expensive, often hard-to-find components for sale at a fraction of their original cost!

You'll find every part you need—either brand new, or removed from equipment (RFE) in excellent condition. But quantities are limited. Order from this ad, or visit our retail showroom and find exactly what you need from the thousands of items on display. Open Mon.-Sat., 9–5.

THERE'S NO RISK.
With our full 30 day warranty, any purchase can be returned for any reason for full credit or refund.

K. 49 KEY KEYBOARD
Replace the membrane keyboard on your Timex/Sinclair Z-80/1000 with this brand new "big computer" keyboard from Texas Instruments. Simple to install—complete instructions and schematic included.

$5.95 NEW

BLOWERS—POTENTIOMETERS—COUNTERS
TIMERS— Relays—Voltage Regulators—Power Supplies

P. EXPAND YOUR PC STORAGE CAPACITY
5½” floppy disc drive. Self-contained power supply. Plus... matching disc drive controller. Originally used with TI home computer. Each unit tested and in working condition, but sold "as is"—no warranty.

While they last, $99.00 COMPLETE.

Q. 12V NICAD BATTERY BACK-UPS (RECHARGEABLE)
12V @450Ma.
Contains 10 AA cells.
Charging rate 45Ma. 16-18 hours.
Case with tab output connections.
Input: 115/230VAC or 190-260 VAC, 50/60 Hz.

$5.95 RFE

$19.95 RFE

O. 18” COLOR X-Y DISPLAY
Originally designed for use in Atari coin-operated games. Contains a SVLUP22 3-gun color tube, focus and brightness controls. Has electromagnet deflection and solid state circuitry with three “Z” amp inputs (red, green, blue). Ideal for arcade replacement or, with the addition of external circuitry, for color graphics display. Manual included.

$195.00 NEW

ORDER TOTAL

American Design Components
62 Joseph St., Moonachie, NJ 07074
(201) 939-2710

R. AUDIO & VIDEO

Designed for use with TI computers.
Can be used with video cameras, games, or other audio/video sources. Built in A/B switch enables user to switch from TV antenna without disconnection. Channel 3 or 4 selection. Operates on 12VDC. Schematic included. IBM and Apple compatible.

Mfr. TI #UM1391-1

$7.95 NEW

R. ATOMIC DESIGN COMPONENTS, 62 JOSEPH STREET, MOONACHIE, N.J. 07074

MINIMUM ORDER $15.

Card No.
Exp. Date
Signature
Telephone: Area Code
Number

State Zip

All inquiries and free catalog requests call 201-939-2710.

Free Catalog of electro-mechanical devices sent with every order.

For all phone orders, call TOLL-FREE 800-524-0809.

In New Jersey, 201-939-2710.

February 1983 • Byte 445
No late-comer to the high tech business world, we perfected our IC remanufacturing process in 1975... and have been serving the needs of important, quality-conscious OEMs and distributors ever since. Now we are making available, to the serious "hobbyist," our vast inventory of ICs.

The patented Krueger Process is the key to the quality or our remanufacturing. Using patterned and controlled infra-red heat, we remove soldered-in ICs from obsolete, over-run, or scrap PCBs. Then we use automated, state-of-the-art procedures for lead-straightening, replating, optical scanning, and functional testing. The result is ICs which are "better than new" because they're already burned-in and retested. This means that you can now buy just like the OEMs... the same top quality, in the small quantities that meet your needs... 100% tested and guaranteed. Use your Visa or MasterCard.

The listings on this page are but a sample selection from our full inventory. Call our toll free number to place your order or obtain information.

NOTE: This is just a sampling of our 6 million IC inventory. In addition to microprocessors and memory, we carry a full inventory of linear, digital, and interface devices.
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 346

ORDER TOLL FREE
1-800-EEI-PROM
(1-800-331-7766)

CROSS SOFTWARE for the NS32000

INCLUDES:
- Cross Assembler
- Cross Linker
- Debugger
- N.S. ISE Support
- Librarian
- Pascal Cross Compiler
- C Cross Compiler

U.S. prices start at 8500

SOLUTIONWARE
1283 Mt. View-Alviso Rd.
Suite E
Sunnyvale, Calif. 94089
408/745-7818 or TEL 495424

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.

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 346

ORDER TOLL FREE
1-800-EEI-PROM
(1-800-331-7766)

CROSS SOFTWARE for the NS32000

INCLUDES:
- Cross Assembler
- Cross Linker
- Debugger
- N.S. ISE Support
- Librarian
- Pascal Cross Compiler
- C Cross Compiler

U.S. prices start at 8500

SOLUTIONWARE
1283 Mt. View-Alviso Rd.
Suite E
Sunnyvale, Calif. 94089
408/745-7818 or TEL 495424

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.

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 346

ORDER TOLL FREE
1-800-EEI-PROM
(1-800-331-7766)

CROSS SOFTWARE for the NS32000

INCLUDES:
- Cross Assembler
- Cross Linker
- Debugger
- N.S. ISE Support
- Librarian
- Pascal Cross Compiler
- C Cross Compiler

U.S. prices start at 8500

SOLUTIONWARE
1283 Mt. View-Alviso Rd.
Suite E
Sunnyvale, Calif. 94089
408/745-7818 or TEL 495424

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.

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 346

ORDER TOLL FREE
1-800-EEI-PROM
(1-800-331-7766)

CROSS SOFTWARE for the NS32000

INCLUDES:
- Cross Assembler
- Cross Linker
- Debugger
- N.S. ISE Support
- Librarian
- Pascal Cross Compiler
- C Cross Compiler

U.S. prices start at 8500

SOLUTIONWARE
1283 Mt. View-Alviso Rd.
Suite E
Sunnyvale, Calif. 94089
408/745-7818 or TEL 495424

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.

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 346

ORDER TOLL FREE
1-800-EEI-PROM
(1-800-331-7766)

CROSS SOFTWARE for the NS32000

INCLUDES:
- Cross Assembler
- Cross Linker
- Debugger
- N.S. ISE Support
- Librarian
- Pascal Cross Compiler
- C Cross Compiler

U.S. prices start at 8500

SOLUTIONWARE
1283 Mt. View-Alviso Rd.
Suite E
Sunnyvale, Calif. 94089
408/745-7818 or TEL 495424

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.

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 346

ORDER TOLL FREE
1-800-EEI-PROM
(1-800-331-7766)

CROSS SOFTWARE for the NS32000

INCLUDES:
- Cross Assembler
- Cross Linker
- Debugger
- N.S. ISE Support
- Librarian
- Pascal Cross Compiler
- C Cross Compiler

U.S. prices start at 8500

SOLUTIONWARE
1283 Mt. View-Alviso Rd.
Suite E
Sunnyvale, Calif. 94089
408/745-7818 or TEL 495424

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.

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 346

ORDER TOLL FREE
1-800-EEI-PROM
(1-800-331-7766)

CROSS SOFTWARE for the NS32000

INCLUDES:
- Cross Assembler
- Cross Linker
- Debugger
- N.S. ISE Support
- Librarian
- Pascal Cross Compiler
- C Cross Compiler

U.S. prices start at 8500

SOLUTIONWARE
1283 Mt. View-Alviso Rd.
Suite E
Sunnyvale, Calif. 94089
408/745-7818 or TEL 495424

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.

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 346

ORDER TOLL FREE
1-800-EEI-PROM
(1-800-331-7766)

CROSS SOFTWARE for the NS32000

INCLUDES:
- Cross Assembler
- Cross Linker
- Debugger
- N.S. ISE Support
- Librarian
- Pascal Cross Compiler
- C Cross Compiler

U.S. prices start at 8500

SOLUTIONWARE
1283 Mt. View-Alviso Rd.
Suite E
Sunnyvale, Calif. 94089
408/745-7818 or TEL 495424

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.

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 346

ORDER TOLL FREE
1-800-EEI-PROM
(1-800-331-7766)

CROSS SOFTWARE for the NS32000

INCLUDES:
- Cross Assembler
- Cross Linker
- Debugger
- N.S. ISE Support
- Librarian
- Pascal Cross Compiler
- C Cross Compiler

U.S. prices start at 8500

SOLUTIONWARE
1283 Mt. View-Alviso Rd.
Suite E
Sunnyvale, Calif. 94089
408/745-7818 or TEL 495424

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.
<table>
<thead>
<tr>
<th>RAM Type</th>
<th>Size</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>2114-25</td>
<td>1024</td>
<td>9.90</td>
</tr>
<tr>
<td>2147-4096</td>
<td>1024</td>
<td>5.45</td>
</tr>
<tr>
<td>7364-250</td>
<td>8192</td>
<td>7.45</td>
</tr>
<tr>
<td>TMS2716-2048</td>
<td>8</td>
<td>6.95</td>
</tr>
<tr>
<td>TMS2516-2048</td>
<td>8</td>
<td>5.45</td>
</tr>
<tr>
<td>1716-2048</td>
<td>8</td>
<td>1.95</td>
</tr>
<tr>
<td>2764-250</td>
<td>8192</td>
<td>7.45</td>
</tr>
<tr>
<td>4116-250</td>
<td>65536</td>
<td>2.99</td>
</tr>
<tr>
<td>4164-150</td>
<td>16384</td>
<td>1.20</td>
</tr>
</tbody>
</table>

**DYNAM CRAMS**

- Single 5 Volt Supply

**MICROPROCESSORS**

- 1 MHz
- 2 MHz

**DISC CONTROLLERS**

- IBM
- 2.5 MHz
- 4.0 MHz

**CRT CONTROLLERS**

- 1984
- The IC Master
- Your ticket to fast and easy IC selections

**LOW COST EPROM PROGRAMMER**

- The "Shooter" $39.95
  - 32K bit upgradeable 128K memory
  - Built-in Serial RS-232 Port
  - Program and verify 2716 thru 27256
  - Intelligent, fast programming
  - Read/download Hex, Binary, ASCII etc.
  - Serial RS-232 interface compatible

**UV ERASERS**

- QUV-TB/1
  - $49.95 ECONOMY Model
  - Erases 6 EPROM's in 2 minutes
  - Plastic Enclosure

- QUV-TB/2T
  - $97.50 INDUSTRIAL Model
  - Tray Action, UV Indicator
  - 80-minute adjustable timer
  - Safety switch
  - Erases 15 EPROMS in 20 minutes

- QUV-TB/2N
  - $89.95 (No Timer)
  - UV-1
    - $149.95 PRODUCTION Model
  - QUV-TB/2
    - $124.95 FAST Industrial Model
  - ST-8
    - $195.00 B-Tray Storage Cabinet

**GANG PROGRAMMER**

- GANPRO-8™ $99.95
  - High throughput
  - Reliable, user-friendly
  - Intelligent algorithm
  - Program and verify 2716 thru 27256
  - Stand alone (RS-232 option $195.00)

**OTHER PRODUCTS**

- PROMPRO-8 $689.95
  - 84K Versa
- PROMPRO-7 $489.95
  - 32K non-expandable unit
  - 23K memory buffer option available
- PALPRO-2 $1895.95
  - Stand-alone RS-232 Unit
  - Programs 20 and 24 series PALs
- PALPRO-1 $995.95
  - Programs 20-pin PALs

**MEMORY EXPANSION KIT**

- 4164 200ns
  - 9 for $29.97
Inquiry 360

Inquiry 42
You can develop software for Z80, 8080, 8085, Z8000, and 8086 using native code compilers and assemblers. Use low-cost cross tools for other microprocessors. Interface in-circuit emulators perfectly. You can run Intel development tools under ISIS or UDJ.

Inquiry 229
You can develop software that 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!

Inquiry 82
FREE SOFTWARE RENT FROM 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!

