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UNIX System V, the new standard in multiuser 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.

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Germany.
ANOTHER WORLD: THE 68000

A year and a half ago, the world of personal computing looked as if it were becoming more and more the domain of a single class of computers: the IBM PC and its compatibles, and a single family of microprocessors, the Intel 8088 and its relatives. The IBM-Intel world has fostered the development of a great variety of software but signs of intellectual stagnation had appeared. Almost all hardware manufacturers had the same strategy: IBM compatibility. Almost all software houses besieged the same market: the corporate office.

When IBM reduced its prices and introduced the PC AT at a surprisingly low price, many manufacturers of compatibles faltered or fell. While a number of software houses tottered, IBM introduced dozens of its own software packages. Macintosh offered some hope of a pluralist world in personal computing but software was extremely slow to appear, and in many cases the Macintosh version of a program originally developed for the IBM PC was less capable. It was unclear whether the Macintosh would be able to stem the tide of IBM machines and software.

In the past few weeks, however, an assortment of 68000-based machines has been announced or reported.

Listings in BYTE

To make listings easily accessible to BYTE readers, we try to put all listings pertaining to an article on our bulletin board, BYTEnet Listings. (603) 924-9820. Listings for each issue are included in the FROMBYTE area. We may print some complete or partial listings in the magazine when required for clarity or understanding, but these listings also will be on BYTEnet Listings, along with public-domain software and utilities. Log on and see what we have to offer. Please be aware that material in the FROMBYTE area of BYTEnet Listings is for personal, noncommercial use only.

TENTH ANNIVERSARY ISSUE

BYTE is planning a special section to be published in our tenth anniversary (September 1985) issue. We'd like your help if you've been computing for several years or if you have a vintage computer that still works. We're thinking about doing a personal history of microcomputing that focuses on what people were doing with computers in a certain year: for example, "By late 1976. I had received my Altair and was trying to learn 8080 machine language..." We'd like a short reminiscence (under 300 words, double-spaced) that includes what year it was, what equipment you had, and what you were using it for.

Also please contact us if you have an old computer that is still in working condition and has some sort of BASIC with it. We think it might be interesting to run some benchmarks and compare the results to those of newer machines.

Address all materials to either Gregg Williams or Richard Shuford at BYTE, POB 372, Hancock, NH 03449. Thanks.

Atari has announced 68000-based systems at astonishingly low prices and with impressive software from Digital Research. Hewlett-Packard's 68000-based Integral is a remarkable UNIX transportable with an electroluminescent display. Tandy also introduced a 68000-based system at the Consumer Electronics Show. Commodore has acquired rights to the 68000-based Amiga system. Published reports say that AT&T will release a powerful 68000-based system. Put all these together with the 68000-based Apple machine, the Sinclair QL, S-100 68000 systems, and systems from Cromemco, Arete, Sun, Charles River Data Systems, Stride, Altos, IBC, Plexus, Pyramind, and several others, and you have a remarkably rich world encompassing everything from $300 home machines to expensive but economical 88-user UNIX systems.

Will 1985 be the year of the 68000? The Motorola processors may not surpass the installed base of Intel processors, but 68000s will definitely be abundant enough to inspire massive and diverse software development efforts. The prospect of having a Macintosh-like icon-based environment on inexpensive Atari home machines as well as powerful UNIX systems is exciting, and Digital Research's Graphics Environment Manager (GEM) may indeed be available across the entire range of machines. Just as the world was getting dull, things are starting to get very interesting again. IBM's long stranglehold on the mainframe market may not be replicated on small computers after all.

BYTE welcomes the emergence of an equal alternative world. We will keep close watch on the world of the 68000.

—Phil Lemmons, Editor in Chief
For your Big Blue, only the Gold Standard will do. Maxell. The floppy disk chosen by many disk drive manufacturers to test their new equipment. Each Gold Standard is backed by a lifetime warranty. And each is a perfect match for your IBM. In fact, there's a Gold Standard for virtually any computer made. Even if it's the new IBM PC AT!
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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.
IRIS Tightens Rules on Business Use of Home Computers

Effective January 1, the Internal Revenue Service added temporary regulations requiring that a log be kept of home computer use in order to deduct the computer’s business-use costs. After a comment period, permanent regulations will go into effect in late spring or early summer. An earlier rule, still in effect, states that home computer expenses may be deducted only by the self-employed or those who must own a home computer to hold their jobs.

MSX Computers Shown, Not Sold, at CES

A number of Japanese and Korean companies exhibited MSX home computers at a Microsoft-sponsored MSX booth at January’s Consumer Electronics Show in Las Vegas, but only Yamaha has definite plans to bring an MSX computer to the U.S. (See page 435 for details on Yamaha’s CX5M Music Computer.) Because computers based on Microsoft’s MSX standard all use the same basic hardware and software configuration, MSX cartridges and cassette software will run on any MSX computer.

Canon, Casio, Daewoo, Hitachi, Mitsubishi, Panasonic, Pioneer, Sanyo, Sony, and Toshiba all showed MSX computers—available in Japan—but declined to comment on U.S. pricing or availability dates. Most companies said they were waiting for reaction from American dealers and consumers. Spectravideo, the only U.S. company making an MSX computer, also displayed its computer. Financially troubled Spectravideo was recently acquired by Bondwell, a Hong Kong computer maker.

At least 19 software companies are reportedly developing versions of popular programs for MSX computers in Japan and the U.S., including Activision, Brøderbund, Infocom, and Spinnaker. However, those companies, like U.S. dealers, are hesitant to commit large development efforts to an American MSX computer market until the Japanese commit to a U.S. marketing effort, which they failed to do at CES.

Also at CES, Nintendo showed its Advanced Video System, a version of the FCS home video-game system it offers in Japan and that it says holds 90 percent of the Japanese home video-game market. An optional keyboard unit turns the system into a computer; several other peripherals will also be available. Nintendo had not set a price for the system but said it will be available in the U.S. in June.

Digitizer Includes Software to Modify Images

Inovion, Layton, UT, announced a $3500 image-capture system that can be used to digitize an image from a camera or other device. Also included is “paint” software with pop-up menus, which can be used to edit an image. Included in the Personal Graphics System are a 19-inch color monitor that displays the 512- by 480-pixel image in up to 250,000 colors, 780K bytes of graphics memory, a mouse, and composite video and RS-232C ports.

Japanese Show More Wrist Computers

Seiko and Epson both showed watches that interface with computers at CES. Seiko’s RC-1000 is similar to its earlier UC-2000, which used a separate keyboard to enter 2K bytes of text data for later reference. However, the RC-1000 includes an interface to any computer with an RS-232C serial port.

Epson’s RC-20 wrist computer uses a Z80-compatible processor and features a 23-position touchscreen. It includes 8K bytes of ROM, 2K bytes of RAM, and a 4-line by 7-character display. Programs are included for appointment scheduling, address and phone listings, a calculator, and standard time and alarm functions. Neither price nor availability date were released.

(continued)
New Pointing Devices Unveiled at CES

For those who aren't sure if they prefer the trackball or the mouse, Wico introduced the MouseTrac Combo: a removable cap on the three-button mouse uncovers a trackball. Wico also sells a keyboard with a built-in trackball.

Koala now offers KAT, a touch-tablet-like pointing device, which allows you to control a cursor by moving a finger across the tablet's surface.

Personal Peripherals Inc., Longview, TX, dropped the price of its Super Sketch graphics pen/tablet device to $29.95.

TI Offers AI Software for IBM PC, TI Professional

Texas Instruments planned to announce Arborist, a decision-analysis tool for managers, late last month. Arborist, an expert system that allows you to enter information in a natural-language format, sets up decision trees that can be graphically displayed. It is expected to sell for about $500.

TI also announced that all of its artificial-intelligence software, including the Personal Consultant expert-system generator and its Natural Language products, would be available for the IBM Personal Computer as well as TI's Professional Computer.

Braille Printers Aid Sight-Impaired

Visualtek, Santa Monica, CA, is shipping the MBOSS-1 Braille Printer, a bidirectional, continuous form-feed braille embossers. Based on a Hitachi F10-55, MBOSS-1 runs at 10 cps and produces hard copy from a computer, word processor, or refreshable braille device. It connects through RS-232C serial or Centronics-type parallel interfaces and uses audio status indicators. The list price is $3225.

Nippon Dentsu Co. Ltd., Hachioji-City, Tokyo, Japan, will ship its Ohtsuki braille printer to the U.S. this month. The Ohtsuki produces standard text and braille simultaneously. It can be run from a standard word-processing program.

NANOBYES

Microsoft has upgraded its $150 COBOL compiler to meet the ANSI 74 level 2 standard. It also released a version of its Macro Assembler that works with Intel 80186, 80286, and 80287 processors as well as the 8086, 8088, and 8087, which were supported in earlier versions... Micro Computer Technologies, Santa Monica, CA, unveiled an IBM PC version of its SpeeDemon speed-up card. This card will swap the PC's 4.7-MHz 8088 with a 10-MHz 8086, but it will cost about $700. Another version of the card, priced at $295, replaces the Apple's 1-MHz 6502 processor with a 3.5-MHz 6502...

VIP Technologies, Goleta, CA, has announced VIP Professional, an integrated spreadsheet/database/graphics program for the Apple IIe/Iic. The $199 program uses the Apple's double-hi-res graphics mode and requires 128K bytes of RAM... CompuSonics, Denver, CO, showed a digital-audio system at CES that uses high-capacity 5¼-inch floppy disks to store sound information. The company says its $1200 DSP-1000 recorder/player will store about 45 minutes of sound on a special 25-megabyte disk being developed by DriveTech. Most consumer digital-audio products use read-only compact discs that store the equivalent of 550 megabytes of sound...

Taliq Corporation, Mountain View, CA, is selling its Opto-film Window Cells, which use liquid-crystal technology to mask or reveal images. The window squares switch from opaque to transparent... The Lisp Company, Los Gatos, CA, has released a $100 version of Logo for Z80 computers. A $50 MSX version is also planned... Quantum Microsystems has a 300-bps direct-connect modem for the Atari 800 family. The $150 modem includes communications software and all necessary hardware. Quantum also offers a $50 Atari RS-232C serial interface... Imaging Technology, Woburn, MA, announced ImageAction, a $995 program that works with its PCVision Frame Grabber. The software allows captured images to be filtered, manipulated, and analyzed using a mouse and menus. The company also said that 8-bit digitization and monochrome "pseudocolor" capabilities had been added to the $3000 Frame Grabber, which works with an IBM PC XT.
The TI 855 is the only printer with letter quality, draft speed, graphics, plug-in font modules... all for under $1000. (suggested retail price)

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For more information, call 1-800-556-1234, Ext. 34. Or write Citizen America Corporation, 2425 Colorado Avenue, Santa Monica, CA 90404.

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PRAISE FOR PICK

Your technical articles on "The Pick Operating System" by Rick Cook and John Brandon (October and November 1984) were very enlightening and should expose many BYTE readers to a powerful relational data-management structure. However, several statements were made that cloud the issue of Pick machine compatibility that we at Cosmos would like to clarify.

Cosmos has developed a software system called Revelation, an implementation of the Pick operating system for almost all MS-DOS-based machines. Revelation is functionally identical and code-compatible with the standard Pick facilities, including the relational file structure, data dictionaries, query language, BASIC compiler, and associated utilities. Our PC-specific enhancements include simplified interaction with DOS files and programs and advanced networking capabilities. It has been designed to run as an adjunct to the standard operating system. With Revelation, you can experience the Pick operating system as a set of programming tools and not consider it only as a replacement operating system.

The authors state, "Pick software is highly portable, but the operating system itself is not. Getting Pick running on a new machine takes a lot of work." There is no question that code developed on any specific Pick machine is highly portable to other Pick-based systems, including Revelation. With Revelation, however, machine compatibility becomes a far less significant issue.

The Pick operating system discussed in the article runs only on the IBM PC XT, and system overhead can occupy up to 2 megabytes of available disk space. (Limitations are even more severe if you partition the hard disk to allow for MS-DOS applications.) Because the Pick operating system runs only on standard XT hardware, you would be hard pressed to increase mass-storage capacity.

Revelation provides an alternative. Designed to run with PC-DOS or MS-DOS, software applications are highly portable to many different systems. Hard-disk and other peripheral expansion is easily accomplished through standard DOS facilities (notably the installable device drivers). Any DOS program or function can be called and executed directly from Revelation. Original Revelation was available only for the IBM PC XT, or compatibles, but this summer Cosmos released a "generic" Revelation, offering portability across more than 40 MS-DOS-compatible machines, including the complete IBM PC product line. You can even run Revelation on the recently revamped PCjr, although two disk drives are preferred.

Another claim is that "Pick is not a number-crunching system. There are better operating systems for scientific and engineering work. Pick will score poorly on a computational benchmark such as the Sieve of Eratosthenes." This may be true of Pick Systems' implementation, but Revelation from its conception was designed to take full advantage of the Intel 8086 microprocessor family architecture, including use of the math coprocessor chip. Direct benchmarks against far more expensive minicomputer systems demonstrate that Revelation can hold its own when put to serious number-crunching tasks. (Our software also tests to see if the math coprocessor is resident and will download proper emulation routines in its absence, to ensure a high degree of machine portability.) Revelation not only sports more transcendental math capabilities and much higher precision in computation than a standard Pick implementation, but any program can be called directly from DOS to supplement the facilities of Revelation.

The article made only brief mention of other Pick-based systems on the market, and some expansion on this issue would be of benefit to your readers. The Pick operating system was first made available commercially in 1973 as the proprietary Microdata Reality system. Pick Systems began porting its code to different machines for other vendors in 1978. Those vendors included the ADDS Mentor line (with a Zilog Z8000 implementation) and the General Automation Zebra line (with one of several Motorola 68000 implementations). Other vendors have provided implementations for IBM, DEC, Honeywell, and other mini- and mainframe computers, up through the IBM 4300 Series.

In 1980 Prime Computer introduced its Information series, a family of Pick-compatible machines developed independently of Pick Systems that exist as Pick work-alikes; while these are viewed by the Pick software-development community as another line of compatible hardware, Prime has made no claim to the Pick name.

Cosmos's Revelation, first shipped in March of 1983, was also developed independently of Pick systems. Cosmos has a licensing agreement with Pick Systems, and we can promote our system as a full Pick-compatible software environment.

GARY BENNETT
OEM Product Manager
Cosmos Inc.
Seattle, WA

There is a sigh around the Pick world: "They finally did it." The article about the Pick operating system was well done. My conversations with the micro world seem to go something like this:

CP/mer: How many fields can you have in a record?
Picker: Uh, well, I suppose there is a limit, but it's more than I have ever wanted.
CP/mer: Well, then how big can the fields be?
Picker: Uh, well, I suppose there is a limit, but I never hit it.
CP/mer: Oh, then how many files can you have open at one time?
Picker: Uh, well, I suppose there is a limit, but I don't know what it is.

(continued)
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.
Inquiry 371

LETTERS

The conversation continues on in the same way for some time. Since Pick is the only operating system I have used, sometimes I do not understand the questions. The first time I heard the one about the number of files that can be open at a time, I had to ask the meaning of the problem so that I could understand the question.

I have made a discovery. It is a lot more fun bugging the eyes out of a CP/Mer than a complete computer novice. The novice thinks that a computer is magic anyway, so nothing is impressive. The CP/Mer is really impressed.

A word of caution: The road into the world of Pick and Pick-like operating systems is a one-way street. Once you have used Pick, you will never want to go back to the other stuff.

The migration of Pick from minis to micros has been exciting to watch, but there is a serious problem coming. A company that spends $100,000+ for a computer system can live with a $50-60/hour system designer to create software for it. Not so the company that spends $500.

My tool to bring costs down is an application generator (not a code generator) called UHL (WhitHurst Corp. Box 21, Issaquah, WA 98027). UHL extends the philosophy of Pick's inquiry language (Access in the article) to entry screens, menus, and posting processes. Just as you can type

```
LIST INVOICES INVOICE CUSTOMER AMOUNT
```

with UHL you can type

```
ENTER INVOICES INVOICE CUSTOMER AMOUNT
```

and the proper entry screen is created. Likewise, posting is done with

```
POST INVOICES ADD AMOUNT TO BALANCE ON CUSTOMERS FOR EACH CUSTOMER
```

These sentences can be stored in Procs and hooked together with the menu processor to create a total system in about one-tenth the time that it can be done with BASIC. Debugging and modifications are even faster.

Asking me to create an application without UHL would be like asking a carpenter to build a house without any power tools. It could be done, but I wouldn't like it, and you wouldn't want to pay for it.

Melvin G. White
Issaquah, WA

I'm glad to see BYTE has finally discovered one of the most underrated products in the computer industry: the Pick operating system. As Business Week once commented, "Pick is "one of the best kept secrets in the data processing world." Pick is a lousy marketer, but a superb programmer. His operating system is easily the best thing

(continued)
Top Modem

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It's the only modem that lets you expand into a full telecommunications center with add-ons. The OPTIONS PROCESSOR gives you Data Store and Time Base Continuity with battery backup, Personal/Business Telephone Directory, and Automatic Receipt/Transfer Buffer, expandable to 64K. The OPTIONS PROCESSOR also enables ProModem to operate unattended, with or without your computer.

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212A Modem Comparison Chart

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Hayes Command Compatible (Works with Smartcom®)
Additional telephone jack with exclusion switching
Analog loop back self test
Self Test at Power Up
Call Progress Detection (Busy, Dial Tones, Trunk Busy, etc.)
Speaker and External Volume Control
Full Complement of Status Lights
8 Switch Selectable power-up defaults
Adaptive Dialing
Auto Redial on Busy
Ergonomically designed easy to read front display panel
Internal Stand-Alone Power Supply
Built in Real Time Clock/Calendar
Help Command
300 baud connect while maintaining 1200 baud RS-232 link

EXPANDABLE OPTIONS

Automatic Receiver Buffer
Automatic Transmit Buffer
On-board Personal/Business Directory Buffer, Expandable to 64K
Auto Logon Macros
Auto message transmission to groups of numbers
Records call duration
12-character Alphanumeric Display

*Comparison made by Prometheus on the basis of the best information available to Prometheus at time of printing.
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ENHANCED FRACTALS

I enjoyed Peter Sørensen's article on fractals (September 1984, page 157). It caused me to go out and buy Benoit B. Mandelbrot's book on the subject—and then wish I hadn't. Sørensen crammed more practical help for anyone who wants to produce fractals into nine pages of BYTE than Mandelbrot got into 468 pages. How can this happen? Let me quote Mandelbrot himself in reference to the French mathematician Fatou, who was one of his predecessors in the study of iterated transformations: "In many cases the purpose is to reveal little, but to squirrel evidence that the author had thought of everything." Just so: 468 squirrelous pages, less the
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lovely illustrations... which are produced so that the probability level $P$ can be changed during program execution, one finds for certain fractals that the "painting in" of portions of the curve can be greatly speeded. In other words, the statistics of fractal painting is influenced by the probability mix of roots of the iterated parabola, $z_{\text{new}} = \lambda z_{\text{new}} (1 - z_{\text{new}})$. This is not a cure-all, but it sometimes works. As for the accompanying "dragon" figure (figure 1), for which lambda equals $1.5 + i$, wherein the "inward spiraling" parts (notably, near points specified by $z_{\text{old}} = z_{\text{new}} = z$, which has roots $z = 0$ and $z = 1 - (1/\lambda)$) are filled in very rapidly by choosing $P = 0.1$. Another trick is to plot on the screen each calculated $z_{\text{new}}$ value not merely to diagonal quadrants, as in the given program, but symmetrically to each quadrant. This sometimes does graphic wonders, with formation of seemingly recognizable figures, etc.—as good as any inkblot test, and based on the same symmetry principle.

The parabola provides a takeoff point for generalizations. Any monotonic function of $z$ can be substituted for $z_{\text{new}}$ in the right-hand side of the above equation. Choosing $\exp(z)$ and taking lambda equal to $0 + 3.5i$, for example, we get figure 2. (Turn it sideways to see why I entitle it "The Marxist Mustache.") Oddly enough, the more complicated functions seem generally to lead to simpler (less ornate) fractal curves. In fact, this one does not look self-replicative at all, but the smooth curves are multiple and are "strange attractors" (another term for fractals) in the sense discussed by Hofstadter and illustrated on page 34 of Scientific American, November 1981.

The parabola also links up with the mathematical objects known as continued fractions. If $n$ is iteration number, then with $z_{\text{old}} = z_n$ and $z_{\text{new}} = z_{n+1}$ we can regroup the recurrence relation as

$$z_{n+1} = \frac{z_n \lambda}{1 - z_n}$$

By repeated substitutions this becomes

$$z_{n+1} = \frac{z_n \lambda}{1 - z_n} \frac{z_{n-1} \lambda}{1 - z_{n-1}} \ldots$$

If the remainder term $z_{n+1}$ in the "tail" of this expression could be set equal to zero, this would be a classical continued fraction (c.f.). However, the latter, as conventionally defined, is at most single-valued, so such a definition sacrifices the ability to represent both roots of the original quadratic. This eliminates the root ambiguity necessary for generation of fractals. (Try imposing a cyclic pattern on root selection in place of $\text{RND}$. It reduces the fractal to a finite point set in the complex plane.) So the classical definition of "value" of a c.f. is useless and—as I have argued elsewhere (in Naval Ordnance Laboratory Technical Report 71-36, "A New Ap-
The approach to Evaluation of Infinite Processes, March 1, 1971—can advantageously be replaced even in classical analysis with a two-valued conception of these second-order infinite processes. In any case, the c.f. form is not a practical one for computation because so many arithmetical operations soon get overwhelmed by round-off error. A more general recursion such as \( z_{n} = \alpha z_{n-1} (1 - z_{n}) \) can generate true c.f.-like objects with sequentially variable partial numerators, but I cannot vouch for their capacity to represent fractals. It is apparent that a rich and unexplored field exists for "classical" mathematical analysis.

Thomas E. Phipps Jr.
Urbana, IL

UNIX vs. XENIX

I read with great enthusiasm the more technical articles of your magazine. Those covering C and UNIX were very interesting. However, I have formulated specific questions about UNIX that I find only vague or (apparently) contradictory answers to, and these concern the difference in meaning between "UNIX" and "XENIX."

I understand that UNIX is a trademark of AT&T and XENIX is one of Microsoft. Beyond that, the difference is treated superficially or not at all. In the June 1981 issue dealing with operating systems, on page 248, paragraphs 4 and 5 state:

The heart of the XENIX system is the UNIX operating system . . . And, in addition to supporting and enhancing the operating system proper, Microsoft will adapt . . . its BASIC interpreter and compiler, FORTRAN, Pascal, and COBOL . . .

However, in the September, October, and November 1983 issues, you state that these languages are available to UNIX license holders as added programs if they are not included in the basic UNIX system. Is XENIX constructed in this way?

The June 1981 article by Robert Greenberg ("The UNIX Operating System and the XENIX Standard Operating Environment," page 248) mentions real-time capabilities under XENIX. Do these involve modifications to the various (ported) UNIX kernels, or does Microsoft use existing kernels; i.e., are UNIX and XENIX kernels fundamentally different?

Is the shell of a XENIX system either the Bourne shell or the C-shell? Do programs
LETTERS

written in UNIX C run under XENIX and vice versa? Is the XENIX system directory tree rearranged with respect to, for instance, that of an AT&T UNIX System V configuration? Can TAR format data be interchanged between the two? Can a XENIX system hook into, for example, that of an AT&T UNIX System V configuration? Can TAR format data be interchanged between the two? Can a XENIX system hook into, for example, USENET? Why would I purchase a XENIX system if I can get UNIX and install everything I wish (depending on the answers to the previous questions)?

In a July 1984 article ('XENIX for the IBM PC XT page 235), Steven H. Barry and Randall Jacobson reviewed Sritek's VersaCard, a hardware-software combination that brings XENIX to the IBM PC XT. They cited discrepancies between this implementation of XENIX and UNIX version 7. Do these discrepancies between XENIX and UNIX systems usually not exist?

I understand the limited scope of an article, but I would have expected to come across answers to these questions somewhere since the beginning of BYTE, particularly since in recent times the acronyms UNIX and XENIX have cropped up so frequently. I realize that it makes little or no sense to ask "Where does UNIX end and XENIX begin?" but I would appreciate knowing the exact difference between "UNIX" and "XENIX."

DIRK U. MITTLER
Baie d'Urfe, Quebec, Canada

BYTE replies:

XENIX is an enhanced version of UNIX licensed by Microsoft Corporation from Western Electric. The original XENIX license was for Bell Laboratories' UNIX Timesharing System, Seventh Edition (also called version 7 UNIX), but Microsoft's current XENIX 3.0 is an enhancement of UNIX System III: XENIX 5.0, to be available in 1985, adapts UNIX System V. Therefore, XENIX clearly is UNIX—the name was changed for legal and marketing reasons. XENIX is a trademark of Microsoft.

The only language that you receive as a XENIX purchaser is the C language, since the C compiler is an integral part of UNIX/XENIX. Some vendors provide the C compiler with only a "software developer's" version of XENIX—the user version has no compiler. You can purchase other language compilers to run under UNIX/XENIX at additional expense.

XENIX includes three shells: the Bourne shell, named after its author, Stephen R. Bourne; Microsoft's own Visual Shell, which uses a menu-driven command processor; and Berkeley's C-shell. Any of these shells can be invoked from within any other shell, but most users choose one and stick with it. C programs written to run under UNIX will also run under XENIX, although there may be some machine-dependent differences (the portability of UNIX and C is another can of worms). The directory structures of UNIX and XENIX are identical. You can exchange data among UNIX and XENIX systems, and XENIX users can access USENET.

The decision whether to buy UNIX or XENIX is primarily a vendor decision. Typically, you buy a computer bundled with UNIX or XENIX from the hardware vendor.

The enhancements to UNIX that constitute XENIX's advantages include (continued)
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record and file locking, semaphores, shared memory management, and hardware error recovery. The version of XENIX that you can buy depends on your computer. XENIX 3.0 runs on the IBM PC AT, while XENIX 2.3 runs on the Altos, Tandy, and other 16-bit multiuser computers.

THE REAL RSA ALGORITHM

Charles Kluepfel's article ("Implementing Cryptographic Algorithms on Microcomputers," October 1984, page 126) is not based on the real RSA algorithm but on Donald Knuth's version of it. Knuth uses the exponent 3 to encode a message, but the full RSA allows any exponent that does not share any prime factors with \((p-1)\cdot(q-1)\). Instead of having to ensure that messages are greater than the \(\frac{n}{3}\), one can choose any encoding key such that \(r^s > n\) and then be sure that all messages except 0, 1, and \(n-1\) are thoroughly encrypted.

The full RSA system also allows the decoding key to be chosen for special properties and the encoding key to be deduced from it; for instance, the decoding key may be kept short (15 digits or so) or close to a power of 2 for easier computation when the recipient of messages has less computing power than the sender.

I'm not sure why Knuth's version is different: perhaps his knowledge of RSA was based on an early version, before the main paper was published. CACM, volumes 21 and 22, pages 120-126 (1978).

I have tried running Kluepfel's example on our own Big Integer BASIC interpreter on a 3-MHz Z80-based CP/M machine, with the following program:

```basic
100 INPUT N,D
110 INPUT MS
120 CO = MS-[N]3 : PRINT CO
130 MT = CO-[N]0
140 IF MS=MT THEN PRINT "OK" : PRINT : GOTO 110
150 PRINT "**ERROR**":MT
```

Apart from problems with a misprint in listing 9 (a spurious "1" in "182818281" in the first two occurrences of MS), the program ran first time. It took a second or so to encode and 115 seconds to decode. Our factorization program in BASIC took 2.5 minutes to factor BYTE's telephone number: 13 * 4703 * 98799 = 6039249281. No doubt the IBM PC version will be faster.

MARTIN KOCHANSKI
Speldhurst, Kent, England

Charles Kluepfel replies:

At the time I wrote the program and article, all descriptive references that I saw to the RSA system used the power 3, including Knuth, who in fact referenced the same article Mr. Kochanski mentioned. As Knuth provided an unambiguous description, I felt that it was the same as in the RSA reference, and I did not seek that source. However, the Knuth description is, indeed, based on the real RSA algorithm, as a particular instance of using 3 as the encoding power.

Referring now to that main paper, wherein the power in question is denoted by e (as opposed to s in Kochan-

(continued)
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**LETTERS**

ski's letter), the algorithm included there for determining a pair d and e can be incorporated into my RSA program by modifying the SETUP function as follows: In place of the line in listing I that says

D: QUOTIENT(2*(P - 1)(Q - 1) + 1,3),

put the following coding:

D: NXPRIME(P + Q).

**LOOP**

D: NXPRIME(D + 1),
XO: (P - 1)(Q - 1),
X1: D,
A0: 0,
B0: 0,
A1: 0,
B1: 1,

**LOOP**

QU: QUOTIENT(XO,X1),
X2: X0 - QU*X1,
A2: A0 - QU*A1,
B2: B0 - QU*B1,
X0: X1,
X1: X2,
A0: A1,
B0: B1,
B1: B2,
WHEN X1 = 1,
A: ABS(B1), EXIT,
ENDLOOP,
WHEN E > 2026, EXIT,
WHEN 2^E * N, EXIT,
ENDLOOP.

Then E and N are the public keys, and D is the private key. Encoding is via CD: POWERMOD(MS,E,N) and decoding via POWERMOD(CD,D,N). As all messages raised to the E power are larger than N, there is no problem of a message being too short, as you pointed out.

Unfortunately, my system runs out of space when this modification is made; it bogs down endlessly reshuffling its atoms and lists, as muSimp dynamically allocates all the time.

**MAKEBAT.ASM**

**Corrections**

I recently received and installed the Columbia 1600-4. I have found it easy to install and a breeze to upgrade (except for having to remove the power supply and disk assemblies to install the 8087). I immediately began rummaging through my back issues of BYTE for little tidbits of programming hints to help me along. I was delighted to find in the BYTE Guide to the IBM Personal Computers the program (continued)
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**SORRY, WRONG NUMBER**

We are very pleased with the responses and the sales received as a result of our full-page TransMIT software ad in your December issue. Considering that we inadvertently had the wrong phone number in our ad, the demand for our easy-to-communicate software has been overwhelming. The phone number should have read (804) 622-5598.

We hope that we have not caused any inconvenience to your readers and those who called to purchase TransMIT.

CHELSEA A. CARTER
Vice-President—Marketing
Micro Innovative Technology Inc.
Norfolk, VA

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**ADDING A HARD DISK**

I read with interest Roy M. Matney's "Adding a Hard Disk" (October 1984, page 203). I did, however, find several items I simply must comment on. Having been through the IBM third-party maintainer course and having added hard disks to many systems, I feel qualified to comment.

On the topic of power requirements, the author implies that you should add "an additional, external power supply." While this is certainly a viable alternative, there is a better way.

Most of the basic PCs sold come with a 63.5-watt power supply. This supply is sufficient to run a PC with a full complement of RAM chips and dual disks. As the author correctly states, it is marginal for running a hard disk. In the XT, which comes with a hard disk as a standard option, the power supply is replaced with an identical-looking unit that provides 130 watts. The only apparent difference in these two units is on the data plate.

Removing and replacing an IBM power supply is very simple. Remove the outer case cover by removing the five ¼-inch hex head screws on the rear apron. Disconnect all of the power-supply cables (two cables go to the motherboard and one to either disk drive). Remove the four ¼-inch mounting screws on the rear apron of the chassis located at the corners of the supply. Slide the supply forward the front of the chassis about ½ inch (loosening the disk drives or removing the interface cables may help in this step) and lift the entire supply out of the unit. Replace the supply with the same sequence of steps in reverse.

(continued on page 428)
E Pluribus Unum. IBM Personal Computer graphics hardware covers a lot of territory, from graphics cards and monitors to printers and plotters. Color monitors alone are available in four models that can satisfy varying levels of color graphics requirements, from home or office to the laboratory.

Two of the most recent, for example—the IBM PC Enhanced Color Display and the IBM PC Professional Graphics Display—offer advanced business and technical graphics capabilities. The IBM PC Enhanced Graphics Adapter can also be used to extend some of those capabilities to the IBM PC Monochrome Display and the IBM PC Color Display.

This growing array of hardware products is unified by a strong IBM Personal Computer graphics software development strategy, one that can dramatically improve your programming efficiency and broaden the application potential of your graphics programs.

Independence. Graphics software has traditionally been written for a specific graphics device and couldn’t be run on a second device without complex and time-consuming reprogramming. By using the IBM Personal Computer Graphics Development Toolkit, however, you can now develop software that is compatible with all existing IBM PC graphics hardware products.

This is possible because the Toolkit contains a constant interface—the Virtual Device Interface—to which all applications can be written. The result is device-independent software.

The Graphics Development Toolkit allows you to program bit-map graphics to a 32K x 32K addressable point window and to combine graphics and text capability on a variety of graphics devices. The device drivers necessary for information exchange with existing IBM PC graphics devices are included in the Toolkit, as are a driver for the IBM PCjr Video Subsystem and language interfaces for the IBM BASIC, FORTRAN, C, and Pascal compilers and for the IBM Macro Assembler.

The right tools. Several products from the IBM PC Engineering/Scientific Series also play an important part in the IBM PC graphics programming strategy. All of them incorporate the Virtual Device Interface discussed above.

The IBM Personal Computer Graphical Kernel System—which is consistent with Draft ISO and ANSI GKS Standards—gives you a common high-level graphics language that can help further simplify your programming tasks. It also helps increase the portability of applications between computer systems.

In addition, the IBM Personal Computer Plotting System provides a
subroutine library of functions that help make it easy to produce a wide variety of charts and graphs. There's also a Metafile Interpreter available to facilitate retrieving and manipulating graphics images.

This range of IBM graphics programming tools is designed to help speed and simplify nearly every aspect of your graphics programming work. They can substantially reduce the time and tedium involved in program development, and the device independence they provide can help increase the flexibility of your finished programs. Device independence also helps extend the life—and marketability—of your programs, because applications developed with the Virtual Device Interface can interface with future generations of graphics devices.

HARDWARE NEWS

Lock and key. Troubled by people who try to peer without permission at sensitive business or personal data stored in your IBM Personal Computer? You can go a long way toward locking it up with the IBM Personal Computer Keylock Option.

Fifteen minutes and a screwdriver are all you need to install the Keylock Option on your IBM Personal Computer: IBM Personal Computer Expansion Unit, IBM Personal Computer XT, IBM Personal Computer XT/370, or IBM 3270 Personal Computer.

Once your system unit is outfitted with the Keylock Option and locked, it will be difficult for someone without the proper key to access the hardfile and all the valuable software it contains. Also, other users in a network won't easily be able to access or tamper with data stored on your system. In fact, when the Keylock Option is installed, the system unit can be powered up only with the key and can't be powered up through the CRT plug port.

And with the Keylock Option locked in place, the system unit cover can't be removed—short of forcible entry—by just anyone who might want to browse around inside your IBM PC during off hours.

Small packages. If you need more memory but don't have a full-size slot available in your system unit, the IBM Personal Computer 256KB Memory Expansion Option may be the answer. It offers 256KB of additional memory on a short card 5 inches rather than 11 inches, with a comparably diminutive price.

That makes it ideal for adding memory to the IBM Portable PC. This Memory Expansion Option is also a compact way to beef up your IBM Personal Computer or IBM Personal Computer XT (which has two slots for short cards).

Talkies. The combination of film and sound revolutionized the movies. Speech capability may soon spell an equally big change for computers. The IBM PCjr Speech Attachment is a step in that direction.

It's a side-attached option for the PCjr that permits speech and sound under control of software such as IBM Writing to Read.* The Speech Attachment contains 196 words and sounds in its ROM. Cartridges manufactured with prerecorded speech can be used under program control. And with the purchase of a microphone and the proper software, you can even record your own speech data on an IBM PCjr diskette.

So far, at least, the last word is ours.

WHAT'S THE PROGRAM?

Retrieval. Whether you work with pen and paper or the latest word processing software, writing documents is only half the battle. Try finding them again a month later.

We don't claim to have discovered a better system for paper filing. But a new software package from IBM—Office Correspondence Retrieval System (OCR5)—does promise to make life a lot easier for those who store written work on a fixed disk or who have a library of documents stored on diskettes.

OCR5 can help in two ways. First, it makes document abstracts and stores them in a summary file for future reference. OCR5 automatically searches out keyword information such as date, subject, sender—or any other significant word. You can also add keywords other than those actually contained in the document.

Second, and most important, simple English language queries will prompt OCR5 to locate the original document. A document search request can be entered as individual words or complete sentences. You don't need to learn a special query language.

OCR5 can abstract and retrieve any type of file containing ASCII text such as letters, charts, and computer programs. It can also directly abstract documents written with IBM

Help protect your software and hardware with the IBM Personal Computer Keylock Option.
IBM PCjr Speech Attachment

Writing Assistant. IBM PCWriter: a WordStar® and documents using IBM Revisable Form Text Document Content Architecture (RFTDC). Documents can be converted RFTDC data format by IBM IplayWrite 1 and 2 and PCWriter.

With OCRS, missing reports be a thing of the past.

Evolution. Like their human language counterparts, computer language and operating systems change and evolve. Occasionally, an entirely new dialect crops up, such as the IBM Personal Computer XENIX® Operating System.

IBM Personal Computer XENIX is derived from the UNIX® Time Sharing System. Several enhancements designed specifically for the IBM Personal Computer AT allow you to take full advantage of its power. IBM Personal Computer XENIX supports both single-user and multi-user configurations. It also enables you to run several programs at the same time—you can, for example, compile a program in the background while you edit one in the foreground.

There are two additional packages available to be used with the IBM Personal Computer XENIX operating system that deserve special mention. First, the IBM Personal Computer XENIX Software Development System gives you tools to generate code suitable for either XENIX or IBM Disk Operating System (DOS) operation. Second, IBM Personal NIX Text Formatting that can help with the production of technical reports, memoranda, formal papers, and documentation—it's especially useful for publications that require technical or scientific formats.

IBM DOS has been updated twice recently. DOS 3.0 provides all the functions contained in DOS 2.1 plus enhancements to support the IBM Personal Computer AT. DOS 3.1 incorporates further enhancements that support the IBM Personal Computer Network.

There are also new versions of the IBM BASIC Interpreter and of the IBM Macro Assembler. BASIC 3.0 contains several noteworthy new functions that provide access to user-installed device drivers. They are: SHELL, IOCTL and IOCTL$, ERDEV and ERDEV$, and ENVIRON and ENVIRON$.

The recent 2.0 version of the IBM Macro Assembler supports both the 8088 and 80286 processors and the 80387 and 80287 Math Co-processors. Other additions include a new Library, a

Manager, and a Structured Assembler Language Preprocessor. And you can use the IBM Professional Debug Facility to put the finishing touches on your assembler language programs.

See your authorized IBM Personal Computer dealer or IBM Product Center about an economical trade-up from your 3.0 version of IBM DOS to version 3.1 or from Macro Assembler version 1.0 to 2.0.

WordStar is a registered trademark of MicroPro. XENIX is a registered trademark of Microsoft Corporation. UNIX is a registered trademark of AT&T's Bell Laboratories.

Budding User Groups

cetting started. Ever considered forming a group to exchange ideas about using your IBM Personal Computer but never got around to sorting out all the start-up details? Or, once past that first stage, does your group find it difficult to come up with new information, presentation materials, and connections with other groups? Help is at hand.

Because of the growing interest in PC user groups all across the country, IBM has expanded its efforts to encourage new groups and to support existing ones. There's no charge for this assistance, and all groups—whether they have 10 or 1000 members—are eligible for the same basic level of support.

For starters, the IBM User Group Support department will provide a package that introduces you to some of the basics of organizing a club. It includes a sample constitution and bylaws, suggestions for officers' titles and duties, and a list of other groups already in the program.

Staying started. Once the initial burst of enthusiasm is past, a PC user group needs more than a common interest to maintain its membership—it needs some focus for that interest. IBM can provide information and materials to help keep your group going.

Perhaps the most impressive
form of support is a monthly newsletter on diskette, complete with color and sound. It includes reviews of new products, editorial commentary, and technical tips. The newsletter also carries reprints of the best articles from participating group newsletters, so you can follow the activities of other user groups around the country.

Other sources of useful information are the PC User Group Phone Line and PC User Group Bulletin Board System. You can use the phone line to get answers to questions about the organization and functions of a user group and to find out about other groups in your area.

The bulletin board, which can be accessed through your IBM Personal Computer, carries new production information from the day of announcement. It also provides a means of communicating with other PC clubs.

Finally, to provide topics of interest for your regularly scheduled meetings, IBM will send timely presentation and demonstration materials. Better still, group officers can use the phone line to request guest speakers from IBM for special meetings.*

*For more information about participating in the IBM User Group Support program, please write to: IBM User Group Support, IBM Corporation 2900, P.O. Box 3022, Boca Raton, FL 33432.

Added color. Bored with the black screen that appears on your IBM PC Color Display when you boot up your system? There are lots of other color possibilities, and the brief program below shows you how to set them from DOS.

It will give you a display with a black border around a rectangle 80 columns wide and 25 lines high. The program can be used in an AUTOEXEC. BAT file to produce a starting color, and DEBUG will maintain the color you set.

All you have to do is substitute number or letter values for the colors you want where the ?? appear in the following program. For the first ?, substitute one digit (0-7) for the background color. For the second ?, substitute either a digit or a letter for the foreground color (1-7 for regular colors, 9-F for intensified colors). For example, 28 will give you grey text on a green background. For a complete listing of the color codes, see the Color Statement section of your IBM BASIC manual.

To set your screen colors, do the following from the DOS prompt:

A>debug colorcom

File not found (ignore this message)

-e 100 2b 60 e 50 b5 03 00 cd 10 b8 00 06 b9 00 00 ba
-e 110 50 20 b7 ?? cd 10 b4 02 ba 00 00 b7 00 cd 10 cb
-w

Thereafter: you need only type "color" at the initial DOS prompt after booting your system to change the display from black and white to your preset colors.

For more information about IBM Personal Computer products discussed in this issue of Read Only, see your authorized IBM Personal Computer dealer or IBM Product Center. To learn where, call 900-447-4700. In Alaska and Hawaii, 800-447-4890.
FIXES AND UPDATES

BYTE’S BUGS

C Bugs

The name of Mark Williams Company C Source Debugger was incorrectly stated in a Product Description in the December 1984 BYTE. (See “C-Language Development Tools” by G. Michael Vose, page 119.)

The correct name for the debugger is csd and not dbc as reported. Shortly after the article was written, the folks at Mark Williams discovered that another firm had used the latter name, which necessitated the change.

Our thanks to Diane Treacy, Director of Corporate Communications for Mark Williams Company, for bringing this to our attention.

Also, the address for Relational Systems Inc., publisher of Instant-C, was misstated in the article. The correct address is POB 480, Natick, MA 01760. The telephone number is (617) 653-6194.

FEEDBACK

Travesty Generator Enhanced

Trygve Lode, a reader in Englewood, Colorado, sent Joseph O’Rourke and Hugh Kenner some code that “effects such a vast improvement on their Travesty program with so little extra code” that they wanted us to pass it on to you. (See “A Travesty Generator for Micros” November 1984, page 12.)

The code given in listing A speeds up the Travesty listing (November, page 450) by a factor of about five; for example, Kenner reports that on a 2-MHz Heath H-89 Travesty now runs nearly twice as fast as Hellbat (page 469), a faster version of the program.

Kenner explains that Lode’s code starts each search chain from a point much deeper in BigArray than the program did previously. This point is located at a (probable) two-character match.

The increased speed resulting from this new strategy can seem spectacular, writes Kenner, “until you remember how rare most character pairings are in normal text.

Increase Multiplan Cell Size on Mac

San Francisco’s Steve Fogel read with interest Mitch Trachtenberg’s “Multiplan/Chart on the Macintosh” in the BYTE Guide to the Apple Personal Computers. (See page A85 in the special supplement to the December 1984 BYTE.)

In that article, Trachtenberg expresses his disappointment with the small amount of cells that can be displayed at any time in Multiplan on the Mac. 15 rows by 6 columns. It was suggested that this is a result of Microsoft’s sacrificing the quantity of displayed cells for the clarity of displayed text. Multiplan uses the Mac’s Seattle-10 character font, which imposes the cell-size limit due to the size character it generates.

Fogel, however, has come up with a way to display more cells in a slightly smaller typeface. Here’s what you do:

• Copy the Mac’s Font Mover program to the Multiplan boot disk, and use it to copy the Seattle-10 and -20 fonts from the System file to the Fonts file. (If you lack a Fonts file, Font Mover will create one.)
• Remove the two fonts from the System file and quit Font Mover.
• Rename the Fonts file to Seattle, which maintains it for future use.

With Seattle removed, Multiplan will default to one of the Mac’s 9-point character fonts. This results in a larger, 20-row by 7-column worksheet, according to Fogel. Since the 9-point font is smaller than Seattle and because the default cell width at program start-up remains the same, Multiplan automatically adjusts the (continued)
number of cells displayed to match the character size used.

To return to the larger character size, rename Seattle to Fonts, open Font Mover, and copy the Seattle fonts back into the System file. This will return the worksheet to its original size. Remember that worksheets created with the 9-point font may not display properly with the reinstituted Seattle font.

**BYTE’S BITS**

**Proximity’s Set Spells Writers**

Shortly after Steve Rosenthal’s article on the PF474 string comparator chip appeared in the November 1984 issue, we received notice of a new integrated-circuit set, called Spell-ROM, from the Florida-based manufacturer of both products, Proximity Technology. (See “The PF474,” page 247.)

Spell-ROM is an implementation of Proximity’s linguistic technology. Designed for spelling error detection and correction, Spell-ROM uses the Proximity/Merriam-Webster database. It automatically detects misspellings and suggests possible corrections.

It’s made up of five 32k-byte ROMs coupled with 8k bytes of RAM. Two pairs of ROMs store the 50,000-word, phonetically encoded linguistic database. The fifth ROM is used for error detection and spelling correction. The total executable code is controlled by an 8088 microprocessor.

Spell-ROM is available to office machines and computer manufacturers for $399 to $2190, depending upon licensing agreements. Proximity Technology Inc. has its headquarters at 3511 Northeast 22nd Ave., Fort Lauderdale, FL 33308, (305) 566-3311.

**FREE EDUCATIONAL FINDINGS**

A free disk containing the results of a nationwide survey of American education is available from the Department of Education. This program provides access to more than 800 findings that have been compiled by the National Assessment of Education Progress, an ongoing survey examining what American students are learning.

This program, called NAEPIRS (National Assessment of Educational Progress Information Retrieval System), is said to differ from standard computer retrieval systems in that it gives you the data directly rather than telling you where to find more information. You can request findings according to subject or age group, look for trends or attitudes, or compare findings between varying groups of students, such as rural and urban students or males and females.

To obtain the program, send a self-addressed mailing label and a double-sided, double-density IBM PC-DOS 2.0 or higher system formatted (i.e., format/s disk to NAEPIRS, Testing, Assessment, and Evaluation Division, Teaching and Learning Program, National Institute of Education, 1200 19th St. NW, Mall Stop 9, Washington, DC 200208.

**Try Out Some Software**

Pfister Research wants to test the viability of a series of software for IBM PC or XT-compatibles. The following programs are available for a nominal charge on a first-come, first-served basis: mail management, inventory management, accounts payable, and accounts receivable.

All programs are said to be complete. If you find them useful, you may make a donation. Send $6 for each item requested to Pfister Research, POB 529, Garden Grove, CA 92642-0529.

**MUSEUM NEEDS VOLUNTEERS**

The Computer Museum in Boston, Massachusetts, seeks volunteers and new staff to assist visitors. Contact Katherine Schwartz, Exhibits Operations Manager, 300 Congress St., Boston, MA 02210, (617) 426-2800, for further details.

**PC-DOS HELP FUNCTIONS**

Chris Bailey has offered a low-cost public-domain software package that provides a help function that you can invoke from the command level of PC-DOS.

The software provides two levels of help for all PC-DOS commands: an abbreviated version and a detailed explanation with examples. In addition, it discusses a number of topics at length, including solutions to common computer problems and clarifications of PC-DOS concepts. Help screens are modifiable.

This package works with IBM PC-DOS version 2.0 and 2.10 for the PC and PC XT and with the PCjr running PC-DOS 2.10. One disk drive and an 80-column display are required. A single copy costs $10; additional copies are $25. For more information, write to Chris Bailey, POB 332, Peterborough, Ontario K9J 6Z3, Canada.
THE MI-286 DUAL CPU BOARD IS AT LEAST TWICE AS FAST AS COMPUPRO'S 8085/88... AND IT'S A DIRECT REPLACEMENT!

The 20-second revolution. It only takes about 20 seconds to bring your S-100 system up to its ultimate speed/power potential. Just pull out the old fashioned 8085/88 board and plug the MI-286 in its place. That's all there is to it. You're off and running with more power than ever before.

The 80286 and Z-80H. The MI-286 is the first dual-CPU board using the new, high speed Intel 80286 coupled with a Z-80H. It is designed for use with a variety of operating systems, including MP/M 8-16. It will support all your current 8086/88 and Z-80/8085 software. It can accommodate an optional 80287 math co-processor. In short, it gives you the best of both worlds.

Add more users. The MI-286. It improves throughput so dramatically you can add those extra users you've always wanted. It carries S-100 technology to its logical limit.

Upgrade your S-100. The MI-286 is only one of Macrotech's products designed to maximize the performance of your S-100 system. The MAX Dynamic Memory gives you up to 1 Mbyte of memory for your system memory and virtual disk applications. ADIT lets you control up to 16 different terminals, modems or printers from a single slot in your S-100 bus. And our static board is the S-100 world's first 1/2 Mbyte static memory. Call or write us today, and find out how easy it is to upgrade your S-100 system.
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.

- **The PRINCETON HX-12** RGB color monitor, with a dot pitch of .31mm, 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.

- **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 monocard—no special card is required.

**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.

**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.

**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 more information call toll-free:
**800-221-1490 Ext. 804**

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Technologically tuned for excellence
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.

* StarWriter is a Trademark of C. Itoh Digital Products, Inc
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WHAT'S NEW

Two New Color Computers from Atari

Atari has two new color computer lines: the 68000-based ST and the 800-compatible XE.

The ST comes with a two-button mouse and Digital Research's GEM, a user interface that has pull-down menus, icons, and overlapping windows. GEM is embedded in 192K bytes of ROM along with TOS (Tramiel operating system, named for Atari president Jack Tramiel) and a game. For more on GEM, see page 39 of the December 1984 BYTE.

The ST, which can handle television, composite color, monochrome, and RGB outputs, produces graphic resolutions ranging from 640 by 400 pixels (monochrome) to 320 by 200 pixels (16-color mode). Its 84-key keyboard is augmented with a numeric keypad and 10 function keys. ROM cartridge, RS-232C serial, Centronics parallel, and floppy- and hard-disk drive interfaces are supplied. Also, the ST carries a three-voice sound chip and a MIDI port for linking to musical instruments and synthesizers. The 128K-byte Model 130ST will sell for approximately $400, and the 512K-byte Model 920ST will be about $600. Shipments are to begin shortly. Atari plans to offer a 10-megabyte ST hard-disk drive for about $600. Both a composite color monitor and a 3½-inch disk drive will be priced in the $150 range.

Four versions of the Atari XE computer will soon go on sale. The basic XE comprises a 57-key keyboard, five special-function keys, a ROM cartridge slot, BASIC in ROM, and four-voice sound. Graphic resolution is 320 by 192 pixels. Atari's 11 graphics modes and Player Missile Graphics are provided.

The Model 65XE, with 64K bytes of RAM, will cost $120. The 5400 portable 65XEP comes with a built-in floppy-disk drive and a 5-inch monochrome monitor. The 128K-byte 130XE will be under $200. The 65XEM will be outfitted with an eight-voice music synthesizer chip. Its pricing had not been finalized at press time.

Contact Atari Corp., 1265 Borregas Ave., Sunnyvale, CA 94086. (408) 745-5224. Inquiry 600.

Integrative Software for Ataris

Infinity, an integrated software package for the Atari's 800XL and XE series, is made up of word-processing, spreadsheet, file-management, graphics, and communications functions. It uses pull-down menus, icons, split screens, and context-sensitive help. Files can be imported or exported in any of nine formats, one of which lets you transfer data over a local-area network or through an RS-232C port.

Developed by Matrix/Sys-

tems Group Corporation, In-
finity will be distributed for the 800XL and XE by Atari. Versions are also planned for Atari's ST series and other systems using Digital Research's GEM operating environment.

Contact Atari Corp., 1265 Borregas Ave., Sunnyvale, CA 94086. (408) 745-5224. Inquiry 601.

Sharp Computer Has Four-Color Plotter

Sharp's PC-2500 portable computer comes with a four-pen color plotter that draws graphs or text on paper up to 4½ inches wide. The PC-2500 has 5K bytes of battery-backed memory and a 4-line by 24-character LCD. Address/phone-directory software and BASIC are incorporated in ROM.

This notebook computer has a low-power serial port so that it can interface to other Sharp peripherals; an optional adapter can convert this signal to an RS-232C serial interface. An 8K- or 16K-byte battery-backed RAM-card option expands the PC-2500's data storage. The 3-pound PC-2500 will sell for less than $450. Contact Sharp Electronics Corp., 10 Sharp Plaza, Paramus, NJ 07652. (201) 265-5600. Inquiry 602.

Sample output produced with the PC-2500's color plotter.
The Commodore LCD has a 16 by 80 display.

The Commodore LCD is a 3-pound portable computer with a flip-up, 16-line by 80-column liquid-crystal display (LCD) and a built-in 300-bps modem. It's powered by either batteries or an external AC supply.

The LCD comes with word processing, file-management, spreadsheet, appointment-schedule, and communications software in 96K bytes of ROM. It also has calculator, memo-pad, and address-book features. Because the software resides in ROM, the LCD's 32K bytes of RAM are ready for file and data storage. Commodore says the LCD can employ any C64 serial peripherals, such as printers and disk drives. It also has both RS-232C serial and parallel ports.

The Commodore LCD is expected to sell for under $600. Contact Commodore Business Machines Inc., 1200 Wilson Dr., West Chester, PA 19380. (215) 431-9100. 
Inquiry 603.

120-cps Printer for the Commodore

The Okimate 120 printer is tailored for the Commodore 64 and VIC-20 computers. In its draft mode, the Okimate 120 can print 120 characters per second. It works at 60 cps in the enhanced print mode.

The Okimate 120 uses a nine-pin dot-matrix print head. The list price is $269, including cables. Contact Okidata, 532 Fellowship Rd., Mt. Laurel, NJ 08054. (609) 235-2600. Inquiry 605.

Three Printers from Epson

The Spectrum LX-80, the P-80, and HomeWriter 10 are three additions to Epson America's line of printers. The Spectrum and HomeWriter come with a Selectype feature, which lets you modify such print modes as italic, compressed, or emphasized through software or from the front panel.

Base prices are $349, $249, and $269, respectively. Tractor and cut-sheet feeds are offered for the Spectrum and HomeWriter. The former is $399.95, and the latter is $999.95.

The Spectrum LX-80 produces draft-quality copy at 100 cps and near letter-quality print at 16 cps. It's shipped with a 1K-byte buffer, friction-feed capabilities, and a parallel interface. A 32K-byte print buffer card can be purchased for $175.

The portable P-80 is an 80-column thermal-transfer printer that uses a nine-pin print head to generate hard copy at 45 cps. Although this friction-feed printer measures only 2½ by 4½ by 11½ inches, it works with plain paper up to 8½ inches wide. It has both RS-232C serial and parallel ports and uses rechargeable nicad batteries or an AC adapter.

Plug-in interface cartridges configure the HomeWriter 10 for operation with Apple, Atari, Commodore, and IBM computers. It runs at 100 cps in the draft mode and 16 cps in its near letter-quality mode. Interface cartridges are $60 each.


The Word Is Updated: Supports Graphics, Offers Hyphenation

Microsoft began shipping Word 2.0 last month. Word 2.0 can display text as bit-mapped graphics on screen, and it works with IBM's Enhanced Graphics Adapter and Hercules' high-resolution graphics card. Word 2.0 displays special characters, such as italics, small capitals, superscripts and subscripts, and strikethrough, on screen.

Automatic or interactive hyphenation and the ability to run DOS commands without exiting have been built in. In addition to on-screen formatting, Word 2.0 has style sheets for writing quick memos and letters.

A keepfollown option prevents page breaks from occurring in unwanted places, and an interactive repagination option lets you confirm each page break. An option for switching commands off is provided.

Word 2.0 calculates proportional spacing and type justification for any typeface. It can produce hard copy through a host of printers and comes with font and character tables specific to Quiet Writer, Wheel Writer, Xerox 2700, and IBM printers. It also works with Hewlett-Packard's Laserjet printer.

Standard are an 80,000-word dictionary that can be run from within the Word 2.0 environment, mail merge, multiple windows, cut-and-paste between windows, an undo command, and running headers and footers.

Hardware requirements are an IBM PC or PC AT with 256K bytes of RAM and one double-sided floppy-disk drive (two are recommended) or a hard disk. DOS 2.0 or higher is necessary. The suggested retail price is $375, including documentation, keyboard template, and instruction disk.


(continued)
They said it couldn’t be done. Borland Did It. Turbo Pascal 3.0

The industry standard
With more than 250,000 users worldwide Turbo Pascal is the industry’s de facto standard. Turbo Pascal is praised by more engineers, hobbyists, students and professional programmers than any other development environment in the history of microcomputing. And yet, Turbo Pascal is simple and fun to use.