IBM PC-SIG (PC-DOS) LIBRARY
Volumes 1-330, 5% disks 9200

ORDER TODAY! Only $14.95

Inquiry 247

Inquiry 28

Inquiry 16

Inquiry 305

Inquiry 244

FREE SOFTWARE RENT FROM 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!

IBM PC-SIG (PC-DOS) LIBRARY
Volumes 1-330, 5% disks 9200

ORDER TODAY! Only $14.95

Inquiry 350

Inquiry 229

Inquiry 82

Inquiry 42

Inquiry 360

Inquiry 247

Inquiry 28

Inquiry 16

Inquiry 305

Inquiry 244
**OKIDATA Prices Slashed**

*FREE IBM ROMS*

160 CPS, Correspondence Quality
LIST JADE

- Okidata 92 parallel $99 $399.95*
- Okidata 93 parallel $99 $399.95*
- Okidata 93+ parallel FREE tractor $99 $399.95*
- 2K serial board $120 $99.95
- IBM PC ROMS for 92 $99 $49.95
- IBM PC ROMS for 93 $99 $49.95
- Extra 82/83 Ribbon $9.95 $4.95
- 82/92 tractor $89 $54.95

120 CPS & 200 CPS OKIDATAS LIST JADE

- Okidata 82 120 CPS $499 $299.95
- Okidata 83 120 CPS $775 $599.95
- Okidata 84 parallel 200 CPS $495 $799.95*
- Okidata 84 parallel 200 CPS $495 $799.95*
- Okidata 84 serial 200 CPS $1495 $99.95
- 2K serial board $150 $119.95
- IBM PC ROMS for 82/83 $49 $39.95
- IBM PC ROMS for 84 $99 $59.95

*FREE! Plug-n-Play option with purchase of 92, 93, or 84

**A-B PRINTER SWITCH**

Allows your computer to run either of two printers standard parallel switch box.
LIST JADE

Print switch $149 $89.95
Extra Cable $40 $29.95

**The LITTLE BOARD with FREE! CP/M 2.2**

Miniature single board CP/M computer designed to mount directly on top of a 5 1/4" floppy disk drive (7.75" x 5.75") Contains 280A, 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 $349.95
Support package $50 $49.95
Serial cable $13 $11.95
Diskless monitor Eprom $30 $24.95
190K Disk drive $229 $99.95
350K Disk drive $399 $149.95

**SUPER DISKETTE SPECIAL Perfect for IBM, Apple, Kaypro, etc.**

Ultra-high quality diskettes from a premium U.S. manufacturer, certified to be absolutely error free for one full year. Buy a box of ten this month and we will include a plastic storage/library box FREE!

- Single-sided, double-density $34 $16.50
- Double-sided, double-density $42 $19.50
- Bulk Diskettes as low as $10

**OKIDATA 350K Disk drive**

Diskless monitor Eprom

**LEVER QUALITY PRINTERS ON SALE!**

**EPSON PRINTERS New Plus Series in Stock!**

- EPSON RX-80 SAVES $80.00
- EPSON RX-80/F/T SAVE $10.00
- EPSON RX-100/F/T SAVE $200.00
- EPSON FX-80/F/T SAVE $200.00
- EPSON FX-100/F/T SAVE $300.00
- EPSON LO-1500 SAVE $300.00
- EPSON/COMEX 420 CPS SAVE $500.00
- 2K Serial Board RX/FX $149 $99.95
- FX-80 Tractor $59 $39.95
- LO-1500 Sheeter $89 $49.95
- LO-1500 Sheeter $89 $49.95

**LETTER QUALITY PRINTERS ON SALE!**

- Diablo 630 40 CPS $2340 $1699.95
- Tractor for 630 $250 $199.95
- Starwriter F-10 40 CPS $1895 $999.95
- Tractor for F-10 $59 $199.95
- New Comrex CR-11E $599 $439.95
- Tractor for CR-11 $120 $99.95
- Keyboard for CR-11 $199 $179.95
- Sheet feeder for CR-11 $259 $199.95
- Tractor for 630 $599 $439.95
- NEC 3550 33 CPS $199.95
- Tractor for 3550 $2250 $1399.95
- Tractor for 3550 $2250 $1399.95

**TOSHIBA P1351 High speed & letter quality!**

High quality 24 pin head, 192 CPS draft mode, 96 CPS letter quality.

- P1351 LIST JADE $1985 $2999.95
- Tractor $165 $174.95
- Sheet Feeder $1085 $899.95

**MANNESMAN-TALLY Spirit 80 Printer**

List Price $399 $249.95

**PRINTER ACCESSORIES**

LIST JADE

- IBM PC style cable $54 $28.95
- Standard parallel cable $40 $28.95
- Apple Card & cable $109 $49.95
- RS-232 serial cable $30 $24.95
- Ribbons $39 $27.95

**MICROFAZER BUFFERS Quadram**

Expandable to 64K (parallel model expands to 512K)

- 8K parallel in/parallel out $149 $399.95
- 32K parallel in/parallel out $225 $164.95
- 128K parallel in/parallel out $445 $269.95
- 8K serial in/serial out $139 $169.95
- 32K serial in/serial out $280 $199.95
- 64K serial in/serial out $280 $199.95
- 8K parallel in serial out $299 $199.95
- 32K parallel in serial out $299 $199.95
- 8K serial in serial out $299 $199.95
- 32K serial in serial out $299 $199.95

**MICROBUFFER Practical Peripherals**

Stand alone Microbuffers
LIST JADE

- 32K parallel in/parallel out $299 $229.95
- 64K parallel in/parallel out $349 $269.95
- 32K serial in/serial out $299 $199.95
- 64K serial in/serial out $299 $199.95
- 32K add-on board $179 $149.95

We accept cash, checks, credit cards, or purchase orders from qualified firms and institutions.
Minimum prepaid order $15.00 California residents add 6 1/2% 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
Guaranteed service, support, and fast delivery on the name brands you desire and...

YOU'LL LOVE OUR PRICES

20 MEGABYTE Tape Back-up System
- IBM PC, XT, AT compatible
- Low-power, half-height tape drive
- Uses standard data cassettes
- Unique flexible software shows choice of file-by-file or complete mirror-image back-up & retrieval
- 6 different file selection parameters
- Automatic error checking & correction
- Includes controller card & software

LIST JADE
20 MB cassette back-up $995 $995.00
45 MB 1/2 tape back-up $1095 $1095.00
External 45 MB system $1495 $1095.00

10 Megabyte Hard Disk for IBM PC $699.00
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. External model includes cabinet & power supply.

LIST JADE
10 mbyte internal $1350 $699.00
10 mbyte external $1585 $899.00
15 mbyte internal $1795 $899.00
15 mbyte external $1895 $1099.00
20 mbyte internal $1800 $995.00
20 mbyte external $2060 $1299.00
33 external $3298 $1495.00
33 external $3399 $1999.00
10 mbyte internal tape $1000 $599.00
10 mbyte external tape $1240 $749.00

KEYTRONICS KEYBOARDS
LIST JADE
$510 $209 $159.95
$512 $299 $199.95

360K DISK DRIVES for IBM PC
Double sided, double density
Tandon 100-2 $159.00 each
Teac 55B $129.00 each
360K Half height drive $99.00 each

LIST JADE

OMNI-READER TEXT SCANNER
For DATA ENTRY
- Enters data at 160 cps
- Serial interface configured as a modem
- 300, 600, 1200, 2400, 4800, 9600 baud

LIST JADE
$479.95

IBM-AT Multi Function Expansion Board
- Up to 3 Megabytes of RAM
- Uses standard 64K or 256K chips
- Has PAL for split addressing
- Low power, IBM-AT high speed bus
- One parallel & one serial port
- Second serial port optional

LIST JADE
128K, 1 serial, 1 parallel $495 $395.00
Second serial port option $59 $49.95

Expansion Boards for your IBM-AT

LIST JADE
Quadport-AT 1S, 1P $175 $139.95
Quadmod-AT 1 MEG $2465 $1995.00
Quadmod-2 MEG $3995 $3195.00
Quadmod-A4 4 MEG $7490 $5995.00
JADE AT-Expando plus $495 $395.00
AT-Memory Master plus $495 $429.00
AST Advantage-AT $495 $449.00
Bar Code Reader System $895 $695.00
128K Upgrade Kit $995 $695.00
20 Megabyte Hard disk $1790 $995.00
30 Megabyte hard disk $1999 $1495.00

PERSEY ST BOARDS

LIST JADE
Mono display adapter $225 $189.95
Mono display adapter w/parallel $250 $199.95
BoB Hi-res display adapter $395 $469.95
Time Spectrum SB 384 64K $595 $495

HIGH SPEED 8087 APU
List Price $293
SALE PRICE $179.95

LIST JADE

HAYES Smartmodem
Sophisticated direct-connect auto-answer/auto dial modem, touch tone or pulse dialing RS232C interface programmable

LIST JADE
Hayes Smartmodem 2400 $595 $469.95
Hayes Smartmodem 1200 $599 $459.95
Hayes 1200B w/Smartcom II $539 $359.95
Hayes 1200B for IBM PC $599 $389.95
Hayes Smartmodem 300 $299 $199.95
Hayes Hayes Trimodem $249 $199.95
Hayes Micromodem 100 $399 $299.95
Hayes Micromodem 50 $299 $239.95
Hayes Micromodem lie $299 $239.95
Hayes Smartmodem II $399 $249.95
Hayes PLEASE Software $399 $299.95
Hayes Smartcom II $149 $99.95
New! from JADE
IBM Multifunction Card
Full one year warranty!
Up to 384K, parallel printer port, RS-232 serial port, FREE serial cable, clock/calendar, RAM disk/spooler and diagnostic software package
0K $349 $199.95
64K $449
256K $549 $349.90
384K $649 $499.90

64K RAM Upgrade Kits for your IBM PC $299.95

IBM VIDEO BOARDS

<table>
<thead>
<tr>
<th>QUADRUM for IBM PC</th>
<th>JADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadboard No RAM</td>
<td>$269</td>
</tr>
<tr>
<td>Quadboard 64K</td>
<td>$275.95</td>
</tr>
<tr>
<td>Quadboard 128K</td>
<td>$281.95</td>
</tr>
<tr>
<td>Quadboard 256K</td>
<td>$287.95</td>
</tr>
<tr>
<td>Quadboard 384K</td>
<td>$293.95</td>
</tr>
<tr>
<td>Quadlink</td>
<td>$680</td>
</tr>
<tr>
<td>Quad 512 plus 64K</td>
<td>$325</td>
</tr>
<tr>
<td>Quad 512 plus 256K</td>
<td>$350</td>
</tr>
<tr>
<td>Quad 512 plus 512K</td>
<td>$375</td>
</tr>
<tr>
<td>Quadcolor I</td>
<td>$175</td>
</tr>
<tr>
<td>Quadcolor II</td>
<td>$190</td>
</tr>
<tr>
<td>Quad color display</td>
<td>$645</td>
</tr>
<tr>
<td>576K Max PAQ w/64K</td>
<td>$205</td>
</tr>
<tr>
<td>516 Max PAQ w/384K</td>
<td>$220</td>
</tr>
<tr>
<td>Asher Voice &amp; Data</td>
<td>$690</td>
</tr>
</tbody>
</table>

IBM VIDEODUE BOARDS

| Hercules Color  | $245 |
| Hercules Graphic| $250 |
| Plantronics Color plus | $255 |
| Quadcolor I     | $295 |
| Quadcolor II    | $300 |
| AST Monograph plus | $305 |
| PC Peacock      | $310 |
| PC384K Genie OK | $320 |
| Paradise Graphics card | $330 |
| Paradise Module A| $340 |
| Paradise Module B| $350 |

Hi-Res MONITORS

| Amdek 300G    | $179 |
| Amdek 300A   | $190 |
| Amdek 310A   | $220 |
| Amdek Color 300| $250 |
| Amdek Color 500| $275 |
| Amdek Color 600| $300 |
| Amdek Color 700| $325 |
| PGS 128K     | $200 |
| PGS 128K     | $225 |
| PGS 128K     | $250 |
| PGS 128K     | $275 |
| PGS 128K     | $300 |
| PGS 128K     | $325 |
| PGS 128K     | $350 |
| PGS 128K     | $375 |
| PGS 128K     | $400 |
| PGS 128K     | $425 |
| Comrex CR6800| $649 |
| Gorilla Green| $89 |
| Gorilla Amber| $99 |
| JADE Hi-res Amber| $129 |
| JADE Hi-res Green| $149 |
| JADE Color RGB 640x240| $209 |
| JADE Color RGB 720x480| $229 |

MICROSOFT for IBM PC

| Mouse with Word| $495 |
| Mouse          | $599 |

IBM PC

| OPTION #1 | 256K, dual disk drives, and disk controller.
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0K</td>
<td>$349</td>
</tr>
<tr>
<td>64K</td>
<td>$449</td>
</tr>
<tr>
<td>256K</td>
<td>$549</td>
</tr>
<tr>
<td>384K</td>
<td>$649</td>
</tr>
</tbody>
</table>

| OPTION #2 | 256K, disk drives, disk controller, monochrome card, monitor, and printer port.
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0K</td>
<td>$349</td>
</tr>
<tr>
<td>64K</td>
<td>$449</td>
</tr>
<tr>
<td>256K</td>
<td>$549</td>
</tr>
</tbody>
</table>

| OPTION #3 | 256K, disk drives, disk controller, color graphics card, parallel port.
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0K</td>
<td>$349</td>
</tr>
<tr>
<td>64K</td>
<td>$449</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SHUGART SA 801R</th>
<th>LIST JADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHUGART SA 801R SS/DD</td>
<td>$359.00 ea 2 for $349.99 ea</td>
</tr>
<tr>
<td>SHUGART SA-801R DS/DD</td>
<td>$459.00 ea 2 for $449.99 ea</td>
</tr>
</tbody>
</table>

PRO MODEMS

<table>
<thead>
<tr>
<th>PRO MODEMS from Prometheus</th>
<th>LIST JADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1200B for IBM PC</td>
<td>$375</td>
</tr>
<tr>
<td>1200B for IBM PC w/software</td>
<td>$399</td>
</tr>
<tr>
<td>1200 RS-322 stand alone</td>
<td>$449</td>
</tr>
<tr>
<td>1200A for Apple</td>
<td>$499</td>
</tr>
<tr>
<td>1200 Mac Pac for Macintosh</td>
<td>$499</td>
</tr>
</tbody>
</table>

ISOBAR

The ISOBAR looks like a standard multi-outlet power strip but contains surge suppression circuitry and built-in noise filters, plus 15 amp circuit breaker.

-4 receptacle $99
-8 receptacle $149

UNINTERRUPTABLE POWER SUPPLY

A must for every computer system

425 Watt UPS | $539 |

Berenoulli Boxes

from IOMEGA

5, 10 or 20 megabyte removable cartridge mass storage system with flexibility not available in hard disks.

-5mbyte system/Macintosh | $189 |
-10mbyte system/IBM   | $299 |
-20mbyte system/IBM   | $399 |
-Extra 10mbyte cartridge | $100 |

APPLE ACCESSORIES

| FULL HEIGHT DISK DRIVE | $299 |
| FULL HEIGHT DISK DRIVE | $299 |
| CONTROLLER             | $100 |
| COM/POS 3D CARD        | $399 |
| ALS Z ENGINE           | $249.95 |
| 16K RAM CARD           | $299 |
| BEST 80 COLUMN CARD    | $299 |
| PRINTER CARD & CABLE   | $299 |
| FAN w/surge protect    | $299 |
| KOALA PAD              | $299 |
| GRAPPLE PLUS           | $299 |
| BUFFERED GRAPPLE/16K   | $299 |
| DISK DRIVE FOR APPLE IIc| $299 |
| 10 Meg Hard Disk       | $499 |

Place Orders Toll Free!

Continental U.S.A. Inside California
(800) 421-5500 (800) 262-1710

Los Angeles Area (213) 973-7707

JADE Computer Products

4001 West Rosecrans Ave. Hawthorne, California 90250
COMPUTERS

SANYO
MBC550 — Includes 128K Memory, 5¼ Disk Drive, Parallel Printer Port. CPU has RGB Color and Monochrome Compost Video. Software includes: Sanyo BASIC, Wordstar, Calcstar and Easywriter. Call for Price
MBC555 Call for Price
Sanyo Monitors, Serial Cards, Upgrades Avail. from Sav-On Call for Prices

COMPAG
COMPAG PLUS 2 Drives [1 Poppy & 1 10 Meg] & 256K...$3740
DESK TOP Model 1 Call
DESK TOP Model 2 For
DESK TOP Model 3 Pricing
CALL FOR PRICING ON APPLE, KAYPRO, TAVA, ZENITH, EPSON, NEC, COLUMBIA AND OTHER CPU’s.
WE CAN GET YOU THE LOWEST PRICE AROUND

PRINTER INTERFACE and PERIPHERALS

PRINTER CABLES
ALL MAKES (6 foot long) ..$20

FOURTH DEMISION
PAR CARD & CABLE for Apple ..$48

ORANGE MICRO
GRAPPLER + ..$119
GRAPPLER + w/16K ..$175

OKIDATA
SERIAL INTERFACE ..$89

MICRO TEK
DUMPING GX ..$65
DUMPING GX (Exp to 64K) ..$45
BAM 16 ..Call

PRINTERS

STAR MICRONICS
GEMINI 10X [120cps] ..$259

OKIDATA
82A [120cps par & ser] ..$299
82P [160cps] ..$399
84P [200cps] ..Call

EPSON
RX800 [120cps, Frac/Tractor] ..$299
FX80 [160cps] ..$399

JUKI
B1000 [18cps & 1st. quality] ..$408
6300 ..Call

BROTHER ..Call

DYNAX ..Call

NEC ..Call

MONITORS

PRINCETON GRAPHICS
HX12’ [High Res, IBM Compatible] ..$459
SR12 ..Call
MAX12 ..$185
SCN DOUBLER ..Call

AMDEK
300G 12” Green ..$126
300A 12” Amber ..$135
310A 12” Amber [Monochrome] ..$160
COLOR I+ [Color Composite] ..$299
COLOR II+ [RGB w/Cable] ..$499

ZENITH
ZVM122 12” Amber ..$99
ZVM123 12” Green ..$99

LEADING EDGE
GORILLA 12” Green ..$89
GORILLA 12” Amber ..$99

DISKETTES

DYSAN
5¼” DS/DD [Box of 10] ..$28

MODEMS

HAYES
300 ..$199
1200 External, PC Compatible ..$469
1200B Internal, PC Compatible ..$399
MICRO MODEM Ile ..$239

NOVATION
ACCESS 123 ..Call
J-CAT ..Call
APPLE CAT ..Call

ANCHOR
MARK VII [300 Baud] ..$99
MARK XII [1200 Baud] ..$239
MARK VI ..$69
CALL FOR PRICING ON OTHER MODEMS

THE Sav-On System

THE PROFESSIONAL SYSTEM
APPLE
2 Drives, 80 Col Card, Apple Monitor
Very Nicely Priced
At A Very Very Low ..$1295

PORTABLE COMPUTER
DATA GENERAL
Small Enough to Fit In A Brief Case
PC Compatible
Low Priced ..Call

COMPAQ
2 Drives with 256K ..$2195.00

APPLE ADD-ONS

TG
JOY STICK ..Call For
SELECT PORT
PADES ..Lowest

MICROMAX
VIEWMAX 80 ..$130
VIEWMAX 80e ..$130

KENSINGTON
SYSTEM SAVER ..$69
MORE AVAILABLE ..Call
CALL US WITH YOUR LOWEST ADVERTISED IBM PRICE ... WE WILL MATCH IT PLUS PAY SHIPPING

<table>
<thead>
<tr>
<th>IBM PRODUCTS</th>
<th>1 up</th>
<th>5 up</th>
<th>10 up</th>
<th>1 up</th>
<th>5 up</th>
<th>10 up</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM COMPUTERS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBM PC Bare Bone 64K w/Dr Cont</td>
<td>$1179</td>
<td></td>
<td></td>
<td>$1150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBM PC 64K w/ 1 Drive</td>
<td>1259</td>
<td></td>
<td>1285</td>
<td>1275</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBM PC 265K w/ 2 Drives</td>
<td>1549</td>
<td></td>
<td>1560</td>
<td>1520</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBM PC XT 128K w/1 Drive &amp; 10Mbs</td>
<td>3349</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBM PC XT 265K w/ 2 Drives</td>
<td>3499</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBM PC AT Emersed, Base, Jr</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBM PORTABLE 265K w/ 2 Dr</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| DRIVING CONTROLLER CARDS | | | | | | |
| IBM Original (Controllers 4 drives) | $139 | | | | | |
| MAYNARD (Any Configuration) | Call | | | | | |
| IBM Copy (120 Day Warranty) | 119 | | | | | |

| COMPATIBLE DRIVES FOR PC | | | | | | |
| CDC (IBM Compatible) | $159 | | | | | |
| TANDON Full Height 320K | 159 | | | | | |
| MPI A2 (IBM Compatible) | 119 | | | | | |

| TALLGRASS HARD DISKS | | | | | | |
| 20Mbyte w/20MB Back-up | Call | | | | | |
| 35Mbyte w/15MB Back-up | Call | | | | | |
| 70Mbyte w/60MB Back-up | Call | | | | | |

| MAYNARD, ALPHA OMEGA, GENIE | | | | | | |
| CALL FOR PRICING | | | | | | |

| IBM PC SYSTEM | | | | | | |
| w/2 Drives, 256K Memory | | | | | | |
| Mono Monitor, Mono Card w/Print Port | | | | | | |
| 8087-3 Math Coprocessor & DOS 2.1 | | | | | | |
| Valintes Specials | $1899.00 | | | | | |

| IBM PC | | | | | | |
| w/1 Drive, 128K, Monitor Interface & Monitor | | | | | | |
| $1599.00 | | | | | | |

| IBM PC SYSTEM | | | | | | |
| 256K, 2½ High TEAC Drives, 10 Meg | | | | | | |
| Hard Disk, Monitor & Interface | | | | | | |
| $2499.00 | | | | | | |

FINANCING AVAILABLE with Approved Credit,

We honor School, University, and qualified business P.O.'s — also Accounts may be set up on credit approval — for more information call (213) 675-2381.

SAV-ON IS HELPING YOU GROW BY SAVING YOU MONEY ON YOUR PERSONAL COMPUTER NEEDS

Sav-On Computers, Inc.
12595 Crenshaw Blvd., Hawthorne, CA 90250

OPEN: 7:30am till 6:00pm Mon.-Fri.
5:00am till 2:00pm Sat.