### MS PASCAL
- **Compilation Speed**: 16 sec.
- **Execution Speed**: 20 sec.
- **Code Size**: 35K
- **Built-in Interactive Editor**: NO
- **One Step Compile**: NO
- **Compiler Size**: NO
- **Turtle Graphics**: NO
- **BCD Option**: NO
- **Price**: $295.00

### TURBO 2.0
- **Compilation Speed**: 8 sec.
- **Execution Speed**: 13 sec.
- **Code Size**: 35K
- **Built-in Interactive Editor**: YES
- **One Step Compile**: YES
- **Compiler Size**: NO
- **Turtle Graphics**: NO
- **BCD Option**: NO
- **Price**: $39.95

### TURBO 3.0
- **Compilation Speed**: 8 sec.
- **Execution Speed**: 9 sec.
- **Code Size**: 35K
- **Built-in Interactive Editor**: YES
- **One Step Compile**: YES
- **Compiler Size**: NO
- **Turtle Graphics**: YES
- **BCD Option**: YES
- **Price**: $69.95

Portability
Turbo Pascal is available today for most computers running PC DOS, MS DOS, CP/M 80 or CP/M 86. A XENIX version of Turbo Pascal will soon be announced, and before the end of the year, Turbo Pascal will be running on most 68000 based microcomputers.

An Offer you Can’t Refuse
Until June 1st, 1985, you can get Turbo Pascal 3.0 for only $69.95. Turbo Pascal 3.0, equipped with either the BCD or 8087 options, is available for an additional $39.95 or Turbo Pascal 3.0 with both options for only $109.90. As a matter of fact, if you own a 16 bit computer and are serious about programming, you might as well get both options right away and save almost $25.

Update policy
As always, our first commitment is to our customers. You built Borland and we will always honor your support.

So, to make your upgrade to the exciting new version of Turbo Pascal 3.0 easy, we will accept your original Turbo Pascal disk (in a bend-proof container) for a trade-in credit of $39.95 and your Turbo37 original disk for $99.95. This trade-in credit may only be applied toward the purchase of Turbo Pascal 3.0 and its additional BCD and 8087 options (trade-in offer is only valid directly through Borland and until June 30, 1985).

Software’s Newest Direction
4133 Scotts Valley Drive
Scotts Valley, California 95066
TELEX: 72094

The best just got better: Introducing Turbo Pascal 3.0

We just added a whole range of exciting new features to Turbo Pascal:
- First, the world’s fastest Pascal compiler just got faster. Turbo Pascal 3.0 compiles twice as fast as Turbo Pascal 2.0. No kidding.
- Then, we totally rewrote the file I/O system, and we also now support full directory support.
- For the IBM PC versions, we’ve even added turtle graphics and full screen directory support.
- For all 16 bit versions, we now offer two additional options: 8087 math coprocessor support for intensive calculations and Binary Coded Decimals (BCD) for business applications.
- And much much more.

The Critics’ Choice
Jeff Duntemann, PC Magazine: “Language deal of the century... Turbo Pascal: It introduces a new programming environment and runs like magic.”

Dave Garland, Popular Computing: “Most Pascal compilers barely fit on a disk, but Turbo Pascal packs an editor, compiler, linker, and run-time library into just 26K bytes of random-access memory.”

Jerry Pournelle, BYTE: “What I think the computer industry is headed for: well documented, standard, plenty of good features, and a reasonable price.”

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Available at better dealers nationwide. Call (800) 555-2283 for the dealer nearest you. To order by Credit Card call (800) 255-8068, CA (800) 742-1133.

(*) Benchmark run on an IBM PC using MS Pascal version 3.2 and the DOS linker version 2.8. The 179 line program used is the "Gauss-Seidel" program out of Alan R. Miller’s book: Pascal programs for scientists and engineers (Sybex, page 109) with a 3 dimensional non-singular matrix and a relaxation coefficient of 1.0.
LCS Technology Converts Monochrome CRT to Colorful Display

The 7-inch Liquid Crystal Shutter (LCS) color-display component from Tektronix provides a simple means of converting a small monochrome cathode-ray tube (CRT) display into a high-resolution color display. LCS technology uses neither shadow-masks nor penetration phosphors to achieve what is said to be excellent contrast in high-ambient light, inherent convergence, and a larger usable viewing area, all in a small, rugged package.

The 7-inch LCS is made up of a pi-cell liquid-crystal switch wedged between a pair of color polarizers and a neutral polarizer. This is combined with a monochrome CRT using a phosphor that emits red and green light. The polarizers transmit polarized red and green light along separate axes, and the pi-cell either passes the light with its polarization direction unaltered, or it rotates the polarization direction by 90 degrees. This process is dependent upon voltage conditions.

Color images are produced by alternating currents between the two color fields so that one color, then the next, is transmitted in rapid-fire succession. This switching is said to be so rapid that your eye integrates the two fields into a single image. Combinations of the two primary colors can be achieved by varying the CRT's beam current, transmitting the information to be displayed in both colors simultaneously, and by adjusting the relative intensities of the two colors.

The pi-cell accomplishes its fast switching by organizing liquid-crystal molecules so that the necessary liquid flow is in harmony with the elastically induced rotation of those molecules when the applied voltage is removed. This alignment and thin cell spacing result in a cell-switching speed that ranges between 0.5 and 3.0 milliseconds. The pi-cell functions as a half-wave retarder, tuned for the wavelength region of interest. Cell spacing is in the 5- to 6-micrometer range with tolerances and uniformities of 300 nanometers.

Teledyne's LCS is said to have excellent contrast in high-ambient light.

32-bit Single-Board Computer Features National Chips

Goodspeed Systems offers original equipment manufacturers and systems integrators the GS-32, a fully equipped, 32-bit single-board computer built with National Semiconductor's NS32000 microprocessors. The manufacturer says that to create a full system all that you want is a power supply, disk drives, and one to four terminals because the GS-32 has been designed to eliminate the need for a card cage and motherboard.

A six-layer system, the GS-32 comes with an NS32082 memory-management unit, an NS32081 floating-point mathematics processor, an NS32201 timing and control device, and a choice of 6-, 10-, or 14-MHz NS32032 central processors. In addition, the Zilog Z80 oversees the I/O subsystem.

Standard are three 16-bit counter/timers, six RS-232C serial channels with rates up to 38,400 baud, a 24-bit parallel I/O link configurable as a Centronics port, virtual memory access up to 16 megabytes, and from 512K to 2 megabytes of on-board RAM. The floppy-disk interface accommodates four drives. All data transfers to the GS-32's SCSI interface are performed using a dedicated DMA channel.


Inquiry 608.
Borland does it again: SuperKey $69.95*

Sure, ProKey™ is a nice little program. But when the people who brought you Turbo Pascal™ and SideKick™ get serious about keyboard enhancers, you can expect the impossible . . . and we deliver.

**Total ProKey compatibility.** Every ProKey Macro file may be used by SuperKey without change so that you may capitalize on all the precious time you’ve invested.

Now your PC can keep a secret! SuperKey includes a resident file encryption system that uses your password to encrypt and decrypt files, even while running other programs. Two different encryption modes are offered:

1. **Direct overwrite encryption** (which leaves the file size unchanged) for complete protection. At no point is a second file that could be reconstructed by an intruder generated. Without your secret password, no one will ever be able to type out your confidential letters again.

2. **COM or EXE file encryption** which allows you to encrypt a binary file into an ASCII file, transmit it through a phone line as a text file and turn it back again into an executable file on the target machine (only of course if your correspondent knows the secret password). Now, you will even be able to secretly exchange programs through Public Bulletin Board Systems or services such as CompuServe.

Totally memory resident at all times, gives SuperKey the ability to create, edit, save and even recall new or existing macro files anytime, even while running another program.

**Pull down macro editor.** Finally, a sensible way to create, edit, change and alter existing macro definitions. Even while using another application, a simple keystroke instantly opens a word-processor-like window where you’re allowed to see, edit, delete, save and even attach names to an individual macro.

---

**SuperKey**

<table>
<thead>
<tr>
<th>Feature</th>
<th>ProKey</th>
<th>SuperKey</th>
</tr>
</thead>
<tbody>
<tr>
<td>All features resident in RAM at all times</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Resident pull-down macro editor</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Resident file encryption</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>ProKey compatibility</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Display protection</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Ability to import data from screen</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Pull-down menu user interface</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Entry and format control in data fields</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Price</td>
<td>129.95</td>
<td></td>
</tr>
</tbody>
</table>

**Sorry ProKey™!**

Superb software at reasonable prices!

There is much more to SuperKey. Maybe the best reason to buy SuperKey is that it is a Borland International Product. Each the best in its category. Want absolutely superb software at reason price?

An offer you can't refuse!

Whether you are a ProKey keyboard enhancer before, you can get your special introductory price.

Get your PC a SuperKe

SuperKey is available now for compatible microcomputers.

---

**Introductory Offer**

$69.95*

*This price includes shipping to all U.S. cities. All foreign orders add $10 per product ordered.

**Send me ______ copies.**

---

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*For Sale*

Inquiry 47
Footmouse Frees Your Hands

Footmouse Frees Your Hands

Versatron is shipping the Footmouse, a foot-operated mouse for microcomputers. The manufacturer notes that the primary advantage of the Footmouse is that it frees both your hands for data input.

Footmouse reportedly works with any software package that uses a cursor. It emulates the keyboard cursor functions, yet it does not interrupt normal cursor operations. Footmouse plugs between the keyboard and the computer, requiring neither special boards nor software support.

Presently available for the IBM PC and IBM PC-compatibles, versions of the Footmouse for the Apple IIe, Macintosh, IBM PC XT and PC AT, Iyonix, Compaq, and RS-232C terminals will be available shortly. The suggested list price is $225.

Contact Versatron Corp., 103 Plaza St., Healdsburg, CA 95448, (800) 443-1550, in California. (800) 435-1550 or (707) 433-8244.

Inquiry 609.

Multitasking, Multiuser DOS Runs with MS-DOS

Multitasking, Multiuser DOS Runs with MS-DOS

A multitasking, multiuser operating system for 8086/8088 microcomputers running MS-DOS has been introduced by FORTH Inc. Called polyFORTH II, this operating system gives you the ability to run multiple terminals, unlimited tasks, and concurrent printer operations. The environment that polyFORTH II creates is said to be suitable for such interactive, real-time computer-control applications as robotics, data acquisition, image processing, and process control.

Any number of asynchronous processes running concurrently are supported by polyFORTH II. A company spokesperson reports that polyFORTH II does not impose a cap on the amount of users supported, although this is subject to hardware constraints. Further, the spokesperson notes that polyFORTH operates at reasonable speeds, the rate of which is dependent on the number of processes running.

Tasks can be assigned private partitions, or they may execute shared, re-entrant routines. Active tasks require as little as 100 bytes of memory, and context switches need only 14 machine-language instructions. Several configurations of polyFORTH II, reflecting increased capabilities and support services, are available for MS-DOS computers. Level 3, which costs $600, includes the operating system, a FORTH turnkey compiler, assembler, editor, mathematics library, database support system, utilities, and source code for all but the nucleus.

Priced at $3200, polyFORTH II level 4 comes with all the capabilities of level 3 as well as full system source and the Target Compiler, which is capable of generating applications that can be embedded in ROM or re-compiling polyFORTH itself.

All polyFORTH II disks are compatible with MS-DOS, and its FORTH blocks are maintained in data files.

Contact FORTH Inc., 2309 Pacific Coast Highway, Hermosa Beach, CA 90254, (213) 372-8493.

Inquiry 610.

Methods for Smalltalk Programming

Methods for Smalltalk Programming

Methods is a Smalltalk program-development system for the IBM PC and compatibles running under DOS versions 2.0, 2.1, or 3.0. Fully compatible with Xerox's Smalltalk-80 language.

Methods includes nearly 100 classes, which are programming tools that define the structure and behavior of abstract data types such as integers and points.

Smalltalk, an extensible, object-oriented language, is suitable for simulation and graphical user interfaces. For a broader discussion of Smalltalk, see the August 1981 BYTE.

Methods gives you access to most of the source code from which it is built. It has more than 2000 routines, or methods, that you can browse through, put to use, or modify. Primitive methods can be implemented in assembly language.

The user interface features a character-mapped display, pop-up menus, and extensive use of color (monochrome displays are supported). Your cursor keypad is used as if it were a mouse. Methods also comes with a system transcript, file editor, and a window for debugging.

Methods requires 512K bytes of RAM and a pair of 360K-byte disk drives or a hard disk. Two manuals are supplied. The suggested price is $250. Contact Digital Inc., 5200 West Century Blvd., Los Angeles, CA 90045, (213) 645-1082.

Inquiry 611.

Peripheral Boosts the Mac's Versatility

Peripheral Boosts the Mac's Versatility

MacEnhancer from Microsoft lets you add three different peripherals to Apple's Macintosh. Requiring a single Macintosh RS-422 port, MacEnhancer gives you two RS-232C serial ports and a parallel printer interface.

MacEnhancer arrives with drivers for a number of popular dot-matrix and daisy-wheel printers and with terminal-emulation software for accessing information services and bulletin boards. Its list price is $249. For further information, contact Microsoft Corp., 10700 Northup Way, POB 97200, Bellevue, WA 98009. (206) 828-7400.

Inquiry 612.
Borland’s SideKick™
1984 Product of the Year *

The Critics’ Choice  What more can we say?

“SideKick™ stands in the shadows behind whatever program you are using, ready to jump forward when you need it. The program’s various functions use windows that overlay the display you are working with and restore the screen when you are through. The program contains a respectable word processor for note taking, a dialer that your smart modem can use with your phone list, a calculator for hexadecimal/binary/decimal arithmetic, an appointment calendar and an ASCII table for programmers . . . SideKick is a time-saving, work-saving, frustration-saving bargain. Having a programmer’s calculator, an appointment calendar, and a notepad at your beck and call, no matter what program is running, is the first big step to making the paper and pencil obsolete.”

—Dan Robinson
of InfoWorld

And he’s not the only one talking:

Charles Petzold, PC Magazine: “In a simple, beautiful implementation of WordStar™’s block copy commands, SideKick can transport all or any part of the display screen (even an area overlaid by the notepad display) to the notepad.”

Jerry Pournelle, BYTE: “If you use a PC get SideKick. You’ll soon become dependent on it.”

Garry Ray, PC Week: “SideKick deserves a place in every PC.”

---

The Telephone Autodialer/Directory places calls for you via your Hayes™-compatible modem and locates numbers from one of the program’s several directories. Here the dialer is running on top of WordStar.

The calendar can record appointments, records and notes—yours or those of the entire department—up to the year 2099. Here the dialer is running on top of Lotus.

The ASCII reference table, important enough to be in every manual, is now at your fingertips at all times. Here the screen shows all windows, including an ASCII table running over Lotus.
Eye strain 55%
Back pain 43%
Shoulder problems 25%
Headaches 30%
Neck pain 15%
Hand/wrist problems 18%
Computers can only perform as well as the people who use them.

The chart below is disturbing. It shows the kinds of problems computer users are having.

<table>
<thead>
<tr>
<th>Computer-induced Problem</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye strain</td>
<td>55%</td>
</tr>
<tr>
<td>Back pain</td>
<td>43%</td>
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<tr>
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<td>30%</td>
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<td>25%</td>
</tr>
<tr>
<td>Hand/wrist</td>
<td>18%</td>
</tr>
<tr>
<td>Neck pain</td>
<td>15%</td>
</tr>
</tbody>
</table>


Before you dismiss them as trivial, consider two things:
1. First, more than twenty states are now preparing legislation to protect computer users from problems like these.

And if someone with a headache or eyestrain is doing the telling, they're likely to make mistakes.

Quite clearly, it's in everyone's interest to solve the problem.

You are not a machine.
As you would expect, computers are designed by engineers. They usually know a lot about technology but very little about people. And even less about ergonomics. Which is why so many computers are technically impressive yet strangely unnatural to use.

Ericsson, in its very Swedish way, has always believed that excellent ergonomic design isn't a privilege. It's a right.

That it isn't just a noble gesture. That it's demonstrably good business. Because computers can perform only as well as the people who operate them.

It's an attitude that has made Ericsson No. 1 in Europe twice over: As the giant of European telecommunications. And as the biggest European workstation company by far.

(You couldn't ask for a better marriage of technology for the future.)

Here is one example of how Ericsson got there.

It's the first of a whole range of computers to be introduced in the U.S.A.

**The Ericsson P.C. It's Ergo-Intelligent.**
Ericsson has spent $300 million finding ways to make computers more ergonomically intelligent.

Here are some of the results.

**Ergo-Screen.**
Aspirin gets rid of a headache. Ergonomics gets rid of the cause.
The characters are amber on a specially developed low-fatigue background color.
Even the shape of the 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 text and graphics at the same time.

**Ergo-Arm.**
A computer is designed for the "average" person. The average person is 5'9". If you're not that height, the computer world has a simple answer.
It's your problem.
Ericsson disagrees. Your monitor comes with an Ergo-Arm that lets you move and angle your screen exactly where it suits you.
Far 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.

**Ergo-Space.**
The system unit is one-third smaller than IBM's. It even fits under your desk in a special vertical rack. So your desktop is your own again.

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, 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.
Conducted by Steve Ciarcia

SEARCH AND REPLACE

Dear Steve,

In the December 1983 BYTE, Donald Derksen requested advice in searching sermons for specific text. I am not certain that a program exists to do a word search over anything near 100 megabytes. I have several word processors, and each creates a temporary file, almost as long as the original file, when I try to bring it up. A 150K-byte sermon in this case will require a 300K-byte disk to access. To get WordStar to bring up a 150K-byte file, I go to lunch while it gets its stuff in order. If I accidentally ask for a global search, I go out and buy a case of beer.

If WordStar could handle a file in the megabyte range on a hard disk, presumably the best Mr. Derksen could get would be less than 50 megabytes on a 100-megabyte disk. Of course, since his workday comes only once a week, the system could grind away doing a global search. I bought my computer for the sole purpose of working my family tree, which is 200K bytes. Can you recommend any simple “find and replace” word processors for this job?

Marvin Konopik
APO San Francisco, CA

I compared the times to search and replace through a 120K-byte ASCII file produced with Volkswriter Deluxe using three different programs on the IBM PC. These were one-word “find and replace” operations, and the word occurred 63 times in the file. The file contained 2900 lines of text.

WordStar version 3.3, in the nondonum form mode, using the “QO” QA N command to repeat the find/replace without stopping, took 221 seconds. Using the “QA NG” to perform the same function took 206 seconds.

Volkswriter Deluxe can handle somewhat larger files, since it puts the temporary file on a different disk from the main file. Volkswriter took 112 seconds to perform the same operation on the same file.

The real speed demon of the three is Edlin, the line editor that comes with the IBM PC as one of the utilities included with PC-DOS. This program could handle only 1200 to 1300 lines at a time but performed the find/replace operation in about 10 seconds on each of three 1000-line segments. The whole operation of loading the file, replacing the strings, and saving the edited file could be done in about the time it takes WordStar or Volkswriter to save the edited file.

Edlin file size is limited by its requirement to make a backup on the same disk as the original file. It may handle larger files than WordStar but not 200K bytes as a single file on a 320K- or 360K-byte floppy disk.

The most efficient method of finding the lines containing a string is the DOS 21 Find Function. This function found and returned the line numbers and text of all 63 occurrences of the search string in 26 seconds, including time to read the Find program into memory. Unfortunately, no replace option is available.

Both WordStar and Volkswriter speeds were limited by the disk-access speed, since both programs keep only part of the file in memory and transfer the overflow to a temporary disk file. Volkswriter’s higher speed appears to be due to using a slightly more efficient method of using the temporary “spill file.”

ATARI AND COMMODORE

Dear Steve,

In Yugoslavia it is hard to obtain information about Atari and Commodore computers. I shall be very grateful if you could give me a few names and addresses of Atari owners in your country so I could exchange information.

I am also interested in names and addresses of firms selling software.

Robert Devcic
Zagreb, Yugoslavia

The Blue Book for the Atari Computer and The Blue Book for the Commodore Computer are two “where-to-find-it” books covering software, hardware, and accessories. These two books are available for $17.95 each from HEC Computerics Inc., 50 North Pascack Rd., Spring Valley, NY 10977.

The Toronto PET Users Group offers access to hundreds of public-domain programs and a monthly club magazine for the Commodore 64. Membership for 12 months is $30 overseas and $20 in the U.S. and Canada. A program and information catalog is available for $1 from Toronto PET Users Group, 1912A Avenue Rd., Suite 1, Toronto, Ontario M5M 4R1, Canada.

A number of magazines publish programs for the Commodore 64 and Atari computers. They are mostly hobbyist magazines with emphasis on entertainment and programming techniques. Seeing how someone else did it can be very helpful to one learning about computers, and, of course, contributions are welcome. Some of these magazines include: Analog 565 Main St. Worcester, MA 01611 Computel and Computel’s Gazette POB 5406 Greensboro, NC 27403 Run Subscription Dept. POB 954 Farmingdale, NY 11737

--Steve

ACOUSTIC MODEMS

Dear Steve,

I am the owner of an Atari 600XL home computer with a 1027 printer and the 410 recorder. Is there a way to use an acoustic modem without the aid of the Atari interface box?

Also, is there a way to erase programs stored on tape? Jon Paul Parker
Kansas City, MO

Most acoustic modems require a serial interface, such as that provided by the Atari 850. For disk users, the $49.95 R-Verter from Advanced Interface Devices Inc., POB 2188, Melbourne, FL 32902, can be used instead of the Atari 850 to connect most modems and RS-232C serial devices.

(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.
Interfacing a direct-connect modem is easier. Two units are available that plug into Joystick Port 2. The $149.95 MPP-1000C from Microbits Peripheral Products, 255 West Third St., Albany, OR 97321, is a direct-connect auto-dial/auto-answer modem that comes with Smart Terminal, a cartridge containing many features useful for uploading and downloading.

Volksmodem ($79.95 plus cable) from Anchor Automation, 6913 Valjean Ave., Van Nuys, CA 91406, is another product, but it does not offer the auto-dial/auto-answer capability.

Erasing a program stored on a cassette is accomplished the same way that an audio program is erased. Position the tape, then press Record and Play. Since nothing is being transmitted, blank information is recorded on the tape, effectively erasing it.—Steve

C64 RS-232C PORT

Dear Steve.

The Commodore 64 has a built-in serial interface, but it uses TTL (0–5V) signal levels instead of the ±12V levels needed by EIA-compliant modems. The C64 “USER PORT” is a 24-line male edge connector that brings out 9V AC as well as the TTL signals. It would seem fairly straightforward to rectify the 9V AC for EIA-level supplies and use a couple of RS-232C line driver/receivers like the MC1488 and MC1489 (Radio Shack parts 276-2520 and 276-2521) to make a true RS-232C modem interface.

PETER F. KLAMMER
Golden, CO

If you could inform me of any program that can accomplish this task, I would be most grateful.

CHRISTIAN DREIY
Vestal, NY

Converting the instructions of one microprocessor to another requires an emulator program. Such programs must not only convert machine-language instructions but must translate the addresses of any ROM routines that are used. They must, therefore, be machinespecific. I am not aware of such a program to convert from Z80 code to 8088 code.

Hardware implementations are more popular. Auxiliary processor boards are available to run programs written for other microprocessors. Two such boards are:

Big Blue ($595) from Quality Computer Services 3 Quises Dr. Metuchen, NJ 08840 (201) 548-2135

Baby Blue CPU Plus ($600) from Microlog Inc. 222 Rt. 59 Suffern, NY 10901 (914) 368-0353

Both units feature a Z80 processor and will allow CP/M-80 programs to be run on an IBM PC.—Steve

RAM FOR ROM

Dear Steve.

I bought a four-function bare board for my Apple II that provides two serial and two parallel ports. The board comes with a rudimentary communications program and no program that I can use with my serial printer. My problem is that I need a method to develop and debug software before burning it into a 2716 EPROM that will reside on board.

Recently, I saw an article that said that the 6116 is pin-compatible with the 2716. Can the 6116 RAM be used as a direct replacement for the 2716 EPROM, or is a modification required? I have in mind a modification that California Computer Systems provides on its 7710A asynchronous serial card. On that card, the firmware is on two 256 by 4-bit ROMs. Quoting from the documentation, the ROMs are equipped with a power-down feature like the 83048. Should you desire to develop your own software, you may substitute

(continued)
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**ASK BYTE**

RAMs (2112s) for the ROMs. If you do so, the memory power-down feature must be disabled and the R/W line enabled to the RAMs. One jumper wire will do this! I have used this card with RAMs and found it very flexible. As I have both my printer and communication drivers on disk, I can easily download whatever is needed. But as I expect to do more communications, I would prefer to have both residing in memory. The new card gives me this capability.

If the direct replacement is unworkable, I would appreciate you outlining the modification that would provide me with a pseudo emulator.

**BASIL JOHNSON**
Ottawa, Ontario, Canada

Although I know of no commercially available EPROM emulators for the Apple II, a few articles have been published on how to build your own. One recent one appeared in the November 1983 issue of inCider magazine. “Apple EPROM Emulator” by Douglass Ortmann describes the construction of an emulator using 2K bytes of RAM to simulate a 2716 EPROM.

Another source for instructions on making your own EPROM emulator is the book “The Custom Apple & Other Mysteries” by Hofacker & Fleoel, published by IJC Inc., 1953 West 11th St., Upland, CA 91786. This book is currently available in many bookstores and retails for $24.95. Chapter 5 consists of directions for building an EPROM/RAM board with four banks of 2K bytes each. A combination of 2716s or EPROM-compatible RAMs (e.g., 6116s) may be used. Instructions are also given for the necessary jumpers when using RAMs.—Steve

**COMPUTIZED HOME**

Dear Steve,

Even though your articles in BYTE are somewhat above me, I find them intriguing. My data-processing knowledge makes the software concepts understandable, but my engineering and electrical background is lacking.

I am in the process of designing a ranch house and would like to wire the house for as much computer control as possible. Is it to my advantage to wire the house, or should I look toward a BSR-controlled house? If you suggest wiring, what type of wire is needed? I currently do not own a computer but plan on purchasing one after the house is complete. Any help that

(continued)
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- BBS STARS IN CALIFORNIA—KAY•FOG, affiliated with the First Osborne Group (FOG) of Daly City, California, is a 24-hour remote bulletin-board service (RBBS) and RCP/M with 16 megabytes of hard-disk storage area for public-domain software. Because there are no access charges, it is open to the general public. FOG members can register online; nonmembers register through the mail. To contact the KAY•FOG sysop, call Bond Shands at (415) 285-2678. For details about FOG, contact the First Osborne Group, POB 3474, Daly City, CA 94015, (415) 755-4140.

- MPX-16 USERS NEWSLETTER—Owners of the Micromint MPX-16 single-board computer have formed a newsletter to share solutions to problems. It is produced every other month and has an annual subscription fee of $5 ($10 overseas). Send a self-addressed, stamped envelope to Michael Bamberg, 1059 Northwest Darnelle St., Hillsboro, OR 97124, or call (503) 640-5926 in the evening.

- COMMODORES IN BCS
  Members of the Boston Computer Society's (BCS) Commodore Users Group meet regularly to witness demonstrations and produce Sprite, a bimonthly newsletter. It contains reviews, group news, and articles. Subscription is free with membership in BCS. Contact Jocelyn LeFond, Commodore Users Group, Boston Computer Society, One Center Plaza, Boston, MA 02108. (617) 367-8080.

- THE QUICK BROWN BOX
  The Southern California Digital Group Computer Society meets at 1 p.m. on the second Saturday of even-numbered months in the Los Angeles metropolitan area. The $7.50 annual dues cover the costs of producing and mailing a newsletter that features club news and items of interest for users of Digital Group computers. Contact Paul Bernstein, Apt. 2102 B, 333 East Ontario St., Chicago, IL 60611, (312) 762-8400.

- APPLE CART IS FIVE
  The Apple Cart Special Interest Group of American Mensa, now in its fifth year, produces a bimonthly newsletter about Apple II and Macintosh computers and operates a software exchange. Members of Mensa, the American branch of the international high-IQ society, pay $6 in annual dues; all others pay $8. Send a self-addressed, stamped envelope to C. Brandon Gresham Jr., The Apple Cart, Bin "R"—Project 58101, Pasadena, CA 91109.

- FOR LAWYERS AND VENDORS—The Lawyers Microcomputer Users Group, LAW MUG, holds monthly meetings, runs a BBS at (312) 280-8180, and produces a monthly newsletter. Vendors are invited to join. Annual dues are $50, plus a one-time sign-up fee of $75. The $125 fee includes an annual newsletter subscription. Contact Paul Bernstein, Apt. 2102 B, 333 East Ontario St., Chicago, IL 60611, (312) 782-8400.

- BRIDGE THE GAP
  The Fifth Generation Group is a forum for discussions, projects, and presentations of fifth-generation computer systems. Members meet in the Silicon Valley. Contact Kingsley Morse Jr., Fifth Generation Group, 1930 Park Ave. #12, San Jose, CA 95126, (408) 296-3316.

- SANYO IN CO
  The Sanyo Computer Club of Colorado Springs, Colorado, meets on the second Monday of every month. The members produce a monthly newsletter, and membership is open to everyone. Annual dues are $15. Contact Don Ruokonen, 11930 Northcliff Rd., Elbert, CO 80106, (303) 495-3815, or Norman Martell, 6651 Metropolitan St., Waukegan, CO 80911, (303) 992-9826.

- INVITE THE CHAMPION
  The Champion Users Group has special utilities and individually written routines that can be used in conjunction with Champion, the compiled version of the accounting program written in dBASE II. Contact with other licensed users across the country is welcome. A subscription to the bimonthly newsletter is included with the $33 annual membership fee. Contact Jerry Schwartz, 2054 Webster, Redondo Beach, CA 90276, (213) 316-4406.

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- NEWS AT HAND

The Pocket Computer Newsletter contains reports on pocket and notebook-size computers, including Sharp, Radio Shack, Casio, Epson, Hewlett-Packard, and others. Products are presented in hardware and software reviews. The newsletter also contains operating tips, practical programs, and technical information. For details, write the Pocket Computer Newsletter, P.O. Box 232, Seymour, CT 06483.

- ELECTRICAL UPDATES

The Electrical Industry Computer Users Group (EICUG) addresses the changes in the electrical industry caused by microcomputers. Members are connected with New York City's electrical construction field and are currently researching training programs for workers seeking further expertise. Original equipment manufacturers (OEMs) of industry-related devices and other interested parties can contact Michael Higgins via MCI Mail; on CompuServe at 73333,1545 or at EICUG, Suite 3F, 69-16 14th St., Flushing, NY 11365.

- RAINBOW IN PHILADELPHIA

The Delaware Valley DEC Personal Computer User Group News is a newsletter produced one numbered month in the first Wednesday of odd-numbered months in the Hewlett-Packard Sales Office (2 Choke Cherry Rd., Rockville, MD 20850). Members exchange ideas and information and witness presentations. For more information, call Bruce Baxter at (202) 566-3252.

- DESKTOPPERS ORGANIZE

The Hewlett-Packard Desktop Users Group (for 9825, 9830, 9835-9845, 9000 Series 200 and 500, or Series 80) is an organization serving users of a variety of personal computers ranging from handhelds to multiusers. It meets the first Wednesday of odd-numbered months in the Hewlett-Packard Sales Office (2 Choke Cherry Rd., Rockville, MD 20850). Members exchange ideas and information and witness presentations. For more information, call Bruce Baxter at (202) 566-3252.

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The Pocket Computer Newsletter contains reports on pocket and notebook-size computers, including Sharp, Radio Shack, Casio, Epson, Hewlett-Packard, and others. Products are presented in hardware and software reviews. The newsletter also contains operating tips, practical programs, and technical information. For details, write the Pocket Computer Newsletter, P.O. Box 232, Seymour, CT 06483.

- ELECTRICAL UPDATES

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UNIX PRIMER PLUS
The Waite Group
Howard W. Sams & Co.
Indianapolis, IN: 1983
414 pages, $19.95

THE BUSINESS GUIDE TO THE UNIX SYSTEM
Jean L. Yates and Sandra Emerson
Addison-Wesley
Reading, MA: 1984
474 pages, $19.95

UNDERSTANDING UNIX: A CONCEPTUAL GUIDE
Paul Weinberg and James R. Groff
Que Corporation
Indianapolis, IN: 1983
240 pages, $17.95

Reviewed by
Irene Pasternack

UNIX books fall into two basic categories: conceptual guides and texts designed to teach you how to use a UNIX system. This review covers one conceptual guide and five books designed to walk you through UNIX. The tutorials cover every level, from computer novice to experienced programmer and UNIX user. I've reviewed the books in rough order of level of difficulty, with the most introductory first and the ones designed for programmers last.

UNIX PRIMER PLUS

UNIX Primer Plus, produced by the Waite Group, is a delightful introduction for new computer users, hobbyists, or anyone who wants to enjoy the process of learning UNIX. It is funny, informal, accurate, and a pleasure to read. The illustrations are excellent, and cartoons are used to make important points. Each chapter ends with review questions and exercises to do at a terminal; these exercises give you a chance to try out commands discussed in the chapter. The authors offer friendly reassurances that you can't hurt the system by exploring it or trying new commands.

The book is designed for users of Berkeley UNIX. It is also useful to people using ports, such as UNIPLUS and XENIX, that have some of the Berkeley enhancements. Commands unique to Berkeley UNIX are marked as such, so a System III or V user could use most of the book. This introductory text is not comprehensive; it covers less than a third of the commands available to the regular UNIX user. This is a real advantage in a beginning-level tutorial; the reader can actually use 50 to 60 commands when he is through. Each command is presented from the perspective of why the user would want to use the command. The authors take nothing for granted, yet they are not condescending.

While reading the book, I had the feeling that a naive user had studied it early in the manuscript stage and had marked all the places that seemed confusing; the authors...
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BOOK REVIEWS

My one complaint to the authors is about their use of commands from different versions of UNIX without adequate explanation. For example, more, a command that displays the contents of a file in chunks, a full screen at a time, is taught early in the hands-on section. A Berkeley enhancement, more is not available on all systems. The writers don't mention that this and other commands might not be on the system the reader is using.

The appendixes reflect the introductory nature of the book. They include a glossary of computer terms and an incomplete directory of vendors and training companies. As there is no command summary, it would be useful to have a manual or pocket reference handy while working through the exercises.

I have recommended The Business Guide to several clients. They have all been quite satisfied with its practical and thorough tutorial approach. I would suggest using this book in conjunction with a manual or one of the more comprehensive introductions.

UNDERSTANDING UNIX: A CONCEPTUAL GUIDE

A clear guide to the capabilities of UNIX and its place in the larger picture of computers. Understanding UNIX is not a tutorial, and it is not designed to be read while you are using a terminal. The writers, Paul Weinberg and James R. Groff, make no assumptions that readers know anything about UNIX, but they apparently expect readers to have some understanding of computer terminology. They provide the technical and marketing perspective useful to someone wanting an overview.

I recently taught a class called "UNIX for Managers," and I wish I had had this book to hand out. Unlike Kaare Christiaan's The UNIX Operating System (New York: John Wiley and Sons, 1983; see the review in the July 1984 BYTE, page 82), Understanding UNIX is designed for the business user.

In all their examples, Weinberg and Groff use business-related files and include excellent presentations of turnkey processing and office support. Each chapter begins with a one-page summary, making it feasible for the reader to skim and pick out only what is relevant. Sections for more advanced readers are marked as such. Examples and commands are taken from System V UNIX, and the descriptions of some new features, such as shared memory and semaphores, are excellent.

The authors begin with the typical coverage of perspective, structural overview, file system, and the shell. In the next chapter they cover the functions and commands of multiprocess operation. Chapter 7 presents the only information on turnkey processing with UNIX I have seen. For a prospective business user, or an applications programmer unfamiliar with UNIX, this section explains the strong and weak points of UNIX, including process management, file sharing and locking, memory management, and building a turnkey application.

(continued)
File-processing utilities are well organized by function; clear pictures illustrate the concepts of processing tabular data. In the section on text processing, Weinberg and Groff introduce the capabilities of various utilities and editors, providing short examples of the commands necessary in each one to produce reasonable output.

A chapter on software development includes sections on the capabilities of the C language, the tool approach, libraries, the Source Code Control System, and cross-development. The book explains communications facilities of System V.

Parts of this book will rapidly become dated. The section on the future of UNIX is amazingly up to date—about as current as the major magazine articles. Projections about AT&T's ability to become an effective computer distributor and supporter and IBM's UNIX plans should turn into clear reality in the next year or two.

My one frustration with this book is the authors' failure to clearly explain that the utilities they cover are from UNIX System V. Someone not knowing UNIX would expect all versions to have the commands they explain, and many are new to System V. Though the various versions are explained in the first chapter, the commands should have been marked, and the differences between the versions should have been made clear.

If your goal is to understand UNIX, and you either don't have a system or don't want to learn the details, I would recommend Understanding UNIX over all the tutorials. It is well written and comprehensive, and it provides a needed perspective.

**A PRACTICAL GUIDE TO THE UNIX SYSTEM**

Mark G. Sobell's *A Practical Guide to the UNIX System* is a book for newcomers to UNIX. It helps to have had some exposure to computers, and for several chapters some familiarity with the tasks of programming is useful. Sobell does not take much for granted here: he devotes a whole page to the concepts of filled and justified lines in word processing. To go in 428 pages from this level through programming the Bourne shell and using the complex variable arrays possible in C-shell is a challenge the author meets well.

Sobell presents concepts and utilities in a logical order that matches the likely questions of a newcomer to UNIX. Concepts are nicely illustrated, and there are a lot of charts in this book. Sobell provides enough of the "why" for each topic so that the "how" makes sense.

A *Practical Guide* begins with a short overview of UNIX system features that stresses the "whys" from the user's point of view. Sobell next presents ed so that the user can create files to work with. He discusses file structures and the shell as command interpreter and covers word processing with vi and nroff, the visual editor and text formatter. The chapter on vi is comprehensive and clear.

(continued)
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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.

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BOOK REVIEWS

Learning UNIX is a challenge. The manuals that come with each system provide some information on each command, but they provide little on how everything fits together and less on how to extend the commands into your own personal toolkit. Two books now available, Stephen R. Bourne's *The UNIX System* and Brian W. Kernighan and Robert Pike's *The UNIX Programming Environment*, fill these gaps for people who know something about the C language, computers, and UNIX.

Both books were written by original authors of Bell Laboratories UNIX. They cover Version 7, System III, and System V rather than the Berkeley flavors of UNIX. Neither book says very much about applications. Both are directed at the person who really wants to use the tools built into UNIX. I would not give either book to a complete newcomer to UNIX or to someone who likes his hand held as he learns.

The books cover basically the same topics: fundamentals, file system, the shell, utilities, editing, C. system programming, document preparation, and data manipulation. Bourne's book features better appendices listing all the commands discussed (with options), system calls, C subroutines, ed, vi, sh, troff, and editing macros.

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BOOK REVIEWS

BOOK REVIEWS

terse, with no exercises and short examples. I use Bourne’s
text when I am stuck: it is slightly less terse than manuals,
yet I can find what I’m looking for.

Kernighan and Pike write in a friendlier style: their many
eamples build on each other. topics are prefaced with
an explanation of why they are useful. and the exercises
are nicely graded from easy to quite difficult. While
reading this book. I kept going to the computer to try out
new ways of combining utilities and making my own shell
scripts. The UNIX Programming Environment is an excellent
learning guide due to its content and. more important,
because of how well the writers convey the philosophy
of UNIX and the process of developing new tools.

THE UNIX PROGRAMMING ENVIRONMENT

A book with a title like this one has one major job to
do: communicate the philosophy and power of using
UNIX tools by teaching the skills necessary to use them.
Kernighan and Pike’s book does an excellent job. I came
away from reading and doing the exercises feeling em­
powered to create my own tools through a more in­
novative use of existing ones. Before. the gap between

my level of expertise and what I imagined it would take
to make modifications beyond aliases and simple shell
scripts seemed too big to bridge. But I got a clear picture
of how UNIX came to be the set of tools it is and how
simple many standard UNIX tools are.

The authors discuss the capabilities of UNIX that make
it such a fine programming environment. Differences be­t­
 tween UNIX versions are handled clearly: Kernighan and
Pike have tried to stick with features and utilities common
to all versions but indicate when they do not. It is a book
to use and practice with. not one to read casually. unless
you are already an experienced C and shell programmer.
The exercises go from easy to very hard and are designed
to make you think. No answers are provided.

The “UNIX for Beginners” section (read “Beginners” as
UNIX beginners but experienced programmers) is not
meant to be comprehensive. However. it does pick up on
common confusions (such as identifying the two mean­
ings for f) and refers readers to other introductory sources.

However. without more editing skills than the book
teaches. the exercises are impossible. In the first chapter.
the authors discuss enough about ed to enable you to
enter a short file. but they mention nothing about editing
a file or adding or changing text. The authors comment.
"By all means. use whatever editor you like best” (and
learn it somewhere else). The two chapters on using the
shell and filters stress making usable. personal. small pro­
grams. such as phone and mail lists. Information on
creating more usable programs comes later.

Kernighan and Pike discuss frequently used filters: pro­
grams that read input. perform a transformation. and write
the results as output. Theirs is the only presentation of
awk I’ve seen that includes a clear description of arrays
and associative arrays.

For their discussion on the tools available for develop­
ing programs. the authors chose to develop a language
interpreter as their sample large program. Yacc. make.
and lex are included. Chapter 9 covers document prepara­
tion. After a short presentation of the macros mm and
ms. which hide the naked troff. the authors demonstrate
how to actually use troff.

Kernighan and Pike present all programs in the way pro­
grams are actually written. Rather than list a finished
debugged version. they start out with an idea and a sim­
p1e outline. play with it a bit to find the bugs. then either
fix them or suggest fixes as exercises.

The UNIX Programming Environment is meant to become
a classic. It is not comprehensive—no 350-page tutorial
could be. But it is accurate. and it does the best job of
stimulating creative use of UNIX of any book I’ve seen.

THE UNIX SYSTEM

S

 tephen R. Bourne’s The UNIX System is terse and com­
prehensive. It has been around since 1982. and I have

(continued)
What C did for Programming
Mark Williams has done for C Programming

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:

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<tr>
<th>Library</th>
<th>Company</th>
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<td>Briefe</td>
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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.
Super assemblers plus the world's largest selection of cross assemblers!

Z-80 Macroassembler
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
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
Instant Z-8000 Software! This package allows development and conversion of software for the Z8001, 8002, 803 and 8004 based machines on a Z-80, Z-8000 or 8086 machine. This powerful package includes:
• a Z-80/8080 to Z-8000 Assembly Language Source Code Translator
• Z-8000 Macro Cross Assembler and Linker
The Translators provide Z-8000 source code from Intel 8080 or Zilog Z-80 source code. The Z-8000 source code used by these packages are the unique 2500AD syntax using Zilog mnemonics, designed to make the transition from Z-80 code writing to Z-8000 easy.

All 2500 AD Assemblers and Cross Assemblers support the following features:

Relocatable Code — the packages include a versatile Linker that will link up to 128 files together, or just be used for external reference resolution. Supports separate Code and Data space. The Linker allows Submit Mode or Command Invocation.

Large File Handling Capacity — the Assembler will process files as large as the disk storage device. All buffers including the symbol table buffer overflow to disk.

Powerful Macro Section — handles string comparisons during parameter substitutions. Recursion and nesting limited only by the amount of disk storage available.

Conditional Assembly — allows up to 248 levels of nesting.

Assembly Time Calculator — will perform calculations with up to 16 pending operands, using 16 or 32 Bit arithmetic (32 Bit only for 16 Bit products). The algebraic hierarchy may be changed through the use of parentheses.

Include files supported — Listing Control — allows listing of sections on the program with convenient assembly error detection overrides, along with assembly run time commands that may be used to dynamically change the listing mode during assembly.

Hex File Converter, included — for those who have special requirements, and need to generate object code in this format.

Cross reference table generated — Plain English Error Messages —

System requirements for all programs: Z-80 CP/M 2.2 System with 54k TPA and at least a 96 column printer is recommended. Or 8086/88 256k CP/M-86 or MSDOS (PCDOS).

Cross Assembler Special Features
Z-8 — User defined registers names, standard Zilog and Z-80 style support. Tec Hex output option.
8748 — standard Intel and Z-80 style syntax supported.
8051 — 512 User defined register or addressable bit names.
6800 Family — absolute or relocatable modes, all addressing modes supported. Motorola syntax compatible. Intel Hex or S-Record format output.
6502 — Standard syntax or Z-80 type syntax supported, all addressing modes supported.
<table>
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<tr>
<th>Product Description</th>
<th>Z8000™ CP/M®</th>
<th>ZILOG SYSTEM 8000 UNIX</th>
<th>IBM PC MSDOS</th>
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Subtotal $_______ $_______ $_______ $_______ $_______

Name ____________________________
Company ____________________________
Address ____________________________
City _______ State ______ Zip _______
Phone ____________________________
Make and model of computer system ____________________________
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□ VISA or MasterCard
Number ___________________
Expiration Date ____________________

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BOOK REVIEWS

referred to it since then when I can’t figure something out. Usually I go to the manual first, then to Bourne’s book, then, as a last resort, to a guru. For my first six months of learning UNIX, most of Bourne’s text was totally incomprehensible.

The file system commands, the shell, pipes and filters, file-name generation, quoting, communications, commands, system inquiries, and 11 useful commands (including grep, sity, od, and find) are presented in 16 pages. I warned you that Bourne tends to be terse. The first chapter ends with a brief review listing the 13 most important commands taught. It is the only time the author repeats anything.

In the second chapter, Bourne covers editing with both ed and vi. Examples are short and to the point. He explains the full range of commands, and he presents vi commands in lists. This is the only place I found minor errors. vi enables the user to map commands to any character or function key. Bourne suggests using unused keys in vi to make these maps. However, I use three of these keys frequently: the comma, the semicolon, and the underscore.

Bourne covers the Bourne shell as a programming language. The chapter on C is actually about C rather than using C with UNIX. The author covers lexical considerations, expressions, operators, control flow, functions, arrays and pointers, structures, and unions, as well as the UNIX-specific C preprocessor, the library, and management commands. Again, don’t try to learn C from this chapter: it best serves as a reference. Chapter 6 describes the C interface to UNIX. Topics include creating and removing files, creating processes, handling interrupts, sending signals, and the use of pipes.

Bourne emphasizes document preparation, giving it a full 40 pages. He presents nroff and troff first, and includes descriptions and examples of creating your own macros. He does not discuss the popular formatting packages, such as me or mm, but he summarizes ms in an appendix. This is the only book I’ve seen that explains how to create your own macros.

In the last chapter, Bourne covers data-manipulation tools. His emphasis is on using these tools to build new ones: he also emphasizes using the shell to combine tools. The examples tie together the material from several chapters.

The most useful parts of Bourne’s book are the detailed appendices. The index is good, and it is helpful to see the troff macro that produced it. The UNIX System, alone among the UNIX books because it can be used without a user’s manual, will serve as an invaluable reference for years. Just be prepared to read every sentence five times to determine its meaning.

Irene Pasternack is the director of Specialized Systems Consultants (POB 7, Northgate Station, Seattle, WA 98125-0007). She teaches seminars on UNIX and is chairman of the Seattle UNIX User Group’s board.
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**DESIGN SHOW**
The 1985 National Design Engineering Show, McCormick Place, Chicago, IL. More than 600 CAD/CAM system and electronic component companies will exhibit products. Contact the Show Manager, National Design Engineering Show, 999 Summer St., Stamford, CT 06905, (203) 964-0000. March 11-14

**CAD COURSE**
Computer-aided Drafting and Design (CADD), Mechanical Engineering Graphics Lab, University of Texas, Austin. A short course for those who wish to work on CADD systems using only systems manuals. Hands-on practice with IBM CADAM and HP/Holquin systems. Contact College of Engineering, University of Texas, Austin, TX 78712, (512) 471-3506. March 11-15

**DATA COMM FROM ALL ANGLES**—Data Communications: Technology, Techniques, and Applications. Tarrytown Hilton, Tarrytown, NY. This seminar covers existing and emerging technologies and data compression techniques and applications. The fee is $150. Contact Glasgail Communications Inc., 207 Washington St., Northvale, NJ 07647, (201) 768-8082. March 12

**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

**HUSKER FAIR**
The Eleventh Annual Computer Fair, University of Washington, Seattle. More than 100 vendors will exhibit. Seminars and exhibits are free. Contact Dr. Thomas Bennett, Academic Computing Center, University of Washington, 3737 Brooklyn Ave. NE, Seattle, WA 98105, (206) 543-5728. March 13-14

**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, Bay Harbor Inn, Tampa, FL. For information, contact Alexander Kran, IBM Corp., East Fishkill Facility, B300-40E, Hopewell Junction, NY 12533, (914) 894-7142. March 13-15

**PERSONNEL SYSTEMS SEMINAR—HRSP 101**

**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 $490. Contact Dr. Linda Lefler, 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 Fair, Delaware State College, Dover. Current technology for school, 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

**EXPOSING THE MYTH OF MICRO-**

ness Seminars, Hyatt Regency, Los Angeles, CA. A seminar that shows nontechnical businesspeople how a microcomputer could be used to increase productivity. Contact International Microcomputer Industries Association, Suite 175, 21 Tamal Vista Blvd., Corte Madera, CA 94925, (415) 924-1194. March 18-19

**WAYS TO USE MICRO IN SCHOOL**—Instructional Strategies for Integrating the Microcomputer into the Classroom. University of Wisconsin, Madison. Hands-on sessions. Contact Dr. Judith Rodenstein or Dr. Roger Lambert, 964 Educational Sciences Building, University of Wisconsin, 1025 West Johnson St., Madison, WI 53706, (608) 263-4367 or (608) 263-2704. March 18-19

**COMPUTER, TELECOMMUNICATIONS CONFERENCE—COMTEL '85**—International Computer and Telecommunications Conference, Informart, Dallas, TX. For information, contact COMTEL '85, Suite 600, 13740 Midway Rd., Dallas, TX 75244, (214) 458-7011. March 18-20

**TECHNOLOGY AND EDUCATION**—The First Annual Conference on Technologies in Education, University of Arizona, Tucson. This conference will focus on the effective implementation of research in educational technology. Contact Steve Louie, NACCIS, Suite 125, 2200 East River Rd., Tucson, AZ 85718, (602) 323-6144. March 18-20

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These assemblers are available to handle the 8748, 8761, 8762, 6502, 65X and other microprocessors. The fee is $795 for MSPS/MDSDS computers. When ordering, please specify processor and computer type.

ACCESSORIES

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EVENT QUEUE

- **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 28–29

- **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 91789. March 28–29

- **WEST COAST FAIRE** The Tenth Annual West Coast Computer Faire. Moscone Center, San Francisco, CA. This is one of the largest computers shows. Contact Computer Faire Inc., Suite 201, 181 Wills Ave., Newton Falls, MA 02159, (800) 826-2680; In Massachusetts, (617) 965-8350. March 31–April 2

- **COMPUTERFEST** The 1985 Greater Baltimore Hamboree and Computerfest, Maryland State Fairgrounds, Timonium. Exhibits, flea markets, 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 21003-0093, (301) 561-1282. March 31

- **FOCUS ON SOFTWARE** Softcon, Georgia World Congress Center, Atlanta. The Spring and Fall Softcons have been merged into this event. Nearly 3000 software vendors are expected to participate. More than 200 seminars, panel discussions, forums, and workshops are planned. Registration is $35 for exhibitors-only admission or $195 for a four-day conference and exhibits badge. For more information, contact Softcon, northeast Expositions, 822 Boylston St., Chestnut Hill, MA 02167, (617) 739-2000. March 31–April 3


- **MICROPROCESSOR IDEA EXCHANGE—The 1985 IEEE Microprocessor Forum. Bally's Park Place Casino Hotel, Atlantic City, NJ. Tutorials, forums, and exhibits will be held. A contest challenging robots to navigate a complicated maze in the fastest time will be held. Contact IEEE Computer Society, POB 639, Silver Spring, MD 20901, (301) 589-8142. March 31–April 4

April 1985

- **GULF COAST SHOW** The Second Annual Gulf Computer & Office Show, Rivergate Convention Center, New Orleans, LA. Seminars, workshops, and product displays. Contact Gulf Computer & Office Show Management, c/o 119 Avant Garde, Kenner, LA 70065, (504) 467-9949. April 2–4

(continued)

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Inquiry 359
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Jeff DuBraven, PC Magazine: “Language deal of the century... Turbo Pascal: It introduces a new programming environment and runs like magic.”

Dave Garland, Popular Computing: “Most Pascal compilers barely fit on a disk, but Turbo Pascal packs an editor, compiler, linker and run-time library into just 29K bytes of random-access memory.”

Jerry Pournelle, BYTE: “What I think the computer industry is headed for: well-documented, standard, plenty of good features, and a reasonable price.”

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From Start to Finish In 300 pages. Turbo Tutor is for everyone, from novice to expert. Even if you've never programmed before, Turbo Tutor will get you started right away. If you already have some experience with Pascal or another programming language, Turbo Tutor will take you step by step through topics like data structures and pointers. If you're an expert, you'll love the sections detailing subjects such as “how to use assembly language routines with your Turbo Pascal programs.”

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Event Queue

- OFFICE, DP EQUIPMENT CeBIT '85, Hannover, West Germany. More than 1300 exhibitors from more than 25 countries will display office equipment and data-processing technology. Held in conjunction with the Hannover Fair. Contact Marilyn Hughes, Trenton State College, Hillwood Lakes ON 550, Trenton, NJ 08625, (609) 771-2487. April 20-21

- COMPUTER FESTIVAL The Tenth Annual Trenton Computer Festival, Trenton State College, Trenton, NJ. Talks, tutorials, user-group activities, exhibits, computer graphics theater, games, and a 50-acre outdoor electronics flea market are some of the highlights of this annual event. Contact Ms. Marilyn Hughes, Trenton State College, Hillwood Lakes ON 550, Trenton, NJ 08625, (609) 771-2487. April 20-21

- EDUCATIONAL AIDS AEDS/ECO '85: The Twenty-Third Annual Convention of the Association for Educational Data Systems (AEDS), Hilton Harbour Castle, Toronto, Ontario. A forum for educators. The theme is "Computing Knows No Borders." Co-hosted by the Educational Computing Organization of Ontario (ECO). Contact AEDS/ECO '85, c/o AISE, 252 Place, Boston, MA. Diagnostic and test instruments will be among the products displayed. Contact Louise Myerow, CWC/Conference Management Group, 375 Cochituate Rd., POB 880, Framingham, MA 01701, (800) 225-4658, in Massachusetts. (617) 879-0700. April 18-19
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Bloor St. W. Toronto, Ontario M5S 1V6, Canada. in the United States, 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 exhibitors will focus on voice synthesis and recognition. Registration is $195. Contact Media Dimensions Inc., POB 1121 Grace Station, New York, NY 10028. (212) 772-7068 or (212) 680-6451. April 22–24

- PUBLIC NETWORK OPERATIONS—X.25 and Packet Switching Networks, Atlanta, GA. This course covers the internal operation of a packet-switching network and its implementation. International standards are also covered. The fee is $795. Contact Elaine Had- den Nicholas, Department of Continuing Education, Georgia Institute of Technology, ATLANTA, GA 30332-0385. (404) 894-2547. April 23–25

- TRADE SHOW CONFERENCE—Electro'85 and Mini/Micro Northeast-85, New York City. Areas to be covered include artificial intelligence, communications and networks, high-density data storage, and personal computing. Contact Electronic Conventions Management, 8110 Airport Blvd., Los Angeles, CA 90045, (213) 772-2965. April 23–25

- COMPUTER APPLICATIONS EXPLORED
PERSCOMP '85, Sofia, Bulgaria. A 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, 113 Sofia, Acad. G. Bonchev St., Bl. 12, Bulgaria; tel: 72-46-98, Tele: 22836. ITRK BG. April 23–26

- MICRO IN EMPIRE

- VIRGINIA COMPUTING

- EQUIPMENT SALE

- INTRO TO UNIX
Introduction to the UNIX System, Atlanta, GA. The pros and cons of UNIX will be covered. Contact Digital Consulting Associates Inc., 6 Windsor St., Andover, MA 01810, (617) 470-3870. April 29–30

- 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) 993-5241. April 29–May 3
COMMERCIAL AI, HIGH-TECH CONFERENCE—AI '85: Artificial Intelligence and Advanced Computer Technology Conference/Exhibition, Convention Center, Long Beach, CA. More than 20 technical sessions as well as panel discussions and product displays are planned. Contact Tower Conference Management Co., 331 West Wesley St., Wheaton, IL 60187. [312] 668-8100. April 30–May 2

MEETING ON LINE National Online Meeting, Sheraton Centre Hotel, New York City. On the docket are 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) 654-6266. April 30–May 2


NETWORK SCHEMES Local Area Networks, Atlanta, GA. This course covers the many approaches on which local-area networks are based. Fee: $795. Contact Elaine Hadden Nicholas, Georgia Institute of Technology, Atlanta, GA 30332-0385, (404) 894-2547. May 7–9

PC DISPLAYS PC Expo, Convention Centre, Montreal, Quebec, Canada. Contact PC Expo, 20 Butterick Rd., Toronto, Ontario MB 328, Canada, (416) 252-7791. May 8–10

MEDICAL GRAPHICS Computer Graphics in Medicine and Surgery, Virginia Mason Medical Center, Seattle, WA. Contact Linda Orgel, Virginia Mason Medical Center, 1100 9th Ave., Seattle, WA 98111. (206) 223-6898. May 10

GRAPHICS FOR ENGINEERING, DRAFTING Computer Graphics for Engineering/Drafting Practice and Computer Graphics Workshop, University of Texas, Austin. These short courses stress learning the principles of computer graphics and seek to develop the ability to prescribe computer graphics equipment for engineering applications. Contact Col-

May 1985

8086 CPU

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- TEST, MEASUREMENT
  - EXPO 1985 Test and Measurement World Expo, Convention Center, San Jose, CA. Conferences and exhibits. Contact Meg Bowen, Test and Measurement World Expo, 215 Brighton Ave., Boston, MA 02134, (617) 254-1445, May 14-16

- MODULA-2 ENGINEERING
  - Software Engineering with Modula-2, Atlanta, GA. See April 3-5 for details. May 15-17

- OK SHOW
  - The Eighth Annual Show & Tell Microcomputer Conference, University of Oklahoma, Norman. Microcomputer fans of all ages and levels of expertise come together to share ideas and demonstrate applications and hardware. Contact Richard V. Andree, Show & Tell Computer Conference, Mathematics Department, University of Oklahoma, 601 Elm, Norman, OK 73019, May 18

- COMPUTERS AND MEDICINE

- COMPUTER GRAPHICS

- SOFTWARE AND HUMAN DEVELOPMENT
  - Computer Software and Human Development Conference, Royal York Hotel, Toronto, Ontario, Canada. Held in conjunction with the Third Annual Software Panorama, this conference will examine the impact of software development on business, education, health, and agriculture. Contact Reuben Lando, The Software Developers Association, Suite 500, 185 Bloor St. E., Toronto, Ontario M4W 1C8, Canada, (416) 922-1153, May 22-24

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**MARCH 1985 • BYTE 95**
IN CIARCIA’S CIRCUIT CELLAR this month, Steve starts a project that sparked his interest way back in 1981. Now that hardware costs have descended to an acceptable level, he can put together a complete home-management/control system. Beginning with a cost-effective DTMF (dual-tone, multiple-frequency) decoder, Steve combines some commercial products to produce a truly personalized electronic mailbox, the first step in this multipart construction project.