TERMS: We accept Visa, MasterCard, C.O.D.'s, and Wire Transfers. No surcharge for Credit Cards. Call for Federal Express or Airborne shipping information. Call, cable, FAX, or mail your orders. Prices subject to change without notice. Not responsible for typographical errors.
Terms:
We accept MC, Visa (3% handling charge on AMEX only), Wire transfer, and Purchase Orders from
qualified firms. All returns wi thout RMA are subject to 20% restocking charge . Utah residents pay
5.75% sales tax. Call for freight charges. Prices subject to change and are in U.S. Currency only.
MINIMUM OROl;:R s15.00
UPS Surface
Min. 3 to 10 day delivery
UPS Red Label
1 day delivery
UPS Blue Label
3 day de livery

IBM PC-1 Includes 64K, RAM,
1 ea. 360K FD, KB
$1449
IBM PC-2 64K RAM, 2 ea
360K FD, KB . . . .. . . . ..

$1599

IBM PC-22 256K RAM, 2 ea
360K FD, KB ........ , . . . . ..

$1699

IBM PC-3 256K RAM, 2 ea
360K FD, IBM Mono Display,
IBM Mono Card, KB .. .... .... $2129
IBM PC-33 256K RAM, 2 ea 360K FD,
Color Bd. Monitor, KB ... ... . $2049
IBM PC-4 256K RAM, 2 ea 360K FD,
Everex Graphics Edge,
Qui max PX4, KB .... ........ .. $2549

MEMORY BOARDS

MEMORY UPGRADES

AST 6 Pak+ w/64K (Expands to 384K) ha s Par,
Seri al. Clk, RAM Disk. Spooler .. ... ... . $259
AST 6 Pak + w / 384K Plus all
above features . .. .. . .. . . . . . ... ... . $449

IBM UP-GRADE FOR PC

P.C. WARE " 256K RAM'" w/O RAM .... ... $119
P.C. WARE "256K RAM" w/64K R AM . . .. . $159
"Ouadboard 384" w/64K (Expa nd s to 384K)
ha s Par, Serial, Clk. RAM Disk.
Spooler. Game Port . . . • . . . . . . . . . . . . $269
"Ouadboard 384 " w/384K and all
above features . . . . . . . . . . . . . . . . . . . .

3 TIMES SPEED OF XT
IBM -A T (Base Model) includes 256K RAM.
1.2 MB F.D .. Clk/Cal. 8 Slots.
Keylock. KB. . . . . . . . . . . . . . . . . . . .
$3900
IBM-AT (Enhanced) includes 512K RAM.
1.2 MB FD. 20 MB F i xed Drive.
Ser I Par Port. 8 Slots. Keylock. KB . . . . . $5700

AT ADD - ON

AT

INCLUDES 9EA. 41 64·200NS
FOR EXPANS ION ON ALL PRODUCTS
WITH PARITY

$28.00

~ - -~

PEA SET

~

·..,.;,_"'

':~ ·

$25.00
,;4i

~'

5 OR

MOAE

1

""~-

IBM MEMORY UPGRADE FOR AT ~
9 EA 4128 - 200 NS (256K)
,.;; "» '

'$

$229.00
0

-~"1*'·· ~ '

'

'""?.""'

-

DRIVES

20MG Hard Disk
$1295
30MG Hard Disk
S1695
1.2 MG F.D. w/Rails . .. , . , .... , . . . . . . . . $329
360K F.D . w/Rai ls
... .. $229

;f;;·~ ,

' COMPAQ M EMo'ifr (256K) UPGRADE .
9 ea 256K C HIP (200 NS)

$,2~-~:.0 Q.

ADD-ON MEMORY BOARD

• STB " Rio Grande" w/128K . , . . . ,
Expands to 1.SMG
Has Par/Ser/Optional Serial & GP
• STB "Gran d Byte " w/128K
Expands to 2 MG

$359

$299

MODEM~
Anchor M ark XII - External-Direct Connect­
Hayes Commands Includes Serial CableAu to Answe r & Dial . . . . . . . . . . . . . . . . $239
Hayes 1200 - External-Direct Connect . . . . . $479
Hay es 12008 - Internal fo r IBM
with Software . . . . . . . . . .. . .. . .... . $399
Popcorn Xl OO External 300/ 1200. Auto Answer/
Auto Dial (20% more features than
Hayes 1200) ... ... ... ' .. .. ' .. .... .. ONLY $319
Pro-Modem 1200 - Ext erna l-D irect Connectw /C lock - Hayes Com mands ­
Auto Answer and Dial
. .... . ....•, $329

Amdek 300A ........ , ... . . , ........... .
Amdek 310A

IBM Monochrome wt Par Port
HERCULES Graphics Card . . . . . . . . .
PERSYST Monochrome w/Par Port . . . . .

$229
$329
$199

COLOR CARDS
Hi-Res. 14" Screen Tilt & Swivel
DM14A (Amber) , . . . .... , . .... .
DM 14G {Green) ..
PX-IV (4) - Hi-Res RGB w /Switch

to convert to green for Word Processing
w /Tilt & Swivel Base ...
(Better than Princeton H X-12)

10, 15, 22 and 30 MG Hard Disk
Subsystems
Plug in controller and have instant Mass Storage 1

FDC (Controls up to 4 ea. 5" ) . .. .
.. . . • $119
$219
Maynard "Sandstar" FDC . . . . . .
(5 " or 8" wl Ability to add Par, Serial,
Clock. Game Port or Hard Disk Modules)

ALPHA-OMEGA HARD DISK
TURBO 20 20MG Hard Disk wt Cont . .
$1795
TURBO 10 1OMG Hard Disk w/Cont . . . . . . . . . . $749
TURBO 10T 10MG Hard Disk w iCpntroller
and Tape Backup . . . . . . . . . . . . . . . . . . .
$1495
...... . . ..... $539
COGITO 1OMG Hard Disk
COGITO 20MG Hard Disk . . . . . . . . .. . . .. . . . . $1199

• 3 times faster than XT
• Boot from hard disk
•Fully PC or XT compat ib le

Size
10MB
15 MB
22 MB
33 MB

Intern al

$749
$989
$1349
$1769

External
$889
$1089
$1529
$1889

10 MG TAPE STREAMER
• 10 MG Streamer Tape back-up

• Back-up in 8 min .

lnternalStream 1/2 HGT. . . . . . . . . . . .... $899
External Stream (w/Power Supply
and case) (1 /2 HGT) ... . . . .. ... . ... . $995
10.38 MG Tape Cart ri dge .. .... .. . .. . . . . $29

IBM Color Graphics . ... . . . , . . .... . . , . . .
$219
AST Monograph w/Par. Ser. Clk .. . . .. . . . . ... CALL
EVEREX " Graphics Edge"
Runs Mono & RGB Color at same time (640X200)
16 Color/Hi-Res Mono/Par Port 80x25
or 132x44 . . . . .. . . . . . . . . .. . . . . . .
$399
HERCULES Color . . .
. ... •. .... ... ... $199
PARADISE "'Multi-Display"' w/Par
$319
Paradise "Modular Card" . . . . .
$345
Modular A
. ..........
$88
Modular B . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . $240
STB "Graphic's Plus 2"
Composite. Mono. RGB/50% Faster Scroll/Flicker
Free/(320x200) 16/(640x200) 4/(640x352)
Mono . . . . . , . . .. . . , . . . . . . . . . . . . . . . . . . . $349
TECMAR "Graphics Master"
128K RAM/(640x400) 16/(720x480) 4
RGB and Mono . , .... , .... , ... . , . .
$499

IBM MISCELLANEOUS
IBM Memory Upgrade Kit (64K) . . . . . . . . . . . $32
P.C. Ware Serial Board .... . . .. , . . . . . . . $79
P.C. Ware Par Board . ... .. . . .. , . . . . . . . $75
P.C. Ware Clock/Calendar .... .. . . . . . . . . $59
Math Co-Processor - 8087 . ... • • .. • . . .. $149
IBM DOS2 .1 . . .. ... . . . . . . . • .. . ... .. $57
IBM DOS 3.0 . . . . . . . . . . . . . . • .. .. .... $60
LO T US 1-2-3 .... , . . . . . . . . .
, . $299


IDEAL FOR OEM MANUFACTURERS, UNIVERSITIES, RESEARCH LABS ETC.

THE ULTIMATE PC COMPATIBLE ENCLOSURE

IDEAL FOR MEGA-BOARD™ XT OR ANY IBM-PC PC-XT COMPATIBLE BOARDS

EASY ACCESS!!
FLIP-TOP-CASE™ OPENS FOR EASY ACCESS TO INSIDE!!

EXCLUSIVE FLIP-TOP-CASE™
Overcomes Problems With PC Case

Bus Expansion Slot
Allows External Access To PC Bus

Mounts Standard Power Supply
Mounts Standard Half or Full Height Floppy Disk or Hard Disk Drives

Blank Label Inset
For Your Company Or University Name Here

Rugged Heavy Gauge Steel Construction

ADVANCED KEYBOARD

FEATURES: • Horizontal Return Key
• Caps Lock and Num. Lock Indicators
• Enter Key for Numeric Keypad

ONLY $99.95
COMPLETE

ONLY $149.95

Fully Assembled and Tested with One Year Limited Warranty

DISPLAY TELECOMMUNICATIONS CORPORATION
4100 SPRING VALLEY ROAD
SUITE 400
DALLAS, TX 75234
(214) 991-1644

TERMS: We accept cash, checks, money orders, or purchase orders from qualified firms and institutions. Prices and availability subject to change without notice. Shipping and handling charges via UPS ground 50¢/lbs. UPS air $1.50/lbs. Minimum charge $3.00

©1984 Display Telecommunications Corporation

458 BYE • FEBRUARY 1985

*IBM and IBM PC are trademarks of International Business Machines

Inquiry 94
#1 CHOICE OF MAJOR OEM MANUFACTURERS, UNIVERSITIES, RESEARCH LABS ETC. A THOROUGHLY FIELD PROVEN DESIGN, HIGH VOLUME PRODUCTION ENGINEERED.

- FULL IBM PC-XT* COMPATIBILITY!
- FULL MEGA-BYTE RAM CAPACITY ON MOTHERBOARD!

DEALERS AND OEM MANUFACTURERS QUANTITY DISCOUNTS AVAILABLE

Eight Compatible I/O Interface Connectors
(Full PC compatible)
(compatible with all
IBM-PC* plug-in cards)

Special J1 Interface
(Allows horizontal mount-
ing of compatible expand-
sion cards for easy bus expansion and custom configu-
ring) (Board has 62 pin gold plated compat-
ible connector)

Extended ROM Capability
(Runs all compatible PC ROMS) (Jumper program-
able 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)

Full Mega-Byte Ram Capacity!
On board!
(With parity)
1256K Bytes using 64K chips
11 Mega Bytes using 256K chips

Only! $99.95
Mega-Board™
Evaluation Board Kit!
(Blank board with full assembly instructions and parts list.)
Includes highest quality PC board
with gold plating, silk screen, solders mask
Board Size 10.5 inch x 13.5 inch

FREE OFFER

FREE! Displaytel™ Exclusive.
Our Commitment to Microcomputer
Education!

FREE Intel 8088 Data Book with each
Mega-Board™Order!

ORDER NOW!!!!

CALL 214-991-1644

100% SATISFACTION GUARANTEE

Immediate shipment!
Most instock items shipped
same or next day!

10 Day money back guarantee
if not completely satisfied!

DVC™ DISPLAY
TELECOMMUNICATIONS
CORPORATION

4100 SPRING VALLEY ROAD
SUITE 400
DALLAS, TX 75234
(214) 991-1644

©1984 Display Telecommunications Corporation

IBM and IBM PC are trademarks of International Business Machines

Inquiry 94
Upon request, all drives are supplied with power connectors and manual. These Qume D T8i842 disk drives are NEW double sided units acquired from the excess inventory of a Five Inch Winchester Hard Disk Drives. They have historically been used by thousands of quality conscious equipment manufacturers because of their extremely high degree of reliability. These units are current production rack mountable LB tech's. The drives are identical in drives currently sold by distributors at $600. California Digital has acquired these NEW units as a result of a change in marketing strategy of the A. M. Jacquard Corporation. This is the best value that has ever been offered on any Shugart eight inch disk drive. SHU-801R

**QUME DT8**

$319

These Qume DT8/842 disk drives are NEW double sided units acquired from the excess inventory of a major computer manufacturer.