John Markoff, senior technical editor in our Palo Alto office, gives us a Product Description of Factfinder, the first free-form text database for the Macintosh. Factfinder uses the Mac’s windows and a “MacWrite-style” editor. It also has some Mac-imposed limitations. We are planning on a full review of Factfinder in a subsequent issue.

Comparing longhand calculation results with those obtained on a microcomputer can cause some head scratching. When you exceed the allocated integer storage space, floating-point decimals can cause rounding-off errors. Peter Rice describes a BASIC program that gets around this problem in “Arithmetic on Your PC.”

$100 for a serial card for a bargain computer? In keeping with this month’s theme, Bob Kong Win Chang shows us how to build a serial card for the Sanyo MBC 550 for about $15. All you need are three ICS and a few more inexpensive components.

This month, Richard Shuford, BYTE’s special-projects editor, takes a look at “Two Flat-Display Technologies”: gas-plasma panels and electroluminescent displays. Though the conventional glass CRT might appear to be an easy target for replacement, the current crop of LCDs have their own drawbacks in spite of their widespread use in portables. The two technologies he discusses show promise of replacing the CRT in several workaday instances.

The cost of satellite-based navigation equipment is high, but you can use your microcomputer to help you across the seven seas. Frederic Rounds’s article describes the principles of navigation, and his Sunfix navigation program is available via BYTEnet Listings.

Even though there are many fundamentally simple approaches to converting between different units of measurement, David Kahn has developed what he considers a rather unique algorithm on which he bases his Convert program, which also is available on BYTEnet Listings. With it, you can have an electronic conversion system on your microcomputer to convert number bases or other measurement units.

—Gene Smarte, Managing Editor
BUILD THE TOUCH-TONE INTERACTIVE MESSAGE SYSTEM

BY STEVE CIARCIA

An autodialer, DTMF decoder, and speech synthesizer in an answering machine

In December 1981 I published my first article on DTMF (dual-tone, multiple-frequency) decoding and conceptualized many of the essential ingredients of an integrated control-and-messaging system for your home. My original words were:

I have always wanted to be able to telephone the computerized home-control system in my house from anywhere in the country, to find out what the conditions are like in and around the house, be informed of problems or messages, and remotely control lights and thermostat settings.

This idea is neither new nor something found only in science fiction. Any computer presently equipped with an auto-answer modem could conduct such a dialogue with a remote user terminal, transmitting and receiving ASCII (American Standard Code for Information Interchange) characters.

But I really don't want to carry an ASCII terminal with me. For the simple functions ... the keypad on a Touch Tone telephone receiver is a readily available, convenient means of transmitting data ... My first step was to decode the DTMF tones. As the title of this article indicates (Build a Touch Tone Decoder for Remote Control), I didn't get much further.

In retrospect, I was biting off a lot trying to create a totally integrated home-control and voice-message system at that time. While many of the pieces seemed available, they were elementary in function and expensive to implement. Turning concept into reality had to wait for some cost-effective hardware evolution. Now that that has happened, I am ready to present working projects that demonstrate these concepts. Over the next few months, I will describe how to build a complete home-management/control system and an electronic-messaging system. I start this month by describing how to build a cost-effective DTMF decoder. Combined with some commercially available components, I will then construct the auto-answer DTMF communication system that I alluded to in 1981. The end result will be a truly personalized electronic-messaging system. But first, some DTMF encoding and decoding basics.

PRINCIPLES OF DTMF

The next time you pick up the handset of a Touch Tone (only telephone instruments (continued)

Steve Ciarcia (pronounced "see-ARE-see-ah") is an electronics engineer and computer consultant with experience in process control, digital design, nuclear instrumentation, and product development. He is the author of several books about electronics. You can write to him at POB 582, Glastonbury, CT 06033.
from AT&T are properly called Touch-Tone—the generic term used by other telephone manufacturers is DTMF signaling) or other DTMF-signaling telephone receiver, press one of the keys and listen. The sound you hear is not a single-frequency sine wave but a combination of two frequencies. The 12 keys are arranged in four rows and three columns, as shown in table 1. All the keys in a given row or column have one tone in common. For example, pressing the digit "9" (row 2 and column 2) produces an 852-Hz tone and a 1477-Hz tone simultaneously. Similarly, pressing "6" (row 1 and column 2) produces 770- and 1477-Hz tones simultaneously.

The full DTMF encoding standard defines four rows and four columns, for a total of 16 two-tone combinations. Standard telephones use only 12 of these combinations. For the purposes of this discussion, however, we shall consider all 16. Depending upon your application, these extra codes may be useful.

The eight frequencies associated with the rows and columns are separated into two groups. The low group, containing row information, has a range of 697 Hz to 941 Hz. The high group, containing column information, covers 1209 Hz to 1633 Hz.

A variety of methods are employed to generate and decode these tone combinations. Generally, the level of sophistication employed in these circuits is governed by the application. Telephone companies strive for reliability and aren't particularly concerned with the size and weight of the result. Their primary concern is that the system should still work 20 years from now. Except in the very latest equipment, discrete LC-tuned circuits are usually found in telephone-company equipment. (LC means induc-

Table 1: The scheme of the DTMF-signaling system.

<table>
<thead>
<tr>
<th>Low Group</th>
<th>High Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Row 0, 697 Hz</td>
<td>Column 0 1209 Hz Column 1 1336 Hz Column 2 1477 Hz Column 3 1633 Hz</td>
</tr>
<tr>
<td>Row 1, 770 Hz</td>
<td>2 3 4</td>
</tr>
<tr>
<td>Row 2, 852 Hz</td>
<td>7 8 9</td>
</tr>
<tr>
<td>Row 3, 941 Hz</td>
<td>10 11 12</td>
</tr>
</tbody>
</table>

Figure 1: Block diagram of the Mostek MK5087 DTMF-signal encoder.
Commercial users of DTMF signaling take a different approach. Instead of LC-tuned circuits, they generally prefer crystal-controlled, integrated-circuit-based systems. One system is not necessarily better than the other, but the LC probably has a longer mean time between failures. In computer-control applications, it is better to follow the commercial designers, using large-scale ICs (integrated circuits) where possible. In the case of encoding and decoding the row and column signals, specialized ICs greatly simplify the task.

**DTMF ENCODING**

Telephone companies have traditionally used transistor LC oscillators to encode the DTMF tone pairs. The practical alternative for the rest of us is to use an integrated tone-encoder component, such as the MK5087 from Mostek. Referred to as an integrated tone-dialer circuit, this chip divides a 3.579545-MHz reference frequency into eight DTMF frequencies. The frequency combinations are selected by a 12- or 16-key matrix keypad connected directly to the chip. The output is a stair-step (digital-to-analog) approximation of the mixture of the high- and low-group tones. No frequency adjustment is necessary to meet standard DTMF specifications, and the average circuit configuration requires little more than the keypad, a crystal, and the IC. Figure 1 shows a block diagram of the MK5087, and figure 2 demonstrates a typical DTMF-encoder circuit.

If you don't want to assemble a DTMF encoder, Radio Shack sells an encoder complete with a 12-key keypad.

**DTMF DECODING**

DTMF decoding is considerably more complicated than DTMF encoding. Only recently has the advent of the single-chip decoder/receiver, such as the Silicon Systems SSI 204, made reliable DTMF decoding easy to achieve. Figure 3 is a block diagram of the SSI 204, which is a 14-pin 5-volt (V) chip that detects all 16 DTMF tone pairs. It uses an inexpensive 3.58-MHz color-burst crystal and requires no front-end prefiltering. The SSI 204 incorporates switched-capacitor filtering to separate the high- and low-frequency bands as well as to detect the individual tones. The output, shown in table 2, is 4-bit CMOS (complementary metal-oxide semiconductor) tristate logic with a data-available strobe.

Figure 4 and photo 1 show a general-purpose DTMF decoder board. Containing the SSI 204 and three additional chips, the decoder board has both 4-bit and 1-of-16 outputs. Four LEDs (light-emitting diodes) are included to show the code of any incoming signal.

When a signal is received, the particular code for that tone pair (row-column) is presented on the D1 through D8 lines (D8 is the MSB [most significant bit]), and the data-available (DV) line goes high. The DV line stays high until the input signal is released. With JPI in the momentary position (as shown), one of the normally low output lines S0 through S15 goes high. If the tone pair for a “7” were detected, for example, S7 would go high for the duration of the tone input. (With no input signal present, the S0 output is high.)

When JPI is in the latch position, any output is held until the next input is detected. If a “4” is received, S4 goes high. It stays high even with no input until another DTMF tone pair is received.

While implemented in this article as an electronic-messaging system, I designed the DTMF decoder board to serve more general applications. Some of those applications might be better satisfied with latched rather than momentary outputs. The example shown in figure 5 combines the

<table>
<thead>
<tr>
<th>Digit</th>
<th>OUTPUT CODE D8 D4 D2 D1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0 0 0 1</td>
</tr>
<tr>
<td>1</td>
<td>0 0 1 0</td>
</tr>
<tr>
<td>2</td>
<td>0 1 0 0</td>
</tr>
<tr>
<td>3</td>
<td>0 1 1 0</td>
</tr>
<tr>
<td>4</td>
<td>1 0 0 0</td>
</tr>
<tr>
<td>5</td>
<td>1 0 1 0</td>
</tr>
<tr>
<td>6</td>
<td>1 1 0 0</td>
</tr>
<tr>
<td>7</td>
<td>1 1 1 0</td>
</tr>
<tr>
<td>8</td>
<td>0 0 0 0</td>
</tr>
<tr>
<td>9</td>
<td>0 0 0 1</td>
</tr>
<tr>
<td>*</td>
<td>0 0 1 0</td>
</tr>
<tr>
<td>#</td>
<td>0 1 0 0</td>
</tr>
<tr>
<td>A</td>
<td>1 0 0 0</td>
</tr>
<tr>
<td>B</td>
<td>1 0 1 0</td>
</tr>
<tr>
<td>C</td>
<td>1 1 0 0</td>
</tr>
<tr>
<td>D</td>
<td>1 1 1 0</td>
</tr>
</tbody>
</table>

*Continued*
The speech synthesizer may be virtually any one on the market.

enhance the functions of standard telephone-answering machines. The Circuit Cellar TIMS is not computer-specific and can be attached to any parallel I/O (input/output) port. I chose to demonstrate it on the IBM PC because it has more memory and faster disk I/O.

The TIMS functions as follows:

When someone calls your telephone, it rings a prescribed number of times and then is automatically answered by a telephone-answering machine. The prerecorded message states that you aren't home and that at the tone the caller should either leave a message for you or enter a special access code via the Touch-Tone pad for a personal message that you may have left for them.

At the tone, the caller presses a 3- or 4-digit sequence. The computer switches on line (the recorder can be selectively switched off or left running) and searches for any files corresponding to that entry code. When the computer finds the file, it turns on a voice synthesizer that speaks the file contents to the caller, "Hi Bob, I had to go to BYTE. You can reach me at (603) 924-9281. Ask for Peggy if you need to find me. I'll be back tomorrow."

If there was no message, the synthesizer would simply say so or, if the entry code was invalid, state that as well.

Besides personalized messages, the TIMS could provide instant message transferal. In addition to giving you your message, the TIMS could ask specific questions and register those answers via DTMF tones as well. Perhaps you are on the move and constantly changing locations but need to talk to a particular person. You periodically call TIMS and enter a call-forward telephone number where you can be reached. When the person calls TIMS and enters his or her code, the message says that you want to contact them immediately about a meeting on Friday. At the verbal prompt, the caller enters the telephone number where they are and an additional entry to signify concurrence or rejection of the meeting time (you might have said enter a 1 for date okay or a 0 for no). The TIMS computer records this information and, after the caller hangs up, telephones you at the number you have previously left to give you the caller's number and the message. (While most expensive answering machines allow you to remotely listen to telephone messages, none to my knowledge call-forward selectively or offer specialized messages.)

INSIDE THE TIMS

The level of sophistication of the TIMS is solely dependent on the application software. Searching the directory for a 3-digit code and outputting it to a communications port (attached to the synthesizer) is a relatively simple task. Registering responses and call-forwarding is another matter entirely.

The TIMS hardware configuration, shown in figure 6, is virtually the same for all situations. Five basic ingredients are included in the electronic messaging system I have described: standard telephone-answering machine, DTMF decoder, speech synthesizer, computer interface, and a data-access-arrangement (DAA) connection to the telephone line.

The answering machine may be any one of a number of available machines and is employed here only to inform your caller of the existence of the TIMS functions; it must have an earphone output if it is to be used, however. The speech synthesizer may be virtually any synthesizer on the market, such as those from Votrax, Micromint, Sweet Micro Systems, or Street Electronics. (I refer you to the references at the end of the article for a listing of the various synthesizers I've designed and presented.)

The primary considerations in the choice of a particular synthesizer are that it have text-to-speech capability and be easy to use. While my Sweet Talker II and Lis'ner 1000 synthesizer designs are easy to use, they use too much computer memory for my purposes, and they are computerspecific. So I chose my Microvox speech synthesizer. The stand-alone Microvox has its own processor that runs an on-board text-to-speech algorithm. It can be connected to the computer through either a serial or parallel port. On the IBM PC, sending speech through the TIMS is accom-

(continued)
Figure 6: The Circuit Cellar Touchtone Interactive Message System.
Figure 7: Modified Microvox output circuit. This schematic appeared in its original form in the September 1982 BYTE.
plished simply by executing an LPRINT command in BASIC. I modified the Microvox's output slightly so that it connects directly to the DAA and avoids any noise introduced by the output amplifier. Figure 7 shows the new output circuit.

**TELEPHONE AND COMPUTER-INTERFACE CONNECTIONS**

The recorder, DTMF decoder, and speech synthesizer constitute the TIMS. Using it, however, requires connecting it to the computer and the telephone lines.

The TIMS requires 2 output and 6 input bits. (An additional port, serial or parallel, is required for the speech synthesizer.) When I first thought about using the IBM PC, I figured I could easily use the standard serial and parallel printer ports to control the TIMS. According to the technical manual, 5 input bits are available on a parallel port. When I experimented with it, however, I could find only 3 bits that I could seem to receive data on. I concluded that something else in my system was interfering.

The only alternative was to build a separate parallel port. A schematic for such an interface addressed at location 260 hexadecimal is shown in figure 8. It's easy to build, but I had mixed success. I built the circuit, plugged it in, and it didn't work. I changed the address to location 160 hexadecimal and it still didn't work. Finally, after a day of scratching my head and staring at a scope, I switched computers and it worked! The logic may be fine and the computer might have been at fault, but this isn't an article on parallel interfacing, so I didn't pursue it. I just traded computers. If you build the circuit, you might have to experiment with the addresses.

Connection to the telephone lines is something else. For many years, telecommunication articles published for experimenters have mentioned the requirement that connection to the telephone line be done through an FCC-registered DAA. Unfortunately, neither a source of DAAs nor an explanation of a DAA's use is included. While the authors may have covered themselves legally by mentioning the requirement, they fully expect that most of the dozen or so project builders will merely use a 600-ohm coupling transformer and dispense with signal-level and protection circuitry. TIMS requires a DAA both functionally and legally. With the potential of hundreds of the Circuit Cellar TIMS being built, I'd rather be (continued)

![Figure 8: Parallel port for the IBM PC.](image-url)
Registered DAAs are available from various sources, including the telephone company itself. A popular one is the Cermetek CH1810.

remembered for creative inspiration than for the demise of the telephone system through unprotected connections.

A registered DAA is more than a 600-ohm transformer. Among its functions are ring detection, on/off-hook control circuitry, modem control logic, and analog transmit/receive logic. The telephone is attached to the tip-and-ring side of the DAA, and anything you build is attached to the other side. The DAA serves to protect your circuitry from line transients and the telephone line from your circuit.

Registered DAAs are available from various sources, including the telephone company itself. One of the more popular commercial DAAs is the Cermetek CH1810. A block diagram is shown in figure 9.

THE CH1810

The Cermetek CH1810 DCPH (direct connect protective hybrid), shown in photo 2, is a module that provides a complete DAA function. It is registered under part 68 of the FCC rules and regulations for direct connection to the telephone line. FCC recertification is not required when integrated into systems, providing that the included label is externally attached listing the registration number and ringer equivalence.

The DCPH can be mounted directly on the PC board, and telephone-line connection is made via an external cable with an RJ11C or equivalent mating plug. As illustrated in figure 9, the CH1810 includes many signal-processing features. The major functional blocks include

1. XMIT Squelch
2. XMIT Attenuator
3. Excessive-Power Detector
4. Billing-Delay Timer
5. Analog Loop-Back Control
6. 2- to 4-Wire Converter
7. DC Loop Control
8. Ringing Detector
9. MIC Monitor

The device is powered from +12- and -12-V supplies, but logic-control inputs and all status outputs are CMOS-level-compatible (0 to +5 V).

TRANSMITTING AND RECEIVING DATA OR VOICE

Audio that is destined for the telephone line is called XMIT (transmit) audio. This audio can be the voice

Figure 9: Block diagram of the CH1810 direct connect protective hybrid telephone-line interface.
from a recorder or the FSK (frequency-shift keying) tone outputs from a modem. It is applied at the CH1810’s TRXCAR signal input. Low-voltage signals may be directly connected, but best protection is afforded by coupling the input through a 0.1-microfarad (µF) capacitor.

After the XMIT audio passes through the attenuator stage, it is applied to the telephone line by a 2- to 4-Wire Converter. This block performs three functions: partial separation of receive (RCV) from XMIT audio on the 2-wire telephone line, a 600-ohm AC-impedance termination, and a conversion of the single-ended audio to a balanced audio pair at tip and ring.

After passing through the 2- to 4-Wire Converter, RCV is then passed to the Analog Loop-Back switching block. When ALEN is a high logic level, this audio is asserted at the RCV audio-output pin, RCVCAR. When ALEN is low, however, the audio present on TRXCAR is looped back and asserted at RCVCAR. This function is important for use in half-duplex modem applications.

TELEPHONE-LINE CONTROL

Four major telephone-line control functions are implemented by the CH1810.

The first is telephone-line loop-current control. When your telephone handset is on the cradle, it is considered to be on hook, and no DC loop current exists between your telephone and the telephone-company switching station. When you lift up the handset, the telephone is off hook, closing a low-current DC circuit at the switching station that indicates a call is being initiated or answered. The DC Loop-Control block, at input pin OH, controls a relay on the DCPH that switches the unit from on-hook to off-hook modes. Since this is a relatively high quality, fast relay, it is also suitable for pulse dialing. Once the OH line has established an off-hook condition, the OH line can be pulsed for automatic dialing.

OH also controls a second telephone-line control function, the Billing-Delay Timer. FCC part 68 requires that the first 2 seconds after a telephone connection be kept silent. This allows central offices to exchange billing information such as the caller and called telephone numbers. On the transition of OH from on to off hook, the DCPH starts a 2-second timer that squelches the transmit audio path during this interval.

The third function is ringing detection. Circuitry is included to assure elimination of false transients on the RI (ring indication) line due to pulse dialing and other transient signals.

The MIC Monitor (unused in my application) is the last control function. It simply converts a contact closure between MI and MIC to a logic level at SH. Contact closures usually emanate from a local dataphone. On such a dataphone, the exclusion key or equivalent-data key controls the state of the MI/MIC contact. External circuits typically monitor the DCPH’s SH line for a voice-to-data exclusion-key transition to begin a modem originate data call. The definitions of all the CH1810’s pins are given in the text box “CH1810 Pin Descriptions.”

USING THE TIMS

As previously mentioned, the DAA, recorder, synthesizer, and DTMF decoder board are combined together, as shown in figure 6 and photo 3, and interfaced to the computer to form the TIMS. The parallel port is attached to the DAA and the DTMF decoder board. As configured in figure 8, the port-address is location 260 hexadecimal (608 decimal), and the three ports and mode register occupy four sequential addresses (608 through 611). The value loaded into the mode register configures the (continued)
three ports as input or output and designates handshaking if required. The value 139 (8B hexadecimal) loaded into the mode register (611) assigns A as output, B and C as input, and no handshaking. (Refer to the references list for a more in-depth explanation of 8255 programming.) This configuration is easily accomplished in BASIC with OUT 611,139. A port is read by performing an INP at that address (OUT 608,x to output to port A and INP (609) to read port B).

The telephone line is attached to J1. It is also attached to the tip and ring inputs of the DAA and also through a normally closed relay contact to J2. The telephone-answering machine is plugged into J2 and its earphone output attached through a normally closed relay to the DTMF decoder board. (While my prototype picture shows two relays, they are both SPDT and no handshaking. (Refer to the ref-assigns A as output. B and C as input.)

The telephone line is also attached to the tip and ring inputs of the DAA and also through a normally closed relay contact to J2. The telephone-answering machine is plugged into J2 and its earphone output attached through a normally closed relay to the DTMF decoder board. (While my prototype picture shows two relays, they are both SPDT and no handshaking. (Refer to the ref-assigns A as output. B and C as input.)

When it concludes and gives the caller the beep to start recording, the recorder enables its earphone output. If the caller enters a DTMF tone, the DL line (port 609, bit 7) goes high and the 4-bit DTMF code is present on bits 0 through 4 of port 609 (port B). It is up to the application program at this point to determine whether the code is valid. (The DTMF decoder cannot be directly connected to the telephone line and must go through either the CH1810 or the DAA in the recorder. For it to receive data through the CH1810, however, the CH1810 must go off hook. Such a condition would stop the recorder from automatically answering.)

If the code is valid, the computer has two options. It can go off hook with the recorder still on or shut off the recorder (by breaking the line to it as though the caller had hung up) and continue the call only through the DAA. Two outputs are provided: SWITCH and ON HOOK. With JPI in the opposite position as shown, the relay and the DAA are separately controlled. A logic 0 on the SWITCH input energizes the relay, and a logic 1 to ON HOOK causes the DAA to go off hook. Life is simplified by tying the DAA OH line to the relay (with JPI and operating them synchronously.

If the codes received by the computer are okay and a message is to be transmitted, a logic 1 is sent on port 608, bit 1 (ON HOOK). This causes the DAA to go off hook, the recorder will shut off, and the input to the DTMF decoder instead comes from the RCVCAR output of the DAA. At this time (after a 2-second billing-delay—where DAA doesn’t know that the call was already answered), any audio signal input on TRXCAR is heard by the caller. The TRXCAR line is in turn attached to the Microvox speech synthesizer. The computer merely executes an LPRINT to send ASCII data to the Microvox and speak to the caller.

The call is terminated by receiving an appropriate DTMF entry from the caller (“enter an asterisk when you wish to terminate the call”) or timing out after sending the synthesized message. These options as well as automatic dialing are under program control. I could have incorporated busy-signal and dial-tone reception, but it would have increased cost and complexity.

Listing 1 is a simple BASIC program that demonstrates automatic answering, caller DTMF inputs, and voice response. [Editor’s note: This program is available for downloading via BYTEnet Listings. The telephone number is (603) 924-9820.] You’ll note that it takes relatively little software to use the

### CH1810 PIN DESCRIPTIONS

**TRXCAR**: Transmit audio input.

**RCVCAR**: Receive audio output.

**TIP/RING**: Direct telephone-line connections.

**PR/PC**: External program resistor inputs. In a programmable telephone connection, the various resistive combinations set the DCPH XM7 attenuation from 0 to -12 decibels (DB).

**OH**: On-hook input. When asserted low, telephone-line loop current is broken. Pulse dialing may be done through this input.

**RT**: Ringing indication output. It is asserted low during the typical 2-second telephone-ringing period.

**TIM**: Billing-delay timer squelch output. When OH is low (on hook) and for nominally 2 seconds after a transition to the off-hook state, TIM is asserted high. While TIM is high, XMIT audio is squelched.

**CCT**: Coupler connected through output. CCT indicates the status of the excessive-power detector. When CCT is high, the XMIT path is squelched due to audio levels at TRXCAR in excess of 0 dBV.

**ALEN**: Analog-loop enable input. When asserted low, TRXCAR is looped to RCVCAR. This is internally pulled up.

**ATEN**: Attenuator enable input. When asserted low, the XMIT attenuator is replaced by a 0-dB path. When held high, the XMIT attenuator is enabled. This input is internally pulled up.

**MMIC**: MMIC inputs. These two pins connect through the telephone cable and jack to the dataphone voice-data mode contacts.

**SF**: Switch-hook output. Reflects the state of the MMIC contact inputs. If there is a contact closure between M1 and M2, SF is asserted high.

**TIMSTR**: Time start input. When strap S2 is inserted, this input is connected to the OH input. A low-to-high transition causes the 2-second billing-delay timer to begin its timing.

**SQ**: Squelch input. This input, when asserted high, squelches or breaks the transmit audio path. If asserted low or left unconnected, it has no effect on transmit-path squelch.

+12V: Positive-supply input. This supply is 12.0 V DC ± 10 percent at 60 milliamperes (mA).

-12V: Negative-supply input. This supply is -12.0 V DC ± 10 percent at 30 mA.
TIMS. A more involved messaging system, such as the one described at the start of this article, remains to be written.

IN CONCLUSION
It's taken a few years and some major cost-effective advances in hardware design to make life simple, but my TIMS is a reality. Inexpensive DTMF decoding is the key, and the SSI 204 has the right price/performance ratio. The DTMF decoder board easily interfaces to practically any computer.

I consider software the limiting factor. A well-thought-out electronic-messaging-system program could establish the standard by which others are compared. Given the limited time between projects and the level of effort involved in the home-management/control system coming up, I will have little time to continue improving on it. True fame is therefore left to the reader who implements this system with some profoundly significant application software. Keep me in mind if you are giving away copies of your program. I don't want to wait another four years to schedule an update to my system.

CIRCUIT CELLAR FEEDBACK
This month's feedback begins on page 390.

NEXT MONTH
Build the Circuit Cellar home-management/control computer system.

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Diagrams and data specific to the SSI 204 are reprinted courtesy of Silicon Systems Inc.

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Listing I: TIMS demonstration program.

```
100 OUT 611,139 :REM SET PORT A OUT AND PORTS B AND C AS INPUT
110 OUT 608,0 :REM SET ON HOOK
120 GOSUB 280 :REM READ DAA R1 INPUT SIGNAL
130 IF RING>0 THEN GOTO 120 :REM CHECK FOR RING INDICATOR
140 IF RING=0 THEN GOSUB 280 :IF RING=0 THEN 140 :REM WAIT FOR RING TO STOP
150 IF RING=0 THEN GOTO 140 ELSE OUT 608,2 :REM AUTO ANSWER AND GO OFF HOOK
160 PRINT "ANSWERING"
170 LPRINT "..." :REM WAIT FOR 2-SECOND BILLING DELAY
180 LPRINT "THANK YOU FOR CALLING..." :REM HELP ME TEST YOUR PHONE...
190 LPRINT "PRESS A NUMBER BUTTON AND I WILL GUESS IT..." :REM WAIT FOR RING TO STOP
200 LPRINT "OR...PRESS THE ASTERISK...TO END THIS CALL"
210 GOSUB 280
220 IF DTMF=11 THEN LPRINT "THANK YOU,G00D BYE" :GOSUB 300 :PRINT "ON HOOK" :GOTO 110
230 IF DTMF=0 THEN LPRINT "YOU PRESSED A" :DTMF
240 IF STROBE = 128 THEN GOSUB 280 :GOTO 240
250 GOTO 210
260 REM
270 REM
280 A = INP(609) :DTMF = A AND 15 :STROBE = A AND 128 :RING = A AND 64
290 RETURN
300 REM 5-SECOND DELAY
310 FOR T=0 TO 3000 :NEXT T :RETURN
```

REFERENCES

To receive a complete list of Circuit Cellar's Circuit Cellar project kits, circle 100 on the reader-service inquiry card at the back of the magazine.
"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 say 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 for any large multiuser installation. Yet, backing up a hard disk can be a nightmare if you only have floppy's to work with. That's why we've added a tape backup option to all the larger Stride 400 Series machines. It's irresponsible 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. We 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 multiuser 68000 systems than anyone else."

"The marketing pressure to be compatible instead of being better, has blinded the industry."

"A surprising feature is compatibility. Everybody talks about it, but nobody does anything about it."

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FACTFINDER

Editor's note: The following is a BYTE product description. 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.

Factfinder is the first free-form text database to be introduced for Apple Computer's Macintosh. It was designed by independent software developer Rudi Diezmann and marketed by Forethought Inc. of Mountain View, California, and it uses the Macintosh window-based interface and a simple MacWrite-style editor to provide a variety of database operations. For more information on text databases, see "Text Databases" by Ezra Shapiro, October 1984 BYTE, page 147.

With Factfinder, each individual database is a "stack" and a record is a "factsheet." Currently, stacks are limited in size to 1 megabyte—an arbitrary limit imposed by the use of 16-bit pointers within the database. According to Diezmann, when hard disks are widely available for the Macintosh, it will be easy to recompile the program with 32-bit pointers yielding stack sizes that may be dramatically larger. On the 128K-byte Macintosh, individual factsheets are restricted to approximately 11K bytes—a limit imposed by available system memory. When Factfinder runs on a Macintosh with 512K bytes of RAM (random-access read/write memory), factsheets can be as large as 30K bytes—the limit in this case imposed by the Macintosh system software.

At present, Factfinder's performance is I/O (input/output) bound: the speed and capacity are significantly improved on hard-disk versus floppy-disk-based systems. Also, performance has been improved on the 512K-byte versus the 128K-byte Macintosh.

Figure 1: Factfinder's text-entry screen, similar to Macwrite, features an "elevator bar" on the right, and "browse" and "zoom" buttons on the bottom.

A flexible, text-oriented database

**BY JOHN MARKOFF**
because program segments do not have to be swapped into and out of memory.

Factfinder is intended for storage and retrieval of text information that cannot be organized easily into highly structured categories. Typical Factfinder applications might include creating abstracts from magazine and journal articles, downloading information from on-line databases and news services, organizing and saving random notes or journal entries, or indexing legal notes and trial material.

Rather than using a "forms-oriented" metaphor for data entry that is typical of structured databases, Factfinder uses a "computer paper" metaphor; information is entered into a scrolling document that you can move backward and forward under a window on the screen display. Thus, in practice, using Factfinder is much like using a text editor. However, with the addition of a flexible keyword function, Factfinder allows you to create an extensive retrieval scheme that stretches far beyond the individual document title.

**BASIC FACTFINDER OPERATIONS**

When you first open Factfinder to begin entering data, you are presented with a Text Editing window and several smaller windows that provide for attaching keywords, developing queries, and displaying lists of factsheets found on any particular search. To designate words as keywords in each factsheet you point at them with the mouse and then press a command-key sequence (Command-M) or draw down a selection from the Factfinder menu bar and then click the mouse.

Within each factsheet you can also designate key phrases and individual words by using the mouse to move the cursor and extend a selection. Additionally, a keyboard window permits you to append keywords and phrases to each factsheet, even though they do not appear in its text.

A file menu provides the option to open, close, print, or create new stacks. You can also lock a stack to protect it; when a stack is locked the stack's icon cannot be removed from the Macintosh desktop by throwing it in the trash-can icon.

**FACTFINDER WINDOWS**

Factfinder corresponds closely to the Macintosh user interface, with several extensions. For example, if you are familiar with the MacWrite word processor, you will already know how to use the Factfinder text editor (see figure 1), a simple editor with a single font and no margin adjustment, spacing control, or right justification. It does, however, provide automatic word wrap, mouse-oriented cursor control and editing, and an insert mode. An "elevator button" on the right side of the Text Editor window allows you to page and scroll through text. The scroll bar at the bottom of the window has two "browse" buttons and a "zoom" button. The browse buttons allow you to scan through factsheets one at a time (only one factsheet can be loaded into RAM at a time), while the zoom button enlarges the Text Editing window to full screen size or shrinks it.

Factfinder has four smaller windows. Figure 2 shows the Find window, for preparing queries; Names Found window, which displays the names of factsheets selected by a particular query; and the Keys window, for entry and display of an alphabetical list of keywords and phrases for each factsheet. The Index window (figure 3) provides an alphabetical index of all the keys, factsheet titles, and creation and modification dates in a given Factfinder stack.

**FACTFINDER KEYWORDS AND SEARCHING**

To search through a Factfinder stack, you first have to prepare a query, either by entering the desired words or phrases directly into the Query window or by pointing at them in the Keyword Index window and selecting them with the mouse, which causes them to be copied to the Query window. A series of logical operators such as "and;", "or;", and "to" also appear at the bottom of the Index window and can be selected in the same fashion. Other operators include "all;", "[ ]" to indicate precedence, "?" as a wild-card suffix, and "found;" which allows you to narrow searches to include only those factsheets that were located on the previous search. This function will be familiar to those who have used larger on-line databases such as Lockheed's Dialog and Mead's Nexus.

Factfinder lets you draw keywords from within the text or attach them separately to each factsheet. You can even make keywords out of individual words within the factsheet title by selecting them and typing Command-M while entering the title. Any keyword (or fact-
One of the most intriguing aspects of Factfinder does contain two "hidden" fields: "creation" date and "modification" date. You can use these dates in a variety of ways, such as to archive all factsheets created before a certain date or to select all factsheets that were modified between two dates.

Factfinder also provides an auto-key option. From the Keys menu option, you select an Automatic Keys window. Keywords that you add to this window are thereafter attached to each new factsheet. You can turn this special group of keywords on or off from the Keys menu. This feature might be useful when you are entering a series of article abstracts from a single magazine and need to add the same keywords to the entire group.

Once you have composed a query, you initiate a search by pressing the Enter key on the Macintosh keyboard. After Factfinder finishes its search, it displays the factsheets that match the query in a Names Found window and places the first factsheet located in the Text Edit window. You can then browse through the selected factsheets using the browse buttons.

Loading and Unloading Text

One of the most intriguing aspects of Factfinder is that it permits easy loading and unloading of simple ASCII (American Standard Code for Information Interchange) text files. If you select a single factsheet or series of factsheets and then select the Unload to Text option from the menu bar, Factfinder will create a file on disk in MacWrite text-only format (straight ASCII) with appropriate header information and field delimiters.

Even more interesting is Factfinder's ability to read a text file from disk and load it into an individual factsheet or series of factsheets. In this case the process is slightly more complicated: you have to precede the text with the phrase FACTFINDER TEXT FILE, insert a field delimiter (of your choice) and add the name of the factsheet, creation and modification dates, keywords (separated by carriage returns), and delimiters before and after the text block. This procedure allows you to enter information into Factfinder from a variety of sources including word processors and on-line databases. After including the information in a Factfinder factsheet you can index it further.

The Factfinder Upload function was designed to directly read the text portion of a document that you have downloaded via a Macintosh terminal. Thus, you can unload a portion of a stack from one Macintosh and then send it directly by modem to another system.

You can also use the standard Macintosh cut, copy, and paste features to transfer portions of factsheets from Factfinder to the Macintosh's Scrapbook, and from there to other applications.

Copy Protection

The designers of Factfinder have come up with a novel copy-protection scheme that lets you copy Factfinder to other disks freely. These copies of Factfinder, however, are crippled: a stack may hold no more than 15 factsheets. A full-function backup copy is sent to all users who fill out and return registration cards.

If you have a hard disk, you can use a special function in the Factfinder utility menu to install the program. Once you have copied the program to the hard disk, you can run it without inserting the master disk each time. The special installation program will work "several" times, in case the hard disk needs to be reformatted. Forethought has tested the hard disk installation feature on the Davong, Corvus, and Tecmar hard disks, as well as on the Lisa.

Special Uses

Factfinder designer Diezmann stresses that the program should not be viewed as a traditional database manager. For example, he notes that Factfinder does not include a report generator. Factfinder can, however, store and print mailing labels if you enter address information in a systematic fashion. The first release of Factfinder also includes an undocumented Sort command that you can use in the Query window. This command is fully functional but won't be demonstrated to users until Forethought releases a more extensive version of the program.

The Factfinder program disk comes with a series of special stacks, including examples, hints, and a Help stack. This stack installs itself as a special Help menu. When you remove the Help stack from the disk, the Help function disappears from the program.

Factfinder is available for $150 from Forethought Inc., 1973 Landings Dr., Mountain View, CA 94043. (415) 961-4720.

Figure 3: You can build queries either by entering them directly into the Find window, or by double-clicking on a keyword or phrase in a stack's index, which automatically copies the phrase to the Find window.
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ARITHMETIC ON YOUR PC

Use strings and arrays to perform operations on 200-digit numbers

Ask some bright 10-year-olds to square your Social Security number and, after a bit of pencil chewing, they'll give you the answer. Ask your computer to do the same, and you will receive something like this:

$$302.325.855 \times 302.325.855 = 9.1400922601481025 \times 10^9$$

Note that the correct answer is 91,400,922,601,481,025. The reason for the slight inaccuracy is that all computers—including the IBM Personal Computer (PC), on which I made this calculation—assign a specific amount of space for storing integers. Any number that requires more than the allocated space is converted to a floating-point decimal. In the case above, the last digit was lost and the answer was rounded off. In the IBM PC, an integer must fall between -32,768 and +32,767; if a calculation exceeds this range, the IBM PC converts the result to a double-precision real number, accurately represented to 16 digits.

Who cares? Anyone who is keeping books for a company that deals in large-number transactions will demand software that can calculate accurately to the penny.

Another application involving large-number arithmetic is the prime-number security code, which is based on the computer's ability to verify that a large number (50 to 100 digits) has no factors. Using such a code involves manipulating large numbers in software.

The four algorithms for large-number arithmetic operations have been well known for a long time. Everyone is taught to add, subtract, multiply, and divide integers. In his book *The Art of Computer Programming, Volume 2: Seminumerical Algorithms* (Addison-Wesley, 1969), Donald Knuth agrees that the old algorithms are the best algorithms to use, but applying them to a computer is not as easy as it sounds.

**ADDITION AND SUBTRACTION**

In this article I'll describe a BASIC program for all four of the arithmetic algorithms that lets you circumvent the floating-point decimal limitation of the IBM PC. If you use Microsoft BASIC, the program in listing 1 will run without change. For other microcomputers, the program is relatively easy to translate.

The program takes 12 seconds to multiply two 20-digit numbers and 3 minutes, 55 seconds to divide a 160-digit number by a 40-digit number.

A number is a string of digits; addition and subtraction are performed digit by digit, by carrying and borrowing. (Knuth explains that a digit can be relative to any base, making it possible to create programs designed to take advantage of the architecture of a specific computer. I chose a simple example using base 10, so a digit is a number between 0 and 9.) Multiplication, the way we learned it, with partial products running down the page, is not the easiest way to get the job done on a computer, but it is not far from the best method. Long division is just as complicated when done by computer as it is on paper. You (or the computer) have to do some guessing (try out a quotient and change it if it is too big). A couple of programming tricks shorten the work, but little is changed from the old paper-and-pencil method.

If you check listing 1, line 1040, you will see that a number is read into a string variable, with each digit recorded as a character. Because arithmetic (continued)
Arithmetic can't be done with characters directly. The string is converted to an array in which the zeroth value is the units digit, the first value is the tens digit, the second value is the hundreds digit, etc. Using notation, \( X(7) \) is the digit in the seventh place (the 1 in 10,000,000). The last element of the array is the largest place value in your number. (This information makes it possible to run FOR . . . NEXT loops only as long as they have nonzero values to work with, a great savings in time.) For example, the number 44,098 would be represented as \( X(0)=8, X(1)=9, X(2)=0, X(3)=4, X(4)=4, \) and \( X(200)=4 \). All other array values are 0.

To add two numbers, add the digits by columns, as in the following:

\[
\begin{array}{c}
34,456 \\
83,509 \\
117,965 \\
\end{array}
\]

The first sum is 6 + 9 = 15. The 5 is recorded (put into the zeroth place), and the 1 is carried to the next sum: 5 + 0 + 1 = 6. The 6 is put away in the first place, and a 0 is carried to the next sum. The process is repeated from right to left until the end of both numbers is reached. The program starts by finding the number of digits in the larger number (line 10010). In the example, it's 83,509 (five digits; four place values). The loop in lines 10020 to 10050 calculates and carries. Line 10060 checks to see if a 1 was carried on the last addition (as it was in the example) and, if so, sets the length of the answer.

Subtraction is almost as simple for the program. When a subtraction results in a negative value, a 1 is borrowed from the next place. (Borrowing is the reverse of carrying. A 1 is subtracted from the next place instead of being added to it.) Only one problem can occur: subtraction can result in a negative number. The program checks to see if the result is negative by looking at the borrow on the last subtraction. If there was one, that digit is negative and tells the program that the result is negative. This is done by lines 11020 to 11060.

---

**Listing 1: Four arithmetic operations in BASIC.**

1000 ' initialization
1010 DEFINT A-Z
1020 DIM XX%(200), Y%(200), Z%(200)
1030 PRINT "ENTER A NUMBER, UP TO 200 DIGITS."
1040 INPUT XX$ 
1050 WHILE LEF$(XX$, 1) = "O": XX$ = RIGHT$(XX$, LEN(XX$) - 1)
1060 PRINT "ENTER AN OPERATION: + - * /"
1070 INPUT OP$
1080 PRINT "ENTER A SECOND NUMBER, UP TO 100 DIGITS."
1090 INPUT YY$
1100 WHILE LEF$(YY$, 1) = "O": YY$ = RIGHT$(YY$, LEN(YY$) - 1): WEND
1110 XL = LEN(XX$)
1120 FOR I = 1 TO XL
1130 X%/(XL-1) = VAL(MID$(XX$, 1, 1))
1140 NEXT I: X%(200) = XL - 1
1150 YL = LEN(YY$)
1160 FOR I = 1 TO YL
1170 Y%/(YL-1) = VAL(MID$(YY$, 1, 1))
1180 NEXT I: Y%(100) = YL - 1
1190 OPERATION = ASC(OP$)
1200 IF OPERATION = 43 THEN GOSUB 10000: GOTO 1260 'addition
1210 IF OPERATION = 45 THEN GOSUB 11000: GOTO 1260 'subtraction
1220 IF OPERATION = 42 THEN GOSUB 12000: GOTO 1260 'multiplication
1230 IF OPERATION = 47 THEN GOSUB 13000: GOTO 1260 'division
1240 PRINT "DON'T UNDERSTAND OPERATION"
1250 GOTO 1610
1260 IF OPERATION = 43 THEN GOTO 1300
1270 IF OPERATION = 45 THEN GOTO 1400
1280 IF OPERA = 42 THEN GOTO 1500
1290 IF OPERATION = 47 THEN GOTO 1600
1300 ZZ$ = " "
1310 FOR I = 0 TO Z%/(200)
1320 ZZ$ = CHR$(Z%/(1) + 48) + ZZ$
1330 NEXT I
1340 PRINT "THE SUM IS"; PRINT ZZ$
1350 GOTO 1610
1360 IF Z%/(200) < 0 THEN GOTO 1430
1370 ZZ$ = " "
1380 FOR I = 0 TO Z%/(200)
1390 ZZ$ = CHR$(Z%/(1) + 48) + ZZ$
1400 NEXT I
1410 PRINT "THE DIFFERENCE IS"; PRINT ZZ$
1420 GOTO 1610
1430 PRINT "THE DIFFERENCE IS NEGATIVE"
1440 GOTO 1610
1450 ZZ$ = " "
1460 FOR I = 0 TO Z%/(200)
1470 ZZ$ = CHR$(Z%/(1) + 48) + ZZ$
1480 NEXT I
1490 PRINT "THE PRODUCT IS"; PRINT ZZ$
1500 GOTO 1610
1510 ZZ$ = " "
1520 FOR I = 0 TO Z%/(200)
1530 ZZ$ = CHR$(Z%/(1) + 48) + ZZ$
1540 NEXT I
1550 PRINT "THE PRODUCT IS"; PRINT ZZ$
1560 GOTO 1610
1570 ZZ$ = " "
1580 FOR I = 0 TO Z%/(200)
1590 ZZ$ = CHR$(Z%/(1) + 48) + ZZ$
1600 NEXT I
1610 ZZ$ = " "
1620 PRINT "THE PRODUCT IS"; PRINT ZZ$
1630 GOTO 1610
1640 ZZ$ = " "
1650 FOR I = 0 TO Z%/(200)
1660 ZZ$ = CHR$(Z%/(1) + 48) + ZZ$
1670 NEXT I
1680 PRINT "THE PRODUCT IS"; PRINT ZZ$
1690 GOTO 1610
(continued)
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next line strips leading zeros from the
difference.

MULTIPLICATION
The multiplication algorithm involves
multiplying digits and putting the
results in the right place. (The place
of the result is the sum of the place
values of the numbers being multi­
plied.) For example, multiply 78 and
105. The first step is 5 \times 8 = 40,
which belongs in the zeroth place
because 5 and 8 are each in the
zeroth place in their respective
numbers, 0 + 0 = 0; followed by 5 \times
7 = 35, which belongs in the first
place because 5 is in the zeroth place
and 7 is in the first place, 0 + 1 = 1;
then 1 \times 8 = 8 goes in the second
place, and 1 \times 7 = 7 goes in the third
place. The other products are 0. When
two numbers go into the same place.
they are added; therefore, the prod­
cut above is 7, 8, 35, 40 with the
places separated by commas. Of
course, we don’t write 783540 since
the 35 and 40 are bigger than 10.
Rather, the tens digit of each of these
numbers is carried into the next
place: 7, 8+3, 5+4, 0 = 7, 11, 9, 0 =
7+1, 1, 9, 0 = 8190. (Carrying occurs
when a product is greater than
10; the tens digit is carried to the next
place.) The loop in lines 12010 to 12080 per­
forms this: it takes pairs of digits, finds
the product, adds that to the digit
already in the answer at the proper
place and, if the result is greater than
10, divides by 10 and puts the re­
mainder back into the result. and car­
ries the quotient to the next higher
place. (Reverse slash, "\", in
Microsoft BASIC is the integer divide
function. It gives the integer quotient
only, dropping the fractional part.
MOD is the function that calculates
only the fractional part, i.e., the re­
mainder.) This algorithm differs from
the manual method only in that, in­
stead of writing down partial products
and adding at the end, you keep a
running total.

LONG DIVISION
The division algorithm requires a
preface. Calculating on paper, you

(continued)
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divide the divisor into the first few digits of the dividend, arriving at a single-digit result. Then you multiply the divisor by this digit and subtract from the dividend (in the right place). Choosing this digit requires some care. Looking at the first digits of the divisor and dividend is some help, but usually you try it out, decrease the integer by one, and try again. Knuth proves a theorem that says that, in certain circumstances, the result of dividing the first one or two digits of the dividend by the first digit of the divisor is never more than two units too big. These circumstances can be manufactured by multiplying the divisor and dividend by the right number. The calculation of this number $D$ and the multiplication by it take place in lines 13140 to 13330.

The digit in the quotient, calculated in line 13360 (or 13350). Another refinement is used in line 13370: $C$ is checked to see if it is too large when considered as the quotient of the first three digits of the dividend by the first two digits of the divisor. If it passes this test, then you can be sure that it is not more than one unit too big. If it does not pass this test, decrease it (line 13380) and try again.

The actual division—multiplication by $C$ and subtraction—takes place in lines 13400 to 13510. When that is finished, you check to see if $C$ was one unit too large (line 13520) and correct $C$ and the dividend (lines 13530 to 13570). The final steps are to set the length of the quotient (13610) and the length of the remainder (13620 to 13660) and divide the remainder by $D$. It is not necessary to divide the quotient by $D$ because if $X/Y = Q$ with remainder $R$, then $X = QY + R$. Multiply by $D$: $DX = QDY + DR$. so $DX/DR = Q$ with remainder $DR$.

[Editor's note: The 8088 assembly-language source code listings of these four algorithms and a BASIC program that can call them are available for downloading via BYTEnet Listings. The telephone number is (603) 924-9820. The filenames are LINGMATH.ASM, LONGMATH.BAS, and LINGMATH.TXT (an explanatory file).]
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As indicated, Area I and II account for more than half of the total revenue for the leading brand. The newest sales region, Area IV, added 12% to the total, more than double the original projection. The most dramatic results have come from Area III. From a year ago low of 15%, sales have risen to 25%.
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I believe the Sanyo MBC 550 is a good, inexpensive computer. Unfortunately, some of its options are expensive. For example, Sanyo's serial card costs about $100, but you can build your own for about $15.

Figure 1 shows my serial-card design. The card plugs into the Sanyo's serial-interface connector on the motherboard and works exactly like Sanyo's version. Table 1 is a list of parts I used in this project.

I hope that this small project and others like it will help keep inexpensive computers inexpensive.

Robert Kong Win Chang, a research assistant at Brandeis University (Ford Hall, Waltham, MA 02254), is currently involved in the design of a Prolog compiler.

Table 1: The parts list.

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC1</td>
<td>8251 USART (universal synchronous/asynchronous receiver/transmitter)</td>
</tr>
<tr>
<td>IC2</td>
<td>MC1488 quad line driver</td>
</tr>
<tr>
<td>IC3</td>
<td>MC1489 quad line receiver</td>
</tr>
<tr>
<td>IC4</td>
<td>74LS32 quad OR gates</td>
</tr>
<tr>
<td>CN1</td>
<td>ribbon header socket (type IDS20)</td>
</tr>
<tr>
<td>CN2</td>
<td>RS-232C female connector</td>
</tr>
<tr>
<td></td>
<td>Four 0.01 µF decoupling capacitors</td>
</tr>
<tr>
<td></td>
<td>Short piece of 20-strand ribbon cable</td>
</tr>
<tr>
<td></td>
<td>Perf-board (4.3 by 7.0 centimeters)</td>
</tr>
</tbody>
</table>

Figure 1: The serial-card schematic for the Sanyo MBC 550.
TWO FLAT-DISPLAY TECHNOLOGIES

Gas-plasma panels and electroluminescent displays

No one likes the bulk and fragility that arise from the classical cathode-ray tube's (CRT's) bulbous vacuum-tube-electron-gun structure. Yet in cost, versatility, and quality of display, the technology of the CRT has proved hard to beat. At present, there are three leading alternatives to CRT's: the liquid-crystal display (LCD), the gas-plasma-discharge panel, and the electroluminescent display (ELD). All of these are flat screens, and the display modules are a couple of inches thick at most. Currently, each excels in certain applications; none has yet attained the general-purpose utility of the CRT, but efforts to improve all three are continuing.

The LCD has become familiar through its use in wristwatches, calculators, and most of the current generation of briefcase-size portable computers. It is the most common flat-screen alternative to the CRT today. The LCD's frugal power requirements are especially valued. (See references 1 and 2.)

But the liquid-crystal display has its limitations. Not emitting light, it must scatter or absorb light supplied by other sources. Furthermore, the constraints of pixel (picture element) decay times and scanning rates cause problems in the larger sizes preferred for computer work, notably lack of contrast, and adjustment of the viewing angle is usually critical. Also, current LCD technology can produce only a poor gray scale.

The other two display technologies, though less familiar, show promise of eventually supplanting the CRT in several workaday contexts. In this article I will focus on gas-plasma and
electroluminescent displays—their principles of operation, their good and bad points, and what improvements are currently being worked on.

**FUNDAMENTAL CONSIDERATIONS**

In designing a practical computer display you have to decide whether to confine its contents to distinct characters (alphanumeric or symbolic) or to allow arbitrary graphic displays. It's somewhat easier to design a flat-display screen limited to characters. But a screen that can be used for a wider variety of applications, including complex graphic displays, is desirable for use in a computer. The greatest versatility is found in a screen in which pixels cover the entire surface and can be turned on and off in arbitrary combinations and sequence.

If the screen is to be flat, each pixel location must contain some active mechanism that emits light or modifies incident light; for practicality, the mechanism is activated by application of an electric voltage or current. In principle, it would be possible to control each pixel with a separate driver transistor, but the prospect becomes forbidding when you contemplate wiring a large display that could contain 10,000 elements (except in one proposed scheme where a transistor would be physically built into each pixel). If, however, the pixels are addressed by rows and columns, with each pixel connected to a column conductor and a row conductor, the number of drivers is drastically reduced. A display panel with each pixel thus wired in two dimensions is called a bit- or pixel-addressable matrix.

However, matrix addressing introduces a constraint on the active material used to make the pixels: the material must have an activity or switching threshold—a definite level of electrical current or potential below which there is no effect; only when the threshold is reached does emission or modification of light begin. When a pixel is to be activated, part of the potential intended for the addressed pixel can be applied through the row connection and part through the column connection. The other pixels that share either a row or column address with the desired pixel see only part of the potential, a part that falls below the activity threshold. Only the addressed pixel changes state.

While a switching threshold is a prerequisite characteristic, another trait that is highly desirable in a practical flat-display technology is bistable memory. If a display's pixels can be set either on or off and they will stay in that state until explicitly told otherwise, the display needs no external memory for refreshing the image. (This is especially valuable in light of the current cost structure of flat display panels: around 65 percent of a typical panel's cost goes for the electronic circuitry to drive it.)

One reason it's somewhat easier to design a flat screen limited to characters instead of arbitrary graphics is that characters are confined into distinct lines. The interstices between the lines then contain no active pixels. These dead areas can contain some of the panel's supplementary parts—physical spacers, driver transistors, or interconnections, making fabrication of the display potentially easier and cheaper. But development seems to be currently concentrated on the more general-purpose type.

**GAS-PLOasma Displays**

Gas-plasma displays are divided into two varieties, according to whether the pixels are activated by an AC or DC voltage. As shown in figure 1, both kinds of plasma display consist in essence of a glass envelope filled with a gas (usually neon or a neon/argon mix) at low pressure. When the gas is subjected to a sufficiently high electrical voltage, electrons are dissociated from the atoms by the electrical field, and the gas begins to emit light.

(continued)

Richard S. Shuford is BYTE's special-projects editor. He can be contacted at POB 372, Hancock, NH 03449.
The electric field, and the plasma that gives this technology its name is formed. When the electrons recombine with atoms, energy is released in the form of photons, and the gas glows with a bright orange-red hue. In a pixel-addressable design, the potential is developed at intersections between column and row electrodes arranged in a matrix, and current flows through the plasma at the intersections when a pixel is active. (The electrodes are usually made at least partially from a transparent material to allow the emitted light to escape more easily.)

The AC type, shown in figure 1a, places a dielectric layer between the neon and the electrodes; an AC signal is required to excite the neon because the only coupling from the electrodes to the gas is capacitative. The DC type, shown in figure 1b, is of simpler construction—omitting the dielectric layer and dividing the envelope into separate chambers for each pixel—and requires less complex drive circuitry. But the DC type shows less promise for use in general-purpose computer displays because it requires that the image be constantly refreshed from an external source. Considering the need to avoid flicker, the DC type is limited in practice to displays of no more than about 40 alphanumeric columns.

Even with the greater complexity of the circuitry needed to drive the display, the AC plasma technology is preferred for large screen sizes because most implementations need no image refreshing. Once the gas-plasma in the region of a given pixel has been stimulated to emit light by the application of a signal that exceeds the threshold voltage (by the combined potential at the intersection of the currently addressed row and column electrodes), the emission of light can be continued by maintaining an AC keep-alive voltage on the electrodes. The capacitive coupling allows enough voltage through to maintain the activity of currently conducting electrode intersections while not presenting enough potential to nonconducting areas to turn them off. (The display drivers must explicitly turn off any pixels that should be darkened by bringing the voltage at the appropriate intersection below the keep-alive point.)

The most widely known example of AC plasma technology is the IBM 581 Plasma Display. This 17.2-inch-diagonal, 3-inch-thick module contains 960 rows and 768 columns, for a total of 737,280 pixels. The contents of four conventional 25-line by 80-column screens can be displayed simultaneously with room left over. A demonstration of the 581 drew a crowd at the 1983 National Computer Conference (NCC), where it displayed images transmitted from an IBM Personal Computer (PC). But don't expect to see great numbers of IBM PC users switch to using the plasma screen: at over $2,500 in small quantities it costs more than an entire IBM PC system. The IBM plasma displays are usually sold to VARs (value-added resellers) as components to be built into special-purpose equipment. IBM also builds a few finished products of its own, such as the model 3295 display (shown in photo 1), which sells at retail for $8,369.

Researchers at the Burroughs Corporation have developed a promising hybrid AC/DC plasma display that combines the better characteristics of each: the drive simplicity of the DC type and the image memory of the AC units. Shown in figure 2, the scheme employs DC electrodes to "prime" the gas and make it more easily ionized, plus a separate set of AC electrodes to control the image. This technology is being brought to market by Plasma Graphics Corporation, a manufacturing firm associated with Burroughs Corporation.