**Five Inch Winchester Hard Disk Drives**

<table>
<thead>
<tr>
<th>Model</th>
<th>Capacity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>FUJITSU M2235AS 27 Meg.</td>
<td>999 999</td>
<td></td>
</tr>
<tr>
<td>RODINE RO-208 53 Meg.</td>
<td>1589 1493</td>
<td></td>
</tr>
<tr>
<td>MAXTOR XT1063 65 Meg.</td>
<td>1595 1963</td>
<td></td>
</tr>
<tr>
<td>SHUGART 712 13 Meg. 1/2 Ht</td>
<td>795 765</td>
<td></td>
</tr>
<tr>
<td>SHUGART 604 6.7 Meg.</td>
<td>159 149</td>
<td></td>
</tr>
<tr>
<td>TANDON 502 10 Meg.</td>
<td>419 395</td>
<td></td>
</tr>
<tr>
<td>TANDON 503 19 Meg.</td>
<td>795 775</td>
<td></td>
</tr>
</tbody>
</table>

Upon request, all drives are supplied with power connectors and manual.

**MEMORY**

**4164 DYNAMIC MEMORY**

150ns $3.95

**DYNAMIC MEMORY**

<table>
<thead>
<tr>
<th>Address</th>
<th>1-25</th>
<th>26-50</th>
<th>51-75</th>
<th>76-100</th>
</tr>
</thead>
<tbody>
<tr>
<td>4110</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>4111</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>4118</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>4119</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>4120</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>4121</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>4122</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>4123</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>4124</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>4125</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>4126</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>4127</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>4128</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>4129</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>4130</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>4131</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>4132</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>4133</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>4134</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>4135</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>4136</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>4137</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>4138</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>4139</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>4140</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
</tr>
</tbody>
</table>

**STATIC MEMORY**

- **Address**
- **Price**

**EPROMS**

- **Address**
- **Price**

**REMEX DOUBLE SIZED**

$219

**Eight Inch Single Sided Drives**

<table>
<thead>
<tr>
<th>Model</th>
<th>Capacity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHUGART 801R</td>
<td>159 159 154</td>
<td></td>
</tr>
<tr>
<td>SIEMENS FDD 100-8</td>
<td>129 125 119</td>
<td></td>
</tr>
<tr>
<td>TANDON 840E-1 Half Height</td>
<td>369 359 349</td>
<td></td>
</tr>
</tbody>
</table>

**Eight Inch Double Sided Drives**

<table>
<thead>
<tr>
<th>Model</th>
<th>Capacity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHUGART SA851R</td>
<td>495 485 475</td>
<td></td>
</tr>
<tr>
<td>QUME 842 &quot;QUME TRACK 8&quot;</td>
<td>319 319 313</td>
<td></td>
</tr>
<tr>
<td>TANDON 840E-2 Half Height</td>
<td>459 447 435</td>
<td></td>
</tr>
<tr>
<td>REMEX RFD</td>
<td>400</td>
<td></td>
</tr>
<tr>
<td>MITSUBISHI M2894A-63</td>
<td>447 439 433</td>
<td></td>
</tr>
<tr>
<td>MITSUBISHI M2896-63 1/2 Ht.</td>
<td>439 449 409</td>
<td></td>
</tr>
</tbody>
</table>

**ENCLOSURES**

California Digital manufactures an assortment of stock and custom drive enclosures. The volume is produced with custom design and an enclosure for your application. The following stock disk drive enclosures are available. All include power supplies. Some enclosures are supplied with exhaust fans.

- **Horizontal mount dual 8" full height drives.** $179.00
- **Vertical mount dual full height 8" drives.** $199.00
- **Horizontal mount one full height or one half height 8".** $199.00
- **Horizontal one half height or two half height.** $69.00

Shipping: First five pounds $3.00, each additional pound $.50. Foreign orders: 10% shipping, excess will be refunded. California residents add 8.25% sales tax. COD's are discouraged. Open account orders extended to state supported educational institutions and companies with a strong "Dun & Bradstreet" rating.
### Promethean ProModem 1200

- **Price:** $399
- **Description:** The ProModem 1200 is a high-speed modem that supports 28800bps and is compatible with Hayes compatible modems. It includes a Hayes compatible modem feature and supports up to 28800bps. The modem is equipped with a serial interface and is compatible with Hayes compatible modems. It also features a built-in diagnostic test.

### Model 40 Teletype

- **Price:** $995
- **Description:** The Model 40 Teletype is a high-speed printer that supports 2400bps and is compatible with Hayes compatible modems. It includes a Hayes compatible modem feature and supports up to 2400bps. The printer is designed for use with Hayes compatible modems.

### Sellout Dragon 127

- **Price:** $127
- **Description:** The Sellout Dragon 127 is a portable printer that supports 2400bps and is compatible with Hayes compatible modems. It includes a Hayes compatible modem feature and supports up to 2400bps. The printer is designed for use with Hayes compatible modems.

### Tally 504 Winchester

- **Price:** $159
- **Description:** The Tally 504 Winchester is a low-cost printer that supports 2400bps and is compatible with Hayes compatible modems. It includes a Hayes compatible modem feature and supports up to 2400bps. The printer is designed for use with Hayes compatible modems.

### Promethean ProModem 1200 Specifications:

- **Speed:** 28800bps
- **Interface:** Serial
- **Compatibility:** Hayes compatible modems

### Model 40 Teletype Specifications:

- **Speed:** 2400bps
- **Interface:** Hayes compatible modem

### Sellout Dragon 127 Specifications:

- **Speed:** 2400bps
- **Compatibility:** Hayes compatible modems

### Tally 504 Winchester Specifications:

- **Speed:** 2400bps
- **Compatibility:** Hayes compatible modems

---

**TERMINALS**

- **Function:** Dial-up, Route, Line Monitor, Call Waiting, Call Forwarding
- **Speed:** 2400bps
- **Compatibility:** Hayes compatible modems

**TOLL FREE ORDER LINE**

(800) 421-5041

---

**TECHNICAL & CALIFORNIA**

(213) 217-0500

---

*February 1985*
Call for an IBM PC system custom enhanced to meet all your business needs.

Printers:
- EPSON JX-80 (160cps, 10", 8 colors)...
- EPSON FX-80 (160cps, 10")...
- EPSON FX-100 (160cps, 15")...
- EPSON RX-80 (100cps, 10")...
- EPSON RX-80F/PLUS (100cps, 10' w/platen near LO)...
- EPSON RX-100 (100cps, 15" while they last)...
- OKIOATA ML92 g60cps, DATAPRODUCTS 8010 (180cps, dot matrix, 10") CALL...
- GEMINI 15X (120cps, 15") $395...
- TI-855 (LO dot matrix w/1ont aut)...
- DATAPRODUCTS 8050 200cps, dot matrix, 15")...
- NEC 3550 L33cps...
- NEC 2050 (Durable, low cost LO)...
- C.ITOH A10 (New letter quality)...
- OIB 630ECS (192 chars on wheel)...
- OIB 630API (40cps LO)...
- FLORIDA DATA PRINTERS (High speed, durable)...
- C.ITOH PRINTMASTER (55cps LO)...
- BROTHER 10-25 (23cps LO, 15')...
- BROTHER HR-15 (13cps LO, 10")...
- COMREX DYNAX PRINTERS...
- OUME SPRINT 1140 (40cps LO)...
- OUME SPRINT 1155 (55cps LO)...
- CAU FOR ADO-ON TRACTORS & CllT SHEET FEEDERS...

Miscellaneous:
- POLAROID PALETTE (Makes hires slides from PCs)...
- ORCHID PC TURBO (Same compression rate as Adobe)...
- KEYTRONIC 516 KEYBOARD (Sep. cursor keys)...
- MOUSE SYSTEMS (Optical mouse, runs LOTUS)...
- MICROSOFT SERIAL DB BUS MOUSE (w/software)...
- IBAR SURGE PROTECTORS (4 & 8 plug)...
- POWER BACK-IP (200 & 425 watts)...
- MICROTECH (5-10XK cmt buffer)...
- ASHER by QUADRAM (Electronic ticker, more)...
- SANTA CLARA PC TERMINAL (Smart terminals plus)...

Diskettes:
- VERBATIM: SS-DD Box $24- Case $199...
- DS-DD Box $29-Case $240...
- FOR DYSAN, MAXELL, 3M $425...

Floppy Disk Drives:
- TANDON TM 100-2 $179...
- SHUGART SA 455-2 $149...
- SONY 500-2 $169...

Multifunction Boards:
- QUADRO (up to 4MB RAM)...
- QUADRO (64-384K, S.P.G.C/bracket)...
- QUADRO (Serial & parallel wrption of 4 monoserial)...
- AST ADVANTAGE (ups ATs RAM to 3MB sparingly)...
- AST-1P (64-384K, S.P.G.C/bracket)...
- AST-1P (64-384K, S.P.G.C/bracket)...
- ORCHID BLOSSOM (64-384K, S.P.G.C/bracket)...
- NEW PROFIT RAM ELITE & PLUS (64-512K/2x or 128K/2x)...
- MAYNARD SANDSTAR MODULAR BOARDS...

Plotters:
- HP7470 & 7475 PLOTTERS...
- HOLL Os TInstruments (Full Line)...
- AMDEK AMPLI II (8 Pen, does overlays)...

Emulation Boards:
- UIRA BY DCA (3276 Terminal Emulation)...
- Imaline (3276 REL)...
- Textrite "Use with Imaline)...
- IMAPRINT (3276 emulation)...
- IBM 3274, 3278 Controller...
- FORTE DATA SYSTEM...
- TECHLAND BLUE LUX (3270 & 3251)...
- AST PCIX SNA, BCC, 3766, 3251...

Monitors:
- AMDEK COLOR 701 (No glare, more color)...
- AMDEK COLOR 701C (New Ultra Hi Res)...
- AMDEK COLOR 600 (New Hi Res, RGB Ripple)...
- AMDEK 300 A and G (Ambre or green)...
- AMDEK COLOR 500, 400, 300 (New Hi Res RGB)...
- AMDEK 310A (Amber, dark non-glare tube)...
- PGS SR-12 (690x480 non-interlaced)...
- PGS HX-12 (690x480 interlaced)...
- PGS SR-12 (720x350 monochrome)...
- KIMTRON TERMINALS...

Floppy Disk Drives:
- PEACHTREE PERIPHERALS 10MB internal...
- PEACHTREE PERIPHERALS P-30 AT & P-50 AT...
- EVERYTEXT 10MB Internal...
- MAYNARD 10MB Internal...
- MAYNARD External...
- MAYNARD MAYNSTREAM (Portable tape back-up)...
- MITSUBISHI 10MB & 25MB tapes...
- SYSGEN 10MB HARD DISK (write/backup)...
- SYSGEN 20MB HARD DISK (write/backup)...
- SYSGEN IMAGE 10 minute XT tape backup...

HARD DISKS:
- INTERNAL/LOW POWER...
- EXTERNAL/MASS STORAGE...
- ARCHIVE TAPE BACK-UP...
- REMOVABLE MEDIA...

IBMPcs:
- IBM PC w/256K, 2 360K drives, controller, Monochrome Printer adapter, Amdek 310A...
- IBM PC w/256K, 2 360K drives, controller, Color Graphics adapter, 12" color monitor...
- IBM PC w/256K, 2 360K drives, controller, 10MB hard disk w/backup...