AC plasma displays have already been successful enough to shoulder aside the CRT in applications where extremely large displays are required, such as in a document-processing station where several entire pages must be shown side by side or in military battlefield displays. But plasma displays remain expensive for several reasons. As mentioned earlier, the cost of the drive electronics is the

---

Figure 1: In both kinds of gas-plasma-discharge display, a glass envelope is filled with a gas (usually neon or a neon/argon mix) at low pressure. Electrons are dissociated from the atoms by the electric field of a high electrical voltage. When the electrons return to a lower energy state, photons are released, and the gas glows a bright orange-red. So that every pixel may be easily addressed, the voltage is developed at intersections between column and row electrodes arranged in a matrix. The AC panel, shown in 1a, requires somewhat more complex drive circuitry but has inherent memory for the image. The DC type, shown in 1b, is of simpler construction.
The voltages that must be used to excite the gas-plasma are high, compared to digital-signal levels, and are not easily generated by integrated circuits. Until recently, driver components have been partially integrated hybrids, but semiconductor companies have been working on the problem and better solutions are beginning to appear.

Although the glass panels are a smaller part of the cost, their fabrication is not without its own complications. Because the gas can be readily ionized into a plasma only at low pressures, the glass envelope must be able to withstand the considerable force from the outside atmosphere: the total pressure differential on the panels of the IBM 581 is about 1 ton. Furthermore, the amount of panel bending that can be tolerated is small; the proper distance must be kept between electrodes (typically 0.08-mm millimeter spacing with a tolerance of 0.008 mm either direction). Most designers cope with this problem by inserting physical spacers between the glass layers.

But these spacers create a new problem: there are small areas that interfere with the intended image in many ways—by remaining dark, by spuriously reflecting light from nearby discharges, by interfering with the discharges, or by perturbing the placement of the electrode conductors. The spacers in the IBM 581 are specially treated to reduce undesirable effects, which adds to the cost, and they are sized to avoid the electrodes. But even with these precautions the 581's spacers may be observed by close inspection when the panel is operating. Other makers, such as NEC have tinkered with other design parameters to avoid using spacers altogether in panels of moderate size.

The level of light generated by a plasma panel ranges from about 40 foot-lumens (fL) to a few hundred fL, with most falling in the low end of the range. The power consumption for the panel and its support circuitry is likely to run between 15 and 100 watts; this figure is dependent on the panel's size, the proportion of pixels turned on at a given instant, the efficiency of the driver circuitry, and other factors. A 25 by 80 screen would probably draw at least 30 watts.

The cost of a plasma panel, like so many other technological advances, will likely come down as advances in design are made and as economies of scale in manufacture are achieved. It's possible that within a few years plasma units could be available in large quantities for a few hundred dollars, but the development of satisfactory low-cost integrated support circuits will be a determining factor.

Research continues on enhancements to plasma's basic operating principles. Japanese efforts may eventually achieve a good gray scale, better power efficiency, and perhaps even a practical full-color system, with tricolor phosphors supplementing the orange glow of the neon discharge. At present, plasma displays are suitable for use in certain kinds of fixed-location equipment, but their relatively high power consumption is keeping them out of one major flat-screen application: portable computers. And to establish a beachhead in that market, the plasma panel would have to compete against other flat-screen technologies that are already ashore, including one that has been called the solid-state equivalent of the plasma display, which we shall now consider.

**ELECTROLUMINESCENT DISPLAYS**

If the IBM 581 plasma panel was popular at the 1983 NCC, then the appearance of the Grid Compass computer at the 1982 Office Automation Conference had been a sensation. The sleek black portable machine seemed to be the realization of every computer aficionado's dream: a 16-bit processor, a bubble memory, a built-in modem and telephone, a magnesium case, and more. But the most visually attractive feature of the Compass was its bright yellow display screen. Thus did the computer industry at large become aware of electroluminescent-display technology.

Oddly enough, ELDs have been around almost as long as computers. The idea had been tried during the (continued)
late 1950s, but nagging flaws had kept ELDs from becoming practical. The brightness, contrast, and lifetime were just not acceptable for serious use. However, by the early 1970s, the researchers' disappointment had worn off and work began anew on electroluminescent flat screens.

Four major variants of ELD technology have so far appeared, but all are based on the common motif of causing a phosphorescent substance to emit light by placing it in an electric field. As with gas-plasma-display technology, it is possible to address an electroluminescent screen with either AC or DC current. Furthermore, the phosphorescent substance may take the form of either a macroscopically deposited powder (a thick film) or a thin film formed by various means from molecular-scale particles. The roster of ELD possibilities consists of the four combinations of these choices.

Of the four, the variant that is currently most useful in computer displays is the AC thin-film electroluminescent, or ACTFEL, display. The ELD used in the Grid Compass is an ACTFEL unit built by Sharp Corporation.

Sharp demonstrated ACTFEL feasibility in 1974 with a prototype that operated successfully for 10,000 hours. Most other significant research in the field has been conducted or sponsored by the United States Army, with efforts centered at the Electronics Research and Development Command (ERADCOM) at Fort Monmouth, New Jersey. With the military establishment intent on obtaining a reliable flat screen, refinement of ACTFEL technology has been swift.

Commercial makers of ELDs currently include Sharp, Finlux/Lohja, Planar Systems, General Telephone and Electronics (GTE), Hycom, Kollsman Instrument, Sigmatron Nova, and Aerojet Electrosystems.

The basic structure of an electroluminescent panel, shown in figure 3, is fairly simple. The heart of the ELD is a phosphoric layer usually consisting of zinc sulfide (ZnS) doped with manganese, although other substances are sometimes used. A matrix structure of row and column electrodes surrounds the phosphoric layer. In the AC type, layers of dielectric material insulate the ZnS from direct electrode contact, and the coupling from the electrodes to the phosphoric material is capacitive. The resulting sandwich has five layers.

The addressing of a picture element resembles that of the plasma display. The phosphoric material will emit light when a sufficient voltage is placed across it. Part of the voltage is placed on a row electrode and part on a column electrode, so that only at the intersection of the two does the potential become great enough to exceed the threshold and excite the electrons associated with the atoms of manganese (or other dopant material). When an excited electron returns to a lower energy state, it emits a photon. When manganese is the dopant, the photon is given an amount of energy that causes the emitted light to be a pleasant yellow-amber color.

About half as bright as a plasma panel, the amount of light generated by an ELD ranges from about 20 to 30 fl. The power consumption for ELD panels and support circuitry is generally considered to be about half that of an equivalent plasma display; it can be as low as 13 watts for a 2.5 by 80 screen, although it ranges higher. Designers of battery-powered portable computers are eagerly hoping for further decreases in the current drain, and there is some possibility that a scheme to recapture the capacitive charge lost during the display's refresh cycle may help. A typical price for an ELD panel is $700, which Sharp now charges for a 6-inch-diagonal 40-column unit.

Although the current can be comparatively low (compared to other kinds of displays that make their own light), the voltages required for phosphoric excitation are rather high: at least 80 volts and often as much as 200 volts. On this one fact hang all the problems that occur with the ACTFEL technology.

(continued)
If you own an IBM-PC or PC work-alike, Roland’s new MB-142 monitor lets you show off your text and graphics in today’s hottest colors—black and white. That’s right! The MB-142 gives you black characters on a paper-white background—just like people have been reading for centuries. You can also have white characters on a black background with just the touch of a button.

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Will the ELD's price drop rapidly and make the CRT a museum piece?

Generating a sufficiently high potential and distributing it with the proper timing to all the electrodes in a large matrix is no small task. To begin with, the electrode conductors should conduct electricity well and yet pose no obstacle to the light coming out of the display—not a likely combination of traits. But the greater problem lies in the driver circuits. They must be able to handle the multihundred-volt potentials with some margin for safety and reassurance. They must also be able to drive relatively large capacitances: the long rows and columns of pixels present a considerable capacitive load. And yet the drive circuits must not be too large or the advantage of screen flatness would be lost. As we shall see, there has been some encouraging progress in this area.

Making an ELD that will work and keep working is something of a problem. The useful lifetime of a display panel goes down as greater brightness is demanded of it. Also, the thin-material (0.8 micron typical) films that enable the display to work so well are susceptible to defects that can render parts of the display useless. For instance, if a stray dust particle falls into the phosphoric layer during manufacture, it will cause the phosphoric layer to become increasingly bright as the drive voltage and frequency are increased. And if the impurity problems can be licked, it seems that ELDs could be manufactured at a cost less than plasma or other competing technologies because of their relatively simple solid-state, thin-film construction.

There are hints that someday a full-color ELD is possible. Use of different phosphoric materials changes the color of the emitted light, but there are large differences in the electrical efficiency of the phosphors for different colors and the research has a long way to go. However, two-color ELDs are likely to become available within the next two years.

TECHNOLOGY'S CONTINUING ADVANCE

Both electroluminescent and plasma displays were given a big boost when semiconductor companies recently began to produce integrated circuits that can drive many capacitively loaded lines with high voltages: Texas Instruments, Supertex, and Sharp were the first to succeed in this field, with Telmos and Siliconix recently joining. Supertex currently holds the technological lead, with chips that provide 64 drive channels, while the most advanced chips from other vendors provide 32. This density of packaging, achieved by various mixtures of DMOS (double-diffused metal-oxide semiconductor), CMOS (complementary metal-oxide semiconductor), and bipolar logic, allows a system designer to keep the control circuitry to a size compatible with the flat screen.

Then, too, electroluminescence and plasma discharge are not the only phenomena around which a flat-screen display may be built. Other technologies are under investigation, some tried and true (like vacuum-fluorescence), others exotic and unlikely (like electrochrominance, electrophoresis, and gas-electron phosphors). Even arrays of light-emitting diodes are being considered.

Many questions still remain. Will the electroluminescent display's price drop rapidly and make the CRT a museum piece? Or will the plasma display achieve such heights of resolution and screen size that new applications for computers become possible? Will a practical means of building a full-color display appear for any flat-screen technology? Will electrophoresis suddenly experience a change in its (so far disappointing) fortune and take the display world by storm? Or will LCDs overcome their problems and cause abandonment of all the light-emissive technologies?

Even the experts can't agree on a prediction of the successes of the new flat-screen displays. In a field driven so closely by the pace of technological advancement, we'll all read the announcement of success together, and we'll probably read it on a CRT.

REFERENCES


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A number of years ago, I had the U.S. Navy. At that time, I had to use a books of tables to chart my course. Now, with a portable microcomputer and a few way across any ocean.

Not long ago, only large ships could carry computers with the precision to manipulate the navigator of the smallest computer systems available. (continued)

Frederic N. Rounds (894 Persimmon Ave., Sunnyvale, CA 94087) is a telecommunications engineer with NASA Ames Research Center in Mountain View, California. He has a B.S. degree from Ohio State University and an M.S. degree from California State University at Hayward, both in mathematics. He learned navigation in the U.S. Navy and his interests include amateur radio, backpacking, and sailing.
You can determine a ship's geographic position in degrees of longitude and latitude by calculating your distance and direction from the sun's image projected on the earth at a particular point in time. The ship's location, after you complete your calculations, is called a fix.

At sea, distance and time are measured using certain accepted standards. Distance is given in nautical miles (6000 feet are equal to 1 nautical mile). This convention works well because 1 degree of angular distance measured along a great-circle route equals 60 nautical miles. Therefore, 1 minute of angle equals 1 nautical mile.

You always measure distance using great-circle arcs between points; therefore, the conversion from angular to linear measure is direct. Since most of the navigation process uses spherical triangles, angular measure simplifies the calculations.

The standard for time, called Greenwich mean time (GMT), is based on a 24-hour clock in Greenwich, England. You must keep an accurate clock showing GMT.

You begin solar navigation by first measuring the angular distance between the sun and yourself with a device called a sextant. It measures the altitude ($H_0$), which is the angle between the horizon and the celestial body. The angular distance between you and the celestial body's image is called the zenith distance and is determined by subtracting the sextant reading from 90 degrees (see figure A). When you take your sextant reading, you must also note the current GMT.

You have to keep track of your course and speed. Course is measured clockwise from geographic north, from 0 to 360 degrees. (If you use magnetic north [from a compass] you must apply a correction to get to true north. This correction is found on most nautical charts showing whatever section of ocean you are sailing.)

You must also note the current GMT.

![Figure A: The zenith distance is the angular distance on the earth's surface between you and the sun's image.](image)

![Figure B: Using the sun's position, your position, and the LHA, you can solve for $H_c$ and $Z$ using site-reduction tables, or formulas from spherical trigonometry.](image)

![Figure C: In this case $90-H_0$ is greater than $90-H_c$. Your actual position lies on an arc (LOP) of a circle of center O and radius $90-H_0$.](image)

![Figure D: Your assumed longitude and latitude form a coordinate system that contains the lower right corner of the triangle in figure B. The corner is formed by $90-H_c$ and your longitude. The LOP is a line drawn perpendicular to the radius of length $90-H_0$. This drawing is hypothetical in that it assumes $90-H_0$ is greater than $90-H_c$.](image)
Speed is in nautical miles per hour (knots). If you plot previous fixes, you can track your course by moving your position ahead a distance equal to your speed times the amount of time since you last calculated your position. This process is called dead reckoning (DR), and your estimated position is called the DR plot.

Since the sun is your fixed reference, you must also determine the sun's location for the particular time and date. Every year the Naval Observatory publishes the Nautical Almanac (see reference 4). In it you'll find a table giving the sun's position for any date and time during the calendar year. The GHA (Greenwich hour angle) and the declination mark the position of the sun's image on the earth's surface.

Using the information obtained so far, you can construct the spherical triangle shown in figure B. The angle at the top of the sphere is the local hour angle (LHA), and it is the included angle in the navigational triangle. Before the existence of programmable calculators, navigators had to consult a large group of books called HO 229 (see reference 2) to find solutions to the triangle. These books hold solutions to all the possible spherical triangles you might encounter. However, you can solve the triangle with the following formulas:

\[ H_c = \sin^{-1} \left( \frac{\sin(your \ latitude) \times \sin(declination) + \cos(your \ latitude) \times \cos(declination) \times \cos(LHA))}{\cos(LHA/\cos(H_c))} \right) \]

where \( H_c \) is the altitude you would measure if your ship were actually located at the assumed position (AP) and \( Z \) is the azimuth angle, which you will use later.

There are now two versions of the altitude, \( H_c \) and \( H_o \). If \( H_o \) is less than \( H_c \), then your true position lies somewhere to the right of the AP; if \( H_c \) is greater than \( H_o \), then it is to the left.

For example, let's suppose \( H_o \) is less than \( H_c \) (as in figure C). Since \( H_o \) does not equal \( H_c \), your AP is probably off in both longitude and latitude. Your true position lies on an arc called the line of position (LOP). You must make two assumptions here for short distances (100 miles or less): first, you must treat the earth's surface as if it were a plane, and second, you must be sure the AP is within this 100-mile tolerance. This allows you to use plane geometry to calculate your position.

Figure D shows the lower right corner of the triangle in figure B. The corner is drawn within a coordinate system made with the longitude and latitude of your AP as axes. The corner is formed by using your AP's longitude and a side of 90-\( H_o \). The LOP is shown as a line drawn perpendicular to the radius of length 90-\( H_o \).

Now you need to wait for an hour or more. Of course, during this wait both you and the sun will move. After this time, take another sextant reading and plot a new LOP using the same AP you used earlier. Since your boat has been moving on a certain course and speed, you need to adjust the old LOP to account for the boat's motion. We call this adjustment advancing or retiring the LOP. The LOP is kept parallel while it is moved along the LOP's perpendicular. The distance of the move is equal to the cosine of the angle formed by the course segment and the perpendicular (angle A in figure E).

You should plot the advanced (or retired) LOP and the new LOP on the same coordinate system, and they should intersect at your true fix (see figure F). Without plotting, the intersection can be determined by using analytic geometry and solving a set of two simultaneous equations in two unknowns. The Sunfix program takes the second approach.
In this article, I'll describe the general navigation process. My BASIC program called SUNFIX.DOC computes a ship's geographic position based on two successive sextant readings of the sun. You don't need to be a sailor to use the program, and you can apply its results anywhere in the world—on land or on sea. [Editor's note: The Sunfix program is available for downloading via BYTENet Listings. The telephone number is (603) 924-9820. The program is currently set up to display all prompts and responses on a printer. If you want the displays to appear on the screen, you must replace all LPRINT statements with PRINT statements.]

**THE GENERAL NAVIGATION PROCESS**

Ocean navigation is the method of determining a ship's relationship to a fixed reference point, such as a lighthouse, shoreline prominence, or the image of a celestial body on the earth's surface. We use the sun's image as a reference point. There are some advantages in doing this: the sun is visible most of the time, it is easy to find, and its apparent motion can be predicted accurately for many years into the future with mathematical models.

My program provides accurate solar positions for the next 300 years (see reference 1). For more details on the navigation process, please see the text box "Ocean Navigation" on page 142. For definitions of the navigation terms I use in this article, please consult the Glossary at left.

**THE COMPUTER SOLUTION**

Sunfix computes the exact geographic position of the sun for any date and time of the year. It does this by applying a curve-fitting algorithm to the sun's motion. The expected accuracy is within 1 minute of arc for the next 300 years. You supply Sunfix with easily obtainable data: time of day, barometric pressure, temperature, assumed longitude and latitude, and two sextant readings spaced a few hours apart. In less than 1 minute Sunfix returns a geographic position in degrees and minutes of longitude and latitude.

Sunfix could replace your almanacs. However, you still need a sextant and a chronometer. And, to compute the corrections necessary because of atmospheric refraction during the sextant reading, you also need a barometer and a Celsius thermometer.

Sunfix has four main capabilities. It keeps your current GMT (Greenwich mean time) and date using the computer's clock. It maintains your DR (dead reckoning) position automatically. It computes the GHA (Greenwich hour angle) and the declination of the sun for any particular date and GMT. And it computes your fix or location.

Time is kept by the BASIC TIME function. I wrote the program in TRS-80 Model III BASIC, but I used as (continued)
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much generic BASIC as possible. Although there may be some variances with other computers, I think the Sunfix program can be converted to almost any modern portable microcomputer.

The DR position calculations require a special form of the Julian Calendar. Sunfix begins counting days at noon, January I, 4713 B.C.; hence, the day counts are very large. This is the date-keeping convention used in most astronomy calculations.

To compute the sun's GHA and declination, you must use astronomy. Astronomers locate celestial bodies differently than navigators do, so you have to make some conversions. You have to convert GMT to a standard called Greenwich mean sidereal time (GMST). Sidereal time is based on the sun's position on the first day of spring (the Vernal Equinox)—called the first point of Aries because the sun's position on that day is in the constellation of Aries. In astronomy, the positions of celestial bodies are measured to the east of the first point of Aries—called right ascension. Therefore, if you're going to use astronomy to navigate, you will have to convert from right ascension to GHA (see reference 3, pages B3–B4).

Now you are ready to calculate the right ascension and the declination of the sun. The algorithm used is a sine-cosine series that produces a best fit to the periodic motion of the sun (see reference 5). (The arguments and coefficients in this series require particularly high accuracy, so double-precision variables are used in all the formulas.) This algorithm also provides the earth-to-sun distance for any date and time—a number that becomes important when you are making the necessary corrections in the sextant reading. Once Sunfix has calculated the right ascension, it converts the result to GHA.

In addition to accepting your settings as inputs, the main function of Sunfix is to compute your fix. You begin navigating with a sextant reading, and you must correct it because of the following factors (see also reference 3, pages B13–B16):

- Dip: This correction is required when the sextant reading is taken at some height above sea level.
- Index Correction: The built-in mechanical error of the sextant requires correction. You must determine this correction experimentally.
- Refraction: The earth's atmosphere causes light to bend, which distorts the celestial position. Refraction varies with temperature and pressure so the formula I used in Sunfix is accurate for sextant readings greater than 15 degrees. (More precise formulas are available in reference 3.)
- Semidiameter: The sextant measures from the horizon up to the bottom edge of the sun. You must add the solar radius to the sextant reading because the radius varies during the sun's transit.

After you complete the first sextant reading, the program waits for a second one. The time between the first and second reading is usually several hours. Therefore, you need sufficient power to keep your computer going while the program is running. Two points: course and speed changes are allowable during dead reckoning; during a fix process, however, you must keep your course and speed constant.

CONCLUSION

It's now simple to do a lot of navigation with a portable microcomputer. Of course you still need some basic instruments for environmental readings but you no longer have to spend hours studying almanacs and working on formulas to figure out where you are. After your basic readings have been taken, Sunfix calculates your geographic position in less than 1 minute. This leaves you more time to enjoy the sea.

REFERENCES

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<tr>
<td>1200 and 300 baud, auto-dial, auto-answer</td>
<td>Yes</td>
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<td>Compatible with &quot;AT&quot; command set</td>
<td>Yes</td>
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<tr>
<td>Can be used with CROSSTALK-XVI or Smartcom II software</td>
<td>Yes</td>
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<td>Regulated DC power pack for cool, reliable operation</td>
<td>Yes</td>
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<td>Eight indicator lights to display modem status</td>
<td>Yes</td>
<td>Yes</td>
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<td>Speaker to monitor call progress</td>
<td>Yes</td>
<td>Yes</td>
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<td>Attractive, compact aluminum case</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Two built-in phone connectors</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>Compatible with The Source and Dow Jones News Retrieval</td>
<td>Yes</td>
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<tr>
<td>Unattended remote test capability</td>
<td>Yes</td>
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<tr>
<td>Phone cable included</td>
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<td>Availability</td>
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### Price

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<tr>
<th>Ven-Tel 1200 PLUS</th>
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<tr>
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MODIFY STRUCTURE
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Move the cursor to the place where you want to insert the new field.

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Adds the new field.

The new field will be inserted above the cursor position.

```
SEX
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Specifies that the new field is titled "SEX", has the default value of a character field, and is one column wide.

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W
```

ends your input.

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confirms that you're satisfied with what you've done.

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A unique algorithm for problem solving

Unit conversion is a conceptually simple, easily programmable process. However, the algorithm you choose to perform the conversion has a significant impact on both the complexity of the program and the efficiency of its use.

I developed an algorithm for unit conversion that is rather unique in that I developed it specifically for this problem. As a result, it is a simple, versatile tool that is easy to use and runs efficiently in a 16K-byte computer. While this type of memory limitation is no longer a major concern for most software writers, there is always a need for efficiency.

In developing this algorithm I considered several factors imperative. The algorithm had to be clear and concise. It had to be both simple to use and implement. It had to be easy to stretch to fit superset of the problem. The knowledge base supporting the algorithm had to be both clear and concise and fit the structure of the problem. The algorithm's progress in debugging and analysis had to be easy to monitor. And, finally, the algorithm had to fit the tool used for implementation.

The measurement-conversion program, Convert (see listing 1), processes each word independently. Because the program is table-driven, it can be easily extended to include almost any unit of measure. The listing includes about 80 basic units and 16 prefixes. I originally wrote this program in BASIC for a TRS-80 Model I Level II but have since converted it to run under Microsoft BASIC. This latter version is the one I included in this article. (Editor's note: The Convert program is available for downloading via BYTEnet Listings. The telephone number is (603) 924-9820) The text box "Number-Base Conversion" on page 152 expands the algorithm's application to include conversions between numbers with different bases.

What Are Units?
Units of measure are the result of people trying to quantify the world around them. Some units, such as "day," occur naturally and are understood universally. Distance, on the other hand, has no obvious standard. One early unit used to measure distance was the "pace," but this measure varied from person to person. In some countries, kings declared standard units of length: for example, the length of a "foot" was determined this way. Of course, it was the length of the king's foot that set the standard. Some industries, such as shipping, defined their own units, for example, knot or fathom.

In time, standards did develop, but they rarely extended beyond linguistic and geographic boundaries. Poor communications contributed to the confusion. Individual countries could not easily coordinate unit standards with each other—even when they wanted to. The problem of how to convert units among countries reached a head when countries attempted to draft trade agreements. It became possible for a country with a quantity of Xs to trade with others for a quantity of Ys and it became important to know how many Xs were equal to how many Ys.

Once global communications became easier, countries were able to tell each other the size of their respective units, but they were still faced with a laborious and confusing conversion problem. To solve this, people tried to create "rational" standards (such as the metric system), which take measurements from natural phenomena instead of variables, such as the area a man with a single horse could turn over with a plow during one day (an acre). However, for political and financial reasons (not to mention stubbornness), the metric system has not been accepted worldwide: regional differences and peculiarities continue to exist.

Today, as always, people have to convert units frequently, and not just (continued)

David L. Kahn, manager of decision-support systems for Wang Laboratories in Lowell, Massachusetts, has degrees in computer science and management from MIT. His outside interests include classical piano and recreational mathematics, and he can be contacted at 14 Charlemont St., Newton Highlands, MA 02161.
A simple number-base conversion algorithm has much in common with the single multiplicative factor (SMF) unit-conversion algorithm. I will illustrate one such number method here.

By illustrating the SMF approach in a simpler but related application, I hope to demonstrate many of the subtleties of the SMF program.

In this example it is necessary to distinguish between a quantity and a number. A quantity is an amount that may be represented as a number. A number is a string of numerals. A number in a given base represents a quantity.

**DESCRIPTION**

In symbolic terms, the number \( abcd \), refers to \( ar^3 + br^2 + cr + d \). One fact that should be obvious from this is that, in base \( r \), there must be a numeral for every quantity between 0 and \( r-1 \). If this is not the case, then not every quantity can be represented. The quantity 12 cannot be represented in base 16 with only the digits 0 through 9. The traditional solution is to use A to mean one more than 9. From A, the remaining alphabet can be used in ascending sequence. The numeral C then refers to 12 in base 16.

Note that this standard is arbitrary. For instance, A through Z could be used to refer to the quantities from 1 to 26. In this case, the quantity 38 would be represented as CH.

There are a number of ways to convert a number into a quantity using a given number base. To understand the method I used in listing A, look at formulas F and G below.

**Formula F**

\[ ar^3 + br^2 + cr + d \]

**Formula G**

\[ ((ar + b)r + c)r + d \]

Formula F interprets a number in base \( r \). Formula G factors out individual \( r \) terms wherever possible and is used in the program. With this formula you don't need to know in advance how many numerals are in the number. Each numeral can be processed individually. In turn, from left to right. This sequential processing is illustrated with an example in figure A.

Note that all the arithmetic operations are done on quantities, not numbers. The results do not depend on the internal representation. This operation is the same as that for a reference unit in a unit-conversion scheme, except that here it is better defined. There is a significant distinction between a quantity (an amount of something) and a number (a string of numerals). In the program the numbers are even stored as string variables.

In converting a quantity into a number, you can use the reverse of the G formula, and sequential processing can also be applied. Sequential processing is even more important here, since it isn't obvious how many numerals will be required.

The G formula can be thought of as \( xr + d \), where the \( x \) refers to \( ((ar + b)r + c) \). The total count of preceding numerals in \( x \) is irrelevant. If the quantity of interest is divided by \( r \), the remainder would be \( d \), no matter how complicated the \( x \) term was. This is the modulo function of integer arithmetic. If one then subtracts \( d \) from the quantity and divides the result by \( r \), the result is the quantity represented by \( x \). The process can then be repeated.
Listing A: The user-base conversion program.

10 INPUT "CONVERT NUMBER "; A$  
20 INPUT "FROM BASE "; R1: IF R1 < 2 OR R1 > 36 THEN PRINT "1 TO 36 ONLY"; GOTO 20  
30 INPUT "TO BASE "; R2: IF R2 < 2 OR R2 > 36 THEN PRINT "1 TO 36 ONLY"; GOTO 30  
40 T$ = 0  
50 FOR C = 1 TO LEN(A$)  
60 V = ASC(MID$(A$, C, 1))  
70 IF V > 47 AND V < 58 THEN V2 = V - 48  
80 IF V > 64 AND V < 91 THEN V2 = V - 55  
90 IF V > 96 AND V < 123 THEN V2 = V - 85  
100 IF V2 > = R1 THEN PRINT "NUMERAL TOO HIGH IN NUMBER"; GOTO 10  
110 T$ = T$ * R1 + V2  
120 NEXT C  
130 B$ = ""  
140 WHILE T$ <> 0  
150 V2 = T$ - INT(T$ / R2) * R2: REM V2 = T$ MOD R2  
160 T$ = (T$ - V2) / R2  
170 IF V2 <= V =  
180 IF V2 > = THEN V = V2 + 55  
190 B$ = CHR$(V) + $  
200 WEND  
210 PRINT "THE ANSWER IS: "; B$; PRINT  
220 GOTO 10

Listing B: A sample session demonstrating the program.

CONVERT NUMBER 1425  
FROM BASE ? 10  
TO BASE ? 16  
THE ANSWER IS: 591

CONVERT NUMBER 58F  
FROM BASE ? 16  
TO BASE ? 10  
THE ANSWER IS: 1423

CONVERT NUMBER 1001101110110  
FROM BASE ? 2  
TO BASE ? 16  
THE ANSWER IS: 1376

CONVERT NUMBER 5231  
FROM BASE ? 10  
TO BASE ? 36  
THE ANSWER IS: 41

CONVERT NUMBER ?  
THE HEART OF THE ALGORITHM IN LINES 110 FOR THE INPUT AND LINE 160 FOR THE OUTPUT. THIS IS SIMILAR TO LINE 1120 OF THE UNIT CONVERSION IN THE CONVERT PROGRAM. THE MAJOR DIFFERENCE IS THAT THE UNIT-CONVERSION FORMULA IS INVERTIBLE, REQUIRING ONLY ONE PROGRAM SECTION.

SUMMARY

As can be seen from these two examples, the concept of reference (absolute meaning) where different representations exist is useful. In starting from this assumption, deriving an algorithm that is both general and simple to implement is straightforward.

The number-base conversion algorithm usefully and simply illustrates this approach in a known domain. The SMF algorithm for unit conversion is a more significant application of the approach to an otherwise difficult problem.
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CONVERSION

Listing 1: The Convert program written in Microsoft BASIC.

```
10 PRINT CHR$(12);
15 READ ND, NP, NU
20 DIM PR$(20), PR%(20), UN$(100), UN(100), UN%(100,10)
30 DIM DES(I), D%(10)
100 FOR X=0 TO NP:READ PR$(X), PR%(X), UN$(X), UN(X); NEXT X
105 NEXT X
110 FOR X=0 TO ND:READ DES(X); NEXT X
120 FOR X=0 TO NU:READ UN$(X), UN(X); NEXT X
125 FOR Y=0 TO ND:READ UN%(Y,X); NEXT Y, X
130 PRINT CHR$(12)
195 PRINT "UNIT CONVERSION—COPYRIGHT 1984 DAVID KAHN"
197 PRINT
200 PRINT "TYPE HELP FOR INSTRUCTIONS"
205 PRINT "NOTE: ONLY UPPERCASE LETTERS SHOULD BE USED IN THIS PROGRAM"
210 FOR X=0 TO ND: D%(X) = 0: NEXT X
215 PRINT: I$ = "": INPUT "INPUT""; I$: IF I$ = "HELP" THEN 4000
220 IF LEFT$(I$, 1) = "?" THEN 1$ = MID$(I$, 2) ELSE 300
230 I = 1: GOSUB 1000
240 F = 0: FOR X = 0 TO ND: IF D%(X) > 1 THEN PRINT DES(X) ""; ELSE IF D%(X) = 1 THEN PRINT DES(X) ""; ELSE IF D%(X) < 0 THEN FL = 1
245 NEXT X
250 F = 0: FOR X = 0 TO ND: IF D%(X) > 1 THEN PRINT DES(X) ""; ELSE IF D%(X) = 1 THEN PRINT DES(X) ""; ELSE IF D%(X) < 0 THEN FL = 1
255 NEXT X
260 PRINT: GOTO 210
300 N = VAL(I$): I$ = 0: THEN PRINT "YOU MUST GIVE AN INPUT NUMBER: GOTO 210" ELSE X = 1
310 IF MIDS(I$, 1, 2) = "" OR X + LEN(I$) THEN 320 ELSE X = X + 1: GOTO 310
320 X = 1: I$ = MIDS(I$, X, I$:O = 1: GOSUB 1000
330 I$ = "" INPUT "CONVERT TO"": O = 0: GOSUB 1000
340 F = 0: FOR X = 0 TO ND: IF D%(X) < 0 THEN PRINT DES(X) "" DIMENSION INCOMPATIBILITY": FL = 1
350 NEXT X: IF FL = 1 THEN 210
360 PRINT: "ANSWER = " : I$ = INT(LOG(N) / LOG(10)) + 1
370 IF LO < 5 AND LO > 0 THEN PRINT USING "##.#####"; N: GOTO 210
380 IF LO = 2 THEN PRINT USING "##.#####": N = VAL(I$): GOTO 210
390 PRINT USING "##.#####": N = VAL(I$): GOTO 210
1000 DN = 1
1100 I$ = LEFT$(I$, 1) = "" THEN I$ = MIDS(I$, 2): GOTO 1010
1101 I$ = "" THEN RETURN
1102 FOR X = 1 TO LEN(I$): IF MIDS(I$, X, 1) = "" THEN 1040 ELSE NEXT X
1103 FOR X = 1 TO LEN(T$): IF MIDS(T$, X, 1) = "" THEN 1049 ELSE NEXT X
1104 IF T$ = LEFT$(T$, X - 1): I$ = MIDS(I$, T$:T$ = 1: P = 1
1105 F = "PER" THEN DN = -1: GOTO 1010
1106 FOR X = 1 TO LEN(T$): IF MIDS(T$, X, 1) = "" THEN 1090 ELSE NEXT X
1107 IF X = LEN(T$) THEN 1110
1108 IF P = 0 THEN PRINT "POWER ERROR IN TERM " "": GOTO 210
1109 T$ = LEFT$(T$, X - 1)
1110 IF RIGHTS(T$, 4) = "CHES" THEN T$ = LEFTS(T$, LEN(T$) - 4)
1111 IF RIGHTS(T$, 3) = "IES" THEN T$ = LEFTS(T$, LEN(T$) - 3) + 1
1112 IF RIGHTS(T$, 4) = "S" AND RIGHTS(T$, 2) = "SS" THEN T$ = LEFTS(T$, LEN(T$) - 4)
1113 FOR X = 0 TO NU: IF T$ = UN$(X) THEN 1120 ELSE NEXT X: GOTO 1120
1120 N = (UN$(X) - Y$: P = 1: DN = 1
1130 FOR Y = 0 TO ND: D%(Y) = D%(Y) + P: D%(Y) = UN$(Y): NEXT Y: GOTO 1101
1140 FOR X = 0 TO NP: IF LEFTS(T$, X, LEN(T$) - 4) THEN 1150 ELSE NEXT X: GOTO 1170
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CONVERSION

1150 TS=MID$$(TS,PR6(X)+1):T=PR(X):GOTO 1110
1170 PRINT "UNDEFINED UNIT OR PREFIX IN " ''TS" ""GOTO 210
4000 PRINT CHR$(12);""THIS PROGRAM CONVERTS NUMBERS BETWEEN UNIT SYSTEMS SUCH AS"
4010 PRINT "METRIC AND ENGLISH. IT WILL ALSO EXPLAIN THE DIMENSIONALITY"
4015 PRINT "OF A UNIT OR COMBINATION IF DESIRED. THIS PROGRAM UNDERSTANDS"
4020 PRINT "A LARGE NUMBER OF UNITS AND PREFIXES THAT ARE LISTED ON THE"
4025 PRINT "SECOND PAGE OF THIS HELP DOCUMENTATION. THE THIRD PAGE INCLUDES"
4030 PRINT "SEVERAL EXAMPLES."
4035 PRINT "THE INPUT GIVEN IS ?<UNITS>?, THE DIMENSIONALITY OF"
4040 PRINT "<UNITS> WILL BE PRINTED. IF '<NUMBER> <UNITS>' IS GIVEN;
4045 PRINT "YOU WILL BE ASKED 'CONVERT TO?' AND THE RESULT OF THE CONVERSION"
4050 PRINT "WILL BE PRINTED."
4055 PRINT "THE <UNITS> INPUTS CONSIST OF AN OPTIONAL SEQUENCE OF UNIT"
4060 PRINT "SPECIFIERS, FOLLOWED BY AN OPTIONAL 'PER', FOLLOWED BY MORE"
4065 PRINT "OPTIONAL UNIT SPECIFIERS. SPACES MUST SEPARATE UNIT SPEC BUT"
4070 PRINT "MAY NOT APPEAR INSIDE THEM. A UNIT SPEC IS AN OPTIONAL SET OF"
4075 PRINT "PREFIXES, AND AN OPTIONAL POWER TERM."
4099 INPUT "PRESS ENTER TO CONTINUE";$
4100 PRINT "VALID UNITS ARE:";
4110 FOR X=0 TO NU:0$=UN$(X):GOSUB 4900:NEXT X
4120 PRINT:PRINT "VALID PREFIXES ARE:";
4130 FOR X=0 TO NP:0$=PR$(X):GOSUB 4900:NEXT X
4140 PRINT:PRINT "ONE PREFIX IS PERMITTED IN A UNIT SPEC. TYPICAL"
4150 PRINT "SEQUENCES ARE 'MILES PER HOUR' AND 'KILOGRAMS PER FOOT'^2."
4165 PRINT "EXAMPLES: (INPUTS AT LEFT, RESPONSE INDENTED)"
4175 PRINT "MILES PER HOUR"
4185 PRINT "DISTANCE PER TIME"
4195 PRINT "WATTS"
4205 PRINT "DISTANCE^2 MASS PER TIME^3"
4215 PRINT "8000 BTU PER HOUR"
4225 PRINT "CONVERT TO: WA TIS"
4235 PRINT "CONVERT TO: POUNDFORCE PER FOOT^2"
4245 PRINT "CONVERT TO: POUNDFORCE PER FOOT^2"
4255 PRINT "CONVERT TO: POUNDFORCE PER FOOT^2"
4265 PRINT "CONVERT TO: POUNDFORCE PER FOOT^2"
4275 PRINT "CONVERT TO: POUNDFORCE PER FOOT^2"
4285 PRINT "CONVERT TO: POUNDFORCE PER FOOT^2"
4295 PRINT "CONVERT TO: POUNDFORCE PER FOOT^2"
4305 PRINT "ONE PREFIX IS PERMITTED IN A UNIT SPEC. TYPICAL"
4315 PRINT "<UNITS>"
4325 PRINT "DIMENSIONS ARE 'MILES PER HOUR' AND 'KILOGRAMS PER FOOT'^2."
4335 PRINT "EXAMPLES: (INPUTS AT LEFT, RESPONSE INDENTED)"
4345 PRINT "MILES PER HOUR"
4355 PRINT "DISTANCE PER TIME"
4365 PRINT "WATTS"
4375 PRINT "DISTANCE^2 MASS PER TIME^3"
4385 PRINT "8000 BTU PER HOUR"
4395 PRINT "CONVERT TO: WA TIS"
4405 PRINT "CONVERT TO: POUNDFORCE PER FOOT^2"
4415 PRINT "CONVERT TO: POUNDFORCE PER FOOT^2"
4425 PRINT "CONVERT TO: POUNDFORCE PER FOOT^2"
4435 PRINT "CONVERT TO: POUNDFORCE PER FOOT^2"
4445 PRINT "CONVERT TO: POUNDFORCE PER FOOT^2"
4455 PRINT "CONVERT TO: POUNDFORCE PER FOOT^2"
4465 PRINT "CONVERT TO: POUNDFORCE PER FOOT^2"
4475 PRINT "CONVERT TO: POUNDFORCE PER FOOT^2"
4485 PRINT "CONVERT TO: POUNDFORCE PER FOOT^2"
4495 PRINT "ONE PREFIX IS PERMITTED IN A UNIT SPEC. TYPICAL"
4505 PRINT "<UNITS>";
Inquiry 3 72

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**Magnitude and Dimensionality**

If you look closely at a unit of measure you will see that it has two parts: magnitude and dimensionality. Magnitude is the quantity or extent of a particular unit (how much). Dimensionality refers to the qualitative aspects of the unit (the "what"). It is impossible to convert between units of differing dimensionality. (See the Glossary on page 164 for definitions of the terms I use in this article.) A difference in magnitude might be the difference between a foot and a yard, while a difference in dimensionality might be the difference between a foot and a gallon.

The dimensionality of a unit can be expressed in terms of a power of each of the primary dimensions. Primary dimensions such as distance, time, mass, and angle cannot be further broken down. The English names for the first, second, and third powers of distance are length, area, and volume, respectively. For example, a yard is the first power of distance, an acre is the second power, and a tablespoon is the third. Compound dimensions such as velocity (knots, miles per hour) are made up of powers of more than one primary dimension. Velocity is the first power of distance times the \(-1\) power of time. Conversion can be performed between any two units whose dimensionality (i.e., the powers of all primary dimensions) are identical.

**Existing Conversion Technology**

There are two methods of conversion in use today. The simplest is the con-
version table (an example is shown in table 1). If you know the measure of a unit in the column on the left and you want to convert it into a unit in the column at right, multiply by the number in the middle. The inverse conversion can be performed by division instead of multiplication.

This conversion method works particularly well for specific conversions. One successful application of this method is illustrated by the conversion calculators that are currently on the market. Unfortunately, if you need to convert a wide variety of measurements, the resulting table will be extremely cumbersome.

A more flexible alternative is shown in the conversion matrix in table 2. To convert from the unit at left to the unit on top, use the multiplicative factor at the intersection. Table 2 is a conversion matrix for units of distance. Note that a separate matrix is needed for each simple or compound dimension. For many units of the same dimensionality, the conversion matrix is more concise than the linear table and it can also be used more easily.

**THE SMF CONVERSION METHOD**

The conversion method I used in the Convert program is the single multiplicative factor (SMF) method. This method is easy for a computer to use, but difficult for people to use.

Table 3 illustrates the simplest form of the SMF method. It shows a single factor next to each unit. This number relates the size of that unit to a reference unit, a meter in this case. Note that this is the fourth column of table 2. The reference unit in this table is the meter, but the choice of reference is irrelevant. Table 4 shows the same table with an inch as the reference unit.

Given table 3 or 4, it is easy to convert both to and from the reference unit. Divide to convert to the reference; multiply to convert from the reference. When converting \( n \) feet to yards, divide \( n \) by the foot factor and multiply the result by the yard factor. The reference unit you choose has no effect as long as you use it consistently.

What is the effect of a prefix such as milli- in the unit millimeter? The value of milli- is \( 10^{-3} \) (as shown in table 5). The millimeter factor can be found by dividing the meter factor by the milli- factor. The result is the number of millimeters in the reference unit (1000 with the meter reference). In this manner, conversion can proceed the way I described previously, using the constructed factors. Note that consecutive prefixes can be easily

---

Table 1: The conversion table. To convert from a unit in the column at left to a unit in the same row of the column at right, multiply by the corresponding number in the center column.

<table>
<thead>
<tr>
<th>Multiply</th>
<th>By</th>
<th>To get</th>
</tr>
</thead>
<tbody>
<tr>
<td>feet</td>
<td>12</td>
<td>inches</td>
</tr>
<tr>
<td>yards</td>
<td>3</td>
<td>feet</td>
</tr>
<tr>
<td>miles</td>
<td>5280</td>
<td>feet</td>
</tr>
<tr>
<td>square miles</td>
<td>640</td>
<td>acres</td>
</tr>
<tr>
<td>inches</td>
<td>2.54</td>
<td>centimeters</td>
</tr>
<tr>
<td>gallons</td>
<td>4</td>
<td>quarts</td>
</tr>
<tr>
<td>hours</td>
<td>60</td>
<td>minutes</td>
</tr>
<tr>
<td>days</td>
<td>24</td>
<td>hours</td>
</tr>
</tbody>
</table>

Table 2: The conversion matrix. To convert from a unit at the left side of the matrix to a unit at the top, multiply by the number at the intersection.

<table>
<thead>
<tr>
<th>Inch</th>
<th>Foot</th>
<th>Yard</th>
<th>Meter</th>
<th>Mile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inch</td>
<td>1</td>
<td>0.0833</td>
<td>0.0277</td>
<td>.0254</td>
</tr>
<tr>
<td>Foot</td>
<td>12</td>
<td>1</td>
<td>0.3333</td>
<td>3.048</td>
</tr>
<tr>
<td>Yard</td>
<td>36</td>
<td>3</td>
<td>1</td>
<td>9.144</td>
</tr>
<tr>
<td>Meter</td>
<td>39.37</td>
<td>3.28</td>
<td>1.094</td>
<td>1</td>
</tr>
<tr>
<td>Mile</td>
<td>63,360</td>
<td>5280</td>
<td>1760</td>
<td>1609</td>
</tr>
</tbody>
</table>

Table 3: The meter standard conversion table. To convert from meters to other units, divide by the factor in the right-hand column.

<table>
<thead>
<tr>
<th>inch</th>
<th>foot</th>
<th>yard</th>
<th>meter</th>
<th>mile</th>
</tr>
</thead>
<tbody>
<tr>
<td>inch</td>
<td>39.37</td>
<td>3.28</td>
<td>1.094</td>
<td>1</td>
</tr>
<tr>
<td>foot</td>
<td>0.0833</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>yard</td>
<td>0.0277</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>meter</td>
<td>0.0254</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mile</td>
<td>1.58x10^{-4}</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(continued)
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handled by taking each prefix in turn.

Powers of units are also easy to accommodate. For example, in a conversion from A to B, where \( u \) is the unit factor, \( p \) is the prefix factor, and \( n \) is the power of the unit, compute \( (u / p)^n \) for each. The ratio of these results is the conversion factor from A to B.

Another extension of the SMF conversion method allows you to convert compound units such as foot-pounds and miles per hour, where two or more terms (possibly with prefixes or powers) are combined. Amazingly, the desired factor is merely the product of the individual factors. This is a more general case of the way powers are handled. Also, any term after a "per" (such as in miles per hour) has an implicit \(-1\) power term included.

The SMF conversion method will always work where the dimensionality of the "to" unit is the same as that of the "from" unit. Any attempt to convert between units of differing dimensionality will produce meaningless answers.

### Building A Table

A conversion table should include both the dimensions and magnitude factors for each unit. Choose a standard in each primary dimension. Meter, gram, second, radian, sterdian, and coulomb are the standards used in Table 6. Any compound dimension can be constructed with these; for example, the reference for velocity will be meters per second.

For each simple unit (knot, teaspoon, etc.), compute the conversion factor to the reference (meters per second, meters\(^2\), etc.) and enter the factor in the table. Obviously, either the multiplicative factor or its inverse can be used as long as it is consistent and the program handles it correctly. Then, for each simple unit, indicate its dimensionality in powers of each of the basic dimensions.

### The Convert Program

The Convert program interprets user input. Table 7 shows the program variables and their meanings. Three types of input are accepted. If you type HELP on the input line, three screens of documentation will be displayed with a pause at the end of each screen. Press the Enter key to continue after each screen. The first screen is the overall documentation, the second shows all units and prefixes, and the third shows several examples.

If the first character you type is a question mark, the program will describe the dimensions of the unit (simple or compound) that follows. If you type ?KNOTS, the computer will respond DISTANCE PER TIME. This feature can help you understand the meaning of units such as Btu or watt.

If you type a number followed by a unit (such as 5 MILES), the program will ask CONVERT TO ?. Any response of a unit of the correct dimensionality (such as FEET) will produce an answer. If you request any conversion that is impossible because of
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Both the Convert and

a common subroutine
for input string parsing

When dimensionality differences, the computer will deliver a message indicating that the dimensions are not compatible.

When you start the Convert program, the screen clears for about 3 seconds as the program initializes its internal tables and clears the DI% array. The program then asks for input, and based on this input passes control to the Convert, Describe, or Help routines. Both Convert and Describe use a common subroutine for input string parsing and calculation. Each of these routines then displays the results as requested. The answer display for the Convert routine ensures that the correct number of digits are used, which avoids many rounding problems.

Lines 1000 to 1170 contain the guts of the conversion program. As each term is processed, the power of the unit is removed and its value is stored in the variable P. If there is no such term, P remains 1. The unit table is checked for a match before the prefix table is checked to sort out confusing units such as "micron." Any term with a valid prefix will not match the unit table. If no match is found in either table, the computer will display an error message. After any prefix terms have been combined in the T variable and the unit match is found, the core of the conversion program is reached (in lines 1120 and 1130).

Line 1120 calculates the eventual answer—N, while line 1130 provides the dimensionality check. In both lines, the behavior of the expression is controlled by the flags DN and IO. DN indicates whether a PER conversion has occurred during the parse, and IO indicates whether input (from) or output (to) is being parsed. The

---

| Table 7: A list of the variables and their meanings as used in listing 1. |
|-------------------|------------------|
| Variable     | Meaning                                         |
| ND           | maximum dimension subscript                      |
| NP           | maximum prefix subscript                        |
| NU           | maximum unit subscript                          |
| PR$()       | prefix name array                               |
| PR()        | prefix factor array                             |
| PR%()       | prefix name length array                        |
| UN$()       | unit name array                                 |
| UN()        | unit magnitude conversion factor array          |
| UN%()       | unit dimensionality array                       |
| DE$()       | dimension name array                            |
| DI%()       | working storage for conversion dimensionality   |
| X           | local loop variable                             |
| Y           | local loop variable                             |
| I$          | input string                                    |
| IO          | flag, +1 if processing input, -1 if processing output |
| FL          | flag, used while scanning DI% array             |
| N           | number at beginning of input, calculated upon to produce answer |
| LO          | length of output — digits to left of decimal (log10 N + 1) |
| DN          | flag, +1 to left of PER, -1 to right in input/output processing |
| TS          | next word being processed                       |
| T           | prefix conversion factor                        |
| P           | power term of current unit                      |
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CONVERSATION: Given a quantity Q1 and unit U1 (e.g., 5 gallons), and another unit of the same dimensionality U2 (quarts), conversion is the process of determining the quantity Q2 such that Q1 of U1 is equivalent to Q2 of U2.

DIMENSIONALITY: The shape of a unit in powers of the primary dimensions is its dimensionality. Primary dimensions include distance, time, mass, and angle. Compound dimensions include velocity (distance per time), volume (distance^3), and force (distance mass per time^2).

MAGNITUDE: Magnitude is the size of a unit. Relative magnitudes of units are the conversion factors, such as the 4 to 1 difference between quarts and gallons. Absolute magnitudes are the size of a single occurrence of a unit.

following example should illustrate how this works.

In converting 2 miles into feet, you would divide 2 by the mile factor (producing a meters equivalent) and then multiply by the feet factor to produce the answer. Otherwise, the table look-up and parsing are the same. Unfortunately, it is awkward in BASIC to have an operation that has to choose between multiplication and division. The alternative is to add a power term that is either +1 or -1 and always multiply (or divide). If each factor is always divided into the number, but the power is varied, both multiplication and division can be accomplished easily.

Since there is already a -1 power factor after a PER flag in the input string, the combined factors produce a +1 after the PER in the output parsing.

At the same time, these flags control whether the dimensionality is added or subtracted from the DIM array. The actions on either side of a PER will be opposites, while the INPUT and CONVERT TO will also be opposites. If both INPUT and OUTPUT are of the same dimensionality, then the DIM array will contain zeros at the end.

CONCLUSION
I have described a simple and elegant way to perform unit conversions that can be implemented on any current personal computer. New units can be added to the program if desired.

This program will not convert temperature units. Fahrenheit and Celsius degrees have a 9/5 multiplicative factor in addition to an additive factor. Celsius and Kelvin degrees differ only by an additive factor. Generally, if zero X is not equal to zero Y, then X and Y cannot be converted with the program even if they are of the same dimensionality. Also, units that are logarithmic, such as decibels, or are otherwise nonlinear cannot be converted using this method.

If you would like a copy of the Convert program but don't have a modem with which to download it from BYTE-net, send me $12, and I will mail you a copy in Microsoft BASIC on disk in MS-DOS format (specify 160K-, 180K-, 320K-, or 360K-byte format). Convert is also available on cassette for a TRS-80 Model I Level II for $10.
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*Source: Datamation Magazine, 1983 Brand Preference Study of printer preference by end users and OEMs.
At draft speed, characters come out crisp and clear; at up to 400 cps. At correspondence quality speed, characters are readable; they make the term 'computer print almost obsolete.'
THOUGH WE OFTEN lose sight of the fact, the personal computer has represented an incredible bargain throughout the course of its short history. Imagine shrinking a roomful of computing machinery and placing it on a desktop, in the hands of an individual user! Taken in that light, almost any microcomputer product would qualify for inclusion in this issue.

The selection of articles that we've presented this month merely scratches the surface of "Bargain Computing." Our writers have looked at a number of ways you can extend the power of your system without spending a fortune, but the list of topics is far from complete.

Modern programming editors may be one of the best-kept secrets of the commercial software industry. These text editors lack most of the sophisticated formatting and printing options that characterize traditional word-processing software and as a result are sold at bargain prices. However, in "Build Your Dream Editor," author Steve McMahon explains how you can use built-in macro commands to create customized text-handling tools that might come closer to your personal ideal than you ever thought possible.

XLISP, an experimental, object-oriented programming language available in source code and compiled versions for most major microprocessors, follows in the public-domain tradition of BASIC-E, Small C, and FORTH. David Betz takes you on a guided tour of his creation in "An XLISP Tutorial:"

Kit computers have always provided an exciting alternative to ready-made systems. Laine Stump built the Slicer 80186 single-board computer kit in order to add speed and processing power to his patchwork system. In "The Kit Solution," he outlines the benefits—and the pitfalls—of this approach.

Purists tend to sneer at the so-called "home" computers, but even the lowly Commodore 64 is a powerful machine with great potential if you let your imagination soar. John C. Field, Greg Richards, and Eric Beenfeldt of the University of Maine used the C64 as the nucleus of an 80-column terminal. Their article, "The Commodore 64 80-Column Terminal," tells how.

Public-domain software, which exploded during the glory days of CP/M-80, has taken some interesting twists since then. In "Public-Domain Gems," BYTE technical editor John Markoff and I provide a sampling of free and nearly free software for two machines with newer operating systems, the IBM PC and the Macintosh.

While the SURF 3-D plotting program that BYTE technical editor Tom Clune looks at in "Budget 3-D Graphics" isn't free, he feels the $35 price tag is a bargain for this versatile package.

Are there other bargains? Of course. Thousands of them. If a particular computer or piece of software doubles your productivity and halves your labor, isn't it a bargain? That's the philosophy that inspired this issue, and it's one that you can take with you, bearing in mind one simple rule—something is only a bargain if it works.

—Ezra Shapiro, West Coast Bureau Chief
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BUILD YOUR DREAM EDITOR

by Steve McMahon

Some inexpensive programming editors are quite powerful and highly customizable

Imagine the power of a programming language combined with the speed, responsiveness, and ease of text manipulation available in a word processor. Add to this a high degree of customizability and you have the explicit project of several sets of software developers working on hybrid text editors.

This article looks at a few such programming editors currently available for the IBM PC and compatibles: VEDIT, PMATE, P-Edit and BRIEF. Each has some sort of text-manipulation language or macro-processing capability, along with powerful search and replace facilities, scratch buffers, and memory-mapped video. Each is also highly customizable and, perhaps best of all, has a list price of $225 or less. (Three other editors are discussed in two text boxes.)

Given a little programming skill, you can build your own dream editor—one that does exactly what you want it to—onto the sturdy and powerful skeletons some of these editors provide.

Dual Modes
A principle design choice when incorporating the power of a text-manipulation language into a fast screen editor is how smoothly the two capabilities should be integrated. VEDIT's and PMATE's dual-mode schemes represent one approach, in which relatively little integration is attempted. Large text-manipulation functions are kept relatively separate from screen-editing functions by giving the editor distinct modes of operation.

In their command modes, VEDIT and PMATE are language interpreters, executing the kind of global commands common among the old line-oriented editors; in screen-editing mode they behave as fast microcomputer full-screen editors. Users of UNIX's vi, which has a mode allowing access to the powerful search and replace features of its companion editor ex, will recognize the scheme. The simplest purpose to which the command mode might be put is to set up a global search and replace. For example, the VEDIT command B#S Smythe Smith would cause VEDIT to start at the beginning of its text buffer (B) and substitute (the command $S) the word "Smith" for "Smythe" an indefinite number of times (the symbol # indicates the substitution should be repeated indefinitely, and the backslashes delimit substitution strings).

Macro Languages
The real advantage these editors offer over conventional word processors is that simple command strings like the one above may be combined into small programs. Both PMATE and VEDIT let you draft lists of commands, store those lists in buffers, and execute them. Further, the editors make available iteration commands that function like BASIC's FOR...NEXT structures and integer variables with limited math capabilities. Also included in the languages are the abilities to read and write files, manipulate scratch buffers, print text, and insert variables into text. Macro programs can also chain (continued)
to other macro programs.
This macro-processing power potentially has a variety of uses: restyling documents, reorganizing statistical data sets, or any other task that involves repetitive search and replace operations.

One particularly potent use of macro processing is the translation of code from one programming language to another. PMATE was reportedly used to translate its own source code from its CP/M-80 version to 16-bit versions. And CompuView, the creator of VEDIT, markets VEDIT PLUS (an enhanced version of VEDIT) and a package of VEDIT PLUS macros designed to translate Z80 assembly-language source code to 8086 source code.

PMATE's macro facility seemed to me far more extensive than VEDIT's. PMATE provides full integer arithmetic facilities (addition, subtraction, division, and multiplication) in variable radix (handy for hexadecimal work), while VEDIT's arithmetic powers are limited to addition and subtraction. Both macro languages offer 10 integer variables, but PMATE includes a stack facility that expands the available number of variables (though macro writing would be complicated). PMATE also offers conditional execution structures equivalent to BASIC's IF...THEN and IF...THEN...ELSE constructs and a branching command equivalent to a GOTO. A full set of logical operators is supported. A trace mode for macro execution and provision for comments greatly aids drafting more complicated PMATE macros.

PMATE also can do a lot more with its variables since it makes available language-level access to information like the current cursor position's column and line number, the value of the byte pointed to by the cursor, and the value of the response given from the keyboard to an inquiry made from...
within the macro. (See listing I for an example of the kind of simple program that PMATE can handle that I could find no way to duplicate in VEDIT.) VEDIT, on the other hand, includes a more extensive pattern-matching capability in its search facility, which makes it more serviceable for translation-type macros.

PMATE’s Instant Macros

The PMATE macro language’s superior facilities for access to information about keyboard input, the cursor location, and the characters or text at that position improve the integration of editor and macro processor by making it possible to create entirely new commands that go beyond lists of search and replace commands. The PMATE manual includes sample macros to alphabetize lists, customize cursor motion, center a screen line, and even create an on-screen invoice form with embedded math. All can be made a permanent part of the editor if desired.

Macro programs can also be linked to single keystrokes in PMATE, so that each of the PC’s 10 function keys can cause a macro to run.

BRIEF’s Macros

BRIEF (Basic Reconfigurable Interactive Editing Facility) is even more customizable than PMATE—not only may wholly new commands be created, but they may be assigned to any key, replacing even basic function keys like cursor-control keys or the return key. Rather than building a macro-language interpreting mode onto an editor, the BRIEF authors chose to provide a macro-language compiler, whose products can be loaded into the editor. The compiler accepts structured code using declarations and operators highly reminiscent of the C programming language (though it’s syntactically more similar to certain variants of LISP). Thus, the difference between using the macro languages of PMATE or VEDIT from that of BRIEF is a lot like the difference between programming in interpretive BASIC and programming in C or Pascal. For examples of the different forms of VEDIT, PMATE, and BRIEF programs that perform similar tasks, see listing 2.

BRIEF’s approach yields a lower

(continued)

Table 1: A comparison of program-editor features. WordStar non-document mode specifications are included for comparison.

<table>
<thead>
<tr>
<th>Feature</th>
<th>VEDIT</th>
<th>PMATE</th>
<th>BRIEF</th>
<th>P-Edit</th>
<th>CSE</th>
<th>TED</th>
<th>SPFFedit</th>
<th>WS-NonDoc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory Required (kb)</td>
<td>64</td>
<td>64</td>
<td>192</td>
<td>48</td>
<td>64</td>
<td>128</td>
<td>256</td>
<td>64</td>
</tr>
<tr>
<td>Program Size (kb) Req/optional*</td>
<td>17/6</td>
<td>25</td>
<td>73/+</td>
<td>27/3</td>
<td>29</td>
<td>32/18</td>
<td>160</td>
<td>91</td>
</tr>
<tr>
<td>Memory-Mapped Video</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Largest File in Memory (kb) (11)</td>
<td>47</td>
<td>57</td>
<td>63(2)</td>
<td>63</td>
<td>54</td>
<td>362</td>
<td>210</td>
<td>23</td>
</tr>
<tr>
<td>Edit Multiple Files</td>
<td>no</td>
<td>no</td>
<td>many(4)</td>
<td>2</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Windows</td>
<td>no</td>
<td>no</td>
<td>many(4)</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>2</td>
<td>no</td>
</tr>
<tr>
<td>Scratch Buffers</td>
<td>10</td>
<td>10(5)</td>
<td>1</td>
<td>1(6)</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Keystroke Macros</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Macro Language</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Macro Variables</td>
<td>10</td>
<td>10</td>
<td>many(4)</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Reconfigure Keyboard</td>
<td>yes</td>
<td>yes(7)</td>
<td>yes(7)</td>
<td>no</td>
<td>yes(6)</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Auto-Indent</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Wrap Mode Available</td>
<td>yes</td>
<td>yes(9)</td>
<td>yes(9)</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>DOS 2+ Paths Supported</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Max. Line Length</td>
<td>258</td>
<td>251</td>
<td>144</td>
<td>64k</td>
<td>80</td>
<td>75</td>
<td>255</td>
<td>no limit</td>
</tr>
<tr>
<td>Directory Available in Ed.</td>
<td>yes</td>
<td>yes</td>
<td>yes(10)</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Deletion Undo</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>On-Line Help</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Position Markers</td>
<td>10</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>1</td>
<td>no</td>
<td>10</td>
</tr>
</tbody>
</table>

* Required program size includes only those modules necessary for operation.

Optional size is additional space for modules such as help screens that can be loaded or not as you choose.

(1) Not automatic under certain circumstances. CompuView says fixed in later version.

(2) Per buffer edited.

(3) Any of 10 text buffers can be edited, but they may not be associated with files.

(4) Number limited only by memory for files and variables, screen size for windows.

(5) All scratch buffers may be edited directly.

(6) Limited to 255 characters.

(7) Macros may be assigned to single keystrokes.

(8) Requires recompilation.

(9) PMATE’s wrap mode embeds non-ASCII characters.

(10) By running DOS functions while in editor.

(11) While running PC-DOS 2.1 with no extra device drivers present on a computer with 512K-byte RAM.
degree of editor and macro-language integration if BRIEF is judged by the criterion of spontaneity: since compilation of a macro takes time, and structured code takes greater planning to write, one is a lot less likely to create a spur-of-the-moment macro to solve a one-time problem. However, if the criterion is the degree to which the design approach aids in customizing the editor, BRIEF has to be judged an impressive accomplishment.

A BRIEF macro program, like a C or Pascal program, can and should be modular. It should be made up of discrete subprograms doing particular tasks in isolation from the rest of the program. Variables must be declared; string and integer types are available and may have either global or local scope. The language provides a rich set of predefined functions oriented toward manipulation of text and screen. Arithmetic and logical primitives, type conversion, buffer and window control, search and translate, keyboard input and macro loading, unloading, and execution functions are available. There is even a DOS (disk operating system) function built in that allows you to temporarily exit from the editor to run a DOS command line. A single macro program's source code may be as long as 30K bytes.

Much of BRIEF was written in the BRIEF macro language, and the source of these macros is included with the editor. Using this source, it's possible to customize even sophisticated functions of the editor such as the way the auto-indent, word wrap, or context-sensitive pop-up help menus operate. This code also provides good examples of how to implement new features. (For another look at this approach, see the text box on the C Screen Editor on page 176.)

**A BRIEF DEVELOPMENT TOOL**

An excellent example of the kind of customization BRIEF makes possible is provided by a set of macros included with the editor that make BRIEF a powerful development tool. These macros effectively integrate BRIEF with any of four compilers: three C compilers (Computer Innov...
Listing 2c: A BRIEF macro-language program to create the benchmark text. Of particular interest might be the way insertion of an integer variable into the text is handled. The variable must first be written into a string using a function modeled on the C language's printf. Then, the string may be inserted into the text.

(macro byte_bench

(int paragraph_count line_count) ; first, declare variables
(string output_string)

(= paragraph_count 1) ; initialize the paragraph count

(while (<= paragraph_count 40) ; while paragraph count <= 40 do

(= line_count 1) ; initialize line count

(insert output_string) ; insert that string into text

(= line_count (+ line_count 1)) ; increment line count

(insert " \n") ; add a new line to separate paragraph

(= paragraph_count (+ paragraph_count 1)) ; increment paragraph count

(insert "end \n")

)

)

)
they are made, then playing them back. This facility is also implemented in a variety of other editors including BRIEF and XyWrite II, and by keyboard enhancement programs such as RoseSoft's ProKey and Heritage Software's SmartKey. Like some keyboard enhancers, P-Edit's keystroke macros may invoke other keystroke macros. Unlike such programs, though, a P-Edit macro may chain to one macro or another depending on the outcome of a text search. P-Edit's keyboard macros may also be attached to function keys or stored by name. For example, the macro stripit might remove certain control characters from a file. It would be run by giving the invoke macro command and typing in the macro name. Macros may be of indefinite length and are stored on disk. Temporary macros are deleted at the end of an editing session.

While easy to use, this macro facility is of comparatively limited power. Using keystrokes to define a macro may be intuitively reasonable, but the lack of a formal language restricts the practical extent and complexity of macros—as does the lack of any facility for editing a macro. Also, the storing of macros on disk, from whence they must be reclaimed each time they are to be invoked, makes macro execution hideously slow. Using random-access memory to simulate a disk drive and temporarily storing macros there can improve macro execution times considerably, however.

**STARTUP MACROS**

BRIEF, PMATE, VEDIT, and P-Edit can each be set up to run a macro program immediately whenever the editor is invoked. Such "startup" macros can be used to set up tab stops, read in files, or operate on files. They could even be used to make the text editor into a filter program, taking the file specified on the command line, manipulating it in a specified way, and storing it back to disk.

BRIEF, in addition, can be installed to automatically execute a macro program whenever files with certain extensions are edited. BRIEF can, for example, automatically run its word-processing macro whenever a file with a .DOC filename extension is edited or the auto-indent macro whenever a file with a .PAS, .C, or .M. This can allow the editor to change personality automatically, depending on the type of file being edited.

**PATTERN-MATCHING SEARCHES**

Part of the power of the old generation of line-oriented editors was their ability to do sophisticated searches for character patterns. Sets like "all strings of text in this file enclosed by "(*" and ")") delimiters" or "every identifier without a ·.· in it" or "everything in quotes" are defined by recognizable patterns but can't be reasonably specified by a simple string or a finite set of character strings. VEDIT and BRIEF include such pattern-matching capabilities within their search facilities. A simple example of what this kind of capability is good for is a VEDIT macro to delete all comments (which are delimited by "(" and ")") or "(" and ")") pairs) from a Pascal source file:

```
B#@S\("\*\"M\")\ \$B#@S\{"M\} \ 
```

This command starts the action at the beginning of the text buffer (B),
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Blue chip service from IBM
W while most of the editors discussed in this article provide some features usually available only on mainframe editors, at least two companies have taken a more direct route to mainframe editing power by producing microcomputer editors that closely imitate a popular mainframe programming editor.

Phaser Systems' SPF editor and Morgan Computing's TED should both provide a familiar environment for anyone experienced with IBM's Structured Programming Facility (SPF). Both editors can handle very large files in memory, feature separate file and line command modes, and make it easy to merge multiple files into one file or segment a single file into several. Each is also much more strongly oriented to lines than are most current microcomputer editors: most of the powerful commands available act on blocks of lines specified by line number. And both take some advantage of a microcomputer's strengths by offering fast, memory-mapped video and rapid keyboard response for small changes.

SPF editor emulates the IBM SPF "panel for panel," according to a Phaser spokesperson (I have no experience with IBM's SPF—SPF users are advised to test the quality of the emulation for themselves), while TED's designers appear to have taken a few more liberties in adapting the editor to the IBM PC environment. Both these editors display line numbers on the left of the screen, program lines to the right. Character-oriented changes in text may be made by moving the cursor to a desired point and making insertions or deletions, or overstriking existing text. Line-oriented changes show off the distinctive power of these editors: groups of lines are modified by placing a character or characters inside the line-number field to mark them, then issuing a command affecting the lines.

For example, a block of text may be moved by typing mm in the line number field of the first and last of the lines to be moved, then finding the destination line and placing a b for "before" or an a for "after" in its line field. (Unlike most micro editors, there is no way to mark a block of characters rather than lines.) Similar procedures can copy lines or blocks of lines, delete them, or replicate them. When line-oriented commands are used in conjunction with the file-command mode, specified groups of lines may be copied to other files or lines from other files may be merged into the current file.

SPF editor has two line-oriented sets of commands particularly useful for structured programming work. Data right...and data left... commands increase or decrease the indentation of specified lines of code, a feature very useful for maintaining proper indentation when changing a control structure. Also, SPF editor can "exclude" lines from the display—revealing them again when a show command is issued. This exclude feature provides a nice way to hide the bodies of procedures and functions, showing only their declarations (photo A).

The Phaser product includes a split-screen editing mode that allows the editing of two files on the same screen. Also, the editor can be placed in a mode to display a hexadecimal representation, in either ASCII or EBCDIC, of each line of code.

The TED adaptation of SPF includes a few nice adaptations to the IBM PC environment—screen indicators show the status of the Num Lock and Caps Lock keys: the cursor changes size to indicate insert and overstrike modes: all the function keys may be set up as keystroke macros; and several alternate and control character commands are implemented (one of which will show the screen a
searches for zero, one, or more characters "[^M]" between "(" and ")" and replaces the string (including the "(" and ")") with nothing. "\" contin­
ing until the buffer is exhausted. The escape key has been pressed (in­
dicated here by a dollar sign) to mark off the end of this command from the
beginning of a similar command to do
the same thing for characters delimited by curly braces.

VEDIT pattern recognition extends to white space, new lines, any upper­
case letter, any numeric digit, any con­
trol character, anything other than a

VEDIT's pattern-recognition capa­

BRIEF's pattern-recognition capa­

capability is even greater because it is

BRIEF can search for

BRIEF's pattern-recognition capa­

FLEXIBLE KEYBOARDS

VEDIT, PMATE, and BRIEF each allow

books. Regular expression-translation

libraries. The usefulness of this facility for

One use for such customization

(continued)
Table 2: Benchmark results showing the times required by each editor to execute basic functions used in text processing and macro programming. The Save File, Load File, and Search times are all based on a 4000-word test file. Save File is the number of seconds necessary to save the file to disk; Load File, the time necessary to retrieve the same document. Search is the time required by the editor to find the last word of the test file, starting at the top of the file. Run Macro is the time necessary to execute a macro program creating the benchmark file. Only PMATE, VEDIT, and BRIEF had macro languages sufficiently powerful to accomplish this task. A BASIC time for the Run Macro test and WordStar non-document mode times for Save File, Load File, and Search tests are included for the sake of comparison with readily available programs. All benchmark tests were run on a Compaq running PC-DOS 2.1 on floppy disks with 512K bytes of memory and no extra buffers or DOS devices installed.

<table>
<thead>
<tr>
<th>Editor</th>
<th>Save File</th>
<th>Load File</th>
<th>Search</th>
<th>Run Macro</th>
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<tbody>
<tr>
<td>PMATE</td>
<td>8.4</td>
<td>5.2</td>
<td>1.8</td>
<td>2.4</td>
</tr>
<tr>
<td>VEDIT</td>
<td>11.1</td>
<td>10.7</td>
<td>1.9</td>
<td>2.3</td>
</tr>
<tr>
<td>BRIEF</td>
<td>18.4</td>
<td>2.8</td>
<td>4.0</td>
<td>51.1</td>
</tr>
<tr>
<td>P-Edit</td>
<td>12.8</td>
<td>2.2</td>
<td>5.2</td>
<td>1.1</td>
</tr>
<tr>
<td>CSE</td>
<td>10.8</td>
<td>10.2</td>
<td>1.7</td>
<td>1.3</td>
</tr>
<tr>
<td>TED</td>
<td>12.3</td>
<td>12.9</td>
<td>1.3</td>
<td>11.9</td>
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<tr>
<td>SPFeditor</td>
<td>22.5</td>
<td>8.6</td>
<td>1.3</td>
<td>20.6</td>
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<tr>
<td>WS-NonDoc</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>BASIC</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

A Bona Fide Undo

There is more than one word processor on the market today in which an undelete command, which recovers whatever text was most recently deleted, masquerades as an undo command. People experienced with some mainframe editors like UNIX's vi know better. An undo command doesn't just restore accidental deletions. It undoes accidents—whether the accident is hitting the top-of-file command when you meant to move the cursor one line, erroneously inserting 100 lines of text from the wrong document, or deleting the wrong line.

The problem with implementing an undo command in a microcomputer editor comes from the large storage demands the stack of undo information can require and the functional slowness that can result from having to save all that information.

BRIEF implements a true undo facility, by default allowing command-by-command recovery from the last 30 undoable commands (commands like write-to-disk are not undoable). The number of commands you want to be able to undo can be changed. To the credit of BRIEF's authors, the editor is usually not perceptibly slowed by the housekeeping requirements of the command (certainly not so much as I would ever be willing to give up the feature). The undo feature was principally responsible, I suspect, for the comparatively slow time I recorded when benchmarking BRIEF's macro-execution capabilities (table 2). Only with BRIEF, though, was it possible to undo a macro that produced 4000 words of text with a single keystroke.

Another side effect of BRIEF's undo feature is that the editor is what the impolite would term "a real memory hog." While undo housekeeping, lots of macro programs in memory, and several buffers open for editing, this editor will eat up all the memory you can install and have you wishing for more. To counterbalance this effect, BRIEF does allow some control over memory utilization—in the way text-buffer and undo-stack memory requirements are balanced, for example.

Multiple Buffers, Files, Windows

Multiple text buffers can be put to a variety of uses in these editors. VEDIT and PMATE both make available 10 text buffers that can be used as scrap bins or receptacles for macro pro-

Photo 1: A BRIEF screen shot showing windowing.
grams (both have commands to execute a buffer). PMATE expands on this by allowing each buffer to be edited—in fact, the only difference between the main and auxiliary buffers is that disk buffering when memory is exhausted is only automatic in the main text buffer. PMATE also allows the buffers to be used as string variables in macro programs.

P-Edit and BRIEF allow true multiple-file editing, with full automatic disk buffering. While P-Edit allows only two files to be edited at once, BRIEF’s multiple-file editing capabilities are limited only by available memory. With both editors you can jump from one file to another with a single keystroke and no disk activity.

BRIEF can also split the screen vertically or horizontally into as many windows as will fit on a screen (photo 1). Such windows are called “tiled” because they abut one another without overlap. Different windows may contain the same or different portions of one or several files. The BRIEF macro language and keystroke commands provide complete control over windows and text buffers. Moving the cursor from one window to another is a single-keystroke operation. Within the macro language, it is accomplished with the aid of functions like change_window (direction required) and inq_window_size.

FUTURE PLANS

While a PC-DOS version of VEDIT PLUS wasn’t available in time for discussion in this article, CompuView was preparing to release this product, an enhanced version of VEDIT that offers many of the features of PMATE. Extensions beyond VEDIT include multiple-buffer editing, a full set of arithmetic and logical operators; 17-bit integer variables, string variables, IF...THEN...ELSE- and GOTO-type control structures, and extensions to the VEDIT pattern-matching capability. “Instant macros” are not included in the extensions.

CompuView is also planning to market a 288-to-8086 assembly-language source-code translation package for use with VEDIT PLUS.

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<td>A344</td>
<td>SPU-Z/64K for S100 bus*</td>
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<td>A293</td>
<td>Net 10 Board for CompuPro System 816/10</td>
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THE COMMODORE 64 80-COLUMN TERMINAL

BY JOHN C. FIELD, GREG RICHARDS, AND ERIC BEENFELDT

If you've got an EPROM programmer handy, build this modification for the Commodore 64.

THE MOTIVATION for this project was the 10 Motorola 68000-based Educational Computer boards we have here at the University of Maine at Orono. Although we had the boards, we had no terminals to use with them. We didn't want to buy expensive new terminals, so we looked at alternatives, including building Steve Ciarcia's Term-Mite ST. However, we thought modified Commodore 64s looked like the best alternative because we can use them for microcomputer experiments when we're not using them as terminals.

We modified the Commodore 64s by building an RS-232C converter card for the Commodore's expansion port and a video card for its user port. Both of the cards are shown in photo 1. The video card contains a 2K-byte block of screen memory on a 6116 chip; a 6845 cathode-ray tube controller (CRTC); various timing, logic, and mixing circuits; a character EPROM (erasable programmable read-only memory), and a program EPROM. The RS-232C converter card brings the Commodore's TTL (transistor-transistor logic) voltage-level expansion port up to RS-232C voltage levels.

CARD OPERATION

As seen in the block diagram of figure 1, the CRTC generates both screen memory addresses on lines MA0-MA10 and row addresses on lines RA0-RA3. The screen memory addresses contain ASCII (American Standard Code for Information Interchange) characters, while the row addresses indicate which row of the character is to be output at the present time.

The CRTC begins by sequentially generating the addresses for the first 80 screen memory locations. During this time the row address lines are held at 0 to indicate that row 0 of the first 80 characters is to be displayed. After a horizontal retrace, the CRTC generates the same first 80 memory addresses, but this time with the row address lines at 1 to indicate that row 1 of each character is to be displayed. This continues until all eight rows of the first 80 characters are displayed.

Then the next block of 80 addresses is generated with the row address lines set to 0 again. This procedure continues until an entire screen is displayed. The process is repeated after the vertical retrace.

As each screen memory location is accessed, its contents are latched at the address lines of the character-generator ROM (read-only memory). The row addresses from the CRTC are also applied to the address lines of the ROM. The combination of the ASCII code and the row address forms the address of the location in the ROM of the dot pattern for the row of the character being displayed.

After the dot pattern appears on the (continued)
output data lines of the ROM. It is parallel-loaded into a shift register that serially shifts it out to the video mixer. The video mixer then outputs the composite video to the monitor.

Figure 1 also shows the interface between the card and the Commodore 64. Both devices must have access to the 2K-byte block of screen memory in the middle. The 6510 writes the ASCII representation of a character into it, and the 6845 accesses it for display. In the Commodore 64, the 2K bytes of screen memory are mapped between addresses 9800 and 9FFF (hexadecimal). Contention for the memory is arbitrated using a multiplexer controlled by the 6510. During a write to the screen memory, the 6510 brings up the proper address on the bus, which causes Y3 (RAM) of the 1-of-8 decoder to be negated. This signal enables the bus transceiver and selects the 6510 inputs on the address multiplexer. When the 6510 is accessing the screen memory, the multiplexer also selects the R/W signal from the 6510 and applies it to the R/W of the memory. When the 6510 is not using the memory, the 6845 addresses are selected and the multiplexer selects a +5-volt (V) signal to be applied to the screen memory R/W. This means the screen memory is held in a constant read state while the 6845 is accessing it.

The program EPROM provides the 6510 with the instructions necessary to implement the 80-column features and to communicate through the RS-232C port.

The timing-signals generator shown in figure 2 is the heart of the video circuit. This circuit controls all data transfers. The 16-MHz crystal, three 7404 inverters, and two 620-ohm resistors comprise the DOT clock generator. The DOT signal is a 16-MHz rectangular wave. It is used with a 74161 counter, a 74174 hexadecimal D flip-flop, and inverters to produce the system timing signals S/L, CC, and CC. When S/L is high, the shift register clocks out data to the video mixer; when S/L is low, new data is parallel-loaded into the shift register and a new ASCII character is loaded into the two 74174s. The CC signal is the character clock, which is produced every nine cycles of the DOT clock. The character clock synchronizes the CRTC with the rest of the system. Its duration represents the amount of time necessary to shift out one scan line of one character. The CC signal is simply the inverted version of the character clock.

In the character-generator part of the circuit, two 74174s are used as latches to hold the data from the screen memory at the address lines of the character ROM. After the falling edge of the character clock, the address lines, MAO-MA10, become valid. However, before the data at the output of the screen memory can change, the rising edge of the S/L signal latches the old data into the two 74174s. This same rising edge allows the 74165 shift register to begin shifting out the video data from the previous character. The shifting of data from the screen memory to the character generator to the shift register causes a delay of two character-clock cycles from the time a screen memory address is applied to the time when the corresponding data starts to be clocked out of the shift register.

In the video-mixer part of the circuit, the signals VIDEO, CURSOR, DISPEN, S/L, HSYNC, and VSYNC are mixed together to produce the composite-video signal. The mixed signal is matched to the 75-ohm
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The composite-video signal consists of HSYNC, VSYNC, and the brightness signal. monitor input impedance using an emitter follower.

The CURSOR and DISPEN signals from the CRTC are delayed by two character-clock cycles using the two 74174s. This is to compensate for the two-character delay referred to earlier. The 74174 is clocked with the inverted version of the character clock because its outputs change on the rising edge of the character clock, as opposed to the CRTC, whose outputs change on the falling edge.

After the delay, these two signals, along with S/L, are combined with VIDEO to produce a signal that controls the instantaneous brightness of the trace. Delays between these signals and VIDEO cause some jitter, which is masked by the D flip-flop after the 7404 inverter.

This brightness signal is then mixed with HSYNC and VSYNC via the 2N3638 transistor to produce the composite-video signal. The 2N2222 emitter follower matches this signal to the 75-ohm input impedance of the monitor.

In the memory-accessing ciruclty, the three 74157 Quad 1-of-2 Line Data Selectors make up the address multiplexer. Lines A11-A15 of the 6510 are used with a 74LSI38 1-of-8 Line Decoder to generate the signal RAM. When the machine wants to access screen memory, this signal is low, causing the A inputs of the 74157s to be gated to the outputs. When RAM is high, the machine is not accessing screen memory and the B inputs are selected, applying MA0 through MA10 to the screen memory address lines.

RAM is also applied to the 74LS245 bus transceiver so that when the machine is accessing screen memory.
Figure 2: A schematic of the 80-column video board.
Figure 2 continued.
The Commodore 64 can power the RS-232C interface, but it cannot supply the power needed by the 80-column card.

its data bus is connected to that of the screen RAM (random-access read/write memory). When the machine is not accessing screen memory, this device is 3-stated, thus isolating the 6510 bus from the RAM bus to prevent interference with CRTC operations.

The schematic of the RS-232C interface is shown in figure 3. The 9-V AC outputs from the Commodore 64 are used to produce the plus and minus supplies necessary for RS-232C transmission. While the configuration shown is useful for most equipment, there will be instances in which more handshaking is required and therefore more signals must be used. The configuration presented here makes use of the 3-line mode of the Commodore 64's serial interface. However, you can use the X-line mode instead if necessary.

Although the Commodore 64 can power the RS-232C interface, it cannot supply the power needed by the 80-column card. An external 5-V, 1-A (amp) regulated power supply is needed. (See the January 1985 "Ciarcia's Circuit Cellar" for an article on building your own linear power supply.)

CONSTRUCTION
Wire-wrap construction is probably the best method to use since it is relatively inexpensive, reliable, and makes circuit corrections much easier. Note, however, that you should keep wire lengths as short as possible to avoid introducing excess noise in the

(continued)
circuit. It is important that there be a solid ground connection between the 80-column board and the connector to the Commodore's user port. For example, we used a 50-pin ribbon cable connector and used the extra lines as grounds. To reduce coupling, these ground lines were alternated with the data and address lines where possible. Once the wiring is completed, check each connection for continuity and accuracy before you insert any devices in their sockets. After that's done, you can install the components and connect the board to the Commodore. Program EPROM must have a fast access time. We have had reliable operation with a Motorola MCM2716-35 (360 nanoseconds) and Intel's 2732A (250 nanoseconds).

SOFTWARE
The Commodore 64 has no resident software for the 80-column board. In fact, any software written to control the Commodore 64's own 40-column CRTC will not work on the 80-column board. So we had to write our own, in assembly language, to permit higher data rates than those we could obtain with a BASIC program. The program resides in the 2716 program EPROM that is part of the video board. The complete program is available for downloading from BYTEinet Listings at (603) 924-9820. (See the February 1985 "Claria's Circuit Cellar" for information on how to build your own EPROM programmer.)

Upon power-up, the Commodore 64 looks for the characters CBM80 in the program cartridge ROM. If it finds them, it knows that a cartridge is in place and transfers control to the cartridge. Accordingly, the first few bytes of our listing contain these characters in PET ASCII.

The rest of the program is outlined in figure 4. The first block in the flowchart initializes all I/O (input/output) devices and begins in the listing at the label START. The first four routines, IOINIT, RAMTAS, RESTOR, and CINT, initialize the required Commodore 64 peripherals. The following CLI instruction enables the Commodore 64 interrupt-driven routine to periodically scan the keyboard for input. At the beginning of the next section is a table of initialization data for the CRTC. The routine following the table sequentially places the values in the CRTC registers starting with R0. The next two sections use the Commodore 64 OPEN routine to initialize the RS-232C channel and keyboard.

Figure 3: A schematic of the RS-232C interface.

SUBROUTINES
The following is a summary of the subroutines in the listing, including the parameters passed, altered, and returned:

- XBREAK causes a break by bringing the transmit data line of the RS-232C interface low for a period of time and then returning it to high.
- CLRSCR clears the screen by setting all screen memory locations to ASCII for a space and then returns the cursor to the upper left-hand corner of the screen.
- CHRPRT handles the display of ASCII characters. The character to be printed should be in the accumulator when this routine is called. A printable character is placed in the screen memory. If it is a carriage return, linefeed, or backspace, the appropriate function is performed. If it is none of these it is ignored.
- COPCSR is called after every screen manipulation to update the CRTC cursor registers, R14 and R15. It also checks to see if the cursor address has exceeded the screen memory range. If the address is out of range, it is set to the address corresponding to the upper left-hand corner of the screen.
- LINCLR clears the bottom line of the screen when scrolling. It loads the next 80 screen memory locations to be written to with the ASCII code for a space.

(continued)
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If you don't need 6 outlets, pick up our 4-outlet Wire Tree™. Or our single-outlet Wire Cube™ that's ideal for portable computers.

That'll take care of power surges. But what if your foot gets tangled in a power cord? Prevent this potential disaster with the Wire Away™. It stores up to four 18-gauge wires and ends the hazardous mess of dangling cords.

All our products are backed by a 5-year warranty. So when you shop for a PC, ask for NETWORX computer station accessories. And don't go home without them.
respectively. The last initialization block sets the look-up vector for converting Commodore 64 characters to ASCII, turns the local echo off, and turns on the automatic repeat flag.

As shown in the rest of the flow-chart, the program takes in characters from the Commodore 64’s RS-232C receive buffer and prints them on the screen, while at the same time taking characters entered from the keyboard and sending them to the Commodore 64’s RS-232C transmit buffer. If the local echo is on, keyboard data is also sent to the screen memory.

There are eight function keys on the Commodore 64, f1 to f8. This program uses six of them as follows:

- f1: Backspace
- f2: Set local echo on/off
- f3: Transmit BREAK
- f4: Switch to uppercase letters only
- f5: Clear screen
- f6: Switch to mixed-case mode

You can also use f7 and f8 for functions such as transmitting a null.

See the text box on page 190 for a summary of the subroutines in the listing, along with the parameters passed, altered, and returned.

**POWER UP**

Once the components are inserted, the wiring is checked, and a monitor is connected to the video output, you can power up the board. It’s a good idea to initially leave out the program EPROM so that on power-up the Commodore 64’s operating system is entered. This means that the monitor or television must be connected to the Commodore 64’s video output.

Use the BASIC initialize program (available on BYTEnet Listings, (603) 924-9820) after power-up. The initialize program takes the list of values in the DATA statements and places them sequentially in the CRTC registers R0 through R15. If the circuit is operating properly, the monitor should display 80 columns by 24 lines of random characters. It should be possible to change characters on the screen by entering values into the screen memory with the POKE command. If the characters are there but the display is distorted, try changing the values in the CRTC registers using the above program or individual POKEs. If the screen is rolling or slanted, check registers R4 or R0 because these affect the vertical and horizontal hold, respectively. If the screen is completely unintelligible, check the wiring connections. Once the board is operating properly, you can install the EPROM. But be sure to turn the power off before you install it.

When this board is first connected to a monitor, you may have to adjust the monitor’s brightness, contrast, vertical hold, and horizontal hold.

**IS IT ALL WORTH IT?**

You can put the RS-232C card and the video card together for about $65 if you shop around. Of course, you must also have an EPROM programmer and a power supply to build these add-ons. But the high quality and low price of the equipment make it worth the effort.
NEC Peripherals.
We make everybody look good.

NEC
NEC Home Electronics (U.S.A) Inc.
Wherever there's a computer, there's a need for NEC monitors and printers.

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With a full line of high quality, reliable monitors and printers to choose from, you're sure to find just the right companion for your computer. And they're friendly with just about any computer you can think of. From our very own NEC personal computers to IBM, Apple, TI, Commodore, Franklin and Atari - PCs, NEC has monitors and printers to make their output look even better.

NEC's complete line of 12", 13- and 14-inch monitors include RGB, monochrome, color composite and switchable models. Refer to the compatibility chart below for the model that fits your needs.

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The JB-1201MA, with its classic NEC 12" screen, is our renowned bestseller. Its popularity stems from its 1.0 watts of audio output power, and compatibility and versatility for almost any computer application.

$179.00

NEC MONITOR COMPATIBILITY CHART

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** NEED NEC CG-A CABLE
** NEED NEC PC-8401A CABLE
** NEED NEC PC-8401A CRT INTERF. ADAPTER
** NEED NEC PC-8401A CRT INTERF. ADAPTER
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Using an innovative Impact Line-Dot type Printhead, the PC-PR103A gives you printouts that are practically indistinguishable from letter-quality printers. It also gives you the advantage of printing three times faster, and provides two additional printing modes—graphics and draft quality. It even eliminates "ghosting" with single-pass printing.

$499.00

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<th>Printing Method</th>
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<tr>
<td>Standard Interface</td>
<td>Centronics. 8-bit parallel</td>
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Weighing only 14 lbs., the PC-8027A is the perfect companion for your transportable computer. It has an attached paper bin, and a convenient carrying handle so you can take it anywhere for quick printouts of both text and graphics.

$499.00

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<th>Printing Method</th>
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<td>Buffer Size</td>
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Both the PC-PR103A and the PC-8027A give you all the capabilities you'd normally expect from larger printers. And best of all, they cost less than most of the rest.

For software installation, choose the PC-8023A or any teletype-like printer. These choices will work with some software programs. All features of the printer may not be supported. Please contact the software vendor for additional information.
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Personal Computer Division
1401 Estes Avenue
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NEC Corporation
Tokyo, Japan
THREE YEARS AGO, my idea of "fast" computing was being able to run my college programming assignments on the resident mainframe without having to trudge across campus at midnight and wait in line for a terminal. To achieve this goal, I searched through ads in the computer magazines and found a terminal to put in my dorm room. It was a Hazeltine 1000, circa 1974, and it cost me $150. I rented a 300-bps (bits per second) modem for $5 a month, set the thing up on my desk, and called it high technology, all 12 display lines. Today, I am using the same old terminal (or what is left of it), and I am still clinging to my penny-pinching ways, but now I have a computer system that rivals machines in the forefront of (affordable) 16-bit computer technology.

The computer at the heart of my system is a Slicer single-board computer, sold in kit form or as a total system by Slicer Computers Inc. of Minneapolis, Minnesota. The board measures only about 6 by 12 inches, but that small space contains an extremely impressive list of features, including an Intel 80186 microprocessor, 256K bytes of RAM (random-access read/write memory), two serial RS-232C communication ports, a disk controller for both 8- and 5¼-inch floppy disks, and an SASI (Shugart Associates' Standard Interface) port for connecting a Winchester disk drive. The computer board, in kit form, sells for $815.

The Slicer kit is not for everyone. It takes slightly more expertise to bring up a Slicer than a standard ready-to-run system, but for those who have the expertise (or a desire to get it) and want a high-performance system for developing CP/M-86 and MS-DOS software, the Slicer and all the add-on boards and operating systems available for it are definitely worth a look.

WHAT'S IN A KIT?
This kit includes the printed-circuit board and all the integrated circuits (ICs), resistors, connectors, and other parts that are on the circuit board itself—nothing more. To have a complete system you also need a power supply, a serial data terminal, disk drives, a cabinet, cables, and possibly a printer, all of which will raise the price of the total system to anywhere from $1800 if you buy surplus parts to $4000 or more if you get a Winchester disk, a fancy terminal, and the like. This selling/buying/building strategy is similar to that of the legendary Big Board computer, which has had a dedicated following for the last few years (yes, I own a Big Board, too).

BUILDING THE KIT
The Slicer kit is not intended for the casual user. You must be comfortable with soldering IC sockets and mounting things into cabinets. It is easier to build than most kit computers, though, mainly because the main processor board has just 67 ICs (compared to 118 on the Big Board).

The manual includes step-by-step assembly instructions that can be followed by anyone who knows where to find pin 1 on an IC. The instructions stop at periodic checkpoints to perform tests that tell whether or not you have made a mistake in the assembly so far. For example, a special memory-test monitor allows you to test the machine before you install the RAM.
THE SLICER KIT

(random-access read/write memory) chips. You can test it again after installing the first 128K bytes of RAM. By testing in steps, you can more easily discover where you went wrong and get the system running sooner.

I was lucky enough to build my Slicer during a computer convention. Both the hardware and software designers of the system, Dean Klein and Earl Hinrichs, were looking over my shoulder and the shoulders of 12 other builders, but even without their guidance I probably could have assembled the board in two evenings (it took three hours with their help). Of course, after the board was assembled, it still took my brother and me two full days of building brackets and drilling holes to make the thing into a respectable "system" (you know, the kind of computer that doesn't have PC boards and wires strewn across the workbench). For those of you who still balk at wielding a soldering iron, Slicer offers the option of buying the board fully assembled for an extra $200.

The fact that the Slicer is sold in kit form is what turns most prospective buyers away. Because of this, Slicer recently began offering a complete system based on the Slicer board. It sells for $2995 and includes the Slicer, a cabinet, a terminal, two 800K-byte, 5½-inch disk drives, and the CP/M-86 operating system (MS-DOS is available as an option, and Concurrent CP/M will soon be available). You can also buy the system sans terminal for a reduction in price and without drives for even less.

**HISTORY OF A KLUDGE**

Most of us just don't have the time to solder sockets, build cabinets, and search through magazine ads for inexpensive disk drives. I didn't have the time, either, but neither did I have the money to buy an integrated system like the IBM PC. That's why I built the Slicer (and the rest of my system) from kits and odds and ends.

My entire computer system grew out of the old Hazeltine terminal. After I had been using the terminal for about a year, I decided that 12 lines of display was just not enough. I discussed many alternatives with my brother Cecil (the family hardware guru), and we finally decided that the most practical solution to the problem was to purchase a Big Board computer with a built-in 24 by 80 screen and replace the logic board of the terminal. We ordered the Big Board and installed it in the Hazeltine after literally ripping out the terminal's insides and rearranging all the wiring.

I could now display 24 lines of text on my screen at one time, but without a disk drive I could run only on the modem and experiment with small machine-language programs. This, again, was fine for a while, but within two months I broke down and bought a surplus 8-inch disk drive.

I spent the following summer in Spokane, Washington, with my brother. We decided to go to a convention of Big Board users put on by Micro Cornucopia magazine of Bend, Oregon. That's where I was first introduced to the Slicer. That summer I also acquired, for a very reasonable price, an old Alpha Micro cabinet that had space for two 8-inch drives and a circuit board or two. It was a solid cabinet with a lot of room, and it already had a power supply. Toward the end of the summer, my brother and I started working on a software project. During the winter we had decided that we should move the whole thing over to a 16-bit system, since most of the newer machines are 16-bit. This, and my frustration with the sluggishness of my Big Board, started me thinking seriously about the Slicer.

After another year of school, I spent the summer in Oregon working at Micro Cornucopia as an intern. It was there that I finally got a Slicer. I also purchased a Seagate ST-506 5-megabyte Winchester drive from the surplus market for $100.

My system is currently housed in the Alpha Micro cabinet, which holds the Slicer, a single 8-inch Siemens drive on loan from Micro Cornucopia, and my wondrous ST-506 Winchester drive. I am still having problems getting the right Winchester controller from Western Digital, though, so the Winchester sits idle for the moment. Due to short finances, I am using some equipment for dual purposes: the Big Board/Hazeltine combination acts as a terminal to the Slicer, and the two floppy-disk drives that are hooked to the Big Board must sometimes be hooked to the Slicer for copying between two floppy disks.

**THE SLICER**

The Slicer (see photo 1) seems to have been designed to be fast and comp-

(continued)
COLOR MAGIC: IBM-PC compatible S100 BUS graphics board.
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During the month of March you may purchase the following set of boards at a 15% discount from their individual prices:
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- England — FULCRUM 02621282753; RATIONAL SYSTEMS 0908-613209 or 0908-611349.
THE SLICER KIT

IN BRIEF

Name
Slicer

Manufacturer
Slicer Computer Inc.
2543 Marshall St. NE
Minneapolis, MN 55418
(612) 788-9481

Components
Processor: Intel 80186 (8 MHz)
Memory: 256K bytes of RAM; up to 32K bytes of ROM
Interfaces: Two RS-232C ports with independently programmable data rates up to 38.4K bps; 179x controller and an FDC

Operating Systems
CP/M-86 bundled with kits; MS-DOS ($175) runs with PC expansion board; CCP/M ($85)

Optional Hardware
Slicer Expansion Board: up to 256K additional RAM, two additional serial ports, real-time clock with battery backup, and a Centronics-type parallel printer port
Slicer PC Expansion Board: IBM-compatible monochrome monitor, two IBM-type card slots, and an IBM-type keyboard port

Documentation
Slicer assembly guide (90 pages) with sections on hardware debugging and testing procedures; Intel data and application sheets

Prices
Slicer full kit: $815
easy kit (only hard-to-find parts): $470
assembled and tested: $1015
bareboard: $915

Expansion Board full kit: $575
assembled and tested: $750
memory-board kit: $395
three-port kit: $225
bareboard: $95

PC expansion-board kit: $550
easy kit: $400
assembled and tested: $600
bareboard: $200

Enclosure:

with power supply: $125
with two 5¼-inch 96-tpi (tracks per inch) drives: $245

THE SLICER KIT

IN BRIEF

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Manufacturer
Slicer Computer Inc.
2543 Marshall St. NE
Minneapolis, MN 55418
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easy kit (only hard-to-find parts): $470
assembled and tested: $1015
bareboard (includes documentation and EPROMs): $150

Expansion Board full kit: $575
assembled and tested: $750
memory-board kit: $395
three-port kit: $225
bareboard: $95

PC expansion-board kit: $550
easy kit: $400
assembled and tested: $600
bareboard: $200

Enclosure:

with power supply: $125
with two 5¼-inch 96-tpi (tracks per inch) drives: $245

patible (though not necessarily IBM-compatible). The 80186 microprocessor accomplishes this rather nicely. The clock speed of 8 MHz, along with more efficient microcoding of the instruction set, gives the 80186 an effective execution speed about twice that of the 8088. The 80186 uses the same machine language as the 8088 and 8086, too, so it can run MS-DOS, CP/M-86, and many of the applications programs written to run under these operating systems. The 80186 is also an excellent development environment for new programs for the PC and compatible market.

A side effect of using highly integrated parts, like the 80186 microprocessor, is that the system can be implemented with relatively few ICs. The 80186 itself eliminates several parts. In addition to the normal functions of a microprocessor, it contains the clock generator, two high-speed DMA (direct memory access) channels, three programmable 16-bit timers, and programmable memory and chip-select logic, eliminating the need for several peripheral chips.

The 80186 is high on performance as well as integration. It has a true 16-bit external data bus, which means that the microprocessor can fetch 2 bytes from memory with each memory access. The 80186 takes advantage of this by putting the extra bytes it retrieves during instruction decoding into an instruction queue along with as many other instruction bytes as it can get when the bus is idle. Since most instructions are executed in the sequence in which they are stored in memory, this can save a lot of time. The 8088 processor, used on the IBM and most compatibles, also has an instruction queue, but it does not hold as many instructions as the queue in the 80186. There are further improvements in execution speed over the 8088. The queuing scheme is also used for other memory accesses, and the microcoding for many of the instructions in the 80186 has been redone to make the instructions execute in fewer clock cycles.

The Signetics 2681 DUART (dual universal asynchronous receiver/transmitter), used for the two RS-232C communication ports on the Slicer, is another example of a highly integrated chip. In addition to two serial ports, it contains the data-rate generators for both channels (programmable 50 to 38,400 bps), a 16-bit counter/timer, and an 8-bit output and a 7-bit input port for system control functions.

The floppy-disk controller is a Western Digital 1797, which has all the features of the popular 1793 controller chip while adding a disk side-select output. This family of chips (the 179x series) has several years of field experience behind it, allowing the developers to spend their time writing the software for it rather than debugging a new chip (this was a problem with the early 80186). The floppy-disk controller section also uses an FD9229 data separator. This, again, is a standard part that needs no further description here.

The system monitor is contained in two 2732A EPROMs (erasable programmable read-only memories). You can replace these two chips with 2764s or 27128s if you want a more elaborate monitor.

Aside from these six chips, the only other "large" IC on the board is the TMS4500 dynamic RAM controller. This chip takes care of memory refreshing, chip selection, and miscellaneous tasks. It was designed specifically to control up to 256K bytes of 4164 dynamic RAM chips. The rest of the chips on the board are TTL (transistor-transistor logic) and the RS-232C drivers for the two serial ports.

There are several connectors on the board. The floppy-disk section has two: a 34-pin connector for 5¼-inch drives and a 50-pin connector for 8-inch drives. The SASI port uses another 50-pin connector, and each serial port uses a 26-pin connector. Two more connectors on the board are used as an expansion bus. These two connectors are basically an extension of all the data, address, and control lines from the microprocessor. This expansion bus is used for the Slicer Expansion Board (see photo 2)
and the PC board (described below). You can also use the expansion interface to connect any hardware add-on projects that you might want to build yourself.

The Slicer's power needs are +5 volts (V) 3 amps, +12 V 60 milliamps, and -12 V 50 milliamps. The power supplies hook to the board through a little plug-in connector, so the board is easy to remove. The only chips that need +12 and -12 V are the four RS-232C driver chips for the serial ports; the rest just need +5 V.

You must buy separately any other hardware that you want or need for the system, such as disk drives, printers, and terminals will vary greatly in performance, specifications, and price from machine to machine. Due to the system software of the Slicer, however, you can use nearly any disk drive, printer, or terminal on the market.

For instance, the Slicer recognizes 8-inch single- and double-sided drives (1.3 megabytes maximum on double-sided double-density 8-inch disks), and it recognizes 5¼-inch single- and double-sided, double- and quad-density (800K bytes maximum on double-sided quad-density 5¼-inch disks). It will also automatically recognize most brands of the new 3½-inch disk drives (because most of these drives have been designed to look like either an 8-inch or a 5¼-inch drive).

When you decide that you want to add a Winchester disk, the Slicer already has the software to handle it; you just need to buy the drive, the Winchester controller, and a beefier power supply, and plug them all in. The controller is necessary because the Slicer implements only the "host adapter" portion of the Winchester interface, as do all other computers. The software on the Slicer is set up for the industry-standard Xebec 1410 controller or the Western Digital 1002-SHD. The Western Digital board has been available lately for about $245 and seems to be a solid unit. Make sure to specify the "SHD" portion of the part number if you happen to order the 1002; there are several models, and this is the only one that works with the Slicer.

SOFTWARE
The only software included in the $815 price of the Slicer is a disk containing utility programs written to run under CP/M-86, a BIOS (basic input/output system) for CP/M-86, source code to all these, and the assembly-language source code to the debug monitor and system software contained in the monitor EPROMs. The disk is available in either 8-inch single-sided single-density or 5¼-inch single-sided IBM format.

The debug monitor is another of the Slicer's strong points. It is contained in the monitor EPROMs, so even if you cannot boot up a disk, you can still look around at memory, read and write to the disk, output values to I/O ports, enter small machine-language programs, and so on. The value of this becomes apparent when you're debugging a new program that crashes: if you were running under CP/M's DDT debugger, you would have to reboot the machine and, in the process, write over the very program you were trying to examine. With the ROM-based debugger, you merely hit the reset button and you are immediately at the debugger prompt. You can now look at the contents of memory to discover what went wrong, modify parts of memory, and even restart execution of the program if you like.

One other interesting use of the Slicer debugger is to trace the operation of CP/M-86. By booting up CP/M, hitting the reset button, and telling the debugger to set breakpoints at appropriate locations and restart execution at the BIOS warm-boot location, you can trace every time a certain section of CP/M or the BIOS is executed. This is not possible with a disk-based debugger like DDT, since the debugger would be overwritten as soon as you returned to CP/M.

The utilities on the disk include SETUP, a program to change various system parameters like the amount of memory allocated to RAM disk and the printer data rate; SLIFORM, a disk formatter program for several 8-inch and 5¼-inch formats; and HFORM, a Winchester disk formatter.

The CP/M BIOS is one of the Slicer's more amazing parts. It is set up to recognize automatically not only the density but also the size of each drive. This means that you can hook up two 5¼-inch drives as A and B and two 8-inch drives as C and D today, then reverse the drives tomorrow, and the system will still understand. It will boot from the 5¼- or 8-inch floppy or the Winchester disk. About the only things that the system doesn't auto-

(continued)
automatically recognize are the printer data rate and the size of the Winchester drive; you can set these up in a few seconds with the SETUP program. All this means that you will very infrequently, if ever, have to reassemble the BIOS; almost any hardware configuration of the Slicer will run just fine with the BIOS the way it is.

Another great thing about the BIOS on the Slicer is that it reads the disk a full track at a time, rather than on a sector-by-sector basis. All requests for a sector from the same track of the disk can then be processed without going back to the disk. This speeds up disk activity quite a bit. as evidenced by the disk read/write benchmark (see table I).

**CP/M-86**

Slicer Computers Inc. sells CP/M-86 already configured for the Slicer. You can also buy CP/M-86 for the IBM PC and install it yourself if you like. This will save you $15 to $30 and takes about 15 minutes if you have another system already running CP/M (-80 or -86); complete instructions are included in the Slicer documentation.

CP/M-86 is very similar to good old CP/M-80 (nearly identical, actually). This makes it the preferred (or, shall I say, more comfortable) operating system for many people who, like myself, are coming to the Slicer from a strong 8080 and Z80 background.

This was the first operating system made available for the Slicer, and until recently it was the only one.

**MS-DOS**

Slicer now also sells MS-DOS version 2.11, which opens up another large market of programs to Slicer owners. The performance figures of the Slicer under MS-DOS should be very similar, if not identical, to those of a Slicer running CP/M-86.

**CONCURRENT CP/M-86**

The programmers at Slicer are just finishing up an implementation of CCP/M, a descendant of the IBM version, but with massive changes to get rid of the dependence of the software on a specific configuration. In the process, much of the system has been enhanced. One nice feature of the version for the Slicer is that, unlike the IBM PC version, it allows you to change the number of physical consoles, so you can actually make the Slicer into a multiuser system.

The most incredible thing about CCP/M is that it does windowing on a serial terminal; all other implementations that I have heard of require memory mapping to work (the Slicer version will do memory mapping as well). It was not trivial to make windowing work over a serial line, either. The copy of CCP/M that I received was, of course, a preliminary version (XIOS version 0.4), and there was a note from Earl Hinrichs, who wrote most of the Slicer software: "The window programs supplied by DRI [Digital Research] are very IBM dependent. I did not use any DRI stuff. Ignore DRI window documentation."

I was originally skeptical about the practicality of windows on a serial terminal—waiting for the screen to paint at 9600 bps with just one job is bad enough; four would surely make it unbearable. I was mildly surprised when I tried it: it is passable at 9600 bps and very nice at 19,200 bps. It would probably be bordering on the speed of memory-mapped windows with a 38,400-bps terminal, if I could just find an affordable terminal that could keep up at that speed.

You can access the window functions from the keyboard by typing the Window Command key followed by the function you want to execute. You can modify the size and position of the windows on the screen in real time, without exiting from any of the jobs that are currently running. You can switch to another window, change the windowing mode, display a status line for the current window, or enter the window manager, where you can alter the windows.

There are several different modes of operating in a virtual-terminal environment. The Slicer implementation allows you to change three main parameters affecting the operation of the virtual consoles. The first choice is between dynamic and disk-buffered mode. In dynamic mode, all the consoles are updated as new output is sent to them from their respective programs; in disk-buffered mode, the output of each job is saved on disk until you switch to that job with the windowing commands, then all of the saved output is sent past the screen at once.

You also have a choice between line- and screen-buffered modes. In line-buffered mode, the last 2000 characters output to a job are saved in its buffer in memory; in screen-buffered mode, the CCP/M XIOS (ex-
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One strange thing about CCP/M is that you have to go back to normal CP/M to format a new disk.

CCP/M-86 XIOS; any changes in hardware that are not automatically detected can be changed with SU.

One strange thing about CCP/M is that, since the Slicer disk formatter uses direct disk access, you have to go back to normal CP/M to format a new disk; the same applies to making a new system disk. I am not sure if this is due to the way the Slicer formatter program is written or if it is a restriction of the operating system itself, but it would be nice to be able to operate entirely under CCP/M. As it stands, you must have regular CP/M to install Concurrent on your system. Also, the PC-DOS emulation module hasn't been included in this version. When I asked the people at Slicer about this, they gave a noncommittal reply about possibly putting this feature in sometime in the future; for now you will have to boot up MS-DOS to run MS-DOS programs. A year ago this was normal; now it is a slight annoyance.

The last complaint that I have about CCP/M is that the characters used to separate the different windows on the screen are normal text characters; they sometimes get lost in the text. It would be nice if the SU program could redefine these characters to allow the use of the graphics characters available on some terminals. The display might then appear less confusing.

**ADDING MEMORY**

Another sad note about CCP/M is that it is ineffective when you have only 256K bytes of RAM. With four virtual consoles, I did not even have enough memory left over to compile a 30K-byte Turbo Pascal program, even
when the other three jobs were sitting idle. This is not really the fault of the Slicer people; complex operating systems take a lot of memory, and the only solution is to buy more memory. Unfortunately, the 256K bytes on the Slicer is the maximum that can be put on the main board, one of the reasons why Slicer designed the Slicer Expansion Board.

The Slicer Expansion Board and CCP/M go together nicely. The Expansion Board has the extra memory you need for the larger operating system and the extra terminal ports you need to connect multiple physical consoles. The Expansion Board has the same dimensions as the Slicer, 256K bytes of RAM, four more serial ports, a real-time clock, and a Centronics-type parallel printer port. It is sold in kit form or assembled, just as the Slicer is, and plugs into the expansion bus on the Slicer. It sells for $575 as a complete kit or $395 as just a memory board. You can install multiple expansion boards on the same Slicer, to a limit of 896K bytes.

COMPATIBILITY

The inability of the Slicer to run many 16-bit application programs for the IBM was a major stumbling block in the past; the designers have produced a solution. A soon-to-be-released "PC board" will allow the Slicer to run programs specifically on and for the PC. The first questions asked about the Slicer, "Is it compatible with the PC?" and "Will it run Lotus?" will now have the answers "Kind of" and "Yes, with extra hardware."

Several things are necessary to run programs written for the PC: video, for example, must be memory-mapped, and video memory must be at a certain location in the 1-megabyte address space. The PC board (see photo 3) has a built-in monochrome video controller that has the memory in the right place. If you prefer, you can also install an IBM monochrome or color video card. You can plug many of the other IBM expansion cards into the PC board, too. The only cards that can't be used are IBM memory-expansion cards and cards that use IBM's DMA (e.g., disk controllers).

The most impressive thing about the PC board is that it has the proper firmware (ROM chips) to support IBM ROM (read-only memory) calls. This means that with the PC board, you will be able to run Lotus on the Slicer (or so I've been told). The real test will be Microsoft's Flight Simulator program, but for most people the ability to run 1-2-3 is the compatibility they require.

Even without the PC board, you can still run a lot of stock programs. On the software development side, CompuView sells versions of VEDIT that will run on any CP/M-86 or MS-DOS system, and nearly any compiler for MS-DOS or CP/M-86 will run on the unadulterated Slicer. I use CP/M-86 Turbo Pascal daily and will soon have Turbo for MS-DOS (a generic MS-DOS version is available as well as the version that works only on compatibles). Quite a few C compilers are available for both MS-DOS and CP/M-86 (Manx C, for instance), and there are several FORTRAN compilers, too (although, strangely, only for MS-DOS; could the fact that Microsoft wrote the most popular FORTRAN compiler have something to do with this?).

Lotus will not run on the Slicer without the PC board, but dBASE II runs with no problems. Versions of WordStar that do not use the PC memory-mapped video are also available, so they should run as well. Probably the best way to find out if a program runs on the Slicer is to borrow a copy from a friend and try it.

If you get 5¼-inch drives for the Slicer, you can directly read and write IBM PC single-sided and double-sided disks. You won't have to worry about getting your software purchases transferred to a special format.

Another good source of programs for the Slicer is the public domain. The SIG/M Users Group has several disks of CP/M-86 software, and Micro Cornucopia has disks of public-domain software specifically configured for the Slicer. Turbo Pascal and the CP/M utilities are the only programs I use on my Slicer that are not in the public domain.

DOCUMENTATION

Whether you buy the Slicer as a bare board or as part of an integrated system, you will receive a 90-page manual that contains hardware and
THE SLICER KIT

software documentation. The hardware documentation includes a step-by-step assembly guide with sections on hardware debugging and testing procedures. There is also a theory of operation and schematics for all sections of the board with diagrams showing pinouts of all the connectors. Most of this is detailed enough to make it easy to install peripherals and find hardware problems. A data book on the Signetics 2681 DUART is included, as well as a data book and application notes on the 80186. Unfortunately, there is no data sheet on the TMS4500 RAM controller or the 1797 disk controller chip; apparently, it was decided that most people would never need to do anything with these two chips anyway, but some of us do like to know.

The software documentation has instructions for installing the Slicer BIOS into standard IBM CP/M-86, for running the utilities included on the Slicer disk, and a very detailed description of the contents of the monitor EPROMs. You are not only told about the commands available in the debugger, you are also told how to write software that accesses the monitor routines for doing such things as printing messages, reading and writing on the disk, and so on.

The manual seems to contain enough information for a person who has some experience to find his way around. Some of the information is sketchy, though. I was not overly impressed with the amount of information included on hooking up a Winchester drive. Also, the manual seems not to be organized in any special order. The first section deals with CP/M-86 and the utility programs, then it hops right into kit assembly, followed by the theory of operation, then hardware debugging, then the monitor, and finally back to the connector pinouts and schematics. Hardware and software are not separated; they seem to be shoved together in whatever order they happened to be in when the manual was stapled together.

In addition, you also receive the standard manuals that the software firms prepared on the operating systems.

CONCLUSION

Overall, the Slicer is an inexpensive (for the performance), solid machine that can be the base of an efficient software-development system. It can also be used as a multiuser system in a small business environment.

I bought the system with the idea of using it for software development, and it seems perfectly suited to the task. I wanted a system that was reliable, fast, and mildly compatible with the IBM. The Slicer has remained totally solid since it was first assembled; it is the most reliable piece of hardware I have ever owned. The benchmarks comparing the Slicer to my Big Board speak for themselves; it is fast. The unmodified Slicer has problems running some software written for the IBM, but all software written on the Slicer will run on the IBM. If you must have a true IBM-compatible, then you should probably wait for the PC board to be released or look elsewhere.

The support from Slicer is refreshing, too. There is always someone available to help solve problems when I call. The Slicer had some problems at first, but most of them have been solved because the company actually responds to user requests.

The Slicer is a solid machine; it is the most reliable piece of hardware I have ever owned.
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<td>P.O. Box 6680, Dept. A103</td>
<td>(717) 357-9675</td>
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<td>Stateline, NY 14449</td>
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<td>477 E. 3rd St., Dept. A103</td>
<td>(717) 347-1480</td>
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ALTHOUGH RECENT YEARS have witnessed the widespread distribution of commercial software, it wasn't always this way. In fact, many of the original microcomputers were home-built machines running home-built programs. You were lucky if any software existed for your machine: most programmers wrote their own. As computers grew cheaper and more powerful, they began to spread, but the market for utilities, programmers' tools, character-based games for video-display terminals, and similar programs was not large enough to warrant commercial exploitation. Small computers designed as business and development systems became the targets for creative programmers working at more mundane tasks, as had the mainframe computers before them. These hackers traded programs with each other, and public-domain software was born.

The real mushrooming of public-domain software in the microcomputer arena can probably be traced to two phenomena. First was the emergence of the CP/M-80 operating system, which provided a common ground for software development. Second was the work of Ward Christensen, a programmer who designed a simple protocol for the successful transmission of compiled program files from one computer to another. His XMODEM protocol, often called the Christensen protocol, is still the basis for most personal computer telecommunications. XMODEM served as the kernel for a series of terminal-emulation programs that are still evolving, and it spurred the spread of microcomputer-based bulletin-board systems (BBSs). With the addition of error-free file-transfer capabilities, these electronic message centers soon became an ideal distribution system for programs as well as ideas. Today, there are hundreds—if not thousands—of BBSs in operation around the world.

The advent of the IBM PC in 1981 changed the nature of the personal computer, and it has changed the nature of public-domain software as well. Once IBM adopted it, the personal computer was no longer a curiosity. As significant as the explosion of independently developed commercial software has been to the success of the IBM Personal Computer, public-domain software and Freeware have played an equally vital role.

**FREEWARE**

The concept of Freeware was developed by Andrew Fluegelman. (Because he has trademarked the term, this kind of software is referred to generically as "user-supported" software.) This is software for which you pay only if you believe the program has value to you. The first program to be developed and sold as Freeware was PC-Tulk, a communications program for the IBM PC authored by Fluegelman. Since then, dozens of programs have appeared as Freeware or under similar, related schemes. Freeware programs can be freely copied and distributed, thus providing this type of software with a grass-roots channel of distribution. The programs usually come with a message suggesting a donation ranging from $10 to $50. Underlying the

(continued)
the concept of "user-supported" software is the idea that the copying of programs should be encouraged rather than restricted, as is currently the practice in the commercial software sector. Coupled with this are the ideas that the value of a program is best assessed by the user and that the personal computer community should have an interest in supporting the development of useful software.

The programs listed in this article are only a small sampling of what is available. BBSs around the country permit the downloading of free software for every type of popular personal computer. In some instances system operators (sysops) who maintain the BBSs charge the user a fee to subscribe to their systems, but in most cases software can be downloaded for the cost of a phone call. Locating a local BBS with software available for downloading to your computer can be tricky. Bulletin-board systems are often run by computer hobbyists and come and go at the whim of the owners. To find a current list, it is best to check either a well-established system in your community or a commercial on-line service such as The Source, CompuServe, or NewsNet; each maintains relatively current lists in various databases. Also, several of the books mentioned in the bibliography at the end of this article include comprehensive lists of BBS phone numbers. [Editor's note: As a service to our readers, BYTE maintains the BYTEnet Listings bulletin-board system, which contains public-domain software and listings from some of the articles appearing in the magazine. The number is (603) 924-9820.]

Tracing the development of public-domain software can be an engrossing activity. Frequently, programs are made available in both object- and source-code form, permitting others to modify them—and to fix bugs. Thus public-domain programs tend to evolve even when they aren't supported by the original authors.

The following programs were chosen because of their popularity or because they have become our favorites. We've included distributors' addresses where possible. The programs are generally available on bulletin-board systems, in computer-club software libraries, and, in some cases, in CompuServe Special Interest Group (SIG) databases.

SOFTWARE FOR THE IBM PC

Much of the public-domain software for the IBM PC traces its roots back to the world of CP/M hackers. After all, PC-DOS (or MS-DOS) is merely an evolutionary step from CP/M using a newer microprocessor, and many of the familiar programmers and programs have made the jump to 16 bits. In fact, many of the "standard" features of MS-DOS as distributed by...
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Microsoft are direct descendants of CPM public-domain programs. Also, higher-level languages such as C have smoothed out the transition from one operating system to another. While a few of the operating-system-dependent programs, such as Ward Christensen’s marvelous disk editor/debugger DU (Disk Utility), have only made the jump to CPM-86, more and more programs are appearing every week in MS-DOS versions.

As a result, quite a few of the “smaller” utilities greatly resemble their CPM ancestors. There are modern programs, sorted directory programs, file utilities, languages, and the like that are merely good rewriting jobs. (In many cases, though, the source code has been optimized to make use of the larger memory capacity and improved graphics capability of the IBM PC.) Even the names of these cloned programs are often identical to those of the original CPM versions.

Some of the best of these clones are programs developed as adjuncts to the tedious business of file transfer. The modern programs are the obvious example, but a great deal of thought has gone into devising ways to cut down on long-distance telephone bills. There are a number of programs that can compress and decompress files, often by as much as 40 percent. Most have names like Squeeze and Unsqueeze. There is also an important archiving program called LJ (Library Utility). Originally written by Gary Novosleski for CPM, an MS-DOS version by Tom Jennings is now making the rounds. LJ can create a “library” of files with its own internal directory and storage system. You can take a collection of seldom-used files that are cluttering up your directory and reduce them to a convenient package that exists as a single directory entry.

There are also a good number of programs that perform functions peculiar to MS-DOS. These include volume labelers, RAM-disk programs, and copying programs. Of particular interest are programs such as KEY-STAT, which displays the status of the PC’s Caps Lock and Num Lock keys on the screen.

**COMMUNICATIONS PROGRAMS**

**PC-TALK III:** The Apple Macintosh has been criticized for its current lack of commercial software, but the same situation characterized the IBM PC when it was first introduced in mid-1981. Initially, no professional communications software was available for the PC. To fill the gap, Andrew Fluegelman wrote PC-Talk in interpreted Microsoft BASIC. The program caught on because it could be freely copied and because IBM users were receptive to the idea that they paid for the program only after they had a chance to use it and discover for themselves whether or not it was a good value. PC-Talk permitted users to automatically dial remote computers and send and receive files. Eventually it supported the XMODEM file-transfer protocol that permits binary file transfer. There is now a compiled version of PC-Talk III available that runs on an IBM PC with only 128K bytes of RAM (random-access read/write memory). There are even patches available for the basic program that permit it to display split screens and to operate at 450 bps (bits per second) using a 300-bps modem. The suggested donation is $35. (The Headlands Press Inc., POB 862, Tiburon, CA 94920.)

**ONE RINGY DINGY (IRD):** Written by Jim Button, author of PC-File and other user-supported programs, IRD features a command language with auto-log-on capability and data rates as high as 9600 bps. It also supports the Christensen XMODEM protocol. Suggested donation: $25. (Buttonware, POB 5786, Bellevue, WA 98006.)

**OTHERS:** Kermit is a file-transfer program that permits it to display split screens and to operate at 450 bps (bits per second) using a 300-bps modem. The suggested donation is $35. (The Headlands Press Inc., POB 862, Tiburon, CA 94920.)

(continued)
Fido takes the concept of the BBS a step further.

tool and terminal-communications program that makes it easier for personal computers to interact with mainframes and minicomputers. Developed at Columbia University, Kermit is available in the public domain for a variety of computers including the IBM PC and the Macintosh. MEX mit is available in the public domain for personal computers to interact with mainframes and minicomputers. De­
ess a rather powerful and complex terminal program that can be found in mainframes and minicomputers. De­veloped at Columbia University. Ker­mit is one of the most ambitious attempts at making a success of the user-support concept. PC-Write is a fast in-memory editor with a separate for­matting program. It provides for split­screen editing, permits user-definable keyboards, supports PC-DOS 2.0, allows for recording and playback of keyboard sequences, and permits block moves and a variety of other commands. PC-Write is marketed under an arrangement that Wallace refers to as "Shareware," a variant of Fluegelman's original Freeware Idea; PC-Write is freely copyable. The program comes with documentation on the disk in a compressed form. Wallace will sell the program and documentation on a disk for $10; however, he also encourages users to register for $75. Registration entitles users to a printed copy of the manual, a free upgrade of the next major pro­gram release, a Pascal and assembly­language source disk, and a $25 com­mission when someone else registers from a copy of your registered disk. (Quicksoft, 219 First N. #224, Seattle, WA 98109.)

**FULL SCREEN EDITOR:** D. W. Daetwyler wrote this program. In his documen­tation he refers to it as a T.P.I.R. (The Price Is . . . Reasonable?) product and asks for a contribution of $35, which entitles the user to future updates of the program. Full Screen Editor offers features similar to those of IBM's Per­sonal Editor program. It is designed primarily as a program-development tool, particularly for Pascal or FOR­TRAN programmers. The program is available widely on BBS around the country.

**DATABASES**

**PC-FILE:** Written by Jim Button and distributed by his company, Button­ware. PC-File is one of the classic user-supported programs. It is a simple file manager (not based on a relational model) that supports a maximum of 10,000 records and 41 fields per database. Data can be imported and ex­ported to other programs such as Multiplan, VisiCalc, and MailMerge. PC-File has excellent sorting capabili­ties. Most of the program functions are available by pressing one of the PC special-function keys from the Master Menu Screen. PC-File version III, introduced at the start of 1984, added data encryption, calculated report fields, and support for floating-point notation. Requested donation: $45. (Buttonware, POB 5786, Bellevue, WA 98006.)

**GAMES, UTILITIES, AND PROGRAMMING TOOLS**

**CORE WAR:** An IBM PC implementa­tion of the Core War game was described by A. K. Dewdney in his "Computer Recreations" column in the May 1984 issue of Scientific Ameri­can. Two player-written assembly-lan­guage programs (the assembler is a simple nine-instruction language) operate concurrently within the same segment of memory. A program "loses" when it hits an instruction that it cannot execute. The game is written in Small C by Kevin Bjorke.

**SMALL C:** This language, written by Ron Cain, is a compact subset of the C language model developed by Ker­nighan and Ritchie. It exists for almost every major operating system and is a boon for those who wish to ensure source-code portability for their programs.

**MVP FORTH:** This is a public-domain version of the Mountain View Press implementation of the FORTH lan­guage. Available either as a compiled program or as assembly-language source code, it is a full working FORTH easily equivalent to commer­cial programs. The source code can also be used as an excellent reference for those who wish to build their own threaded interpretive languages.

**LADYBUG:** Originally derived from Logo, this is a graphics-oriented pro­gramming language. It contains many

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<td>ZENITH 1-2-3</td>
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of the graphics commands, procedure-making commands, and control commands found in the Apple II implementation of Logo developed by Terrapin Inc. It also has a library of procedures, a full-screen editor, and support for two displays and sound. Requested donation: $35. (David N. Smith, 44 Ole Musket Lane, Danbury, CT 06810.)

CHASM (CHEAP ASSEMBLER): Written by David Whitman. CHASM is an 8086 assembler. It is not a macro assembler, but it will perform many of the functions that the IBM Macro Assembler does. CHASM produces directly executable code and does not require a linker. CHASM also supports two methods of getting assembly-language subroutines into Microsoft BASIC. Requested donation: $30. (David Whitman, 136 Wellington Terrace, Lansdale, PA 19446.)

EPISTAT: This is a collection of programs written in BASICA for statistical analysis of relatively small data samples. There are 21 different programs that can perform 34 common statistical tests or functions. Results can be printed, graphed, or saved to disk. Requested contribution: $25. (Tracy L. Gustafson, M. D., 1705 Gattis School Rd., Round Rock, TX 78664.)

NEWKEY: This user-supported ProKey-style program allows redefinition of just about any key on the IBM PC keyboard. Keyboard-definition files can be saved, loaded, or merged. UN-WORDSTAR: One of our favorite (and most useful) utilities was written as an assembly-language demonstration by Gene Plantz. Un-WordStar quickly strips the high-order bits out of WordStar files, converting them to ASCII (American Standard Code for Information Interchange) text. Plantz's version is not the only one; this is a wheel that seems to be reinvented by every assembly-language programmer. In fact, we're now beginning to see programs that go the other way, converting ASCII files to WordStar.

MORERAM: This program has been adapted by Daniel O'Brien from articles in several personal computer magazines. It permits an IBM PC to use more memory than is allowed via the motherboard memory switches. Of course this involves violating regions of memory that IBM has designated "reserved." Moreram also has the beneficial side effect of allowing faster power-up sequences by making the motherboard memory-switch settings appear to be set to 64K bytes.

SCREENSAVE: This is another handy utility. It blanks your screen if you leave your keyboard for any extended

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**HEX COM**: This program converts COM and EXE format files to hexadecimal form and vice versa. Written in assembly language, it will convert an 80K-byte hexadecimal file and download it to a floppy disk in about 15 seconds. It is used extensively for exchanging binary file information between systems that do not share the Christensen XMODEM protocol. It was written by Martin Smith and is available from the IBM PC SIG on CompuServe.

**ULTRA-ZAP, ULTRA-FORMAT, ULTRA-FILE**: These are a series of utility programs similar to The Norton Utilities. Ultra-Zap displays and modifies sectors on a disk, searches for character sequences in disk or file sectors, fills or zeros disk sectors, and interrogates disks to display their protection techniques. Ultra-Format formats standard or copy-protected disk tracks and also repairs files containing “flaky” sectors by placing a fresh format on a track without erasing prior data. Ultra-File displays all the directory information about a disk file, assigns and removes system or hidden status of a file, builds files, and resurrects erased files.

[FreeSoft Ultra-Utilities, POB 27608, St. Louis, MO 63146.]

**PUBLIC-DOMAIN SOFTWARE FOR THE MACINTOSH**
Public-domain and user-supported software for the Macintosh is burgeoning. It has been limited to date because of the absence of BBS software for the Macintosh. Though there are currently several BBS systems that support the Macintosh, they are, ironically, on IBM or Apple II computers. As a result, the undisputed best spot to hunt for Macintosh software is the Macintosh section of the CompuServe Micro-Networked Apple Users Group (MAUG) SIG. This SIG has become one of the busiest sections on CompuServe and now includes a special section for developers that is being supported by Apple Computer’s technical staff (on their own time!). It is also a lively discussion forum for program developers and both novice and experienced Mac users.

When the Macintosh was first introduced, there was no communications software available for the new computer. To fill the gap, Dennis Brothers, a Massachusetts-based programmer, wrote MacTeP (Macintosh Terminal Emulator Program) in Microsoft BASIC, permitting Macintosh users to get on line and transfer files. Since then, a number of other public-domain and user-supported communications programs have been written for the Macintosh. MacTerminal from Apple and a number of other commercial packages are also available now.

The list that follows is a sampling of some of the best of today’s programs from the Macintosh section of the MAUG SIG. Many of these programs are also available on disk from local Macintosh computer clubs.

Because the Macintosh is such a new computer and so unlike most other systems on the market, be warned that acquiring Mac public-domain software is not without its risks: quite a few of the programs kicking around are programmers’ experiments designed to provide experience in working with the user interface—for the programmers, not for you. You may encounter major flaws that will never be corrected. On the other hand, this phenomenon provides some delightful surprises; there are some very impressive names generating interesting programs as these programmers work on perfecting the skills necessary for generating more commercial products.

There are currently several hundred programs available for the Mac: we expect a veritable explosion of software now that the 512K-byte Macintosh is readily available as a low-cost development machine. The emergence of new languages over the next few months will also spur the development of public-domain and user-supported software, as will the increasing number of commercial programs (look for templates and all sorts of conversion utilities). There’s a final encouraging sign: As the Mac continues to attract the attention of graphic designers, we can expect to see quite a few more programs that reflect their needs.

**MacTeP V.187**: The Macintosh Terminal Emulator Program written by Dennis Brothers is probably the most celebrated example of Macintosh public-domain software. MacTeP permits the Macintosh user to do the telecommunications basics. It is written in Microsoft BASIC and includes provisions for setting parameters and uploading and downloading files. Brothers is currently working on an improved version.

**RED RYDER 3.0**: This communications program for the Macintosh is written by Scott Watson and marketed under the user-supported concept. Red Ryder is currently written in Microsoft BASIC and makes extensive use of overlays on the 128K Macintosh. It includes auto-log-on and many other features.

**DESK ACCESSORY MOVER**: CE Software markets this user-supported utility program under the “MacHonor” system (that is, the company trusts you to pay the suggested donation if you find the program useful). Desk Accessory Mover....

(continued)
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sory Mover allows users to add and delete desk accessories from the Macintosh desktop. A number of disk accessories are also available, including the famous—or infamous—"bug," a tiny six-legged creature that crawls around (as a background task) on the screen, even if you've crashed the system. (CE Software, 801 73rd St., Des Moines, IA 50312, (515) 224-1995.)

BINHEX VERSION 2: This assembly-language hexadecimal conversion program was written by Yves Lempereur as a demonstration of the Mainstay MacASM Editor/Assembler. The newest version converts compressed files. The program runs many times faster than an early BASIC version written by William B. Davis Jr. and others. It has special knowledge of the Macintosh program file structure.

MENUEDIT: Andy Hertzfeld, a member of the Macintosh design team, wrote this menu editor. It permits adding, deleting, and altering menu titles and makes it possible to add command-key shortcuts for each menu item.

OSAKA FONT: One of the reasons that the Macintosh has achieved such wide acceptance is its bit-mapped graphics. Many users are now using font editors to create their own fonts. Osaka is a micro-miniaturized font that offers a compression of screen space of almost 30:1 compared to New York 12-point. Whole paragraphs shrink to a small line of unreadable bars, but they can be zoomed up to be legible by selecting a larger font size with the mouse. Osaka Font was designed by R. W. Zehr.

SCHEMATIC FONT: This is a special font for creating electronics schematics in MacPaint or MacDraw. It includes ANDs, ORs, NORs, transistors, and resistors. Designed by Paul Dobbs.

LIFE: Apple programmer Bill Atkinson has created an excellent mouse-driven graphics-oriented version of the classic game of Life. Atkinson has also placed a simple card-file database program in the public domain.

REVISED: This version of the game Othello was written by Robert J. Woodhead, of Wizardry-game fame. He asks users to make a donation to a fund for the blind.

DALEKS: This simple game for the Macintosh was programmed by Johann Strandberg while he was at Apple.

MAC BBS

As this article was being completed we discovered that the first low-cost Macintosh BBS program had been announced by Connick and Associates Inc., 2329 Old Trail Dr., Reston, VA 22091. This program was scheduled to be shipped in November and was being priced at $50.

SUMMARY

This article has touched on only a small fraction of the free or nearly free software available for the IBM PC and the Apple Macintosh. Many other computers and operating systems, especially CP/M-80 systems and members of the Apple II family, also have a great deal of user support. Finding user-supported software for your favorite computer will require a little detective work on your part. But if you look, you're certain to find your own public-domain gems.

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XLISP IS AN EXPERIMENTAL programming language based on LISP, with extensions to support object-oriented programming. I designed it to give users of inexpensive personal computers the chance to experiment with concepts from the field of artificial intelligence and the discipline of object-oriented programming. I wrote XLISP in a straightforward dialect of C to allow maximum portability. It will run with little modification on almost every small computer system for which a C compiler exists.

I have placed XLISP in the public domain, and it is available in both source and compiled form from many computer users groups. You may also obtain XLISP by downloading it from one of the many public-access bulletin-board systems around the country that support file transfer. [Editor's note: XLISP is also available for downloading via BYTEnet Listings. The number is (603) 924-9820.]

BACKGROUND
In his book Artificial Intelligence (reference 4), Patrick Henry Winston defines that field as “the study of ideas that enable computers to be intelligent.” He goes on to say that the central goals of artificial-intelligence research are “to make computers more useful” and “to understand the principles that make intelligence possible.” This field has been receiving increasing attention recently, and understanding its basics is becoming important. The LISP programming language is frequently used for developing projects in the area of artificial intelligence, and it served as the basis for much of the philosophy and syntax of XLISP.

Since the appearance of the August 1981 BYTE, the computer community has also given increasing attention to object-oriented programming. That issue was devoted to a language called Smalltalk-80, the first language to be based entirely on the concept that all data within a program should be represented by a collection of objects and all manipulation of data should take place through the sending of messages. Many of the articles were written by people from the Xerox Learning Research Group, who had been doing research into object-oriented programming for many years. Daniel Ingalls, in an article called “Design Principles Behind Smalltalk” (reference 3), wrote that “Computing should be viewed as an intrinsic capability of objects that can be uniformly invoked by sending messages.” However, Smalltalk-80 is much more than just a programming language: it is an entire programming environment built around an object-oriented language.

XLISP provides the essential mechanisms required to experiment with object-oriented programming. It is a subset of LISP and is adequate for learning the basics of the LISP language. It is not a full implementation of LISP, nor is it an alternative to Smalltalk-80. Its advantages over more complete implementations of LISP are that it is available free of charge and comes with complete source code in a high-level language. It has been ported to many different machines and operating systems, and users have found it easy to extend to fill their own special needs.

XLISP is a framework within which to try out new ideas. I consider myself a hobbyist in the field of artificial intelligence.
XLISP TUTORIAL

intelligence, not an expert. I have been intrigued by attempts to produce intelligent machines and was anxious to learn more about the techniques used to approximate intelligent behavior. I invented XLISP because I wanted to experiment with some of those techniques at home. I could have used the big mainframe machines at work, but I wanted to learn about artificial intelligence and object-oriented programming on my own personal computer.

When I first started developing XLISP, my home system was a Digital Equipment Corporation PDP-11/50 running the RT/11 operating system. This machine contains an LSI-11 processor with 60K bytes of memory and two single-sided, single-density floppy-disk drives.

I chose C as the development language for XLISP for several reasons. The most immediate was that a public-domain compiler for C was available from the Digital Equipment Computer Users Society (DECUS) and an RT/11 version of the compiler was available that would run on my PDT. The only other language to which I had easy access was MACRO-II, the assembly language for the PDP-11 processors. I wanted XLISP to be portable to other processors and operating systems. Buying the PDT was a good way to get into home computing, but I knew that I would eventually own a machine that would run a more popular operating system. I wanted to be able to continue using any software that I developed for the PDP on any new computer that I might acquire.

I also wanted to be able to share my work with users who had goals similar to my own. In order to share software with others who have different processors and different operating systems, I needed to write XLISP in a language common among the systems involved. Implementations of C were springing up for every imaginable processor, so it seemed like the logical choice.

The decision to use C instead of assembly language was not without trade-offs. The code produced by typical microcomputer C compilers tends to be both slower and more space-intensive than hand-coded assembly language. Most microcomputer LISP interpreters have been written in assembly language, so XLISP was bound to be slower than other interpreters on similar machines. However, since XLISP was to be a language for experimentation, I decided that C's advantages of portability and ease of extension outweighed the speed and size problems.

The ease with which XLISP could be ported to other systems became apparent early in its development cycle. A friend wanted to experiment with XLISP. He had a CP/M-80 system and a copy of the Aztec C compiler. In only a few hours of editing, he was able to get my PDP-II version of XLISP running on his Z80 system. Eventually, I made XLISP even more portable by adding conditionals to control the compilation process and tailor the system to other compilers and operating systems. You can now compile the same source code for XLISP—without any editing—on the PDP-II under RT/11, RSX, and UNIX; on the VAX under VMS and Berkeley UNIX; on the 8080 or Z80 under CP/M-80; on the 8088 or 8086 under CP/M-86 or MS-DOS; and with several other compilers and operating systems. This ease of portability has allowed many users to contribute to the development of subsequent versions of the interpreter.

PROGRAMMING IN XLISP

XLISP is a conversational language: When you invoke it, it responds with a prompt. Interaction with XLISP consists of a three-step process:

1. The user types an expression in response to a prompt. XLISP computes the value of the expression.
2. XLISP prints the value of the expression.

This process is repeated for as long as XLISP is running. It is called the "read-eval-print" loop. The XLISP prompt is the "greater-than" symbol (>). The appearance of this character at the beginning of a line indicates that XLISP is waiting for you to type an expression to be evaluated. Like LISP, XLISP expressions use parentheses to indicate function calls. XLISP responds to a function call by evaluating an expression of the form

(function arg1 arg2 . . . argn)

The left parenthesis is followed by the function name, the arguments to the function, and a closing right parenthesis. Here is an example of an expression to add two numbers, followed by XLISP's response:

>(+ 2 3)
5

This example illustrates how I will show interactions with XLISP in this article: the XLISP prompt, followed by your input, followed—on a line without a prompt—by the response XLISP generates in response to that input. This is exactly the way real interactions with XLISP take place.

XLISP also uses a second type of prompt, which consists of a number followed by a greater-than symbol. XLISP uses this type of prompt when the expression that you typed in response to the previous prompt contained at least one unmatched left parenthesis. The number preceding the greater-than symbol indicates the number of unmatched left parentheses in the preceding expression, as in the following example:

>(+ 2
1>(* 3 4))
14

The line you entered in response to the first prompt contained one unmatched left parenthesis. This fact is indicated by the digit 1 preceding the prompt on the second line. The number of parentheses is balanced at the end of the second line, so XLISP computes the value of the expression and prints it.

Let's step back a bit and look at the kinds of expressions that XLISP can recognize. Since the structure of

(continued)
XLISP is largely based on LISP; it breaks expressions down into the same basic categories. As such, it has only two different types of expressions: atoms and lists. **Atoms** are symbols, numbers, character strings, files, and objects. Here are some examples of atoms:

132
"a string"
my-function

The first is a number, the second is a character string, and the third is a symbol.

**Lists** are ordered collections of atoms or other lists. Here are some examples of lists:

(red orange yellow)
()
(+ 2 (* 3 4))

The first list contains three elements, each of which is a symbol. The second list contains no elements and is called the "empty list" or "nil." The third list contains three elements, the last of which is itself a list containing three elements.

Atoms and lists taken together are called symbolic expressions or "s-expressions." The last list in the example above illustrates one of the most important and powerful concepts of XLISP (and LISP): Data and programs are represented identically. Thus, we can talk about the expression (+ 2 (* 3 4)) as a piece of data to be manipulated by a program. Or we can pass this expression to the XLISP evaluator to obtain its value as an executable expression.

Because XLISP programs are themselves composed of XLISP expressions, we can write a program that constructs other programs.

Another capability that goes along with the ability to construct programs is being able to execute a program after it has been constructed. This capability is provided by XLISP in the function `eval`. When `eval` is given an expression, it returns the result of evaluating the expression. For example, if we associate the expression (+ 2 (* 3 4)) with the symbol `x` (using the function `setq`, explained below), XLISP will return the expression when we enter `x`:

```
> x
(+ 2 (* 3 4))
```

If, however, we use the `eval` function, XLISP evaluates `x`:

```
> (eval x)
(+ 2 (* 3 4))
```

All of the examples so far have used numbers and arithmetic operators. XLISP is also capable of processing lists. Three basic functions provide the most primitive manipulations of lists. The first is `car`. When you apply the function `car` to a list, XLISP responds with the first element of the list:

```
> (car '(my dog has fleas))
my
```

The second function is `cdr`. When you apply the function `cdr` to a list, XLISP responds with the remainder of the list after removing the first element:

```
> (cdr '(my dog has fleas))
(dog has fleas)
```

These two functions let you take lists apart. A corresponding function, `cons`, allows you to construct new lists. When you apply the `cons` function to two arguments, XLISP returns a new list with the first argument as the first element of the list and the second argument as the rest of its elements:

```
> (cons 'all '(musicians like bach))
(all musicians like bach)
```

You can also combine these functions to do more complicated things:

```
> (car (cdr '(mozart (is a) composer)))
(is a)
```

The evaluation of this expression begins with the application of function `cdr` to the argument `(mozart (is a) composer)`. This results in the expression `((is a) composer)`, which is given to the `car` function. The `car` function then returns the first element of this list, (is a). This construct extracts the second element of a list.

Now let’s define a single function to extract the second element of a list. This requires the use of a function called `defun`, which associates a function definition with a symbol.

```
> (defun second (x) (car (cdr x)))
second
```

The function `defun` returns the name of the function just defined as its value. Notice that I have not supplied any single-quote characters before the arguments to `defun`: `defun` is a "special form," which means that it takes its arguments unevaluated. After this function definition has been entered, you can use the function `second` to extract the second element of a list:

```
> (second '(mozart (is a) composer))
(is a)
```
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You can also associate values with symbols, using the special form setq, which evaluates its second argument and associates this value with its first argument, which must be a symbol. For example:

> (setq x '(mozart (is a) composer))
(mozart (is a) composer)

The special form setq returns the new value of the symbol. Thereafter, when the XLISP evaluator encounters a symbol, it returns the value associated with the symbol:

> x
(mozart (is a) composer)

And in conjunction with the preceding function definition for second:

> (second x)
(is a)

If no value has been associated with the symbol, an error is reported.

Several XLISP functions test whether a condition is true. They are called predicate functions. One predicate function is null, which takes one argument and returns t if the argument is an empty list and nil otherwise:

> (null '())
  t

> (null '(a b c))
  nil

Another predicate function is eq, which takes two arguments and returns t if the arguments are identical and nil otherwise. XLISP uses the value t to represent "true" just as it uses the value nil to represent "false." (Actually, any value other than nil is interpreted as "true". XLISP uses the value t when there is no other more meaningful value to use instead.) Here are some examples of eq:

> (eq 'a 'a)
  t
> (eq 'a 'b)
  nil

Another of XLISP's special forms is cond, used to conditionally evaluate expressions. It is often used in conjunction with the predicate functions to control the execution of a program. A conditional expression has the form

<table>
<thead>
<tr>
<th>cond</th>
</tr>
</thead>
<tbody>
<tr>
<td>(condition-1 action-1-1 action-1-2 ... action-1-n)</td>
</tr>
<tr>
<td>(condition-2 action-2-1 action-2-2 ... action-2-n)</td>
</tr>
<tr>
<td>...</td>
</tr>
<tr>
<td>(condition-m action-m-1 action-m-2 ... action-m-n))</td>
</tr>
</tbody>
</table>

(continued)
By packaging the definition of an object with the definition of the procedures that manipulate it, you can change the implementation just by changing the definitions.

XLISP evaluates this expression by evaluating each of the conditions, in order, until it finds one that is true. If XLISP finds a true condition, it executes the actions associated with that condition, and the value of the expression is the value of the last action for that condition. If none of the conditions is true, the value of the expression is nil. Here is an example of cond:

```lisp
(setq a 0)
0
>(cond ((eq a 0) (setq a 1))
1 > (t (setq a 0)))
1
```

For example, if you set the value of the variable a to 0. The conditional expression then says that if the value of a is 0. set the value of a to 1 and return 1. If the value of a is not equal to 0. then XLISP evaluates the second condition (t). finds it to be true, sets the value of a to 0, and returns 0. Since, in this case, the value of a is 0. XLISP sets the value of a to 1 and returns 1. Checking the value of the variable a confirms that this has happened:

```lisp
>a
1
```

If you had set a equal to any number other than 0, the expression would have returned 0.

**OBJECT-ORIENTED PROGRAMMING IN XLISP**

XLISP also provides a simple facility for experimenting with object-oriented programming. An object-oriented program consists of classes, which contain objects. Each object in a class is an instance of that class and has the same structure as every other instance of that class. For example, to borrow from the article "The Smalltalk-80 System" (reference 6), we can define a class called Point. (By convention, a class name always begins with a capital letter.) The instances of the class called Point are points in a twodimensional field, each of which has data in the form (x,y). The x and y are the instance variables of the class Point. Each instance of Point has a set of values for these variables. A class also has class variables, which refers to data that is common among all instances of the class.

The information contained within the structure of an object can be accessed only by the procedures defined within the object's class. These procedures are called methods and they are invoked by sending messages. A message is a request to an object to perform some manipulation of its internal data by executing a method. For each message that an instance can answer, there is a corresponding method that contains the code to compute the answer to the message.

One advantage of packaging the definition of the structure of an object with the definition of procedures that manipulate it is that you can change the implementation of an object just by changing this package of definitions. Any code that interacts with an object does so only by passing messages and is not dependent on the internal structure of the object. It is only dependent on the message protocol used to manipulate the object.

Each class contains a dictionary that associates message selectors with methods. When a message is sent to an object, XLISP determines the class of the object, looks up the message selector in the message dictionary of the class, and evaluates the code within the method associated with the message.

In XLISP, you send a message to an object by evaluating an expression of the form

```lisp
(object selector arg1 arg2 ... argn)
```

For example, to create a new class, you enter the expression

```lisp
>(Class 'new)
<Object: #1598>
```

In this expression, the object is Class and the selector is new. There are no arguments. Although this may seem confusing, the object Class is an instance of the class Class—it is the only object in XLISP that is an instance of itself. Objects that are instances of Class respond to the message new by creating a new instance of that class. XLISP responds by returning the new object's location in memory. However, it isn't very useful to create a class unless you can refer to it again. To do this, you associate the new object with a name, as shown below.

For the purpose of illustration, we will define a class of objects that represent simple dictionaries. Each instance of this class will be a dictionary capable of storing entries that consist of a name and a value. You will be able to create new dictionaries, add entries to an existing dictionary, and find previously stored entries. To create the dictionary class, type