(These systems are brand new, fully tested and turned in, fully warranted for 30 days AND ARE ALWAYS IN STOCK)
Call for an IBM PC system custom enhanced to meet all your business needs.

**Chips:**
- 64K RAM UPGRADE (Set of 9) $39
- 128K RAM (AT Upgrade) $169
- 256K RAM $279
- 8087:3 IH/gt/l Speed Math $169
- 80287 (AT High Speed Math) CALL

**Modems:**
- HAYES 300 baud external $209
- HAYES 1200 (300 or 1200 baud ext) $469
- HAYES 1200B (300 or 1200 baud int w/soft) $399
- HAYES 2400 (New external, twice the speed!) CALL
- HAYES Compatibles CALL
- SIGNALMAN MARK 12 (1200 baud at 300 price) $259
- VENTEL HALF CARD $429

**Display Cards:**
- EVEREX GRAPHIC EDGE $399
- PARADISE MODULAR GRAPHICS CARD (Color/graphics in mono with most ports options) from $339
- PERSYST 80 (clear text on a color monitor) CALL
- STB GRAPHICS PLUS I (Mono, color, par) $269
- PROFIT MULTIGRAPH (Mono, color, par) $269
- TEMER GRAPHICS MASTER (540x400 + mono) $89
- HERCULES COLOR CARD (New from old faithful) $179
- AST MegaGraphPlus (Lotus mono, serial, par clock) $399
- PLANETRONICS Colorplus (Hires w/color magic) $379
- IBM PC Enhanced Graphics Adapter CALL

**Software:**
- SYMPHONY (new from LOTUS) BEST PRICE
- MULTIMATE (Emulates WANG dedicated WP) $279
- SAMMA WORD III ("Ultra-WANG") $299
- WORDSTAR PRO-PACK (WS-M/BM/MM/Sf) $279
- MICROSOFT WORD w/ MOUSE $399
- CALL
- OPEN ACCESS (Proven Integrated Package) CALL
- eBASE II & III (From Ashton-Tate) $299
- KNOWLEDGEMAN (Version 1.08) $299
- OPEN ACCESS (Proven Integrated Package) CALL
- NUTSHELL by Leading Edge CALL
- LIFEBOAT LATTICE C COMPILER (W/8087 support) $299
- LIFEBOAT LATTICE C-FOOD SMORGASBORG CALL
- MS BASIC, PASCAL, COBOL CALL
- BORLAND TURBO PASCAL & TOOLBOX CALL
- DIGITAL RESEARCH (All products) CALL
-quan JONES (All products) CALL
- BUS A.R. AP, GL, $299
- OPEN SYSTEMS ACCOUNTING MODULES, BEST PRICE
- REAL WORLD ACCOUNTING, CALL
- STATE OF THE ART (CALL W/8088/8087) CALL
- BPI GENERAL ACCOUNTING AND MODULES CALL
- DOLLARS AND SENSE by Monogram CALL
- MANAGING YOUR MONEY by Tobias/McCle $299
- HARVARD PROJECT MANAGER BEST PRICE
- NEWBIRD TEXT PREPARER BEST PRICE
- MICROTAAX CALL FOR PRICE

**NETWORKS FOR YOUR IBMPC**
- SHARE FILES
- SHARE DEVICES
- WE CARRY THE BEST

**COMMUNICATE WITH YOUR CORPORATE MAINFRAME**
- DOWNLOAD DATA
- TERMINAL EMULATION
- CALL FOR DETAILS

**CHIPS**
- 64K · 256K · 8087 · 80287
- MEMORY UPGRADES
- QUANTITY DISCOUNTS
- SOUTH'S LARGEST SUPPLY

**PROGRESSIVE MICRO DISTRIBUTORS**
- FOR ORDERS ONLY
- 1-800-446-7995 for further information and technical support

**HOURS:** 9AM to 9PM EST
(Sat/Sun-12PM to 5PM EST)
7000 Peachtree Industrial Boulevard Norcross, Georgia 30071

All prices are subject to change.

IBM is a registered trademark of International Business Machines.

NO SURCHARGE FOR MC/VISA

Inquiry 256
### Disk Drives

**Teac 55B**
- Slimline, 360K
- PC Compatible
- **As Low As $119 ea.**

**MPI B52**
- IBM Compatible
- 360K Full Height
- **As Low As $90 ea.**

**8" Siemens**
- FDD100-8
- Shugart Compatible
- **As Low As $111 ea.**

**CCU Apple Drives**
- Slimline
- Fully Apple Compatible
- **As Low As $140 ea.**

### Apple Compatible Drives

<table>
<thead>
<tr>
<th>Model</th>
<th>Quantity</th>
<th>1</th>
<th>2</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micro Sci A-2 or A-20 Full HT</td>
<td>$175</td>
<td>$169</td>
<td>$159</td>
<td></td>
</tr>
<tr>
<td>Rana Systems Elite I</td>
<td>$210</td>
<td>$205</td>
<td>$200</td>
<td></td>
</tr>
<tr>
<td>Elite II Dual Height</td>
<td>$305</td>
<td>$300</td>
<td>$295</td>
<td></td>
</tr>
<tr>
<td>Elite II Quad Density</td>
<td>$405</td>
<td>$400</td>
<td>$395</td>
<td></td>
</tr>
<tr>
<td>Controller</td>
<td>75</td>
<td>70</td>
<td>70</td>
<td></td>
</tr>
</tbody>
</table>

**CCU Half Height**
- FD525A Slimline w/cable | $150 | $145 | $140 |
- FD525A Full Height | $160 | $150 | $140 |

**Hard Disk**
- 10 Meg w/controller | Call | Call | Call |

### 5½" Disk Drives

<table>
<thead>
<tr>
<th>Model</th>
<th>Quantity</th>
<th>1</th>
<th>2</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teac</td>
<td></td>
<td>$100</td>
<td>$100</td>
<td>$100</td>
</tr>
<tr>
<td>Tandem</td>
<td></td>
<td>$150</td>
<td>$150</td>
<td>$150</td>
</tr>
<tr>
<td>Shugart</td>
<td></td>
<td>$150</td>
<td>$150</td>
<td>$150</td>
</tr>
<tr>
<td>Mitsubishi</td>
<td></td>
<td>$150</td>
<td>$150</td>
<td>$150</td>
</tr>
</tbody>
</table>

### 8" Disk Drives

<table>
<thead>
<tr>
<th>Model</th>
<th>Quantity</th>
<th>1</th>
<th>2</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Siemens</td>
<td></td>
<td>$120</td>
<td>$120</td>
<td>$111</td>
</tr>
<tr>
<td>Shugart</td>
<td></td>
<td>$150</td>
<td>$150</td>
<td>$140</td>
</tr>
<tr>
<td>Tandem</td>
<td></td>
<td>$180</td>
<td>$170</td>
<td>$160</td>
</tr>
<tr>
<td>Mitsubishi</td>
<td></td>
<td>$210</td>
<td>$205</td>
<td>$200</td>
</tr>
</tbody>
</table>

### Power Supply & Cabinets

<table>
<thead>
<tr>
<th>Model</th>
<th>Quantity</th>
<th>1</th>
<th>2</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>JMR 5½&quot;</td>
<td></td>
<td>$120</td>
<td>$120</td>
<td>$111</td>
</tr>
<tr>
<td>Dual Thinline Cab w/pwr</td>
<td>$60</td>
<td>$60</td>
<td>$60</td>
<td></td>
</tr>
<tr>
<td>Dual Cabinet &amp; Power</td>
<td>$70</td>
<td>$70</td>
<td>$70</td>
<td></td>
</tr>
</tbody>
</table>

---

**Computer Components Unlimited**

A California Corporation

---

**Customer Service & Technical**

(213) 618-0487

**Sales Desk**

(800) 847-1718

Outside California

(213) 618-0477

Inside California

---

No Surcharge For Credit Cards
All Prices Reflect a Cash, Pre-Paid Discount
This Ad Supersedes All Others
Brother
* HR-15XL
  * 17 cps
  $399

OkiData 93P
* 15" Carriage
  * 160 cps w/correspondence
  $589

C. Itoh F-10
  * 40 cps
  * Letter Quality
  $929

Epson
* FX 80+
  * 160 CPS
  * New Version
  Call for Lowest Quote

CALL (800) 847-1718

PRINTERS

Brother
RX-80 (120 cps) $399
RX-80FT At Least $150
RX-100+ $335
FX-80+ $309
FX-100+ $369
LO1500 $409
JX-90 $589

OkiData
OKI82A 120cps $295
OKI83A $549
OKI84P $669
OKI84S $749
OKI92P $359
OKI93P $589

Call for other Models
FREE Plug'n Play Rom w/92 & 93

JUKI
6100, 18cps Ltr. Quality $394
6300, 40 cps "New" w/5K Buffer Letter Quality $775

Brother Dist. by Dynax
HR15, 12 CPS $375
HR25, 25 CPS $659
HR35, 36 CPS $949

Okidata
OKI82A, 120 cps $295
OKI83A $549
OKI84P $669
OKI84S $749
OKI92P $359
OKI93P $589

Call for other Models
FREE Plug'n Play Rom w/92 & 93

Panasonic
Panasonic
Gemini 10X $259
Gemini 15X $369
Delta 10 $379
Power type $390

Star Micronics
Star Micronics
BS10AP $259
F10, 40cps $929
Printmaster F1055pu $1179

C. ITOH

Okidata Options
Tractor for 82 & 92 $59
Serial Interface $99

Fourth Dimension

Microtek
Dumpling GX (Grapplel Compatible) $89
Dumpling GX exp to 64k $149
Dumpling GX 16K w/16K exp to 64K $169

Toshiba

P1351, 192cps $1289

PRINTERS INTERFACES

Fourth Dimension
Card & Cable $49

Microtek
Dumpling GX (Grapplel Compatible) $89
Dumpling GX exp to 64k $149
Dumpling GX 16K w/16K exp to 64K $169

Okidata Options
Tractor for 82 & 92 $59
Serial Interface $99

Orange Micro
Grapplel + $109
Grapplel + w/16K $179

Star or Epson
Epson Serial Interface $119

Power type $390

Retail Hours:
10 a.m. - 6 p.m. Mon.-Fri.
10 a.m. - 3 p.m. Sat.

Customer Service Hours:
10 a.m. - 4 p.m. Mon.-Fri.
(213) 618-0487

Mail Order Hours:
7 a.m. - 7 p.m. Mon.-Fri.
10 a.m. - 3 p.m. Sat.
(800) 847-1718 (213) 618-0477

(RETAIL STORES:
11976 Aviation Blvd.
Inglewood, CA 90304
16129 Hawthorne Blvd., Suite E
Lawndale, CA 90260

MAIL ORDER:
P.O. Box 1956
Hawthorne, CA 90250

All merchandise new. We accept MC, VISA, Wire Transfer, COD, Certified Check. P.O.'s from qualified firms, APO accepted. Shipping Minimum $50 first 5 pounds, Tax, California box only and 6% sales tax. All returns subject to 15% restocking charge. Advertised prices for Mail Order only. Retail prices slightly higher. Prices Subject to Change.

OUTSIDE CALIFORNIA
INSIDE CALIFORNIA

WE STOCK WHAT WE SELL!!
IBM PC System
- PC 256K
- Controller Keyboard
- Two 360K Drives
- IBM Monochrome Card and Monitor
$2059

APPLE IIE System
- CPU, Keyboard
- Two Slimline Drives & Controller Card
- Hi-Res Green Monitor
$1299

IBM PC System
- PC 256K
- Controller Keyboard
- Two 360K Drives
- Color Graphics Card
- Hi-Res Green Monitor
$1799

Apple
- IIe CPU
- Macintosh
- Iic Portable
$690

IBM
- PC 256K, No Drives
- PC 256K, 1 Drive
- PC 256K, 2 Drives
- XT w/10 Meg, 266K
- Additional Memory 64K
- AT Standard Config.
- AT w/20 meg
$1250
$1399
$1599
$3495
$27
$Call
$Call

Kaypro
- II Portable
- Pro
- Pro 10
- Pro 10X
$1895
$899
$Call
$Call

Sanyo
- MBC 550-2
- MBC 555-2
- Optional Serial Port
- Optional 360K Drive
$799
$1089
$69
$159

Compaq
- Portable IBM Compatible
- 2, 360K Drives
- $2150

Taxan
- 425 Color RGB
- 440 Ultra Hi-Res
$399
$999

Amdek
- Model 300
- Color Composite
- (300 x 260)
$279

Princton Graphics
- HX-12 (640 x 280)
- Hi-Res RGB
$459

IBM Monitor
- Monochrome
- (720 x 350)
- Hi-Res Green
$219

Amdek
- Monochrome Green
- Color Hi-Res
- Zenith
- ZVM 122
- ZVM 123
- BMC
- 12AU
$219
$599
$99
$99
$129
$79

Compaq
- Portable IBM Compatible
- 2, 360K Drives
- 256K of Memory
Call for all new Compaq's

Princton Graphics
- MAX 12, Monochrome Amber
- HX 12, RGB Color
- SR 12, D/A Board
$119
$179
$219

Prometheus
- Pro Modem 1200
- $239

Anchor Automation
- 300 Baud
- Internal PC Compatible
$79

U.S. Robotics
- 300, 1200 Baud
- Standalone
- With Cable
- $239

Prometheus
- Pro Modem 1200
- $239

Anchor Automation
- 300 Baud
- Internal PC Compatible
- 205
- 499
- Call

Mark V Forti
- 1200 Baud IBM
$79

Mark VII, 1200 Baud
$229

U.S. Robotics
- Password
- $239
What business does a handsome dog like me have with a top cat like you?

My name's McGruff, and it's my business to help prevent crime. I think it should be your business, too—to teach your employees how to protect themselves. Just send for my business kit, and I'll help you develop a program that teaches your employees how to make their homes burglar-proof, make their neighborhoods safe.

And, while you're at it, get in touch with the cops—they can help you out. So now you're probably wondering (like a top cat businessman should), what's in it for you. That's easy. When your company works harder for your people, your people work harder for your company.

So take the time, and...

TAKE A BITE OUT OF CRIME

McGruff, Crime Prevention Coalition,
20 Banta Place, Hackensack, NJ 07601
Please send me lots of information on Crime Prevention.

Name:
Company:
Address:
City: State: Zip:

A message from the Crime Prevention Coalition, this publication and The Ad Council.

Council ©1980 The Advertising Council, Inc.
No One Will Beat these Prices and Delivery

WE STOCK WHAT WE SELL

BMC 9191 MONITOR
- Color Composite
- Amdek Color I Compatible
- Works w/ Apple, Commodore, IBM and many others
- List $349
- Close Out Price
- $169

IBM PC
- With 256K Memory
- No Drives or Controller
- Build Yourself & Save, Save, Save
- List $1595
- $1250

BMC 12AUW MONITOR
- Hi-Res Green
- 12" Composite Video
- List $99
- Close Out Price
- $69

DISK DRIVE LIQUIDATION
- Your Choice
  - Teac 538
  - Shugart SA465
  - MPI B-52 Full Height
  - All IBM Compatible
- $119 ea.

64K UPGRADES
- 9 - 4164, 150 or 200 ns
- One Year Warranty
- List $99
- 100 sets $22 set

OKIDATA 92
- ML92
- Free Roms
- 160 cpm
- List $599
- $359
- Oki 93P
- $539

AST SIXPACK + w/ 384K Installed
- Par. & Ser. Ports
- Clock / Calendar
- Optional Game Port
- List $799
- $459

HAYES 1200
- 1200 Baud Standalone
- State-of-the-art
- List $698
- $459

Order Desk:
(213) 320-6822
(800) 841-0905
(Outside California)

Mail Order & Warehouse:
20317 Western Avenue
Torrance, CA 90501

We Accept MC, Visa, Wire Transfers, Certified Checks
COD's Available
No Surcharge for Credit Cards
Shipping Minimum $5.00
Purchase Orders Accepted
This Ad Supersedes all Others
Inquiry 250
Prices Subject to Change
**AMERICA'S NO. 1**  
**Systems Specialists**

**WE CUSTOMIZE IBM PC SYSTEMS**

**IBM PC**  
$1499  
256K, two disk drives 360K each, Drive Controller and Keyboard

---

**PRICE WAR**  
**CALL US LAST**

<table>
<thead>
<tr>
<th>PRINTERS</th>
<th>HARDWARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPSON RX-80, $299</td>
<td>RX-80FX, $299</td>
</tr>
<tr>
<td>OKIDATA 92P, $349</td>
<td>93P, $359</td>
</tr>
<tr>
<td>JUKI 1tr Quality, 18 CPS, 13&quot;, wide, $379</td>
<td>6100, $1299</td>
</tr>
<tr>
<td>TOSHIBA 1351, $1299</td>
<td>Tractor, $149 Cut Sheet Feeder, $799</td>
</tr>
<tr>
<td>DYNAX DX-15, $369</td>
<td>Keyboard, $149 Tractor, $599 Cut Sheet Feeder, $139</td>
</tr>
<tr>
<td>BROTHER HR-25, $599 HR-35, $689</td>
<td>Tractor, $119 Cut Sheet Feeder, $139</td>
</tr>
<tr>
<td>QUEM SPRINT 1140, $1299</td>
<td>With IBM Interface Module, $1155, $1499</td>
</tr>
<tr>
<td>NEC SPINWRITER 2050, $699</td>
<td>3550, $1299</td>
</tr>
<tr>
<td>NEC PINWRITER 6850, $1699</td>
<td>P2, $1299 P3, $1299</td>
</tr>
</tbody>
</table>

**MONITORS**

- 192x144 Max 12 Amber - Monochrome, $179
- PG-16, $129 72x16 Super Hi-Res Color, $437 Scan Doubler, $129

**PRINTERS**

- TAXAN 440 Color - Super Hi-Res, $549  
  122(M), $159 1212(M), $159 1146(M), $149
- AMDEK 310A (Monochrome), $179

**MODEMS**

- Microcomera 2, PC Internal 1200 Baud w/software, 4 Yr. Warranty, $359
- Hayes Smartmodem 1200 Baud w/software, $439
- Qubie Standalone, $329 Internal, $299
- POPCOM Internal or Standalone, $299
- Prometheus PROMODM, $299

---

**IBMPC w/10MB**  
256K, one floppy Drive, Keyboard  
10 MB Hard Drive with Controller  
Boots from Hard Disk  
**$2199**

**IBMPC w/30MB**  
256K, one floppy Drive, Keyboard  
30 MB Hard Drive with Controller and Booster Power Supply  
Boots from Hard Disk  
**$3299**

---

**NETWORKING**

**ORCHID TECHNOLOGY**  
PC Net PLUS Starter Kit, $799  
PC Net, $1399  
PC net/Blossom, PC turbo, PC net/Plus, $799

**TECMAR**  
Graphics Master, $429

**HERCULES**  
Color Graphics, $169

**NEW**  
STB Graphics, $299

---

**PRINTER**

<table>
<thead>
<tr>
<th>EPSON RX-80, $229</th>
<th>FX-80, $389</th>
</tr>
</thead>
<tbody>
<tr>
<td>JUKI HR-25, $179</td>
<td>FX-100, $2179</td>
</tr>
<tr>
<td>HAYES 1200 Standalone, $439</td>
<td>1200 Baud w/software, $439</td>
</tr>
<tr>
<td>SMARTMODEM 1200 Baud, $369</td>
<td>1212(M), $169</td>
</tr>
<tr>
<td>MAYNARD 10MB/10MB, $109</td>
<td>122A(M), $169</td>
</tr>
<tr>
<td>8087 Chip, $109</td>
<td>121G(M), $99</td>
</tr>
<tr>
<td>JUKI 6100, $109</td>
<td>116A(C), $149</td>
</tr>
<tr>
<td>IBM PC Keyboard, $349</td>
<td>8087 Chip, $109</td>
</tr>
<tr>
<td>OKIDATA 92P, $349</td>
<td>300A (Composite), $159</td>
</tr>
<tr>
<td>JUKI HR-25, $349</td>
<td>300G, $139</td>
</tr>
<tr>
<td>SMARTMODEM 1200 Baud, $369</td>
<td>AMDEK 310A (Mono), $179</td>
</tr>
</tbody>
</table>

---

**STANDBY**

- 200 Watts, $279
- 300 Watts, $379

---

**MULTI-DISPLAY CARDS**

**ORCHID TECHNOLOGY**  
Blossom 64K (to 384K), $249  
PC net/IARC, $219

---

**MULTI-FUNCTION CARDS**

**ORCHID TECHNOLOGY**  
Blossom 64K (to 384K), $249  
PC net/IARC, $219

---

**MISC. ADD ONS**

- Cable, $25
- Keytronic Deluxe Keyboard KB5151, $179

---

**WILL CALL**

- Please call first for workorder number.
<table>
<thead>
<tr>
<th>RAM Type</th>
<th>Capacity</th>
<th>Speed</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>4164</td>
<td>64K</td>
<td>Dynamic</td>
<td>9.45</td>
</tr>
<tr>
<td>41256</td>
<td>256K</td>
<td>Dynamic</td>
<td>29.95</td>
</tr>
</tbody>
</table>

**STATIC RAMS**
- 256x1 (45ns) for 3.99
- 1024x8 (200ns) for 6.95
- 1024x1 (250ns) for 1.45
- 1024x4 (300ns) for 8.95
- 4096x1 (300ns) for 3.99
- 65536x1 (200ns) for 6.95
- 16384x1 (120ns) for 8.95
- 8192x1 (200ns) for 0.49

**EPROMS**
- 2732A-2 for 10.95
- 2716 for 3.95
- 2708 for 3.95

**CRYSTALS**
- 32768 for 1.95
- 4096 (5V) for 5.85
- 2048 (5V) for 2.95
- 1024 (5V) for 1.95

**CLOCK OXIDATERS**
- 74LS138 for 11.95
- 74LS74 for 2.15

<table>
<thead>
<tr>
<th>CRT CONTROLLERS</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>6845</td>
<td>12.95</td>
</tr>
<tr>
<td>6847</td>
<td>11.95</td>
</tr>
<tr>
<td>74LS154</td>
<td>2.65</td>
</tr>
<tr>
<td>74LS390</td>
<td>3.95</td>
</tr>
<tr>
<td>74LS163</td>
<td>3.20</td>
</tr>
</tbody>
</table>

**ORDER TOLL FREE**
800-538-5000
800-662-6279 (California Residents)

**FUNCTION**
- 4096 (5V) for 3.95

**DYNAMIC RAMS**
- 256x1 (45ns) for 0.49
- 1024x1 (250ns) for 1.45
- 1024x4 (300ns) for 8.95
- 4096x1 (300ns) for 3.99
- 65536x1 (200ns) for 6.95
- 16384x1 (120ns) for 8.95
- 8192x1 (200ns) for 0.49

**RETAIL STORE - 1256 S. BASCOM AVENUE**
HOURS: M-W, F, 9-5
TU-TH, 9-9
SAT, 10-3
PLEASE USE YOUR CUSTOMER NUMBER WHEN ORDERING

TERMS: Minimum order $10.00. For shipping and handling include $2.50 for UPS Ground and $3.50 for UPS Air. Orders over 1 lb. and foreign orders require additional shipping charges. Contact our sales department for the amount. CA residents must include 8.5% sales tax. All prices are subject to change without notice. All merchandise is warranted for 90 days unless otherwise stated. Prices are subject to change without notice. For backorders, please call.