```lisp
>(setq Dictionary (Class 'new))
<Object: #194F>
```

This expression creates a new class and assigns the result to the symbol Dictionary.

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The message ivars defines the set of instance variable names used by each instance of a class. In this case, we need only one instance variable, entries. It will refer to an association list of names and values representing the entries in the dictionary.

You must also initialize new instances of the Dictionary class. You do this by defining a method for XLISP's isnew message. Whenever you create a new object by sending the message new to a class object, XLISP automatically sends the newly created object the message isnew, which allows the new object to initialize its instance variables.

To define a method for isnew use the function answer. A class object responds to the message answer by entering a new selector-method pair into its message dictionary. The arguments to answer are the name of the selector, the formal argument list, and a list of expressions representing the method for answering the message. In the case of a dictionary object, all you need do is define a method that initially sets the list of entries to nil:

\[(\text{Dictionary} \ '\text{answer} \ '\text{isnew} \ '() \ \text{1} \ \text{2} \ \text{3} \ \text{4} \ \text{5})\]

This illustrates another feature of message sending in XLISP. Whenever the XLISP evaluator sends a message to an object, it first associates the symbol self with the object to which it is sending the message. This allows code within the method to refer to the receiver of the message. Because isnew is called immediately after an object is created and the result of sending the isnew message is also the result of the original new message, it is important for the isnew method to return the value of the symbol self. This value will be the new object.

Now we'll define the messages that will be used to manipulate the dictionary objects. The first will be called add and will add a new entry to the dictionary:

\[(\text{Dictionary} \ '\text{answer} \ '\text{add} \ '(name \ value) \ \text{1} \ \text{2} \ \text{3} \ \text{4} \ \text{5})\]

Now it's time to create a dictionary and add some entries:

\[(\text{setq} \ \text{d} \ \text{(Dictionary} \ '\text{new}))\]

Now it's good having a dictionary unless it's possible to find words that have been entered into it. We'll define a method for a message called find that will let you find entries previously added to the dictionary by add:

\[(\text{Dictionary} \ '\text{answer} \ '\text{find} \ '(name &aux \ entry) \ \text{1} \ \text{2} \ \text{3} \ \text{4} \ \text{5})\]

This expression defines find as the message that returns an entry on the condition that the entry exists. The definition also points out two more features of XLISP. The first feature allows you to introduce local variables in a user-defined function or method by including their names in the formal argument list preceded by &aux. These variables will be initialized to nil before the code in the function or method is executed. The second feature, a function called assoc looks through a list of name-value pairs for a particular name. If it finds a name, XLISP returns the pair. If not, it returns nil.

Now that the find message has been defined, you can retrieve entries from the dictionary:

\[(\text{d} \ '\text{find} \ '\text{mozart}) \ \text{composer}\]

\[(\text{d} \ '\text{find} \ '\text{winston}) \ \text{computer-scientist}\]

\[(\text{d} \ '\text{find} \ '\text{bozo}) \ \text{nil}\]

If we try to find a name that has previously been added, we get the value associated with that name. If we try to find a name that is not in the dictionary, we get nil back as the value.

Our definition of the Dictionary class is now complete. You can create new dictionaries, add new entries to a dictionary, and find previously added entries.

**Hierarchies**

XLISP also provides a hierarchical class structure. Every class is a subclass of some other class. The root of this hierarchy tree is the class called Object. This is the only class that is not a subclass of another class. A class inherits all of the instance variables, class variables, and message dictionaries from all of its superclasses (the superclass of any class is the class of which it is a subclass). This inheritance mechanism lets you define classes that are specializations of other classes. An example might be (continued)
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**Table 1: The built-in functions of XLISP version 1.2.**

### Evaluation Functions

- `(eval <expr>)` EVALUATE AN XLISP EXPRESSION
- `(apply <fun> <args>)` APPLY A FUNCTION TO A LIST OF ARGUMENTS
- `(funcall <fun> <arg> ...)` CALL A FUNCTION WITH ARGUMENTS
- `(quote <expr>)` RETURN AN EXPRESSION UNEVALUATED

### Symbol Functions

- `(set <sym> <expr>)` SET THE VALUE OF A SYMBOL
- `(setq <sym> <expr>)` SET THE VALUE OF A SYMBOL
- `(defun <sym> <fargs> <expr> ...)` DEFINE A FUNCTION WITH EVALUATED ARGS
- `(ndefun <sym> <fargs> <expr> ...)` DEFINE A FUNCTION WITH UNEVALUATED ARGS
- `(gensym <tag>)` GENERATE A SYMBOL
- `(intern <sym>)` INTERN A SYMBOL ON THE OBLIST
- `(symbol-name <sym>)` GET THE PRINT NAME OF A SYMBOL
- `(symbol-plist <sym>)` GET THE PROPERTY LIST OF A SYMBOL

### Property List Functions

- `(get <sym> <prop>)` GET THE VALUE OF A PROPERTY
- `(putprop <sym> <value> <prop>)` PUT A PROPERTY ONTO A PROPERTY LIST
- `(remprop <prop> <sym>)` REMOVE A PROPERTY

### List Functions

- `(car <expr>)` RETURN THE CAR OF A LIST NODE
- `(cdr <expr>)` RETURN THE CDR OF A LIST NODE
- `(caar <expr>)` = (car (car <expr>))
- `(cadr <expr>)` = (car (cdr <expr>))
- `(cdar <expr>)` = (cdr (car <expr>))
- `(cddr <expr>)` = (cdr (cdr <expr>))
- `(cons <expr1> <expr2>)` CONSTRUCT A NEW LIST NODE
- `(list <expr> ...)` CREATE A LIST OF VALUES
- `(append <expr> ...)` APPEND LISTS
- `(reverse <expr>)` REVERSE A LIST
- `(last <list>)` RETURN THE LAST LIST NODE OF A LIST
- `(member <expr> <list>)` FIND AN EXPRESSION IN A LIST
- `(memq <expr> <list>)` FIND AN EXPRESSION IN A LIST
- `(assoc <expr> <alist>)` FIND AN EXPRESSION IN AN ASSOCIATION LIST
- `(assq <expr> <alist>)` FIND AN EXPRESSION IN AN ASSOCIATION LIST
- `(length <expr>)` FIND THE LENGTH OF A LIST
- `(nth <n> <list>)` RETURN THE NTH ELEMENT OF A LIST
- `(nthcdr <n> <list>)` RETURN THE NTH CDR OF A LIST
- `(mapcar <fun> <list> ...)` APPLY FUNCTION TO SUCCESSIVE CARs
- `(maplist <fun> <list> ...)` APPLY FUNCTION TO SUCCESSIVE CDRs
- `(subst <from> <expr> <to>)` SUBSTITUTE ONE EXPRESSION FOR ANOTHER
- `(sublis <alist> <expr>)` SUBSTITUTE USING AN ASSOCIATION LIST

### Destructive List Functions

- `(place <list> <expr>)` REPLACE THE CAR OF A LIST NODE
- `(placec <list> <expr>)` REPLACE THE CDR OF A LIST NODE
- `(nconc <list> ...)` DESTRUCTIVELY CONCATENATE LISTS
- `(delete <expr> <list>)` DELETE OCCURANCES OF AN EXPRESSION FROM A LIST
- `(delq <expr> <list>)` DELETE OCCURANCES OF AN EXPRESSION FROM A LIST

### Predicate Functions

- `(atom <expr>)` IS THIS AN ATOM?
- `(symbolp <expr>)` IS THIS A SYMBOL?

(continued)
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<td>(let (binding...) &lt;expr&gt;...) BIND SYMBOLS AND EVALUATE EXPRESSIONS</td>
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<td>(and &lt;expr&gt;...) THE LOGICAL AND OF A LIST OF EXPRESSIONS</td>
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<td>(if &lt;expr&gt; &lt;expr1&gt; [&lt;expr2&gt;]) EXECUTE EXPRESSIONS CONDITIONALLY</td>
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<td>(progn &lt;expr&gt;...) EXECUTE EXPRESSIONS SEQUENTIALLY</td>
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<tr>
<td>(while &lt;expr&gt; &lt;expr&gt;...) ITERATE WHILE AN EXPRESSION IS TRUE</td>
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<td>(+ &lt;expr&gt;...) ADD ONE TO A NUMBER</td>
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<td>(bit-not &lt;expr&gt;...) THE BITWISE NOT OF A NUMBER</td>
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<tr>
<td>(ascii &lt;expr&gt;) NUMERIC VALUE OF CHARACTER</td>
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<td>(itoa &lt;expr&gt;) CONVERT AN INTEGER TO AN ASCII STRING</td>
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<td>(printf &lt;expr&gt; &lt;sink&gt;) PRINT A LIST OF VALUES</td>
</tr>
<tr>
<td>(princ &lt;expr&gt; &lt;sink&gt;) PRINT A LIST OF VALUES WITHOUT QUOTING</td>
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(continued)
a subclass of our Dictionary class that maintains a count
of the number of entries in the dictionary and responds
to a message to return that count.

CONCLUSIONS

I have learned quite a bit from experimenting with XLISP
1.1, the original version donated to the public domain.
Some of this learning came from answering questions from
XLISP users. The most frequent questions related to my
naming XLISP functions after their C equivalents. This
made it difficult to use a textbook on LISP as a guide to
learning about XLISP. I had assumed that XLISP users
would be familiar with C. This turned out to be a bad
assumption; a large percentage of the XLISP users with
whom I have spoken knew nothing about C and just
wanted to use XLISP to experiment with LISP. Version 1.2
of XLISP, the version described in this article, renames all
of the functions that had C-style names to be compatible
with normal LISP usage.

In this new version, you can also read s-expressions from
and write s-expressions to files. Some functions have been
replaced by ones more idiomatic to LISP. (See table I for
a complete list of functions.) The foreach function has
been replaced by mapcar. Destructive list operations are
supported: rplaca, rplacd, nconc, and delete/delq. More
nondestructive list functions are available: member/memq,
assoc/assq, nthcdr, and last. Property lists have been im-
plemented. The evaluator functions apply, and function
calls (funcall) are supported. You can also define functions
with arbitrary numbers of arguments and functions that
take their arguments unevaluated. The evaluator now
detects references to unbound variables and reports an
error.

As you might guess, 1.2 is not the final version of XLISP
either. Version 1.4, now in the works, will be a subset of
Common LISP with extensions to support object-oriented
programming. Basing version 1.4 on Common LISP means
that you will be able to use the second edition of the
Winston and Horne LISP book as a reference for learning
about XLISP 1.4 (or use XLISP 1.4 as a teaching tool for
learning about the basics of Common LISP). It also means
that programs written in XLISP will be compatible with
versions of Common LISP on other machines.

REFERENCES
Company. 1978.
2. Goldberg, Adele, and David Robson. Smalltalk-80: The Language
3. Ingalls, Daniel H. H. “Design Principles Behind Smalltalk.” BYTE.
4. Winston, Patrick Henry. Artificial Intelligence. 2nd ed. Reading,
5. Winston, Patrick Henry, and Berthold Klaus Paul Horn. LISP.
A New Age Dawns for Microcomputer Programming

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BUDGET 3-D GRAPHICS

BY TOM CLUNE

Plotting three-dimensional surfaces on a computer can be valuable to a mathematician or scientist. It can also produce visually pleasing geometric forms. Unfortunately, it is not easy to write a program to generate such plots, especially if you want to include such niceties as hidden-line removal and the ability to rotate your plot around the three axes. However, Bridge Software (31 Champa St., Newton Upper Falls, MA 02164, (617) 244-2306) markets a rather versatile program to make generating 3-D plots easy. The program is called SURF, and it runs under PC-DOS 2.0 or higher on an IBM PC or PCjr with 128K bytes of RAM (random-access read-write memory) and a color monitor. SURF will also plot the surfaces in high resolution on an Epson printer equipped with Graftrak, if you have 256K bytes of RAM. The package includes two versions of the program—one that supports the 8087 NPD (numerical data processor) chip and one that does not. Best of all, SURF (with its 16-page user manual) is available for $35 plus $1.50 shipping and handling.

To use SURF, you just enter the equation of the surface that you want to plot. If there are any singularities in the plot, you also enter them. In most cases, you can then let the package automatically set the parameters necessary to draw the plot by selecting the "auto-graph" feature from the menu. You can rotate the figure around any axis by selecting the appropriate menu item and specifying the number of degrees to rotate (rotation is not done in real time). You can alter the viewpoint or the position of the projection plane as well. In addition, you can stretch the 2-D picture in the horizontal or vertical direction (thus distorting the plot), or you can change the scale of the x-, y-, or z-axis to accentuate a gradual change in one of these directions.

SURF is also sold in a package with two other plotting programs for $90 plus $1.50 shipping and handling. The CURVES program plots one or two 2-D curves in polar, rectangular, or parametric coordinates with up to four parameters and features a movable "magnifying window" that allows you to repeatedly large part of the plot to graphically solve simultaneous equations. The DIFFS program plots any ordinary first-order differential equation as a tangent field.

---

*Tom Clune is a BYTE technical editor. He can be contacted at POB 372, Hancock, NH 03449.*
Photo 2: The plot generated by $\sin(x^2 + 2y^2) \exp(-x^2 - y^2)$ after rotating $-5$ degrees around the y-axis and changing the $x$ and $y$ scales. The colors are the default high-resolution colors.

Photo 3: The plot of $z = x^2 y^2 (x^2 - y^2) / (x^2 + y^2)$. The border has been eliminated and cross-hatching added in this plot. Using red on blue instead of the default colors requires only the use of the estimate-scales selection instead of the auto-graph routine.

Photo 5: $Z = \exp(\sin(x^2 y))$. Plotted with the default settings.

Photo 6: A plot of the same figure as photo 5 after a 45-degree rotation around the y-axis.

Photo 8: $Z = (\sin(x) + \cos(y)) / (\exp(\sin(y) - \cos(x)))$.

Photo 9: The print parameters screen for photo 8. All values were generated by the program. This information is useful in fine-tuning a plot.
UNIX HAS THE REPUTATION of giving experienced users great freedom in system development while giving novices the back of its hand. Machines designed to operate in this environment have a similar reputation for combining high performance with an unforgiving nature. Our first review this month is Greg Corson's evaluation of just such a UNIX-type development system (XENIX) and just such a machine, the Altos 586. While the merits of the combination are enough to evoke considerable enthusiasm, Mr. Corson is equally cognizant of the bugs and inadequacies you ought to know about.

Nippon Electric Company (NEC) is making a lot of claims for its APC (Advanced Personal Computer) III through television and print advertisements. John Unger gives us the benefit of his experience with the APC III; it turns out that a lot of NEC's bragging is more than just idle boasts. Mr. Unger reports that in some ways, especially in its graphics, the NEC APC III is a superior machine. On the other hand, it looks like it may be more than just normally limited in its compatibility with the IBM PC and its attractive universe of available software.

How much of a bargain (this month's theme) is the Atari 800XL? Sure, by now you may be able to pick one up at fire-sale prices, but how do you know you're not the one who's going to be burned? Was Atari's decision to pull the plug on this one purely a marketing move, or are there serious bugs lurking under this calm, earth-tone exterior? Jon Edwards, a BYTE technical editor, has long been an Atari-watcher and has lined up the 800XL's most salient features for scrutiny and comment.

Dazzle Draw is a new Brøderbund Software drawing program for the Apple IIc or 128K-byte IIe. Similar to MacPaint, it gives you the familiar drawing tools—but adds color. In addition, you can use your favorite input device, and printed output can be either black and white or color. Gregg Williams, BYTE senior technical editor, really had fun with this one.

The next review relates to a paint program like Dazzle Draw. Donald Osgood writes that the KoalaPad location-sensing input device is the successor to non-keyboard data-entry devices, including everything from joysticks to trackballs to light pens. As such, it's a natural for applications such as painting; but what else can it do, and how well?

Steven Ryals gives us a look at an alternative to the ultra-expensive word processors that generally grab so much attention. What if you don't need all that power or don't have that much money? Can you get something even marginally useful without paying an arm and a leg? Well, yes and no. According to Ryals's evaluation, FriendlyWriter is definitely a friendly program for novices, but you pay for that friendliness with less functionality.

Last, we look at an expansion board for the IBM PCjr. This review mentions some things to consider if you've got a jr and want to try doing your own upgrade.

—Glenn Hartwig, Technical Editor, Reviews
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You Can Talk To Us!
We seem to have run into something of an upswing in IBM peripherals lately. All of a sudden we got handed an IBM Wheelprinter and a Quietwriter. Also just delivered was a new Professional Graphics display and interface board, but we've barely gotten that box open so there's not much I can say about it.

Along with a swift move to new, temporary quarters, this and other equipment has given us some interesting moments. One of the more curious aspects was getting the Quietwriter in house with no extra ROM cartridges for optional typefaces. The ability to change the typeface by plugging in a new ROM box is, presumably, one of the features that adds to this printer's utility and, to my mind, distinguishes it from others that are similar in quality and operate quietly. At any rate, the company eventually delivered the accessory ROM packs and pinwheel-feed mechanism during the height of our move. We've got it up and running now and we're looking forward to giving it a close look in the next few weeks.

The Wheelprinter looked more promising at first. It's large and well insulated against sound and runs about four characters per second faster than the Juki 6100 it temporarily replaced. But then we found that it costs about three times as much as the Juki. Beyond that, it had a curious tendency to print one line with a strange, rising angle so that the end of the line was noticeably above the beginning of the line. Next was a line with an equally curious descending angle. The result was a divergent set of lines and not at all what you'd expect for almost $1800.

I suppose I could see buying one of these if I were an office manager with a lot of IBM equipment already installed and wanted decent character formation, relatively quiet operation, and a product that my service representative would be obliged to fix if it ever died. That really is a legitimate consideration for a lot of people, so I'm sure there's a place for this printer. It's just that I kept looking at its price and expecting it to be so much more.

T&T Corp., Hampton, New Hampshire, recently announced an Ada subset compiler called New Hampshire Ada, or NH-Ada. Like RR Software's Janus/Ada compiler, NH-Ada is intended mostly as an educational tool for learning the basic syntax and structure of the Ada programming language. However, NH-Ada version 1.0 lacks a lot.

It compiles source programs into a pseudocode, which is then interpreted. This generally results in slower code than that generated by a compiler, which generates machine code that is directly executed by a computer. In NH-Ada's case, however, the speed difference is something to behold. The Sieve of Eratosthenes that Janus/Ada executes in 29 seconds takes NH-Ada over 5½ hours! At 20.400 seconds, this may be the all-time slowest compiler in BYTE experience. NH-Ada's compilation speed looks better: the Sieve compiled to pseudocode in 71.3 seconds under NH-Ada; Janus/Ada took 184.7 seconds to compile the Sieve program to machine code.

Speed isn't the only problem. Janus/Ada, for example, includes most Ada features that are Pascal-like, and the version reviewed in the February BYTE (see page 295) includes a number of more advanced Ada features. NH-Ada, on the other hand, doesn't include floating-point arithmetic, generics, or tasking. NH-Ada also fails to include RECORD types, which are essential to the structure of Ada and high-level languages. It doesn't permit variables to be initialized during declaration. It doesn't permit compilation of a package; they have to be embedded within a procedure.

As for documentation, T&T includes a copy of Ada for Programmers by Eric W. Olsen and Stephen B. Whitehill (Reston, VA: Reston Publishing Co., 1983) with the compiler. Unfortunately, nowhere is there a list of which Ada features NH-Ada does not include. For something that costs over $200, we expected its utility to be higher.

True, this is a first effort. T&T says it plans to enhance the compiler and add features as quickly as possible, with the goal of submitting it for full validation.

We've also taken a look at Rightwriter, which bills itself as an "automatic document proofreader and writing style analyzer." Rightwriter takes any text file you have created and, with a single command, produces a new, marked-up text file that includes a line-by-line critique of the original and a summary of its readability, stylistic strength, and use of adjectives, adverbs, and jargon.

The program seems handy enough for ordinary correspondence and reports: it will catch many of the more glaring errors but then, so would many people. We would be careful, however, in using the program to analyze serious literature. We fed the Gettysburg Address into Rightwriter: it found Lincoln's historic oration to be stylistically "very weak," "wordy," and "complex and difficult to read." Shakespeare didn't do much better, with Hamlet similarly panned. So if Rightwriter doesn't think much of you, you're in good company.

—Glenn Hartwig, Technical Editor, Reviews
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<th>Avocet Cross-Assembler</th>
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UNIX, INQUIRY 40

Inquiry 40
Despite some bugs, it's a good product

BY GREG CORSON

Greg Corson is an independent consultant specializing in putting together computer systems and software for unusual applications. He has written software to run a large multiple-line bulletin board on his Altos 586, which you can call at (219) 277-5743 at 300 or 1200 bits per second.

One of the "new breed" of low-cost, high-performance, UNIX-based microcomputers, the Altos 586 can free you from the restrictions of a computer system at a large university or corporation. With a starting price of $8990 (which includes one terminal), the 586 is appropriate for small businesses, software developers, research centers, and laboratories.

The 586 uses a 10-MHz Intel 8086 to run XENIX, a version of the UNIX operating system produced by Microsoft and based on UNIX Version 7. The 586 cabinet also contains a double-sided quad-density floppy-disk drive, a hard-disk drive, an Intel 8089 microprocessor, 512K bytes of memory, six serial ports, a Zilog Z80 microprocessor, and a high-speed RS-422 port for local-area networking. Altos also sells a second version of the 586, which it calls the 986, that differs from the 586 only in that it has four additional serial ports and 1 megabyte of main memory. An Altos 586 can be dealer-upgraded to a 986 by adding a 512K-byte memory card and a serial port board.

One thing you should keep in mind: although the price of this computer includes the XENIX run-time operating system, you can't do any useful work on the 586 unless you buy additional software. The XENIX run-time system contains only those utilities necessary to maintain the system and run prepackaged applications programs. Business users will need to purchase word-processing, accounting, and other types of software from Altos or another company. People who want all the standard UNIX text processors, editors, compilers, and general-purpose utilities will have to purchase the XENIX Development System from Altos for an additional $1000.

I bought a 586 to develop a multiuser public bulletin-board system. The 586 has been operating 24 hours a day for over two years and has logged over 14,000 hours of use in 38,000 telephone calls. In all this time I haven't had a single hardware failure.

Overall, the 586 is a good computer, and Altos is a good company, but there are, as always, a number of points a potential buyer should be aware of. They include bugs in the operating system, technical-support problems, and the Altos practice of quoting "unformatted" disk size rather than "formatted" (usable) size.

One welcome feature of the Altos 586 is its strong, attractive, and easy-to-carry case. Although the 586 weighs about 33 pounds, the shape of the case makes it easy to lift. I have no trouble getting a grip on the wedge-shaped sides when I need to move the computer.

Although it's unlikely you will ever have to open the 586's case, if you ever do (possibly to change the jumpers of a serial port for modem use) you will appreciate the design. Simply remove the four screws on the back of the system unit, then lift off the top of the case for access to the power supply, 5¼-inch floppy-disk drive, and hard-disk drive. The really ingenious part is that the entire top half of the computer tilts forward on a built-in hinge to allow access to the main-processor board and disk controller.

Altos has made one blunder in the 586's packaging, placing a large unprotected reset button right on the front of the machine. Since resetting a running XENIX system can damage the hard disk and lose data, most manufacturers locate the reset button inside a pencil-size hole where it can't be pressed by accident. Altos should at least have located this hazardous button on the back of the case rather than where it can be bumped by a passerby or tapped by a curious finger. If you plan to install a 586 in a busy office, safeguard the reset button by covering it with the cap from a small aerosol can.

COOLING-SYSTEM PROBLEMS

All the ventilation slots on the 586 are toward the bottom of the machine. Where (continued)
they are sheltered by the overhanging case. This makes it unlikely that a spilled drink or stray paper clip will find its way into the computer. Unfortunately, Altos chose to cool the 586 with a fan that sucks air out of the case, drawing in cool air through the slots. The problem is that the fan pulls dust, smoke, and other contaminants through the ventilation slots and, worse yet, through the door of the floppy-disk drive. The sight of a computer pulling a stream of cigarette smoke into its drive is enough to make any computer user cringe, and the trouble a spilled ashtray might cause is something I'd rather not think about. You could outlaw smoking near the computer, but that doesn't solve the problem of dust and dirt.

Many times I have pulled a floppy disk out of the computer after a day's work and found it covered with a thin layer of dust. It would make a lot more sense to have the fan force air into the case through a dust filter and allow the air to exit through the slots. This would cut down considerably on dust, dirt, and smoke contamination; as an added plus, the filter would muffle the fan noise.

The noise of the fan and the hard-disk drive is another thing you should consider if you plan to install the 586 in an office. Although it probably wouldn't be noticed in a room where copiers and electric typewriters are constantly being used, the noise could be objectionable in a quiet environment.

**INSIDE THE COMPUTER**

The Altos 586 is a true multiprocessor system, having three different microprocessor chips. The processor that runs all the user programs is a 10-MHz Intel 8086, a faster 16-bit version of the processor in the IBM Personal Computer (PC). An Intel 8089 I/O (input/output) chip controls the interfaces for the disk and cartridge-tape drives and Altos-Net. A Zilog Z80 handles the six serial ports used for terminals and printers. The 586 also contains a battery-backed clock, so you needn't set the time of day every time you turn on the machine.

There are two possible avenues for expansion inside the 586. Next to the bank of 64K-byte RAM (random-access read/write memory) chips is a connector. This is where you plug in the memory card that expands the 586's capacity to a full megabyte, the maximum an 8086 can handle. The Altos has another expansion connector, where a four-port serial card can be plugged in for a total of 10 serial ports. Notably lacking is an Intel 8087 numeric data processor. It's a shame Altos doesn't offer an 8087 option; it would increase the number-crunching speed of the 586 by a considerable amount and make it much more useful for mathematical applications.

One of the more misleading things about the advertising for the 586 concerns the matter of disk space. Altos ads for the 586-40 say it contains an 800K-byte-capacity floppy disk and a 40-megabyte hard disk. Actually, the floppy disk holds only 737K bytes and the hard disk around 33 megabytes. The reason for this is that Altos quotes the unformatted capacity of the disks rather than the formatted (usable) capacity. To be fair, Altos should quote either the formatted disk capacity or both the formatted and unformatted capacity on its specification sheets.

**HOOKING UP PERIPHERALS**

The back of the 586 is covered with connectors for terminals and expansion hardware. To the right of the fan are connectors for a second hard-disk drive, cartridge-tape drive, Ethernet, and Altos-Net. Along the bottom are the DB-25 connectors for the six RS-232C ports. To the left of the fan is a removable panel where the four additional serial-port connectors go on a 986.

The transmission rate of each serial port may be set by software to any of the standard speeds from 110 to 19,200 bits per second (bps). All the ports support handshaking through RS-232C pin number 20 (Data Terminal Ready) or by sending XON/XOFF characters to start and stop transmission from the computer. The only other RS-232C handshaking lines the 586 supports are Request to Send (used to detect carrier from a modem) and Data Set Ready (which indicates to a terminal that the 586 is turned on).

The 586 has no Centronics-type parallel printer interface; it supports only serial printers. If you already have a parallel printer, you will have to purchase a serial-to-parallel printer buffer of some kind. Since the serial ports on the 586 can operate at up to 19,200 bps, you should have no trouble driving even the fastest of printers at full speed. The only time the serial interface might slow things down is when you try to print high-resolution bit-mapped graphics.

**SOFTWARE AND DOCUMENTATION**

Standard equipment with the Altos includes two pieces of software and three manuals. The software consists of the run-time version of the Microsoft XENIX operating system and the Altos Diagnostic Executive (ADX for short). The documentation includes the Altos 586 operator's guide, an 80-page book entitled Introduction to XENIX, and the ADX Diagnostics Manual.

Most of the documentation is designed for people who have at least some experience with multituser computer systems. If you have never worked with a UNIX or XENIX system before, try buying some kind of UNIX tutorial to familiarize yourself with operating and maintaining your system.

Of the three, the ADX manual is the hardest to follow. Although most of the sections are fairly clear (but often highly technical), the order in which they are presented is terrible. Some sections neglect important things until it's too late. For example, the instructions for the floppy-disk-copy program don't mention until halfway through the copying process that you have to format the blank disk. Thankfully, the manual for the XENIX run-time system contains step-by-step instructions on most of the important system maintenance jobs. Installing the run-

(continued)
Name
Altos 586

Manufacturer
Altos Computer Systems
2641 Orchard Park Way
San Jose, CA 95134
(408) 946-6700

Components
Size: 17 by 18 by 6 inches
Processors: 10-MHz 8086 main processor, 6089 intelligent disk controller, 280 serial-port controller
Memory: 512K bytes (1 megabyte on 986)
Mass storage: 737K 5¼-inch floppy-disk drive (formatted), 20- or 40-megabyte hard-disk drive (unformatted) (see text)
I/O interfaces: 6 RS-232C serial ports (10 ports on 986), RS-422 Altos-Net port

Expansion Capability
The 586 may be expanded to a 986 by adding a 512K memory board and four additional serial ports; both the 586 and the 986 can support a second hard-disk drive and a cartridge-tape drive

Software
Microsoft XENIX run-time system, Altos Diagnostic Executive, XENIX Development System ($1000) optional

Documentation
ADX Diagnostics Manual; operator's guide; Introduction to XENIX

Price (includes one Altos II terminal)
586-20 (20-megabyte hard disk) $8990
586-40 (40-megabyte hard disk) $10,990
986-40 (40-megabyte hard disk) $12,990

The Memory Size graph shows the standard and optional memory that is available for the computers under comparison. The graph of Disk Storage shows the highest capacity of each system's floppy disks. The Bundled Software Packages graph shows the number of software packages included with each system.

The Price graph shows the list price of a system with a monochrome monitor, a printer port and a serial port, and the standard operating system for each system; the Altos 586 has one hard-disk drive and one floppy-disk drive, while the IBM and Apple offerings have two floppy-disk drives.
A rear view of the system unit. Removing four screws provides access to the computer’s electronics.

The upper board (with disk drives) attaches at the hinges along the top of the board. The units swing apart for access.

The Disk Access in BASIC graph shows how long it takes to write a 64K-byte sequential text file to a blank floppy disk and then read it. (For the program listings see the 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. The Calculations column shows how long it takes to do 10,000 multiplication and division operations using single-precision numbers.

On the System Utilities graph, the 40K Format/Disk Copy column is not applicable to hard-disk systems. The 40K File Copy column records how long it takes for a disk to copy a file to itself. The Spreadsheet graph shows how long the computers take to load and recalculate a 25- by 25-cell spreadsheet where each cell equals 1.001 times the cell to its left. The spreadsheet program used was Microsoft’s Multiplan.
time system on the 586 takes about 30 minutes, most of which are spent waiting while the computer does the work. All you do is insert and remove two floppy disks and type about six commands. At times, messages appear that look like errors but aren't. Luckily, the documentation does a good job of describing which messages to heed and which to ignore. If you are good with step-by-step directions you can probably get through the installation without too many problems. After XENIX is installed, you still have a lot of work to do installing the applications software, putting passwords on the system accounts, creating accounts for people who will use the computer, and other tasks. I would advise novice XENIX users to have their dealers install XENIX and the applications software.

The run-time version of XENIX contains virtually none of the standard UNIX utilities. Only the programs absolutely necessary to maintain accounts, make backups, configure serial ports, and do other essential functions are included. In short, the XENIX run-time system includes everything you need to maintain and operate a XENIX system, but it has no applications software at all.

One useful program the run-time system includes is called the Business Shell. This program maintains a set of menus that guide inexperienced XENIX users through the applications programs. It also helps the system manager install applications software, make backup disks, create accounts, configure serial ports, and handle other important functions. The Business Shell works fairly well in day-to-day use, but it contains menus only for software distributed by Altos. Not all third-party software companies include applicable menus with their products. The programs needed to create and change these menus are not included with the XENIX run-time system. If you want to make all the applications on your system available through the Business Shell, be sure that any package you buy includes a set of appropriate menus. Your dealer may be able to make new ones for you. The software to create these menus comes only with the XENIX Development System; your dealer may not have a copy.

**PROBLEMS WITH THE RUN-TIME SYSTEM**

Altos could easily fix several problems with the XENIX run-time system. The most annoying problem is that Altos forgot to supply a list of operating-system error messages with its manuals. Whenever XENIX encounters a serious problem, the system instantly crashes and types "PANIC TRAP" on the screen, followed by a series of error numbers. A "panic" can be as simple as a memory parity error or as potentially harmful as a hardware failure. Since Altos documentation never mentions panic traps, this message is unnerving the first time it pops up. It's the kind of message that makes you wonder if it is safe to bring the system up again. I have had three panic traps on my 586 in the past year; each time the cause was a memory parity error. The first time I got one of these messages I had to call Altos to find out what it meant.

Every release of XENIX I've gotten has had problems supporting modems. In the past year there have been at least six major releases of XENIX, and every version has problems of one kind or another. One other communications-related problem is the inability of some of the 586's serial ports to handle sustained high-speed input (from another computer, for example). This probably won't bother you if you have nothing but terminals connected to your system. They will never send characters faster than you can type. However, if you plan to use any serial ports to communicate with another computer, you should be aware of the 586's limitations. Of the six ports on the 586, only two of them can handle continuous input at 9600 bps; the rest can't handle sustained input at speeds greater than 2400 bps (even bursts as short as 60 to 100 characters). Altos says the speed restriction is caused by the way the I/O buffers are allocated in the XENIX kernel. (The ports that can handle high-speed input simply have been provided with larger buffers than the rest.) I would assume this means that the rest of the ports could be made capable to accept continuous 9600-bps input. Unfortunately, Altos doesn't give you the utilities you need to make the changes.

Last, one small complaint. You can't set up the 586 to automatically reboot itself after a power failure. The system starts the boot process when power returns but soon stops to ask if you want to check the hard disk for file-structure damage. If you aren't around to answer this question, the system does nothing. Unfortunately, this part of the bootup process is embedded in a compiled program rather than in a XENIX command file. It can't be changed.

**THE OPTIONAL XENIX DEVELOPMENT SYSTEM**

If you want to develop software on the 586 or just need a complete copy of the XENIX utilities, you must buy what Altos calls the XENIX Development System. The system comes on 11 floppy disks and contains nearly all the standard UNIX utilities plus many of Berkeley UNIX. Some of the major programs this package includes are the C-language compiler, Microsoft MS-FORTRAN, C-shell, vi screen editor, uucp file-transfer program, and UNIX source-code control system. You also receive a stack of XENIX manuals that stands about nine inches high.

Almost all the content of the manuals is from the standard AT&T UNIX Version 7 documentation, with some additional material from Berkeley, Altos, and Microsoft thrown in. While these documents are fine for an experienced UNIX user, they are terrible for a novice. Altos and Microsoft have tacked on a myriad of appendices and addenda to cover the material not in the original AT&T documents. There is no comprehensive index for all this material, which makes it difficult to find the things you are looking for. The manuals look like they have been amended too many

(continued)
times. Tutorials are included on many subjects, but they won't help novices much since most of them are aimed at users with above-average computer experience. If you have never programmed in C on a UNIX system, you will definitely need to buy some introductory books on both subjects.

There are several errors and omissions in the XENIX Development System—some in the manuals and some in the programs themselves. A number of XENIX utilities are documented but do not work. Other utilities are included but not documented. And still other programs are documented but not included. Thankfully, most of the omissions problems are small ones. Only two have caused me any real inconvenience. First, the C profiler, a utility that records the amount of time a program spends in its various subroutines, is documented but does not work. Second, there's a problem with the uucp file-transfer utility for moving files between UNIX systems through serial ports or modems. This program is supposed to queue any number of files for transfer at a predetermined time. It is normally very powerful and is supposed to enable large UNIX-based networks to trade electronic mail and programs. Altos's version of uucp has a documented bug that prevents it from queuing more than five files. The bug renders uucp almost totally useless as a networking tool.

**CUSTOMER SUPPORT**

Altos's general policy is that all questions must be passed through the dealer. Support personnel at the company won't normally talk to end users. This policy is fine for most customers since most of them run the relatively simple packaged programs familiar to most dealers. Altos has provided a toll-free number for dealers to use when they run into a question they can't answer. The company even keeps a file of phone messages and dealer names and numbers so that all the information about that dealer is handy. This system is good for handling day-to-day problems and for making sure dealers get fairly prompt answers to queries.

Altos's customer-service system does not work so well if you are writing software on the XENIX Development System and have a problem your dealer doesn't understand. You need to talk to the company yourself or be present when your dealer phones the company so you can speak with the technicians. I have had to call or write Altos on a variety of matters, most often having to do with software bugs, software updates, and missing documentation. More than half the time I had to call them again, and Altos lost several of my letters. Those that got through prompted phone calls from executives who guaranteed that my problems would be fixed soon. Many of those troubles remain unfixed.

Since Altos charges a great deal for the XENIX Development System, it has a responsibility to provide good technical support. Altos should recognize that very few of its dealers can answer the kinds of questions a user of the development system might ask.

Altos doesn't notify customers when an update is available; it notifies only its dealers. The company claims to be able to ship a software update within 24 hours. The best it has done for me is nine days (not including shipping time). More often the delay has been from two to four weeks, and several times Altos accidentally left things out of the shipment.

**PERFORMANCE**

The 586 truly is a high-performance computer. The graphs on the "At a Glance" pages are somewhat misleading since, for some reason, XENIX MBASIC does poorly when running the BYTE benchmark programs (only 1.5 to 3.5 times faster than IBM PC BASIC). This is surprising. The 586's 10-MHz 8086 is supposed to run programs at least three times faster than the IBM PC's 8088. To get a better comparison I tried a version of the Sieve of Eratosthenes benchmark written in C. This time the 586 fared much better, delivering speeds more than five times faster than the IBM PC.

If you compare the C version of the Sieve to the BASIC version, you'll understand the reason for this discrepancy. On the IBM PC, the BASIC benchmark ran 90 times slower than the C benchmark on the Altos. BASIC ran 174 times slower than C. Obviously, the reason for the slower BASIC benchmarks on the Altos is that MBASIC simply is not as efficient as IBM BASIC. If high speed is your objective, write all your programs in C. You will have the pleasure of watching them zip along at speeds 174 times faster than BASIC.

Multiuser performance on the Altos 586 is very good. I routinely have five users on my system simultaneously and notice no degradation. The only noticeable slowdown occurs when there is not enough RAM to hold all the programs running. Then, the operating system begins a process called "swapping." During a swap, the operating system moves programs between RAM and a special disk area, so each program gets its chance to run in RAM.

**CONCLUSION**

I have only two major reservations about recommending the Altos 586. First, I can't recommend it to people who plan to call into the computer via a modem. The bugs in the modem-support software make using modems on the 586 very difficult. Second, I can't recommend the Altos 586 to people who want to develop software. The errors and omissions in the XENIX Development System and in its patchwork documentation make software development much harder than on an average UNIX system.

Overall, the Altos 586 hardware is well executed, fast, and reliable. Very few UNIX or XENIX computers can provide all the features of the 586 for $8990. Due to its small size and low cost, it is particularly suitable as a multiuser business computer. My dealer tells me that many third-party software vendors are making their products available on the Altos 586, which should make it fairly easy to find applications programs.
### HARD DISK

- **APPLE MACINTOSH HARD DISKS** **NOW AVAILABLE!!**
  - CONiUS, DAVIDSON & TECMAJAN... **CALL FOR PRICES!!**
- **IBM** 30 MB IDE-SCSI Back-Up... **$785**
- **EVEREX** 10 MB Internal for IBM... **$699**
- **GENO** 10 MB Internal for IBM... **$599**

### TRANSMITTERS

- **DFP II** (1700 MHz) **$229**
- **DFP III** (2000 MHz) **$299**

### COMPUTER HARDWARE

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<td><strong>PCR-8028</strong> (256k, 2 Drives, 12&quot; Monitor, WordStar, MailMerge, Multiplan, NABIOS)</td>
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<td><strong>Sanyo</strong> MBC-550 (256k, 128K Drive)</td>
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### TOW USER SYSTEM (incl. 10 MB, Advanced Open PC at 6 Terminal) **$3095**

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### MICROSOL PCI-40 (40) AP**                | **$395**    |
| **BROHER DYNAX**                           | **$395**    |
| **TEKTRONIX Graphics Plotter II**          | **$395**    |

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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

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The NEC APC III

A business computer with MS-DOS and color graphics

BY JOHN D. UNGER

The NEC APC III has an 8-MHz 8086 processor, high-resolution color graphics (640 by 400 pixels), and MS-DOS and 5 1/4-inch disk drives for potential software compatibility with the IBM Personal Computer (PC). After using this microcomputer for six weeks, I have found it to be fast, sophisticated, and well designed. However, there are serious limitations to the APC III's degree of compatibility with the IBM PC.

The excellent high-resolution graphics and the software currently available for the computer suggest that NEC is targeting sophisticated business users as its primary audience. For business applications, the APC III is superior to similar products currently available, including the IBM PC.

I review a system with dual floppy-disk drives, an extra 256K bytes of RAM (random-access read/write memory), a color-graphics board, and a color monitor; the suggested list price is $3595.

HARDWARE

The set-up procedures for the APC III are straightforward and clearly covered in the documentation. The system hardware (see photo 1) is organized into the familiar three-piece configuration: the processor/disk-drive unit, monitor (with a tilting and swiveling base), and detached QWERTY keyboard. The monitor's power cord plugs into a switched 110-volt socket in the rear of the main case.

The recessed power switch is conveniently on the right side, and a green LED (light-emitting diode) leaves no doubt that power is on. Unfortunately, the APC III's cooling fan is loud and seems to emit a high-frequency noise. I called NEC about this, and the company's response indicated that the fan on my test machine was faulty. I did not have an opportunity to use another APC III to see if the fan was a problem only with my review computer. The monitor also has its own cooling fan, which is significantly quieter.

MONITOR AND DISPLAY

Like the IBM PC and other microcomputers using the MS-DOS operating system, the APC III supports different screen-display modes. The highest-resolution graphics modes are not normally available on the IBM PC and compatibles.

The character display in the text mode is perhaps the best I have seen. The characters are well formed and are easy to read (see photo 2). Normal text display is 80 columns by 25 rows and in monochrome mode includes normal, reverse video, blinking, and underline attributes. A utility supplied with MS-DOS can change the text display from the normal white on black to green on black on a color monitor.

The APC III can display graphics in up to eight colors and in three screen formats (320 by 200, 640 by 200, and 640 by 400 pixels). NEC uses two 7220 graphics-display controller chips to control text and graphics; one controls the standard text-display modes and the second controls the graphics modes. The APC III uses memory-mapping for exceptionally fast character or graphics video display. In addition to the memory available to the operating system, the user, and the applications programs running on the machine, the computer reserves a specific section of the memory addressable by the 8086 to hold screen-related data.

The main processor writes to video memory at the same time that the display controller reads the data and sends it to the screen. Therefore, as soon as a character (when in text mode) or pixel (when in graphics mode) is changed in memory, the screen
also changes. The standard video RAM is 8K bytes for text and 64K bytes for graphics, adequate for all the monochrome graphics and color text modes. The optional color-graphics board (list price of $200), which includes an additional 128K bytes of video RAM, is required to use the graphics modes with color.

Since the display screen is directly bit-mapped into the video-display memory, each pixel on the screen corresponds to 1 bit of RAM in memory. Every 640-by-400-pixel color-graphics screen has three overlapping planes, each corresponding to the red, green, and blue attributes. Therefore, the system uses 640 by 400 by 3 or 768,000 bits (96K bytes) of RAM to hold all the color-graphics information required for one display screen. Actually, the APC III has available a total of 192K bytes of video RAM, enough to keep two complete pages or screens of information in memory at the same time.

The graphics modes can display text, but these characters are formed from a graphics character set with a density of 8 by 16 pixels; they are not quite as classy looking as the characters in the text modes.

The color monitor performed flawlessly. Resolution is more than adequate to display the highest-resolution color graphics (see photo 3).

**KEYBOARD**

The APC III's keyboard is one of the best I have used. The main section of the keyboard (see photo 4) resembles the popular layout of the IBM Selectric typewriter. The NEC literature consistently refers to the 102 keys. Try as I may, I count only 101: nonetheless, it has a layout that's compatible with ASCII (American Standard Code for Information Interchange) keyboards.

NEC supplies an MS-DOS utility to switch the "key click" into a chirp or beep sound. It provides good audio feedback, a help when typing quickly, but the sound can get on your nerves. There is no way to change the tone or volume.

Across the top of the keyboard are 12 unlabeled programmable function keys. Each can be used alone or in conjunction with the FNC, Shift, CTRL, and ALT keys, giving you potentially 60 different function-key combinations. A utility supplied by NEC lets you program these and all the other keys. Directly above the 12 function keys is a removable template for recording the function of each key.

NEC has written a character device driver for MS-DOS 2.11, ANSI.SYS. The character device driver replaces the standard console device with one that is compatible with ANSI (American National Standards Institute) terminal control sequences. These control sequences allow the movement of

(continued)
applications between computers and terminals, and they are used to control the cursor and display screen. When the ANSI character device driver sees a special sequence of characters (for example, ESC [2], which erases the screen), it interprets them and takes appropriate action. Because of the differences in the ROM BIOS (basic input/output system) between the APC III and other MS-DOS microcomputers, use of ANSI special control sequences is the only way that it is possible for you to get compatibility in cursor and screen I/O (input/output).

**Integral Peripherals**

The two floppy-disk drives have a nominal storage capacity of 360K bytes each. Disks formatted by MS-DOS 2.xx included with the APC III can be read by other MS-DOS and PC-DOS machines. An eight-track format option enables the disks to run on computers using the older MS-DOS and PC-DOS 1.xx versions, but storage is reduced to 320K bytes per drive. The specifications for the disk drives show a head-settling time of 50 milliseconds (ms), a track-to-track time of 5 ms, and a data-transfer rate of 31.25K bytes per second, all of which adds up to fast disk I/O. The drives are rather noisy, especially when moving from track to track. They are significantly louder than the single-sided Teac drives on my Sanyo MBC 555.

**Memory**

The main board of the computer comes with 128K bytes of dynamic RAM. Optional plug-in memory cards come with 128K bytes of RAM plus empty IC (integrated circuit) sockets for 64K-byte RAM chips, providing a total of 256K bytes for a full card. Two memory-expansion cards, loaded to capacity, would bring the APC III to its maximum of 640K bytes. It's easy to add the memory-expansion boards to the computer; four slots for memory boards or other expansion cards are accessible through individual protective covers on the rear panel of the computer (see the photo in the "At a Glance" section). The APC III apparently uses parity checking to test the RAM because nine 64K-byte by 1-bit chips are required for each 64K bytes of memory. The computer performs a memory check every time it boots the system, but the process takes only a few seconds with 384K bytes installed.

A small amount of CMOS (complementary metal-oxide semiconductor) RAM is used as nonvolatile, battery-backed memory to store certain system parameters when the comp-
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REVIEW: NEC APC III

Computer is off. This portion of memory is not directly available to the user. However, NEC utility programs supplied with the computer can access data in the CMOS memory to configure the RS-232C and printer ports and to change RAM-disk parameters, the time, and default display colors for text.

The amount of system RAM does not give a full picture of the total memory used by a powerful graphics machine like the APC III. For example, 32K bytes of ROM (read-only memory) contain the bootstrap loader, a self-test program, and BIOS routines. A color-graphics board would add 200K bytes of RAM for the storage of text and graphics data, which are then directly accessible to the video display. Combined with the 640K bytes of system RAM, that would bring the total amount of memory used by the APC III to about 872K bytes, just 128K bytes shy of the 1-megabyte maximum addressable by the 8086 processor.

Windows

The standard system has two interface ports. A supplied utility program can configure the serial port for all standard data-transmission rates up to 9600 bps (bits per second) and for other data-transfer parameters like word length, stop bits, parity, and XON/XOFF protocol. The printer port is Centronics-compatible; NEC refers to it as IBM-compatible, though I'm not sure what that means here. A utility program allows you to designate your type of printer. There are no hardware options to install additional parallel or serial ports to the computer, but there is an optional expansion card to provide an IEEE-488 interface. Another optional card provides ports for two standard joysticks; the same card expands the APC III's sound capabilities.

Options

I've discussed most of the hardware options for the APC III except the 10-megabyte internal and external hard-disk drives. An APC III configured with this option ($1999), a PC-UX expansion board ($299), and the PC-UX operating-system software ($700) gives you a UNIX operating system. These options make the APC III a machine that's totally different from the one I have been discussing. Since I have not seen the computer in this configuration, I can only speculate that there would be nothing in the hardware components to prevent the APC III from running UNIX as well as or better than any other 8086 or 8088 microcomputer. Although the NEC literature does not mention the conspicuously empty socket on the right of the motherboard next to the 8086 chip, it is almost certainly for an 8087 co-processor chip. The programmer's manual does refer to some possible uses of an 8087 chip, but there is as yet no software designed for this capability.

Software

MS-DOS 2.11 supplied with the APC III appears well integrated with the 8-MHz 8086; I haven't seen any evidence of the operating system degrading the performance of the hardware. In addition to the utilities routinely available with MS-DOS systems, NEC supplies some useful programs written specifically for the APC III, several of which I mentioned earlier. Another utility is the RAM-DISK program, which lets you designate 128K-byte blocks of RAM as the E: drive. The parameters for this utility are kept in nonvolatile CMOS memory; you need only set up the RAM disk once. Nonetheless, you have to disable the RAM disk with the utility program when you want to use the RAM as normal memory.

The BASIC interpreter bundled with the APC III is version 2.01 of Microsoft GW-BASIC. It is the most powerful and versatile BASIC interpreter I have used; it gives you command over all of the machine's high-resolution graphics in sophisticated and innovative ways. Because GW-BASIC appears to be a superset of the old standard MBASIC, programs written in MBASIC should be transportable to GW-BASIC for use on the NEC. However, compatibility between IBM's BASICA and GW-BASIC is more complicated owing to the new color and...
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graphics commands, especially those associated with the APC III's 640 by 400 color-graphics modes. The GW-BASIC manual contains a section detailing the differences. As is usually the case, BASIC programs saved in ASCII format can be transported between the IBM PC and APC III and then tested on the foreign interpreter. I found it strange that GW-BASIC, like IBM BASIC, allows only 64K bytes of total memory for the interpreter and any programs. This version of GW-BASIC gives you 27K bytes for your BASIC programs. By contrast, Sanyo BASIC's program area expands with the amount of RAM available, a convenient feature. GW-BASIC for the APC III includes 173 separate commands and functions (not including normal arithmetic and logical operators) presented in alphabetic order on 249 contiguous pages. The language would be much less intimidating to use if the documentation were organized into sections (for example, graphics, file I/O, and mathematical functions).

The benchmark results for GW-BASIC and the APC III (see the graphs in the "At a Glance" section) show impressive improvements over the IBM PC in all areas except random-access disk read and write, where the two computers are about even. The improvements in the calculations and Sieve benchmarks are most likely caused by the differences in processor speed (8 MHz for the APC III versus 4.77 MHz for the IBM). Note that the DeSmet C compiler ran the programs an order of magnitude faster than GW-BASIC; with the RAM disk, it took a mere 5 seconds to compile and link the C source for the Sieve program.

NEC supplied WordStar 3.30 and its companion programs MailMerge and SpellStar with the test system. I have used WordStar over the past three years on four computers, and I find that the implementation on the APC III is the best (see the word-processing benchmarks in table I). The speed of the processor and disk I/O are one reason. The text scrolls smoothly and rapidly; there is little delay scrolling down through the text when the program loads more of the file from disk into memory. Also, there is only a short delay when overlay programs are read from the disk. Putting the WordStar programs and the file you want to edit onto the RAM disk gives you virtually instant access to all the overlay files as well as extremely fast save and read times for the text file.

The cursor position on the screen and the cursor-control keys are always in sync; you are where you think you are when moving through the text. Other microcomputers I have used with WordStar have had at least some degree of "cursor inertia." The cursor continues to move along when you release the key, or, when deleting, it continues to delete. This doesn't happen with WordStar on the APC III.

NEC sent Microsoft's Multiplan, which I used for the spreadsheet benchmarks. Multiplan ran more easily and quickly than CalcStar, the only other spreadsheet with which I have played. NEC also sent BPS Business Graphics, a well-designed piece of software for graphics displays of many kinds of data. (For a review of the package, see "Three Generations of Charts for the IBM PC." by Jack Bishop, in the November 1983 BYTE, page 352.) Like the rest of the software I received with the APC III, BPS Business Graphics was completely configured for the system, and it takes advantage of the high-resolution graphics of the NEC. The program takes pairs of data points and gives you the option of setting parameters and plotting the points in a variety of graphical displays. One especially valuable feature is that the software accepts data in almost any format and then lets you edit or reformat it the way you want. The input data can come from spreadsheet programs, from sorted data files that originated in a database program, from data created by BASIC or other language programs, or from data typed directly from the keyboard. It is a slick package, and if it is representative of the business software written for the APC III, the computer will be a first-rate business tool. I did not get to plot the graphical output on a printer.

COMPATIBILITY

The things compatible between the APC III and the IBM PC or other MS-DOS microcomputers are the operating system, the disk format, the ANSI-standard terminal control sequences, the BASIC interpreters (to some degree), and the assembly language used to program their processors (8088 and 8086 microprocessors use the same mnemonics for assembly-language programming). The APC stores its video-display RAM in different memory locations, uses different vector calls for its ROM BIOS routines (although the register values used in the BIOS routines and the structure of the BIOS routines are very similar), and has different key codes for some keyboard functions, in both

<table>
<thead>
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<tr>
<td>Document load</td>
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<tr>
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<tr>
<td>Scroll</td>
<td>29.0</td>
<td>41.2</td>
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**Name**
NEC APC III

**Manufacturer**
NEC Information Systems Inc.
1414 Massachusetts Ave.
Boxborough, MA 01719
(617) 264-8000

**Components**
Processor: 16-bit 8-MHz 8086-Z
Memory: 128K dynamic RAM (standard) expandable in 128K increments to 640K; 32K ROM (bootstrap and self-test); 1K CMOS RAM with battery backup (for system use); 8K text video RAM; 64K graphics video RAM (standard); 192K with color graphics (optional)
Mass storage: one (standard) or two 360K double-sided double-density 5½-inch drives (Teac 55B); 10-megabyte hard disks optional
Monitor: Monochrome: 14-inch diagonal, high-persistence white phosphor, 640- by 400-pixel resolution. Color: 14-inch diagonal RGB, eight-color, 640- by 400-pixel resolution
Keyboard: QWERTY with 101 keys including 12 function keys (shiftable five ways), numeric keypad, and cursor keys

**Software**
MS-DOS 2.11, Microsoft GWBASIC

**Expansion Capability**
Four card slots (NEC bus) accessible from outside; one internal slot for optional color graphics card

**Documentation**
MS-DOS user's guide, MS-DOS programmer's reference manual, MS-DOS macro assembler manual, GW-BASIC manual

**Price**
APC-H101M (single 360K drive, monochrome monitor) $1995
APC-H101C (single drive, color monitor) $2495

The Memory Size graph shows the standard and optional memory available for the computers under comparison. The Disk Storage graph shows the highest capacity of a single floppy-disk drive for each system. The Bundled Software Packages graph shows the number of software packages included with each system. The Price graph shows the list price of a system with two high-capacity disk drives, a monochrome monitor, graphics and color display capability, a printer port and a serial port, 256K bytes of memory, (64K bytes for 8-bit systems), and the standard operating system and BASIC interpreter for each system.
The graphs for Disk Access in BASIC show how long it takes to write a 64K-byte sequential text file to a blank floppy disk and how long it takes to read this file. (For the program listings see the June 1984 BYTE, page 327, and October, page 32.) The Sieve graph shows how long it takes to run one iteration of the Sieve of Eratosthenes prime-number benchmark. The Calculations graph shows how long it takes to do 10,000 multiplication and division operations using single-precision numbers. The System Utilities graph shows how long it takes to format and copy a disk (adjusted time for 40K bytes of disk data) and to transfer a 40K-byte file using the system utilities. The Spreadsheet graph shows how long the computers take to load and recalculate a 25- by 25-cell spreadsheet where each cell equals 1.001 times the cell to its left. Microsoft Multiplan was the spreadsheet program used. The tests for the NEC APC III used MS-DOS 2.11 and GW-BASIC 2.01. Tests for the Apple were done with the ProDOS operating system. The IBM PC was tested with PC-DOS 2.0.
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* off newsstand price of $42.00
Very few programs written for the IBM PC or its close clones will run on the APC III. Programs written for generic MS-DOS microcomputers should fare better.

unshifted and shifted states. Therefore, very few software programs written for the IBM PC or its close clones will run on the APC III. Programs written for generic MS-DOS microcomputers should fare better, but unless they use ANSI-standard codes for screen I/O, they will not be able to do anything more sophisticated than write sequentially to the display. I had no problems on the APC III using the DeSmet C compiler (which is written for MS-DOS microcomputers), except that none of the library functions written to do screen I/O using the BIOS interrupts would work. [Editor's note: In an upcoming article, Herbert Stein will discuss an operating system patch that re-shuffles interrupt locations to give the NEC APC III 90 percent IBM PC compatibility.]

**DOCUMENTATION AND SUPPORT**

Five 8- by 9-inch loose-leaf binders containing information on the operating system and GW-BASIC are included with the standard software. Microsoft has written the two volumes on the macro assembler, library-managers, and cross-reference utilities and about 85 percent of the MS-DOS user's guide. Much of the material is applicable to MS-DOS operating systems in general and is not specifically for the APC III. NEC's section in the user's guide for the APC III is very clear and easy to understand; it includes descriptions of special utility programs. The programmer's reference manual provides clear descriptions of the ROM BIOS routines and DOS functions and a good section on the organization of video RAM and the memory structure of the APC III.

A product of NEC Information Systems Inc., the APC III represents NEC's second serious attempt to market a personal computer in the U.S. The division's main office, in Bux­borough, Massachusetts, has provided good support by answering all my questions about the computer, but it appears the company prefers users who go through local dealers.

**CONCLUSION**

Compared with the IBM PC, the NEC APC III is the superior microcomputer, but the availability of software could haunt you. NEC has enlisted some of the biggest names in the software industry to modify programs for the machine, but it is unlikely that much new software will be written explicitly for the APC III. Currently available are Multiplan, SuperCalc, WordStar, the PFS series, dBASE II, Friday!, GraphPlan, DR Graph, DR Draw, BPS Business Graphics, the BPI series, Financial Manager, Dow Jones Market Analyzer, Dow Jones Investment Evaluator, and Dow Jones Link.

If you are looking for a sophisticated, fast microcomputer for business applications, NEC supplies the necessary software. Like many businessmen, I don't want or need access to those "10,000 programs" written for the IBM or Apple; what I require is a computer that will run a few specific programs (language compilers and editors, for example) very well. Compatibility becomes important when I consider that programs I write must run on some other computer. While reviewing the APC III, I have used it as a tool for writing and debugging C programs to run on IBM-type machines. The high-resolution color-graphics capabilities are not used with programs designed for other systems; but for business applications and other programs designed specifically for the APC III, they are a pleasure to have.
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It is uncertain where Atari's future lies, but Jack Tramiel, former Commodore chief and now the head of Atari, has announced his intention to introduce a new range of computers, including the new XEs and a GEM-based 68000 computer. The future of the XL line is unclear, but the quality of the old machine, its current low price, and the enormous amount of available software certainly make it an attractive purchase.

Atari computers have reputations as game machines, an image reinforced by their excellent graphics and sound capabilities. The 800XL is a superb game computer, with the addition of four more graphics modes obtainable directly from BASIC. The total number of modes is now 16, from a 24-by-40-pixel text mode to 192 by 320 pixels for graphics; most graphics modes also have options for 40-column text windows (see table 1 for a summary of available graphics modes).

You can still place up to 256 colors at once on the screen, alter the display list for customized graphics, change all or part of the character set, define up to five sprites (called players and missiles), produce harmonies on four sound channels, use vertical blank interrupts, call on the real-time clock, and add page flipping and fine and coarse scrolling (see photo 1 for a sample screen display). Of course, these capabilities are useful for more than games.

RESTYLING
The 800XL is brown and beige, with silver function keys. It measures 15 by 8¾ by 2 inches and, although it weighs 5 pounds 5 ounces, it has a solid, substantial feel. The XL has a revised Antic chip for the screen display, which offers improved color saturation.

The biggest change, however, is a parallel bus with a 50-pin connector; the bus gives direct access to the 6502 16-bit address and 8-bit data buses. The only presently available devices to take advantage of the parallel bus are 64K-byte memory expansions for the Atari 600XL. Potentially available are similar expansions to 128K bytes for the 800XL, as well as an 80-column board and real-time system control. For more extensive expansion, hackers have the ATR8000 (see "The ATR8000" by Dave Small and Sandy Small, December 1983 BYTE, page 329), which lets the Atari run CP/M-80, CP/M-86, and MS-DOS.

The built-in, 62-key keyboard has a comfortable feel (see photo 2). Features include automatic key repeat, inverse video, and specifically designated keys to move the cursor, insert, delete, clear and set tabs, and clear the screen. A new Help key joins the Start, Select, and Option function keys. The Reset key has a hard spring to minimize accidents. More important, the Reset key provides a true hardware reset, not the pseudo-reset that did not always resurrect the system from crashes.

The inverse-video key is now better placed on the outside rather than the inside of the right Shift key. Only the higher-than-normal position of the Return key remains a problem. You can even eliminate the keyboard click since the sound is routed through the television or monitor speaker and not through the internal speaker. The character graphics available in conjunction with the Control key are not marked on the keys, but stick-on labels are available. A wide range of peripherals, including a numeric keypad, four different graphics tablets, light pens, joysticks, paddles, and trackballs are also available.

Unlike the Atari 800, the 800XL has a single cartridge slot, electrically identical to those in the 400/800. Atari never marketed cartridges for the second cartridge slot on the 800, and a single slot on the XL apparently lessens the game-computer image. Only a few products, including programming aids and a screen-dump utility, used the second cartridge slot, but you might miss its potential. Perhaps for similar reasons, Atari provided only two joystick

(continued)
REVIEW: ATARI 800XL

ports, a policy that will undoubtedly disappoint aficionados of four-player games.

Other changes include the addition of memory, keyboard, and sound tests that use about 2K bytes of ROM (read-only memory) but add very little in the way of diagnostics. The audio-visual test doesn’t identify which colors you ought to see, and the keyboard displayed on screen closely resembles the one on the 1200XL and not the 800XL. A new foreign-character set takes up another 1K bytes of memory. Many users probably would prefer full English error messages in BASIC. The POKEY (sound generator and controller ports) and the PIA (peripheral interface adapter) remain unchanged, save that the second PIA interface, used on the 800 to monitor the third and fourth joystick ports, enables and disables a resident BASIC (starting at address A000 hexadecimal) on the 800XL. To boot programs that do not require BASIC, press the Option key when turning on the computer.

### BASIC

The built-in BASIC, revision B, corrects problems with the original BASIC cartridge, especially the annoying computer lock-ups during heavy editing, but it unfortunately introduces new problems. Repeatedly saving a program under development uses up available memory. Atari includes instructions to recover the unused variable name and program space, which accumulates during successive save/load operations. A better solution is to buy revision C for $15 from Atari Customer Service. Even bug-free, the BASIC could be improved.

However, a number of important features make Atari BASIC attractive to beginners and experienced users. Many will appreciate automatic syntax checking, full on-screen editing, access to sound and graphics without learning specific memory locations, allowance for long variable names, an option in the USR statement to pass several variables to machine-language subroutines, and well-spaced readable code. String arrays can be simulated but not directly implemented. Unfortunately, error messages appear only as cryptic numbers; users should keep their manuals handy. (The original designers of Atari BASIC, Optimized System Software [OSS], have released BASIC XL, an improved BASIC for serious users; see the text box “BASIC XL,” page 271.)

Though advertised as having 64K bytes of RAM (random-access read/write memory), the 800XL actually has 20 bytes less free RAM in BASIC. The additional 16K bytes added to the computer’s memory is bank-selected.

---

### Table I: Summary of text and graphics modes directly available in Atari BASIC (reproduced from Atari BASIC Reference Guide, page 9).

<table>
<thead>
<tr>
<th>Screen Format</th>
<th>Graphics Mode</th>
<th>Columns</th>
<th>Rows—Split Screen</th>
<th>Rows—Full Screen</th>
<th>Number of Colors</th>
<th>RAM Required (bytes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Text</td>
<td>40</td>
<td>24</td>
<td>1.5</td>
<td></td>
<td>992</td>
</tr>
<tr>
<td>1</td>
<td>Text</td>
<td>20</td>
<td>24</td>
<td>5</td>
<td></td>
<td>674 672</td>
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<tr>
<td>2</td>
<td>Text</td>
<td>20</td>
<td>12</td>
<td>5</td>
<td></td>
<td>424 420</td>
</tr>
<tr>
<td>3</td>
<td>Graphics</td>
<td>40</td>
<td>24</td>
<td>4</td>
<td></td>
<td>434 432</td>
</tr>
<tr>
<td>4</td>
<td>Graphics</td>
<td>40</td>
<td>12</td>
<td>2</td>
<td></td>
<td>694 696</td>
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<tr>
<td>8</td>
<td>Graphics</td>
<td>160</td>
<td>192</td>
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<td></td>
<td>8112 8138</td>
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<td>15</td>
<td>Graphics</td>
<td>160</td>
<td>192</td>
<td>4</td>
<td></td>
<td>8112 8138</td>
</tr>
</tbody>
</table>

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Photo 1: Screen display from Electronic Arts’ Murder on the Zinderneuf. The Atari 800XL allows customized graphics displays and character sets.
**AT A GLANCE**

**Name**
Atari 800XL

**Manufacturer**
Atari Corp.
1312 Crossman Ave.
POB 61657
Sunnyvale, CA 94086
(408) 745-2109

**Components**

- **Memory:**
  - 64K bytes bank-selected

- **Processor:**
  - Modified 6502C, 1.79 MHz

- **Special integrated circuits:**
  - GTIA (graphics display), POKEY (sound generator and controller ports), and Antic (screen control)

- **Keyboard:**
  - Full-stroke design; 62 keys, including Start, Option, Select, and Help keys; international character set; 29 graphics characters

- **Display:**
  - TV or video monitor output, 16 text/graphics modes, 256 colors displayable at once, maximum 320-by-192-pixel resolution, 40 by 24 maximum text display

- **Sound:**
  - Four independent sound channels, 3 1/2-octave range

- **I/O interfaces:**
  - Cartridge slot, serial I/O for disk drives, external parallel bus for future peripherals

**Software**

- Resident Atari BASIC, DOS 3.0 supplied with the Atari 1050 disk drive

**Options**

- Wide variety of peripherals, including disk drives, interfaces with parallel and serial ports, printers, graphics pads, light pens, joysticks, CP/M and MS-DOS capability with the ATR8000.

**Documentation**

- Short BASIC and owners guides

**Price**

- 64K bytes, two disk drives, monitor, parallel and serial ports: $1240

---

The Memory Size graph shows the standard and optional memory for the computers under comparison. The Disk Storage graph shows the capacity of one and two floppy-disk drives for each system. The Bundled Software Packages graph shows the software packages included with each system. The Price graph shows the list price of a system with two disk drives, a monochrome monitor, graphics and color-display capability, a printer port and a serial port, and the standard operating system and BASIC interpreter for each system.
The back panel of the 800XL. Note the parallel bus, the XL's most important new feature.

Inside the XL. From lower left, the single board contains the Antic chip, GTIA, 6502C, PIA, and then up toward POKEY (on the right side) the 16K-byte OS ROM, and the 8K-byte BASIC.

The graphs for Disk Access in BASIC show how long it takes to write and to read a 64K-byte sequential text file to a floppy disk. (For program listings see "The Chameleon Plus" by Rich Krajewski, June 1984 BYTE, page 327, and Fixes and Updates, October 1984, page 33.) A modified Sieve graph shows how long it takes to calculate 1000 primes off the Sieve of Eratosthenes prime-number benchmark. The Calculations graph shows how long it takes to do 10,000 multiplication and division operations using single-precision numbers.

The System Utilities graphs show how long it takes to format and copy a disk (adjusted time for 40K bytes of disk data) and to transfer a 40K-byte file. The Spreadsheet graphs show how long it takes to load and recalculate a 25-by-25-cell spreadsheet where each cell equals 1.001 times the cell to its left. The Apple used Microsoft Multiplan. The Atari and IBM used VisiCalc. The tests for the Atari used DOS 2.0 with two Atari 810 disk drives. Tests for the Apple were done with ProDOS. The IBM PC was tested with PC-DOS 2.0.
and available only to machine-language programs and subroutines, including those called by BASIC. A new option that lets developers and users switch operating systems involves new pointers that use up the additional 20 bytes; to date, only Atari provides software that installs a different operating system. This translator disk, released well after the machine's introduction, lets users run third-party software written for the Atari 800 by installing that operating system in the Atari 800XL.

COMPATIBILITY

In creating the 800XL operating system (OS), Atari preserved the entry points to the principle ROM routines. Unfortunately, in a quest for copy protection and additional speed, many third-party software houses bypassed these entry points. As a result, a substantial amount of non-Atari software cannot function on the 800XL. Only two Atari products, States and Capitals and Graph IT, have trouble on the XL.

The translator disk, available from Atari Customer Service and the many users groups for a small fee, does an excellent job of providing compatibility with older software. When loaded, the translator disk switches off the resident ROM and loads a choice of Atari 800 operating systems into lower RAM. One side of the translator disk provides OS version A, installed in pre-1982 Atari computers; the other side contains version B. It also demonstrates on screen the fabulous graphics capabilities of the new GTIA graphics modes.

The translator should run all the third-party software using what Atari originally called "illegal" entry points. Two software retailers reported no consistent returns of products from 800XL owners, and I have had no trouble loading any software. Cassette owners should know that Atari does not provide a cassette version of the translator. Disk and cassette versions currently advertised in Analog and Antic magazines claim to provide a more comprehensive fix than Atari's.

(continued)

BASIC XL

Optimized Systems Software Inc. (OSS), the creator of Atari BASIC, markets BASIC XL, an improved cartridge BASIC. The 16K-byte cartridge has four 4K-byte blocks, only one of which is always active. The other three are bank-selected depending on the function required. The result is much more power and flexibility than the original 8K-byte BASIC.

BASIC XL fully implements string arrays, with the addition of LEFTS, MIDS, and RIGHTS, but preserves Atari BASIC strings as an option. OSS has replaced the numeric error messages with full text. Other features include block deletes, automatic renumbering, inputting with prompts, DOS commands direct from BASIC, built-in trace features, automatic line numbering, and an easier tab function.

A new Print command gives much more versatile outputting to the screen or printer. The command easily allows left or right justification of numeric or string output; filling with blanks, zeros, or asterisks; and printing special characters at specified locations in the numeric or string output.

Other enhancements to the language include IF ... ELSE ... ENDIF; WHILE ... ENDDO; FIND, which searches for characters within strings; DPEEK and DPOKE for single-command handling of 2-byte addresses; and RPUT and RGET, which facilitate input and output of fixed-length records.

A new range of commands eases player-missile programming and joystick reading. WVAR lists program variables and their line-number locations. LOMEM eases the movement of low memory. SET modifies many default conditions, from disabling the break key to wrapping player-missile movement to the opposite side of the screen.

The Fast command placed at the beginning of your programs or used when you run (rather than load) programs transforms all line-number references into absolute addresses. When executing a GOTO, GOSUB, FOR, or WHILE, BASIC XL jumps right to the specified line's address, reducing the running time of many programs. A modified Sieve of Eratosthenes (generating 1000 primes) that takes 3 minutes and 11 seconds in Atari BASIC takes only 1 minute and 38 seconds (1 minute and 11 seconds using FAST) in BASIC XL.