If you have any questions, please contact us at 800-538-5000.
WITH GOLD-PLATED EDGE-CARD FINGERS

Note: 1 inch of insulation is stripped on

OCELLS  QTY. 2  $13.21
AAA CELLS  QTY. 2  $11.71

APPLE

BARE GLASS BOARDS

NO EDGE-CARD FINGERS OR FOIL

24 5.2" x 4.5" x 2", .884 LBS.

BARREL CONNECTORS

TRANSFORMERS

2500va 6.95
5 AMP 6.95
120V AC 2500va

MICROCOMPUTER HARDWARE HANDBOOK

FROM ELCOMP $14.95

20 MHz DUAL TRACE OSCILLOSCOPE

$29.95

WITH PROBES FULL ONE YEAR WARRANTY

MULTIPLIER PEN

GEO NICKEL-CADMIUM RECHARGEABLE BATTERIES

Ni-CAD CHARGER PACKAGE

PRICE INCLUDES CHARGER (INCL. PLUG)
BATTERIES INCLUDED
AAA CELLS QTY. 2  $11.71
AA CELLS QTY. 2  $12.31
D CELLS QTY. 1  $12.31
9VOLT QTY. 1  $12.31

320-30M

SOCKET WRAP I.D.'M

CABINETS #2  $579.00
CABINETS #3  $589.95

HARDWARE

WSU-30 MTR PACKAGE

$139.95

 prevention card

SECRETARY'S TREATY

$9.95

WITH PROBES FULL ONE YEAR WARRANTY

#3 589.95
#2 579.00
#1 569.95

WITH PROBES FULL ONE YEAR WARRANTY
EPROM PROGRAMMER
FOR APPLE COMPUTERS
RP525 $79.95
- LOW COST
- DUPLICATE OR BURN ANY
STANDARD 2700 SERIES EPROM
- MENU DRIVEN SOFTWARE
INCLUDED-NO ADDITIONAL
SOFTWARE REQUIRED
- AUTOMATIC SELECTION FOR
2716, 2732, 2732A, 2764 & 27128
- LED INDICATORS FOR ACTIVITY
- HIGH SPEED WRITE ALGORITHM
- NO EXTERNAL POWER SUPPLY

APPLE ACCESSORIES
BAL-525 $139.95
- ½ HEIGHT-ALPS MECHANISM
- 100%APPLE COMPATIBLE
- FULL 1 YEAR WARRANTY

BAL-500 $169.95
- TEAC MECHANISM-DIRECT DRIVE
- 100%APPLE COMPATIBLE-35 TRACK
- 40 TRACK WHEN USED WITH
OPTIONAL CONTROLLER

MITAC AD-1 $179.95
- FULL HEIGHT SHUGART
MECHANISM
- DIRECT REPLACEMENT FOR APPLE
DISK II

JDR 16K
RAM CARD $39.95
BARE PC CARD AND INSTRUCTIONS $9.95
- 2 YEAR WARRANTY
- EXPAND YOUR 48K APPLE TO 64K
- USE IN PLACE OF APPLE LANGUAGE
CARD

OTHER ACCESSORIES
BMC BX-80 $249.00
CONTROLLER CARD $49.95
VIEWMAX-80 $159.95
VIEWMAX-80e $129.95
GRAPHMAX $129.95
THUNDERCLOCK $129.95
KRAFT JOYSTICK $33.95
POWER SUPPLY $49.95
ZVM-123 GREEN MON $105.00
BMC AU9191U COLOR MON $279.00

DISKETTE FILE
$8.95 IF PURCHASED
WITH 50 DISKETTES OR MORE
$9.95 IF PURCHASED ALONE

BY DEALING DIRECT WITH
THE FACTORY, WE CAN MAKE THIS
UNBEATABLE OFFER

- ATTRACTIVE, SMOKED ACRYLIC CASE WITH
SIX INDEXED DIVIDERS
- RUGGED, HIGH QUALITY
CONSTRUCTION
- HOLDS 70 5¼" DISKETTES,
WITH ROOM TO SPARE

*NASHUA DISKETTES
5¼" SOFT SECTOR
DOUBLE SIDED, DOUBLE DENSITY
WITH HUB RINGS

BULK PACKAGED IN FACTORY SEALED BAGS
OF 50, INCLUDES DISKETTE SLEEVES AND
WRITE PROTECT TABS. IDEAL FOR SCHOOLS,
CLUBS, AND USERS GROUPS. THIS IS A SPECIAL
PURCHASE, QUANTITIES ARE LIMITED.
5 YEAR WARRANTY.

$1.39ea. $1.49ea. $1.59ea.
QTY 250 QTY 100 QTY 50

* NASHUA DISKETTES WERE JUDGED TO HAVE THE HIGHEST
POLISH AND RECORDED AMPLITUDE OF ANY DISKETTES TESTED
SEE "COMPARING FLOPPY DISKS", BYTE9 1984

DISK DRIVES FOR YOUR IBM
TEAC FD55B MPI 52B TANDON TM 100-2
½HEIGHT (same as Tandon) $199.95

WANT TO ADD AN INTERNAL HARD DISK DRIVE TO YOUR
IBM PC?

...BUT DISCOVER THAT YOUR POWER SUPPLY CAN'T
HANDLE THE LOAD?

JDR HAS CAREFULLY SELECTED THE HIGHEST
QUALITY FULLY IBM COMPATIBLE POWER
SUPPLY AVAILABLE.

COMPARE THESE FEATURES
- XT COMPATIBLE
- 1 YEAR WARRANTY
- HIGH QUALITY
CONSTRUCTION
- PLUG COMPATIBLE
CONNECTORS
- FITS INTO EXISTING MOUNTING HOLES
- SOLID 130 WATT OUTPUT
+5V @ 3.5A +12V @ 4.2A
-5V @ .5A -12V @ .5A

$175.00

OTHER ACCESSORIES
SS/DD SOFT $25.95
SS/DD 10 SECTOR $25.95
DS/DD $34.95

RETAIL STORE - 1256 S. BASCOM AVENUE
HOURS: M-W-F, 9-5 TU-TH, 9-9 SAT, 10-3

PLEASE USE YOUR CUSTOMER NUMBER WHEN ORDERING

TERMS: Minimum order $10.00. For shipping and handling include $5.95 for UPS Ground and $5.50 for UPS Air. Orders over $100 from foreign locations only require additional shipping charges. Please contact our sales department for the amount. CA residents must include 8.25% sales tax. Apple and IBM are registered trademarks of Apple Computer Co. All merchandise is warranted for 90 days unless otherwise stated. Prices are 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.

APPLE IS A TRADEMARK OF APPLE COMPUTER CO.

JDR Microdevices
1224 S. Bascom Avenue, San Jose, CA 95128
800-538-5000 - 800-662-6279 (CA) - (408) 959-5430
FAX (408) 275-8415 - Telex 171-110
The product description prepared by BYTE's Ongoing Monitor Box

The description prepared by BYTE's ongoing monitor box focuses on various products and technologies. It includes a range of items such as microprocessors, computers, and other hardware. The author states that they will split the $50 bonus among several people, including Steve Ciarcia, whose Circuit Cellar speech was well-received. The description also mentions the AGATIA Soviet Apple II Computer, which came in second place. The work of several authors is highlighted, and the location of BYTE's recent coverage of the Personal Computer Industry is mentioned.
If you are not a subscriber fill out the subscription card found in this issue or, call BYTE Circulation 800-258-5485.

If you are a subscriber and need assistance, call (603) 924-9281.

If you are a subscriber and need assistance, call (603) 924-9281.
BYTE READER SERVICE
Fill out this coupon carefully. PLEASE PRINT. Requests cannot be honored unless the zip code is included. This card is valid for 6 months from cover date.

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. Select Excellent, Good, or Poor. Based on your overall impression of an article, circle the appropriate number in each column below. Your feedback helps us produce the best possible magazine each month.

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.
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.

<table>
<thead>
<tr>
<th></th>
<th>USA</th>
<th>Canada</th>
<th>Mexico</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 year</td>
<td>$21</td>
<td>$23</td>
<td>$21</td>
</tr>
<tr>
<td>2 years</td>
<td>$38</td>
<td>$42</td>
<td>$38</td>
</tr>
<tr>
<td>3 years</td>
<td>$55</td>
<td>$61</td>
<td>$55</td>
</tr>
</tbody>
</table>

$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

Check enclosed (North America only)

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.
Introducing the Spinwriter 8850.

Our newest, and fastest, Spinwriter® printer operates at over 550 words-per-minute. And it's extraordinarily easy to operate.

For one thing the Spinwriter 8850 takes care of basic settings such as pitch and forms length automatically. Of course you can also change either

printer available for the IBM® PC. It's still one of the few that works with all IBM PC software, as well as all other popular packages. You'll notice even its looks are om-

atible.

Spinwriter printers also give you capabilities you won't find on other printers. Like a selection of 80 different print styles.

And, nine easily installed forms han-
ing options that can accelerate your printed output even more. Spinwriter printers also have an enviable record for reliability.

In fact, several

years without a failure is not unusual. No wonder there are more Spinwriter printers hooked up to IBM PC's than any other letter-quality printer.

How to get up to speed.

For more information on the Spinwriter 8850 or our two companion models, just call NEC Information Systems at: 1-800-343-4418; in Massachusetts call (617)264-8633. Also available at:

Entre, 1-800-HI ENTRE: Sears Business Sys-

t Centers, 1-800-228-2200;

and Comput-
erland stores. (In California) 1-800-3211101; (Out-
side California) 1-800-423-3008.

Find out why more and more IBM PC users are saying, "NEC and me."

NEC

AND

ME

NEC Information Systems, Inc.
1414 Main Ave.,
Dept. 3610
Sewell, NJ
08080

Inquiry 232
TANDY... Clearly Superior™

It's evident when you can cover the MS-DOS market with a line of computers unmatched in performance and value.

Tandy brings you not one, but three solutions to the personal computer dilemma.

Like the IBM PC-AT, the Tandy 2000 performs up to three times faster than the IBM PC. Disk storage is double the PC's. Our color graphics offer twice the resolution, twice the colors. The Tandy 2000 personal computer starts at just $2499.

Or how about a system that does everything an IBM PC XT does—but costs at least $1400 less? The new ten-megabyte Tandy 1200 HD is compatible with virtually all XT software and hardware... yet it's priced at only $2999.

Our new Tandy 1000 comes complete with software. We call it DeskMate™, and it's six programs on one disk.

The Tandy 1000 has many features that cost extra on the IBM PC. Like adapters to use a monitor, printer, joysticks and light pen, plus a Disk Operating System and BASIC—all for only $1199.

For the best in technology, support, service and value, stop by your local Radio Shack Computer Center. We invite comparison!

Available at over 1200 Radio Shack Computer Centers and at participating Radio Shack stores and dealers

Engineered for Excellence

We've introduced the latest in technology for over 60 years. The Tandy 1000 and 2000 represent the state of the art in performance, quality and price.

*Plus applicable use sales tax. Tandy 2000, 1200 HD and 1000 prices do not include monitor and apply at Radio Shack Computer Centers and participating stores and dealers. IBM® registered TM International Business Machines Corp.