BASIC XL will run all Atari BASIC programs.

Photo 2: The keyboard of the 800XL. Note the better placement of the inverse-video key in the lower right corner.
The power supply of the 800XL is completely external.

The much-maligned DOS is actually quite effective and easy to use. Typing DOS from BASIC puts the DOS menu on the screen. Little training is required to print a directory; copy files and disks; lock, unlock, rename, and delete files; or format and write new DOS files. The commands offer flexibility that you can augment with a plethora of third-party software.

Nonetheless, DOS 2.0 has several important problems. Loading DOS from BASIC replaces part of the memory in which a BASIC program resides. Preserving the program requires using a special MEM.SAV file, which takes a distracting amount of time. When you call DOS, programs resident in memory are first saved to MEM.SAV then restored when you rerun BASIC. For many programs it is much faster to save the program, call DOS, and then reload the program. BASIC XL and other third-party DOS patches solve much of the problem by allowing access to several DOS commands directly from BASIC.

DOS 2.0 formats disks into 40 tracks at 18 sectors per track (128 bytes per sector in single density). Of the 720 sectors available, three boot the system, eight contain the disk directory, eight contain the volume table of contents, and sector 720, by accident, is unaddressable. As a result, there are 707 sectors for data. Total storage per disk is only 88,375 bytes. DOS 3.0, now shipped with the Atari 1050 disk drive, offers enhanced density, which involves the same 40 tracks now with 26 sectors per track, giving the drive about 127K bytes of storage. Several third-party manufacturers offer true double-density drives.

Except for the addition of the parallel bus, the back panel of the 800XL provides the same capabilities as the 800. Both contain a 13-pin I/O (input/output) connector, provision for TV or monitor output, a channel 2 or 3 selector, a power jack, and the on/off switch. Unlike the 800, the 800XL's power supply is completely external.

SOFTWARE AND PERIPHERALS

In addition to Atari BASIC, Atari also offers Microsoft BASIC, Pilot, Logo, Pascal, an Assembler Editor cartridge, and FORTH. Several of those packages were available from APX (Atari Program Exchange), which no longer exists. Antic magazine is attempting to fill this void. OSS supplies BASIC A+ and BASIC XL and Action! (see the text box "Action! A Poor Man's C++" on the right). C/65, and the MAC/65 assembler. Three BASIC compilers are available from Datasoft, Monarch, and MMG. MMG claims that its recently released package compiles floating-point and I/O operations.

The most popular word processors are AtariWriter and Letter Perfect (from LJK). Letter Perfect can be integrated with LJK's database manager, Data Perfect, and a spelling checker, Spell Perfect. Documentation has been improved with easy-to-follow tutorials. Data Perfect lets users define their own databases and integrate fields into Letter Perfect. The two together would let a user send the same letter to a list or sublist defined in the database. The spelling program allows expansion of the dictionary to 255 disks and offers a sounds-like feature to help determine whether words are misspelled.

With a separate printer driver, AtariWriter supports a range of printers. LJK supplies a printer driver with Letter Perfect, which can also support 80-column formats and double density. Other available software includes numerous business programs from VisiCalc to a new accounting series from Miles Computing of Van Nuys, California, thousands of games, and a variety of excellent graphics aids.

An impressive and growing number of third-party peripherals are available for the Atari 800XL. For disk drives, consumers can select the Atari 1050, the 'Trak ATD2, the Rana 1000, the Indus GT, Astra Systems' drives, or an
A review of the Atari 800XL by Ed Schneeflock.

**Action! A Poor Man's C?**

By Ed Schneeflock

About a year ago, I looked for a better language system for my Atari but neither Atari BASIC nor Atari's Assembler Editor met my needs. I did not want to use BASIC, not only because of its slowness and lack of debugging features, but also because it's difficult to use BASIC for work at the machine-language level. The Assembler Editor gives enough speed but takes too much programming time.

At work I was programming in Pascal, and I liked the APX-Pascal package. Unfortunately, it requires two disk drives, more than two I had.

I have always had a preference for the C language, so I checked out two C compilers for the Atari. Both are subsets of the complete C language. They lack some of the control and data structures and, most importantly, the ability to handle data structures (records). More important, although the prices were reasonable, both required that I buy an editor and macroassembler.

Then I heard about Action! from Optimized Systems Software. It is a cartridge-based, fast, structured language that permits using data structures. Ten iterations of the Sieve ran in under 18 seconds, compared to 10 seconds for an assembly-language version I wrote. BASIC took 38 minutes. Moreover, the programs compile faster than anything I have ever seen. Action! is enough like C that I can routinely convert programs between the two languages. It also comes with its own editor, one of the best I have used on a small system.

Action! is simple enough for novice programmers: part of the manual describes the language features in terms of their BASIC equivalents. Action! is also powerful enough to challenge an experienced programmer. I have used it to write a terminal program, a program to compare two BASIC programs and list the differences, a program to print an alphabetized list of the contents of a group of disks, and several games. I am currently writing a compiler for a subset of Pascal.

Action! has many impressive features. Programs can be compiled from memory or from disk. You can include separate source files by using the INCLUDE compiler directive. A large program can be managed effectively by putting modules in separate files. This language also has a DEFINE compiler directive much like Cs. You can define both constants and expressions. Data types include bytes (characters) and signed and unsigned integers. You can use these in single-dimensional arrays or combined in records.

Pointers and pointer manipulations are one of the language's best features. Pointers make possible some very concise string-handling routines and dynamic storage of data structures like binary trees and linked lists. Functions and procedures support local variables, and you can pass parameters to them. Parameters are passed by value only, but you can use pointers when passing a parameter by reference is required.

You can initialize variables with either a value or an address. The latter eases the handling of operating-system addresses. Procedures can also be initialized with an address, making it easy to call operating-system routines from your program.

In short, Action! is a versatile language system. However, it is not perfect. It can't link separately compiled routines. And you cannot have records of arrays or arrays of records (though these can be handled with pointers). All variables are static, so writing recursive routines requires explicit stack manipulation. These shortcomings are more than outweighed by Action!'s advantages.

Action! is unique because it was designed from the start to run on the 6502 processor. This has some important implications. First, it runs very well on the Atari. I have used a full C compiler on another 6502-based microcomputer, and while it worked, I quickly sensed that it was taxing the machine's limits. Compiling took far too long. And there were too many steps to follow to get a program written and running. Action! is easy to use, quick, and efficient. It can exploit the Atari's full power. Action! puts programming for the Atari in a whole new dimension.

There are also potentially serious problems with getting equipment repaired. I have had trouble getting disk drives fixed; the nearest service center is two hours away. Moreover, the Customer Service telephone number published in Atari's introductory documentation no longer functions. A toll number now shares with the old number the dubious honor of being perpetually busy.

Still, at the suggested list price, the 800XL is a bargain. I already own one; I may well buy another.

As an assortment from Percom. When Atari temporarily discontinued production of its 850 interface, several manufacturers developed a variety of printer interfaces, some offering RS-232C ports. All non-Atari printers require one of these interfaces.

The Atari computers have some of the most active users groups in the country, many with bulletin boards containing plenty of free software to download. Telecommunications is available to Atari users who own the Atari 850 interface with RS-232C ports and third-party modems that attach to the joystick ports.

**Documentation**

Unfortunately, Atari appears to be able to market the 800XL so cheaply in part by including minimal documentation. A brief pamphlet summarizes Atari BASIC, and slightly more comprehensive instructions show you how to set up the system. I believe that consumers would prefer to pay more for more respectable documentation.

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System Requirements

- IBM PC or XT with 192K RAM, 2 disk drives and DOS Version 2.0
- IBM Color/Graphics Adapter with RGB color or b&w monitor
- Epson MX-80/MX-100 or FX-80/FX-100 dot-matrix printer
- Houston Instrument DMP-41 pen-and-ink plotter (optional)
- Microsoft Mouse (optional)

Wintek Corporation, 1801 South St., Lafayette, IN 47904-2993, Phone: (317) 742-8428, Telex: 70-9079 (WINTEK CORP/UD)
Brodbernd Software's Dazzle Draw is a drawing program similar in nature to MacPaint, with one startling improvement—it lets you draw in 16 colors. As photo 1 indicates, the package is appropriately named: it gives an Apple IIc or a 128K-byte IIe graphics that are unequalled by anything running on an Apple II.

With Dazzle Draw and your favorite input device, you can draw in several ways—using a "paintbrush" with 24 shapes, a "spray can" with four spray textures, or a tool that lets you draw filled or hollow ovals and rectangles. Your "canvas" is the double high-resolution page (the exact size of the Apple display). Although Dazzle Draw's options take up part of the top and bottom of the screen, you can "slide" the viewing area up and down over the actual drawing, using a scroll bar in the lower right corner of the display (see photo 2). You can usually erase your last action by selecting the Undo box, which turns red when the undo feature is available. (Dazzle Draw makes good use of color to indicate the status of menu selections.)

Often, Dazzle Draw interacts with you via dialogue boxes that let you know what the situation is (for example, 'Are you sure you want to clear the screen?') and lets you answer using your input device and a menu of options.

Dazzle Draw accepts several input devices: I tried a joystick, the Apple II Mouse, and the KoalaPad, each of which was more useful than the one before it. Also, you will find Dazzle Draw awkward to use if your joystick doesn't have an auto-centering option. The program also accepts the Apple Graphics Tablet.

Dazzle Draw lets you print in color using the Apple Scribe or the Epson IX-80, or in black and white using one of several printers: Apple Dot Matrix Printer or ImageWriter, NEC 8023A, C. Itoh 8510 (Prowriter), Star Micronics 10X or 15X, or Epson RX-80, MX-80, MX-100, FX-80, or FX-100. I had no problem printing in black and white with the Imagewriter and the Apple Super Serial interface card.

**Details**

Dazzle Draw gives you 16 colors and 30 patterns (8 pixel by 8 pixel) with which to paint, spray, or fill. (The colors are visible in the lower left corner of photo 2; when selected, the patterns appear in that same space, five patterns visible at a time.) On both the color televisions I used as monitors, the "light gray" and "dark gray" colors looked identical, so I actually had 15 colors. But this is still a wealth of colors for someone used to having only 6 (the number available in normal Apple hi-res graphics).

If you do not like the patterns supplied with the program, you can design your own using the Modify Pattern menu selection; this option fills the screen with an enlarged copy of the pattern and lets you change each pixel to any of the 16 available colors. Once you have created a palette of new patterns, you can save them to disk.

The Zoom menu selection is similar to Modify Pattern. It lets you manipulate an enlarged 20- by 24-pixel area using the cursor and the palette of 16 colors, or you can use a "scroller" to move the zoom window over different parts of the document.

The Flood Fill selection has an option that, to my knowledge, is a first for any microcomputer drawing program. Most programs can fill an area with a pattern, but the area has to be bounded by a solid border and sometimes must be filled with a solid color (usually black or white). Flood Fill can replace any colored or patterned area with another pattern. (For example, you can replace an irregular green-and-red-checked area with diagonal light and dark green stripes.) A related feature lets you capture a rectangular area of the drawing (delineated with the "theater marquee" border that MacPaint uses), then exchange two colors in the area or substitute one color for another. Dazzle Draw also allows (continued)

Gregg Williams is a senior technical editor at BYTE. He can be contacted at POB 372, Hancock, NH 03449.
REVIEW: DAZZLE DRAW

AT A GLANCE

Name
Dazzle Draw

Type
Color-display drawing program

Manufacturer
Brøderbund Software Inc.
17 Paul Dr.
San Rafael, CA 94903
(415) 479-1170

Features
Paint Brush (24 brush shapes)
Spray Paint (four spray patterns)
Flood Fill (fill or replace solid color or pattern)
Zoom (manipulate individual enlarged versions of pixels, scroll area under view)
Text (two fonts, two sizes)
Shapes (filled and hollow ovals and rectangles)
Lines (three drawing modes: single, connecting, and "rays")
Capture (take a rectangular area and then move, cut, copy, flip, or invert it)
Mirrors (horizontal, vertical, or both-axes reflection)

Format
Double-sided 5¼-inch ProDOS floppy disk

Computer System
128K Apple IIe or Apple IIc; color display recommended; printer; and either a joystick, KoalaPad, Apple Mouse, or Graphics Tablet

Documentation
36-page tutorial and reference manual

Price
$59.95

Photo 1: Monarch, by Phyllis Paradies, created with Dazzle Draw.

Photo 2: Dazzle Draw at work. Note the pull-down menu. Active selections are in blue, inactive ones in gray; a menu selection is yellow when it is about to be activated by the cursor; the Undo box is red when an action can be undone. The colored areas were made using both solid colors and patterns with the Paint Brush, Spray Paint, Flood Fill, and Shapes tools. The area at the bottom is the "control panel" for the current tool, Flood Fill.
noving: the program forces you to use drive I when making a slide-show disk or initializing a disk. You have access to both drives, however, when loading and saving files.

The second problem, though not overwhelming, is more than a mere annoyance. When you have captured a rectangular area and moved it with the cursor, selecting the Undo box causes the program to erase the area completely, not move it back to its original position. This is definitely contrary to the intuitive working of an Undo facility and causes a nasty shock the first time it happens.

Dazzle Draw has a few other limitations you should be aware of, most of which are direct results of limited hardware. You can only make an Apple (which has an 8-bit 6502 processor) do so much, and David Snider, the creator of the package, has made the Apple do most of it.

The feature I miss most in Dazzle Draw is the "lasso" in MacPaint (which runs on the Macintosh's powerful 16-bit 68000 processor). The lasso lets you capture an area without capturing the white space around it; this enables you to move one image on top of another without any evidence that you have done so. The absence of such a tool limits Dazzle Draw's copy and paste abilities. However, this is not the first time that the medium (in this case, Dazzle Draw and the Apple IIc or IIe) influences the nature of the artwork that can be produced.

Two other limitations are also inherent in Dazzle Draw. First, when the "theater marquee" moving lines are on the screen, the cursor slows down proportionally to the size of the on-screen area; the larger the area, the slower the cursor. The slowness is a result of the processor being asked to do a lot; in any case, the cursor is not so slow that it's useless. Second, because of the high resolution of the image, a disk can hold only eight drawings (six on a slide-show disk). In future products, image-compression techniques may be used to get more pictures on a disk, but such techniques may also slow the loading and

(continued)
OF PIXELS AND ProDOS

Double high-resolution graphics came about when the team that designed the Apple IIe decided to give it an extra 64K bytes of memory by adding a second bank of memory that exactly mirrors its primary 64K-byte workspace. The same circuitry that enabled the Apple IIe to do 80-column text (instead of the standard 40-column text) by interleaving characters from the primary text page and its mirror also enabled the Apple IIe to display twice the number of pixels on a line—560 instead of the 280 of normal hi-res graphics.

Double hi-res is thus 560 columns by 192 rows (the same number of rows as normal hi-res). When these (monochrome) pixels are displayed on a color monitor or television, adjacent four-pixel groups appear as one of 16 possible colors. This means that the effective resolution of double hi-res in color is 192 rows by 140 columns, with 16 colors available.

Since each picture occupies one 8K-byte hi-res graphics page, and its mirror occupies another page, a stored picture should take 16K bytes (actually less—a hi-res picture does not entirely fill up the 8K-byte area allotted to it). For whatever reasons (overhead, probably), Dazzle Draw pictures take exactly 16.5K bytes (33 512-byte blocks) when stored on disk, which allows you to store a maximum of eight pictures on an Apple disk.

Dazzle Draw works under Apple's new operating system, ProDOS, which is supplied on the Dazzle Draw disk. Because of this, you cannot store Dazzle Draw pictures on a DOS 3.3 disk—you have to initialize a separate disk with ProDOS for use with Dazzle Draw.

ProDOS is faster and more versatile than DOS 3.3. Its use of directories enables you to group related files in a hierarchical structure. Because the manipulation of this structure (through a multilevel file prefix) is confusing to some people, you can configure Dazzle Draw to use either an Easy File or a Professional File option. Easy File is much like DOS 3.3 and does not let you access files that are two or more levels "deep" in the ProDOS structure: the Professional File lets you have full access to the ProDOS file structure.

Dazzle Draw is breathtaking. Double hi-res graphics, which came about as an afterthought of the design of the Apple IIe 64K-byte card (see "Of Pixels and ProDOS" at left), is one of the most important new features of the Apple IIe and IIC. Dazzle Draw is the first double hi-res product that is powerful, fast, and easy to use. This program announces David Snider (also the author of two games, David's Midnight Magic and Serpentine) as one of the few masters of Apple II graphics.

CONCLUSION

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The KoalaPad

An inexpensive input device without a keyboard

BY DONALD R. OSGOOD

The KoalaPad touch tablet and its accompanying software represent one type of approach to making computers easier to use. This problem is currently receiving a great amount of attention from both hardware and software developers. The touchpad concept has been around in expensive versions since the sixties along with the trackball, the light pen, and other location-sensing mechanisms. They provide a faster and more satisfactory method of making selections or inputs to the computer. The KoalaPad is an inexpensive touch-sensitive peripheral.

HARDWARE

The KoalaPad touch tablet is mounted on a 6-inch by 8-inch plastic base with a 4.25-inch square sensitive area. At the back it is about 1 inch thick and slopes toward the front. Two wide, rugged buttons are mounted between the sensitive area and the back edge. The sensitive area is made of black plastic (see photo 1). Another layer of conductive material is mounted beneath the surface layer, and when the two layers are firmly pressed together by a finger or stylus, a resistance proportional to the position of the selected point in both x- and y-axes is detected. This serves as an input to the game port of the Apple computer just as would the potentiometers of a joystick. A cable with connector is mounted on the back of the KoalaPad, which plugs into the Apple game connector. The layout of the sensitive area of the pad is similar to that of the high-resolution screen, with the 0.0 coordinates at the upper left-hand edge. Actually, however, the minimum value attainable for the x-coordinate is greater than zero—on the order of 6 to 9, while the maximum is about 256. The KoalaPad utilizes 5-volt power from the computer and draws approximately 20 milliamperes.

SYSTEM REQUIREMENTS

System requirements for use of the version of the KoalaPad that I tested include a 48-byte Apple II, II+, or Ile computer with Applesoft BASIC, one disk drive, DOS 3.3, and a color monitor or television. Although the manufacturer specifies a color monitor or television, I was able to try many of the functions of the system using a standard green-screen monitor. However, a color TV gave much better drawings. Other versions of the KoalaPad are made for Atari, IBM, and Commodore computers.

SOFTWARE

I tested two sets of software with the KoalaPad: the Micro Illustrator (see photo 2) and the Instant Programmer's Guide. The first uses the features of the KoalaPad to provide tools for drawing shapes, lines, points, etc., and for storing and retrieving pictures. It includes utility programs for formatting disks and locking, unlocking, and deleting files. The Instant Programmer's Guide demonstrates a number of segments that a BASIC programmer can incorporate into personal programs.

After you boot the Micro Illustrator disk, the computer displays a menu showing the options of the program. You make selections by using the KoalaPad to move the cursor to the desired option, then touching a button on the pad. Only the storage options require you to use the computer keyboard. The default selection is "Draw," "Normal," "Cursor," and "Green" for the color. A press of a button on the pad blanks the screen and you are ready to start drawing.

In this mode, a cursor appears when you touch the surface of the pad. By holding down the left button while moving your finger or the stylus over the pad, you produce a continuous line. When you release the button, drawing stops and the cursor reappears so you can start a new line. In order to return to the menu, you remove your finger from the pad and press the button.

The Micro Illustrator menu offers a selection of 10 drawing modes plus an erase (continued)
REVIEW: KOALAPAD

AT A GLANCE

Name
KoalaPad touch tablet, Micro Illustrator program, and Instant Programmer’s Guide

Manufacturer
Koala Technologies Corp.
3100 Patrick Henry Dr.
Santa Clara, CA 95050
(408) 986-8866

Size
6 by 8 by 1 inches; active area 4.25 square inches

Weight
Approximately 1 pound

Hardware Needed
Attaches to the game controller port of the Apple, Atari, Commodore, and IBM Personal Computer

Software Provided
Micro Illustrator; the Instant Programmer’s Guide, available separately, also was tested. Several other programs are available from the manufacturer. The system works as a joystick with a number of games.

Documentation
Two 15-page pamphlets

Price
Approximately $125; extra software about $35-$40.

function, normal or magnified scale, storage utilities, and a help screen (see table 1). You also can select a standard cursor or any of eight “brushes” (see photo 2) that leave lines of varying contour on the screen. Color choices include two sets of 9 colors (black and white are included in both sets, which means that there are actually 16 colors).

The Instant Programmer’s Guide includes a number of sample programs and subroutines. It shows how to use the pad as a tone generator and how to generate a cursor for selecting options in your program. The program menu lists eight selections:

- KoalaPad Fundamentals—this demonstrates the plotting of points and lines and the use of the pad as a tone generator.
- Hi-Res Cursor—demonstrates how to use a shape table to generate a cursor.
- Compatibility—discusses the use of the KoalaPad instead of a joystick or a set of game paddles.
- Make Your Own Cursor—tells how to generate a cursor using a data statement.
- Soft Keyboard Ideas—discusses ways to put areas of different sizes on the screen.
- A Text Cursor—shows how to move the cursor around.
- An Invitation—offers the user the opportunity to produce KoalaPad software for publication by the manufacturer.
- Quit—the final menu item worked well.

DOCUMENTATION

The documentation received with the KoalaPad consists of a pamphlet of 15 pages, which describes the Micro Illustrator program as well as the in-

Photo 1: The KoalaPad provides a method for entry of data or for making selections from the screen using touch rather than the keyboard.
INSTALLATION and operation of the system. It also lists and briefly discusses the commands and gives some hints for using the system as well as a glossary of terms.

The Instant Programmer’s Guide includes a pamphlet that essentially contains the text of the tutorials shown on the accompanying disk. It contains a few errors and is succinct to the point of sketchiness, but it is also clear and lucid.

There are areas in the KoalaPad system that would be enhanced by more detailed documentation.

CONCLUSIONS
The KoalaPad is certainly a lot of fun to play with. It does very well at generating simple shapes that look as well as can be expected with the limitations of the Apple Hi-Res screen (see photo 3). The subroutines provided enable BASIC programmers to incorporate the pad into their programs for use as a selection mechanism or as a substitute for either paddles or joysticks.

In the area of freeform drawing or in any use requiring raw data to be plotted, the KoalaPad I tested suffers from severe limitations. I was unable to produce any kind of line drawing that didn’t have glitches and spurious lines, jagged lines, and generally unsatisfactory characteristics. However, in a conversation with one of the software marketing people at Koala Technologies I was told that most of the problems associated with raw data have been eliminated in later versions of the touch tablet.

The manual recommends use of the system to provide not more than a 7-by-7-inch grid of touch-sensitive points because of the danger of overlap. This appears to be a reasonable indication of the discrimination capability of the system. The fact that you have to position the cursor and then push a button means that there is little, if any, advantage to using the KoalaPad rather than using the keyboard for selections.

The use of color makes a big difference in drawing geometric shapes in conjunction with the Micro Illustrator program. Most of my early tests were done on a green-screen monitor and I was very favorably impressed when I hooked up a color television. The highly saturated colors and the three-dimensional effects that can be achieved with color are excellent. (continued)
The KoalaPad system provides a means for interaction with the computer by using a finger or stylus to move a cursor.

The tests using a joystick with the Micro Illustrator program showed that it is just about as easy to use as the touchpad. For some applications, the joystick would probably be better.

**IN BRIEF**

The KoalaPad system provides a means for interaction with the computer by using a finger or a stylus to move a cursor on the screen. The Micro Illustrator software that accompanies it has a good deal of capability. As a matter of fact, it far exceeds the capability of the hardware portion of the system. The shape-generating modes and color graphics are truly impressive. Limitations of the system are due to the small size of the active area, the lack of control over glitches in some modes, and the difficulty in resolving small differences in input without a great deal of random variation.

---

**Review: KoalaPad**

<table>
<thead>
<tr>
<th>MODE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point</td>
<td>A cursor or brush marks a single location each time the button is pressed.</td>
</tr>
<tr>
<td>Line</td>
<td>The cursor is used to specify the origin and end point of a line. After the cursor is positioned at the starting point, the button is pushed. The line then follows the cursor until a second push of the button releases the line in its final position.</td>
</tr>
<tr>
<td>Lines</td>
<td>This mode is similar to the Line mode except that the end point of each line serves as the starting point for the next line.</td>
</tr>
<tr>
<td>Rays</td>
<td>The cursor is set to the end point of one line and the button pressed. It is then moved to the origin, which establishes one ray. When the button is held down and the stylus touched to the pad additional rays are generated, frequently several from a single touch of the sensitive surface.</td>
</tr>
<tr>
<td>Frame</td>
<td>In the Frame mode the locations of two opposite corners are specified and the program draws a rectangle through those points.</td>
</tr>
<tr>
<td>Box</td>
<td>A frame filled with a specified color is produced.</td>
</tr>
<tr>
<td>Circle</td>
<td>The center point and radius are indicated by positioning the cursor, then the program draws an approximation of a circle of the indicated size and center location. This is one of the least satisfactory figures that can be drawn on the high-resolution screen.</td>
</tr>
<tr>
<td>Disc</td>
<td>Provides a color-filled circle.</td>
</tr>
<tr>
<td>Fill</td>
<td>The closed area on the screen in which the cursor is positioned is filled with the active color.</td>
</tr>
<tr>
<td>Erase</td>
<td>A color specification is requested then used to fill the entire screen.</td>
</tr>
<tr>
<td>Magnify</td>
<td>Enlarges the area around the cursor by a factor of seven. This function permits work on the fine details of a shape.</td>
</tr>
<tr>
<td>Normal</td>
<td>Returns to normal from the Magnify mode.</td>
</tr>
<tr>
<td>Help</td>
<td>Calls up a set of detailed instructions about the other modes.</td>
</tr>
<tr>
<td>Storage</td>
<td>Brings up submenus that permit loading and saving graphics using the computer keyboard for control inputs. The user can catalog, load, or save files, or use a set of disk utilities that are provided to format a disk or to lock, unlock, or delete files.</td>
</tr>
</tbody>
</table>

---

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FriendlyWriter and FriendlySpeller

A useful but limited word processor

BY STEVEN D. RYALS

FriendlyWriter and FriendlySpeller might be the program for you. This program’s designers seem to have taken the warm-puppy approach to word processing. The program’s command structure and the user’s manual’s layout anticipate potential problems that a word-processing novice might encounter. For example, the program simplifies file handling by letting you enter a 25-character name for each file and automatically including a 30-character excerpt from the file.

However, like many programs designed for the less demanding user, the RAM-based FriendlyWriter has certain built-in limitations. Text-file sizes are limited and certain conveniences, such as automatic page numbering and search and replace, are missing. The program seems specifically designed to handle business correspondence in a small office.

The package also includes FriendlySpeller, a 70,000-word spelling checker. FriendlySoft has economically priced this combination of FriendlySpeller and FriendlyWriter at $89.95.

INSTALLATION

The installation process is straightforward. FriendlySoft includes a handy utility program that sets up the master disk for you. After you run the setup program, make a working copy using Disk Copy. FriendlyWriter has separate install instructions for one- and two-drive systems, and for the XT and other hard-disk drives. Also included is a set of written instructions in case you prefer the feel of the keyboard under your fingers.

FriendlySoft has a 24-hour hotline number to use in case you experience any problems. This is the first time I’ve ever heard of a round-the-clock software hotline, and I’m impressed.

Another impressive feature of FriendlyWriter is a “no fine print” lifetime guarantee. At no charge, FriendlySoft will replace any master program disk that fails due to normal use; the company will do it within 48 hours of receiving the failed disk. Furthermore, if a floppy disk fails due to abnormal use (e.g., food on the hub ring), the company will still replace the disk. All you have to do is send a blank, unformatted disk along with the original master disk. I think computer users would stand up and cheer if other software publishers adopted such an enlightened policy.

You can easily set FriendlyWriter for monochrome or color monitors, although you have no choice in colors. Text is displayed in white on a blue background. Blocks of text are highlighted in reverse video. The text and cursor turn red in the delete mode and black in the move-text mode.

Printer initialization is also easy. A list of 49 printers is included; simply choose your printer from the list. FriendlyWriter takes care of the rest. FriendlySoft’s hotline helps with any printer setup problems, and other printers are frequently added to the list of those supported. The menu-driven setup procedure makes it easy to successfully install most printers on the first try.

PROGRAM OPERATION AND CONTROLS

Once the installation process is complete, you start FriendlyWriter by typing WR at the DOS prompt (see photo 1). The program takes advantage of the PC’s various function and cursor-control keys. The major commands are set up on the function keys, and the screen’s top two lines always show the current commands available (see photo 2). The function-key commands are consistently set up, with F9 always bringing up context-sensitive help screens and F10 used to indicate finishing a given task. Most of the commands are easy to understand and use, and the control key is rarely necessary.

Margins and other common formatting commands are easily changed from the reformat screen. The default line width for 8½-by-11-inch paper, for example, is 65 columns. Each of the three possible paper sizes has

(continued)
its own default margin. You can also elect to have FriendlyWriter put two spaces after a period. Other available options include double-spacing, right justification, and setting lines and characters per inch. A fast search-string function is provided, though there is no search and replace function.

**Writing and Editing**

If you have spent any time with other word processors, some FriendlyWriter functions can be confusing. For example, in WordStar you turn the text-insert mode on and off with the Insert key. In FriendlyWriter, you can also turn text-insert on and off, but if you use the cursor keys to move up or down a line, or if you delete something, the insert mode automatically turns off. This resulted in my routinely losing work due to inadvertently typing over text instead of inserting additional text. It would be nice to keep insert on until I decide to turn it off.

Another problem I encountered is the speed with which FriendlyWriter updates the screen in the insert mode. The documentation states that the program can handle up to 70 words per minute. I’m not a touch-typist, so I couldn’t test that claim. I had no problem entering text; the program is more than fast enough for me. However, in the insert mode, screen refresh was anywhere from slow to glacial, and the larger the document the slower the speed. The delay became so time-consuming that I gave up using the insert mode for entering text of any appreciable length, especially near the beginning of a document. When I had several lines of text to enter, I added blank lines and then filled them in.

It was very easy, even for me, to fill the type-ahead buffer. This feature is unacceptable to me, and I’m a slow typist. If you fly over the keys, you’ll spend more time waiting for FriendlyWriter to catch up than you will typing, at least in the insert mode.

FriendlyWriter also has a unique way of handling justification. The only way to keep text from left justifying is to use the tab key. This key moves five spaces at a time, but it inserts little dots as it goes. I used this method to center titles on a page (there is no automatic centering of titles or other text). You must use the tab key to create columns and any other text you don’t want left justified. Also, you can’t change the five-space tab setting.

**Saving and Recalling**

File saving and reading is another area where FriendlyWriter takes a different approach. Instead of allowing
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only an eight-character name and optional three-character extension, the program brings up a save-to-disk screen and lets you enter a 25-character filename. Next, the program inserts the date. Finally, FriendlyWriter includes any 30 characters from the file itself. The program pulls the 30 characters from wherever the cursor is located when you initiate a save. If there are no characters after the cursor, the program automatically pulls the first 30 characters from the document. This makes it easier to recognize what's in the files.

The only potential problem with this approach is that a file called MASTER.FW must be on each data disk. This is the file that actually stores the 25-character name and the other information. If MASTER.FW isn't present on the disk, FriendlyWriter can't find any of its own files. The files are actually stored on the data disk as 001.FW, 002.FW, and so on.

If you erase a text file using PC-DOS, FriendlyWriter doesn't know that the file is no longer present. It just looks for the MASTER.FW file and lists the filenames stored there. If the text file is listed in MASTER.FW, FriendlyWriter thinks it still exists. If you try to load a deleted file, the program returns you to the menu without any explanation.

The only way to make sure that FriendlyWriter keeps track of your files is to always use the various utilities included with the program. For in-

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REVIEW: FRIENDLYWRITER

As long as you delete files from within the program, FriendlyWriter has no problem keeping track of your files. This is important, because FriendlyWriter writes a new copy of the file to the disk every time you save. If you save a file regularly, in a short time your disk will fill up with version after version of the same file. You must regularly delete the previously saved files.

FriendlyWriter can also load and save external files created with other word-processing programs, as long as they are in ASCII (American Standard Code for Information Interchange) format. You use special commands for this operation. However, when I used WordStar to number the pages and insert headings in a FriendlyWriter text file, it took over half an hour to clean up the odd spaces FriendlyWriter left in the document.

Document loading is a two-step process. About 6 seconds after file loading begins, a message on the screen asks you to wait while the file is justified. This is because FriendlyWriter rejustifies a file every time you load it from the disk. It took approximately 15 seconds to load the BYTE benchmark text file.

The benchmark results speak for themselves. I'm not sure how valid the comparison is, because WordStar is a disk-based program and FriendlyWriter is RAM-based. I have the maximum 640K bytes of RAM (random-access read/write memory) in my Compaq; when I load WordStar into the RAM disk, it operates faster than FriendlyWriter does. For most people FriendlyWriter will be fast enough.

Because FriendlyWriter is completely RAM-based, a file can't be any longer than the available RAM space. For instance, with my Compaq at 640K bytes of RAM, the status line tells me I have 984 lines available at the beginning of a new file. With a minimum configuration of 64K bytes of RAM and using an 8½-by-11-inch page format with 1-inch margins all around, single spacing, six lines per inch, and 10 characters per inch, you'll have enough room for three pages of text in one file. Without a built-in way to combine several files into one, this program is clearly designed for creating and editing business letters and other kinds of short correspondence. Of course, the more RAM you have, the longer your epistle can be. Using the above-mentioned criteria, a computer with 256K bytes of RAM can hold a document of about 12 pages.

FriendlyWriter keeps track of the pages and displays where you are in the document on line three of the screen underneath the menu, but the program has no provision to automatically place the page numbers in your document.

**FINAL STAGES**

My experience with FriendlySpeller was generally pleasant. For example, when you request alternate spellings, a window opens up at the word in question and presents a list of possible alternatives (see photo 3). You also have the option of entering the correction from the keyboard.

The dictionary contains about 70,000 words and can hold as many more as disk capacity will allow. FriendlySpeller counts the total number of words and the number of unique words and shows you which letter of the alphabet it's checking at any time. This spelling checker and the low price make this an attractive program.

FriendlyWriter uses most of the common printer options, including double-strike, boldface, underline, and italics, assuming your printer has these features. FriendlyWriter also provides for using multiple paper bins with sheet feeders. This lets you put the first page of every letter on your letterhead and subsequent pages on plain paper. A pause feature lets you manually feed in one sheet of paper at a time. I had no problems setting up and using my printer.

FriendlyWriter with FriendlySpeller is a useful word processor and spelling checker for the price. Some of the program's limitations, such as file handling and text insertion, bother me, but it's still an excellent program for less demanding needs. You might find that most of my criticisms are irrelevant to you, in which case FriendlyWriter is a lot of program for the money. However, if you require a full-featured document processor, this is not the program for you.

---

Photo 3: FriendlySpeller in action. The program alphabetically checks each word in a text file, highlights words not listed in the dictionary, and offers alternate spellings.
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<td>Micro Sci</td>
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<td>Elite II, Quad Density Controller/Controller4Drives</td>
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<td>Dual Thinline Cabinet w/pwr</td>
<td>$80</td>
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<td>Shugart</td>
<td>Dual Cabinet &amp; Power</td>
<td>$80</td>
<td>$70</td>
</tr>
<tr>
<td>Mitsubishi</td>
<td>All have 6 month Warranty</td>
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</table>

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  - * 160 cps
  - * NLO Mode
  - **$359**
  - * FREE IBM Proms

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<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
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<tr>
<td>OKI82A, 120cps</td>
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<td>OKI83A</td>
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<td>OKI84P</td>
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<td>$599</td>
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<td>JUKI 6100, 18cps/tractor Quality</td>
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<td>JUKI 6300, 40cps &quot;New&quot; w/3K Buffer</td>
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<td>$949</td>
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<td>Panasonic</td>
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<td>1010, 120cps/w/tractor</td>
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<td>8510AP</td>
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<td>F10, 40cps</td>
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<td>Printmaster F1055pu</td>
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### Brother

- **Brother Dist. by Dynax**
  - **$299**
  - **$599**
  - **$949**

### Panasonic

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  - **Serial Interface**
  - **$59**

### Okidata

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  - **Tractor for 92 & 92**
  - **Serial Interface**
  - **$59**

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  - **$59**

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  - **Save**
  - **At Least**
  - **$130**

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  - * Color Composite
  - * Amdek Color I Compatt
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  - * Hayes Compatible
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### Prometheus

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<tr>
<th>Product</th>
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<tr>
<td>Ast Research Six Pack+</td>
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<td>Megaplate Add on Ports</td>
<td>$265</td>
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<td>Color Card GraphicsCard</td>
<td>$185</td>
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<td>Hard Disk 10 Meg. Ex</td>
<td>$329</td>
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<td>IBM Monochrome Adapter</td>
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<td>PC Products</td>
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### APPLE EXTRAS

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<td>CPS 5.25 Card</td>
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<td>RF Modulator Fan w/ Surge</td>
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<td>Micro Max Viewmax 80, 80 col card</td>
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<td>Micro Soft Mouse Premium Soft Card 164</td>
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<td>Micro Tek Serial Interface</td>
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### 5¼" DISKETTES

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<td>Verbatim</td>
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<td>Sanyo</td>
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### DISK ACCESSORIES

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<td>Head Cleaning Kit</td>
<td>$9</td>
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<tr>
<td>Flip Tub</td>
<td>$17</td>
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<tr>
<td>5¼&quot; Holds 70 Disks, plastic</td>
<td>$5</td>
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A host of problems beset the original IBM PCjr. From its toy keyboard to its paucity of memory to its single floppy-disk drive, the PCjr's deficiencies were generally recognized. The problems inherent in the design reputedly caused IBM's decision to halt sales pending a new introduction of the machine. All well and good. If a new PCjr can take over from the old version, the user will be better served from here on. Give a thought, though, to the folks who bought the initial release.

Apparently, that's what Tecmar Inc. did. The result is a memory-expansion board called the jrCaptain that you can also expand with a product called the jrCadet. You can actually wind up with a PCjr that has 512K bytes of memory. The jrCaptain's design and implementation are quite versatile. You can buy it with no memory (and presumably add your own) for $235 or get it preconfigured with 64K bytes or 128K bytes of memory. The jrCadet's sizes range all the way up to 384K bytes ($595).

The difficulty in reviewing the jrCaptain is that the memory board is identified with the PCjr itself. Trying to expand the machine's capabilities with a $315, 64K-byte, memory-expansion module ($395 for the 128K-byte version) is a laudable idea, but even if the Tecmar board had no problems of its own, it would still suffer from its association with the early PCjr. And the board does have some quirks. I hasten to add that none of the jrCaptain's problems are insurmountable; however, considering the PCjr's intended public, add-ons ought to be as easy as possible to use.

CONFIGURATION

Right out of the box, make sure your jrCaptain's memory configuration switches are set properly. Mine weren't set at all, and the settings are different depending on which size memory chips you buy. You can tell which size you bought by how much you paid. Remember that, because there is no indication as to memory size on any of the packaging, and the manual doesn't give you a clue. Looking at the chips won't tell you much either since the RAM (random-access read/write memory) chips carry the number 8314 and nothing else. I couldn't find any information about an 8314. On page A1 in the appendix, you'll discover that the RAM chips are Intel 4164-20 or the equivalent; this same vague source says that you could have anywhere up to 512K bytes on the jrCaptain. It might grow to that size someday according to Tecmar, but as yet 128K bytes is its largest size without the jrCadet expansion. I guessed my memory size to be 128K bytes based on the assumption that I didn't receive a prototype 256K-byte unit and on the fact that the board looked pretty full.

Section 2 of the manual contains instructions on how to set the configuration switches for the jrCadet. You have to take it on faith that the instructions apply, at least in part, to the jrCaptain as well. It would have been helpful if Tecmar had put this information a little closer to the front of the manual and made it specific for the jrCaptain.

The jrCaptain board snaps onto the computer's right side. You attach it by inserting four mounting screws. The unit has its own power-supply cord and a battery to keep current flowing to the clock and calendar at all times. (Incidentally, you cannot replace the battery yourself.) The documentation doesn't warn you that the expansion board heats up if you leave it constantly plugged in. Whether it's harmful to the board or not, this is another area where advice from the manufacturer would be helpful.

INSTALLATION

The installation instructions are fairly straightforward and, except for figuring out and setting the switches, the process is quite easy. After powering up on DOS, you discover that the jrCaptain has automatical-
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REVIEW: jrCAPTAIN

Name
jrCaptain

Manufacturer
Tecmar Inc.
Personal Computer Products Division
6225 Cochran Rd.
Solon (Cleveland), OH 44139-3377

Dimensions
1.12 by 3.5 by 11.36 inches

Software
Treasure Chest software disk with 24 programs for games and utilities

Hardware Options
jrCadet expansion modules:
64K bytes $195
128K bytes $275
256K bytes $445
384K bytes $595

Documentation
82-page installation manual
82-page users guide
112-page technical reference

Price
No memory $235
64K bytes $315
128K bytes $395

MEMDISK

Memdisk presented me with a number of problems that I never resolved. For instance, the manual gives you instructions for entering the amount of memory you want as your second RAM disk:—BUFFnum for the number of bytes in buffer memory. Both the manual and the screen implied that the number was up to me. But for some reason, the only number the program would accept here was 120. I emphasize that 120K bytes was not just the upper limit I could assign to the Memdisk function; it was the only number I could use. (If you buy the 64K-byte board, your magic number will be entirely different.) I can't say why this was so. It might not even be the case with every board that rolls off the Tecmar production line, but it was the case for this one.

Repeated attempts to reconfigure Memdisk with more or less than 120K bytes resulted in a blank screen or a locked keyboard. Tecmar said that the system automatically reserves a certain amount of memory for applications and lets you have what's left up to the maximum, which in my case was 120K bytes. This doesn't explain why I couldn't use a number less than 120 and Tecmar denied any knowledge of this problem. At any rate, my version of the software (1.0) has been superseded by version 1.2, so maybe this is an isolated incident.

Finally

I didn't run into any other questions that the manual didn't answer. And once I accepted the RAM disk's limitations, I found that loading WordStar on it and logging in on the floppy disk improved writing and editing speeds. However, loading WordStar and two overlays and running the time-display utility called Tick left me with just over 20K bytes on the RAM disk (called the B drive). Since half of that automatically goes for backup, I had only 10K bytes left. If you don't load something as overhead-intensive as WordStar, you'll probably find jrCaption in general, and Memdisk in particular, much more useful.

Given what Tecmar had to work with, I'm inclined to give it the benefit of the doubt regarding jrCaption. By all accounts, Tecmar's products are sound. The early PCjr is not an easy system to love and, once you get past the jrCaption's quirks, it makes the PCjr usable. If Tecmar will reorganize the installation manual and make sure the configuration switches are set at the factory, jrCaption and its jrCadets will save users a great deal of PCjr frustration.
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PORTABLE PROBLEMS

After reading the product preview "The HP 110" by Ezra Shapiro (June 1984 BYTE, page 111) and reviews elsewhere, I ran out and bought one because I wanted the additional memory, screen space, and software promised by the HP. While generally pleased with my decision, I had to adjust to several problems.

First, the HP 110 comes without a programming language. I had to buy a version of Microsoft BASIC and found it more primitive than the version on my NEC portable. It lacks a programmable clear-screen command; I use a subroutine to print a screen full of blank lines. It also lacks full-screen editing.

The HP 110 doesn't have a parallel output port. Hewlett-Packard clearly expects me to buy the companion ink-jet printer. I already have a daisy-wheel and a dot-matrix printer (both with parallel ports) and don't want another. I acquired a converter from Tigertronics, via an ad in BYTE, to convert the signal from the serial port.

I could use the NEC in my lap on any seat on the bus because it did not extend beyond my knees. The HP, when opened wide enough for a decent view of the screen, does not fit in a transverse seat. It has enough room when I sit in a bulkhead seat on an airplane; I have not tried it while sitting in other airplane seats.

Finally, the screen typeface is satisfactory for writing text, but in less-than-perfect lighting conditions it is hard to tell a 3 from a 9, or a 6 from an 8.

MANLY W. MUMFORD
Chicago, IL

JUKI 6100 PRINTER

Regarding your Juki 6100 printer review (August 1984, page 305), we've owned a Juki 6100 for more than six months and use it to create advertisements (right justified in proportional spacing, using our own word processor). We largely agree with you that the Juki 6100 has a lot of features and quality for a relatively small price.

However, upgrading the Juki 6100 from 2K bytes to 8K bytes of memory is not simple. It requires substantial printer disassembly, and although chip patterns are provided on the printed-circuit board for the RAM chips, no spare sockets are included. Soldering in sockets is time-consuming, tedious, and risky.

We purchased the tractor feed and were dissatisfied with it. Wavy lines and erratic line feeds were the results. No tractor-feed adjustment corrected this problem. And to use friction feed you must remove the tractor feed. We've sought assistance from Juki Industries twice, once to correct the tractor-feed problem and recently for a ribbon-feed problem. Juki has not responded in either case.

JOHN J. WILLIAMS
Alamogordo, NM

FORTH

While I found "PolyFORTH and PCFORTH" by Ernie Tello (November 1984, page 303) to be an excellent and fair review, a few errors occurred in the benchmarks. In particular, the Sieve of Eratosthenes figure for polyFORTH, which appears in the "At a Glance" box (page 305) as well as in table I, I measured at 66.5 seconds. Since the native code compiler has no interpreter overhead and does several forms of optimization (register optimization, strength reduction, constant expression folding, and several "peephole" optimizations), it will run at least twice as fast as any interpreted FORTH, and typically five times faster.

Also, since PCFORTH+ is a 32-bit integer FORTH instead of a 16-bit integer FORTH as were the other systems, execution is typically twice as long as in PCFORTH 2.0. Therefore, the first two Sieve times in table I must be wrong, although I do not have that version to give the correct times.

Because of long publishing lead times, the PCFORTH and native code compilers reviewed are earlier versions. The documentation has been completely rewritten, many operations are faster, and the native code compiler now recognizes all the control structures of PCFORTH and loads instantly as a binary overlay. Also, even though the review was for IBM PC-compatible FORTHS, functionally identical (except for minor enhancements for the IBM screen) versions of PCFORTH and the native code compiler are available for generic MS-DOS, CP/M-86, and CP/M-80 (Zilog 286 processor).

THOMAS ALMY
Tualatin, OR

MORE ON LOGO

Two recent BYTE articles on Logo ("Four Logos for the IBM PC" by Mark Bridger, August 1984, page 287, and "Two Logos for the IBM PC" by Morton Goldberg, BYTE Guide to the IBM Personal Computers. Fall 1984, page 91), in addition to containing the specific problems mentioned below and several others not mentioned, reflect the less-than-poor quality of too many Logo articles and reviews.

In Mark Bridger's "Four Logos for the IBM PC" his choice for a graphics benchmark is probably as good as any. But in the Hilbert procedure that he got from "Turtle Geometry by Abelson and diSessa, why does he insert LOCAL "L MAKE "L :LEVEL - 1 and then use L in place of :LEVEL - 1 as indicated by Abelson and diSessa? The procedure as suggested by "Turtle Geometry should work fine in any version of Logo.

Surely Bridger had a working version of Logo but, from what appears in BYTE, I cannot tell what it might have been.

In light of Goldberg's acknowledgment that he only worked with the Logos in question for 10 weeks, his article can be taken less seriously. Still, there are a number of problems. Goldberg completely misses PAUSE as a debugging aid, and his procedure-entering style at best reflects only personal taste.

As for his statement about breaking "out of the educational-software mold," virtually all of us in any way involved with Logo have been striving to do that without compromising its powerful learning philosophy.

Authors and editors who publish articles like Bridger and Goldberg's must be aware that Logo gives you much more to work with than other languages such as BASIC. In fact, the conventions and concepts (continued)
constraints imposed by such languages can be counterproductive when uncritically carried over into current programming languages such as Logo.

Instead of helping the reader learn such facts about Logo, these two articles almost seem intent on hiding them. Both articles are rife with examples of programming conventions required in BASIC and Pascal, along with the false implication and, at times, explicit affirmation that such conventions are necessary or best to use in Logo.

HAROLD NELSON
Francestown, NH

SAMNA BENCHMARKS

I found an inconsistency in a software review that I hope you will correct.

BRUCE C. DOSCHER
Hampton Bays, NY

In your review of the Samna Word III word-processing package (November 1984, page 319), you compare Samna, Volkswriter Deluxe, and WordStar 3.3 in four benchmark tests. The same tests are used for your review of Leading Edge and MultiMate word processors (page 287). WordStar 3.3 is tested in both articles, with grossly differing times for Scroll (10.5 seconds versus 31 seconds) and Search (41.2 seconds versus 4 seconds).

Perhaps BYTE will set up a Bureau of Benchmarks so all comparisons are forever equal. BYTE reviews could make or break some products' marketability, and I'm sure you get mail from manufacturers when a product review does not glow with enthusiasm. Please do not give the propagandists an inch with unbenchmarked benchmarks.

BRUCE C. DOSCHER
Hampton Bays, NY

In the Samna III review, the Scroll title was erroneously applied to the Search graph (and vice versa).

—Glenn Hartwig
Technical Editor, Reviews

JUKI DAISY WHEELS

I enjoyed the letter by Stuart C. Dobson in Review Feedback (November 1984, page 352). Dobson indicates that Juki daisy wheels can be purchased for $7.95 each from his Juki dealer.

I am eager to purchase these daisy wheels but my local Juki dealer tells me they are not available. I would be grateful if anyone could give me information as to how I can purchase them.

ROBERT T. LEVINE
Greensboro, NC

Contact Frank Mills or Paul Dearman, Gentry Associates Inc., 7665 Currency Dr., Orlando, FL 32809, (305) 859-7450.

SANYO SUPPORT

I have had exactly the same reaction from Sanyo as Harvey Coopersmith (November 1984, page 357)—absolutely no response. Sanyo management is completely oblivious to the need for user support. Instead it referred me to a distributor whose only interest is in selling equipment and whose technical knowledge is zero.

My advice to anyone contemplating buying a Sanyo is: Don't. Caveat emptor.

ROBERT M. KEITH
St. Petersburg, FL

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

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IBM Dominance

I enjoyed Ricardo Birmele's review of the elegant WordPerfect (December 1984, page 277). However, I would like to call attention to an omission that is of a sort common in software reviews and, to my mind, counterproductive in the current microcomputer market.

At the start of the review and in the "At a Glance" box, Birmele leaves the Texas Instruments Professional out of the list of microcomputers for which WordPerfect is available. WordPerfect has been running on the TI Professional virtually since the machine appeared on the market.

The Professional is an unjustly ignored machine that is superior to the IBM PC in ways that are pertinent to writing with such a full-powered word processor as WordPerfect. The TIs character set, screen resolution, and keyboard are demonstrably better than those of the PC and the clones that sacrifice screen resolution and an intelligently designed keyboard for full IBM compatibility. What is more, the chief defect in WordPerfect noted in the review—differences of underlining in monochrome and color screens—is obviated in the TI, which runs monochrome and color screens off the same standard board.

I often see Tl and other fine, non-clone microcomputers omitted in software reviews. Each time I read "for IBM PCs, ATs, and IRS" head the list of compatible hardware followed by a partial list of other machines or the anonymous phrase "and compatibles." I can see Big Blue's happy hobo sniggering his way to the bank. The effect of the implicit hierarchy and of inaccurate hardware listings is stagnation of the microcomputer market and a fortune in free advertising for a company least in need of it.

A dozen 16-bit machines now on the market are significantly better than the IBM PC in many important aspects. Their struggle against the marketing power of IBM is tough enough without the inadvertent bias created by such editorial patterns.

RICHARD S. MOORE
Huntsville, AL

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REVIEW FEEDBACK is a column of readers' letters. We welcome responses that support or challenge BYTE reviews. Send letters to Review Feedback, BYTE Publications, POB 372, Hancock, NH 03449. Name and address must be on all letters.
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Jerry Pournelle leads off this month's Kernel, informing us of happenings at Chaos Manor and his visits to the outside world, including the first Hackers' Conference and COMDEX. The BYTE West Coast crew also attended the Hackers' Conference and provide us with a different perspective on it and a brief report on GEM from Digital Research.

In BYTE U.K., Dick Pountain discusses two multitasking FORTH systems that are easy to implement compared to more conventional languages.

Bill Raike, our contributing editor for BYTE Japan, spent a long weekend in the mountains and still found lots of interesting things in Tokyo and environs.

Bob Kurosaka focuses on magic squares and how to generate this classic array on a microcomputer in Mathematical Recreations.

And as usual, Steve Ciarcia answers some questions about his Circuit Cellar projects in Circuit Cellar Feedback.

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We've been busy. BYTE is chopp­ing a month off the pipeline, which means I'm still turn­ing in columns every three weeks. Nearly two weeks of this month were taken up by the Hackers' Conference and COMDEX. That leaves precious little time for mucking about with small computers. I did, however, get to . . .

HACKERCON
Stewart Brand (of Whole Earth fame) has a long history of taking causes, organizing shows and conventions around them, and turning the affair into a happening. He's done it again. Billed as "the first Hackers' Conference: the weekend affair at Fort Cronkhite—an isolated former U.S. Army base just north of the Golden Gate Bridge—was a combination of a meeting of the Homebrew Computer Club, an afternoon in the playroom at MIT's Artificial Intelligence Lab, a computer camp, and a book promotion.

I'd guess the total present at about 150. In theory, attendance was by invitation only and limited to hackers of long standing. I say "in theory" because several national press people were present who didn't seem to know much about hacking, even though other writers with considerably more experience and interest in computers pointedly weren't invited. Apparently the whole conference was put together hurriedly, so it isn't surprising that there were a few glitches.

The wonder is that it went as well as it did. For $90 the attendees got: a bunk in an army barracks—not one of the new style with cubicles, but the old kind with endless rows of double bunks stretching between an orderly room at one end and the showers at the other; six meals served army mess style, at least two of which could have been cooked by my former mess sergeant; a copy of Steven Levy's new book Hackers (Doubleday, 1984, $17.95); a T-shirt emblazoned with the word "Hackers" in what appears to be a Macintosh font; a chance to buy, at full price, Brand's Whole Earth Software Catalog (Quantum Press/Doubleday, 1984, $17.50); rain and wet feet; the chance to stay up all night talking with other hackers and playing with Atari and Apple machines; awakened by a neo-Christian group who shared the facilities and who insisted on getting up at 7:00 a.m. to sing, loudly, "This Is My Father's House"; and the opportunity to have a hell of a great time.

According to Stewart Brand, the conference was supported in part by Doubleday. I presume the support was largely the donation of copies of Levy's book; but since nearly everyone present was in the book and thus, one presumes, would have been given a courtesy copy, it couldn't have cost Doubleday a lot. Still, the conference wouldn't have happened if the book hadn't been coming out; and it did bring some focus to the meeting.

I got my copy of Hackers when I registered. When I saw that my name wasn't in the index, I put it away. Now I wish I'd read it before I went to the conference. I thought I knew a lot of the early people in the computer revolution, and indeed I did; but Levy has dug out stories I wouldn't have suspected about people I've known (or known of) for years. He's also told good stories about people I'd never heard of before I met them at Hackercon.

The Hackers' Conference was in part intended to resurrect the word "hacker:" Although a hack writer is not highly regarded, somewhere back in the sixties the MIT computing community—many of them drawn from the Signals and Power Subcommittee of the Tech Model Railroad Club—began to use hacker as a term of approval. Hackers were adventurous explorers, as opposed to the more staid and prosaic "authorized users" and "programmers." A hacker loved computers for their own sake and had an inner compulsion to do more and more wondrous things with them.
PRIORITY ONE RESPONDS

We at Priority One feel obligated to respond to some of the opinions expressed in Jerry Pournelle’s column in the December 1984 BYTE: “The Great Clock-Board Quest,” page 311, and “Discounted Services...” page 312.

After reading Jerry’s column, your readers could be left with the mistaken belief that the Zenith Z-150 and the STB RIO Plus are not compatible, and that as a result Jerry had to switch to a Quadram board. This is not the case. Our technical evaluations revealed a conflict in the memory-address locations of the two products. (The Zenith Z-150 has 320K bytes of memory; the IBM PC has 256K bytes.) Because of this, you must remove the first row of memory from the STB board. After testing, we returned Jerry’s board to him. This subject is something we imagine Jerry has scheduled for correction in an upcoming column.

The segments of the column we take greatest exception to are Jerry’s errant remarks that for us to be able to sell “...good stuff at big discounts” we must necessarily cut service, and that even though we are “...one of the best of the by-mail discount houses,” on our margins we cannot hold novices’ hands. Contrary to Jerry’s opinion, quality service and support and good stuff at big discounts do not have to be mutually exclusive concepts. We offer ourselves as an example. In addition to the business generated in our retail locations, we are also an industrial distributor and a direct-mail marketer. Our volume of sales allows us to purchase directly from manufacturers at reduced prices that some retailers do not have access to. This extra margin allows us to remain competitive in the price market while financing a superior Technical Services department.

We always have believed that customer loyalty is not the result of random selection but something that is earned. We have worked diligently to recruit and train a superior team of technicians and engineers for our Technical Support group. The technical staff that serves the store Alex Pournelle went to for service is double that of the “full-service” ComputerLand store with which the column compared us. This certainly does not reflect that service has been cut. Our record of growth and customer loyalty speaks for itself.

We also must question the column’s quote of an anonymous ComputerLand manager who claimed that perhaps 25 percent of his calls for technical support came from people who had bought a board from us. Although we doubt the validity of this figure, the existence of its source, and the possible motive behind the comment, the reason behind the practice is easy to appreciate. Imagine you purchased a computer from ComputerLand and later purchased an accessory from us for a fraction of what you spent on the computer at ComputerLand. It is understandable that you might seek assistance from ComputerLand. We believe it is only natural for consumers to seek assistance from where they have spent the most money.

In addition to assisting Jerry with difficulties he encountered integrating a board into a system he did not purchase from us, at his request we also tested a combination of computers, video cards, and monitors, some of which we do not normally stock. Although this necessitated additional expense by us, all these services were performed gratuitously. Perhaps this is what Jerry is referring to when he talks about customers expecting costly advice for nothing.

This response is not intended to be an assault on Jerry Pournelle or his column. We recognize his mass appeal and the service he provides his loyal following. However, we are concerned that those among your readers who are not familiar with Jerry’s style may not be aware that his column is editorial opinion and is not intended to be the reporting of news or factual items.

Thank you for allowing us this opportunity to offer our corrections and express our opinions. —H. L. Kline, President

I have no real disagreement with Mr. Kline; it’s a matter of emphasis. I purchased most of the equipment I run through Priority One, so obviously I think well of the company.—Jerry Pournelle

No one at the conference—including me—was ashamed to be called a hacker. However, we all have different definitions. Levy claims that the earliest hackers resent what has happened to the term: not only has the public used it as synonymous with “thief,” but a great number of people call themselves hackers although by true hacker standards they don’t deserve to. In the early days you had to earn the name “hacker.” Enthusiasm wasn’t enough. You had to do something really neat and get a bunch of hacking colleagues to admire it. It all reminds me of the endless divisions within science-fiction fandom. You can spend six weeks discussing what makes a “true fan”; probably longer to define “hacker.”

GIANTS

Not everyone who was invited came, but there were legendary figures enough. Phone phreaks like Cap’n Crunch and Cheshire (whom I first met a dozen years ago when he handed me a card that said “Have space suit, will travel. Wire OZZIE, Boston”). Millionaire inventors like Steve Wozniak. Lee Felsenstein, chairman of the Homebrew Computer Club and designer of the Sol and Osborne 1 computers. Richard Stallman, who wrote EMACS (Editing Macros) and gave it away. Geoff Goodfellow, high school dropout who loves new and different communications systems and who now gets paid to do whatever he wants to at SRI International. Bill Atkinson and Steve Capps, team leaders in the creation of Macintosh software. Doug Carlson of Broderbund. Richard Greenblatt, once the hackers’ hacker at MIT.

I’d known some of them for years. Others were friends I’d never met: we’d spoken, argued, agreed, debated, or simply flamed at each other over the ARPANET (Advanced Research Projects Agency Network). Some I hadn’t known of were key figures in the micro revolution. Oddly enough, I may have been the senior hacker present, assuming that my 1956 work on matrix-inversion programs for the IBM 650 qualifies as
hacking. On the other hand, I long ago gave up any pretense of being a real hacker; after all, this was for years the User's Column, and that's still how I think of it. I was politely accepted in conversations way over my head. I wasn't surprised that—except for a few who, astoundingly, thought me a legend (not because of BYTE, but because I'd written novels they read in high school)—most of the programming geniuses seemed to regard my presence as a challenge. Some wanted to congratulate me for berating things they didn't care for, but most wanted to convert me to their favorite cause.

I have a secret. I find that one of the best ways to learn something is to lose an argument.

I never learned so much in one weekend in my life.

MEET THE POPE

One of the first people I met was Chuck Moore, the former astronomer who invented FORTH so that microcomputers could control his telescope. Because the FORTH kernel is compact and very portable, FORTH is often the first language available for new microcomputers. The language has fanatic adherents; indeed, my late mad friend Maclean used to say FORTH was at least as much religion as computer language.

Chuck Moore is a large, friendly man with an air of contentment. His tone wasn't threatening when he came over to me. "You said that FORTH is a kind of assembly language that uses the programmer as a preprocessor."

"Yes—"

"...Well, there's a sense in which that's right. But it's not fair."

I admitted that. Indeed, I've already admitted it in print. "What do you think of Dvorak's flame?" I asked. "He says there are no good, fast programs written in FORTH. Of course, he was thinking about Valdocs."

"I have always said that any FORTH program that compiles to larger than 64K can't be any use," said Chuck Moore. "I have my doubts about programs larger than 32K—and I prefer to keep them under 16K."

"Whoa," said I. "Isn't that admitting defeat? I mean, how can you have programs that small?" At which point I got a long discourse.

TRUE FORTH

According to Chuck Moore, "Both the curse and the strength of FORTH is that it's public domain. No one gets paid to develop it—so who will?"

The people who could keep things together—including Chuck Moore—are too busy doing their own work and hacking their own programs. Thus, FORTH has drifted rather aimlessly. "And FIG (FORTH Interest Group)" (continued)
FORTH isn't much use, either."

"So what's standard? What do you use?"

"The idea of a standard FORTH is a contradiction in terms. All good FORTH programmers develop their own extensions to the language."

"But if I want to learn FORTH what should I use?"

"The only one I recommend is poly-FORTH."

"Okay. Now what are some good FORTH programs?"

"You have the wrong idea. Writing big programs to be distributed in object code is a distortion of what FORTH is all about. FORTH is like a set of master's tools. You use it to make still more tools that work with whatever you specialize in. Then you use it to solve problems. FORTH programs should always be distributed in source code. You should have FORTH on line at all times. Recompile whenever you want to use a program. FORTH programs are tailored; they're living and dynamic, not static object code."

The conversation ended with an invitation: I should go to Queen of Angels Hospital, where Moore and his associates have installed a customized record-keeping system written and maintained in FORTH. Moore believes it's one of the best examples of what FORTH, used correctly, can do.

THE MACTRIBESMEN

The early hackers thought that they were leading a revolution against all the things that IBM stood for: batch processing, only the high priesthood allowed to touch the machines, and computers as expensive tools whose use is restricted to experts and the wealthy. Certainly I agree. From its beginning I've used this column and its companion in Popular Computing to promote the idea of distributed real-time computing; one user, at least one processor; higher-level languages, and programming by nonprogrammers. On the other hand, I don't automatically reject computers simply because they're made by IBM. IBM exists, and the PC exists; ignoring them won't make them go away. Hackercon did, however, largely ignore IBM. There were a dozen computers available for us to play with: not one was PCompatible. Except for some Apple 800s and one UNIX box, all the computers were Apples. I don't know whether it was by invitational policy, geography, or accident, but there were more Apple hackers in attendance than any other single category, and most of them were Macintosh enthusiasts.

Not surprisingly, all of the MacTribesmen had things to say to me. A few merely wanted to flame about this column's alleged ill treatment of the Mac: but most, including Steve Capps and Bill Atkinson, wanted to make a convert out of me.

They didn't, quite, but I did learn a good bit.

MacMarvels

First, there were marvels. Robert Woodhead has his fascinating Wizards, and the PC exists; ignoring them won't make them go away. Not surprisingly, all of the MacTribesmen had things to say to me. A few merely wanted to flame about this column's alleged ill treatment of the Mac: but most, including Steve Capps and Bill Atkinson, wanted to make a convert out of me.

They didn't, quite, but I did learn a good bit.
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Life and Reversi are fun on the Mac; there are useful marvels as well. Koala has got a wonderful imaging box called MacVision. Connect it to a video camera, aim the camera at anything from a person to a page of text, fiddle with the controls until you have the contrast and brightness right, and let fly; it will digitize the image into a legal MacPaint file that you can then call up and manipulate with all the standard tools. I asked them if they have a program that will scan a MacPaint file and turn any text it finds into a MacWrite (or ASCII for Information Interchange) file. They don't, but Atkinson thinks that's possible and "might be an interesting thing to do." Even without it, MacVision sure adds to the utility of the Macintosh.

There were other programs, some finished, some under development. Not as many as I'd like, and certainly fewer than were promised last spring; but programs are coming. "So it took a while," one of the MacEnthusiasts said. "There wasn't much software for the PC when it first came out, and it had problems too, and--"

"I didn't recommend that my readers go get an IBM when it first came out," I reminded them. "And there's still not enough good MacSoftware, and my developer friends tell me it's damned hard to write. And I am very weary of watching that watch on the screen--"

"That's changed," they said. "Wait until you work with a 512K Mac and a hard disk--"

"I've looked at hard disks. Real problems. And still slow."

"Ah," they said. "But those others did it the wrong way. The right way is with Hyperdrive."

"What's Hyperdrive?" I asked innocently.

"Well, they open up the Mac and unsolder the 68000 processor chip and solder in a socket. Then they put in a piggyback board that holds the 68000 and a disk-controller chip, and they put the hard disk inside the Mac's cabinet."

"Now wait. You say that's the right way to put in a hard disk?"

A couple of them saw the trap; the rest nodded enthusiastically.

"Isn't that a massive confession of design failure? If the Mac needs a disk-controller chip to work right, why wasn't that done in the first place? Why do you have to hack the Mac?"

A very senior Apple official nearly doubled over with laughter. No one wanted to argue the point.

To get ahead of the story; at COM-DEX (which started the day after Hackercon ended), I made a beeline for the General Computer Company booth; these are the people who make Hyperdrive. They had several to show, and I have to agree; it speeds up the Macintosh something wonderful. No more sitting around waiting for the disk when you want to save or print. Things happen fast, as they ought to. Macintosh plus Hyperdrive is, at last, a good and useful machine.

It's also expensive. General Computer sends a conversion kit to authorized dealers; it takes about an hour for a well-trained and experienced technician to make the conversion from a standard 128K-byte Mac to a 512K-byte Mac with internal hard disk. (General Computer's hard-disk system requires 512K bytes): That costs around $2500. Assume you got the Mac for $2000 (the rest of us who bought early paid more, of course), and you'll have $4500 into the machine with little software and no printer.

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(formerly Sage) will sell you a 68000-based machine with a megabyte of memory, hard disk, modem, and other features for no more. So will CompuPro. The Mac really can’t compete in straight bang for the buck, and even after you’ve paid all that, you still do not have an expandible machine.

Take a RAM (random-access read/write memory) disk as an example. You can use part of the Fat Mac’s 512K bytes as RAM disk, but you’re using up memory, and there’s no provision for adding more. With CompuPro, IBM, Zenith, and other bus-type machines you can buy an external RAM disk and plug it in without hassle. You add other external devices: things like laser-disk readers, larger hard-disk drives, streaming-tape backups; things to let you keep up with the flow of technology. Adding such devices to the Mac requires you to practically rebuild the machine.

True, the 512K-byte Mac with internal hard disk is a lot of computer, something we’d all have thirsted for three years ago. Perhaps you won’t soon run up against its limits. Perhaps, but the micro revolution flows swiftly. We’re in for some really big changes in the next couple of years; changes that will swamp our present software. Oh, sure, what we have now will continue to work, just as most of the early microcomputers continue to do what we bought them for; but will that be good enough?

For example: in my judgment we are headed toward megabyte-size, ROM-based operating systems containing scads of useful utilities. I doubt that it will be real UNIX, but it will have the features and on-line utilities of UNIX, yet be easy to learn and easy to use. The Mac can’t handle that.

No question, the Mac has brought some real changes in the ways we look at software. The ideas were mostly from Alan Kay at Xerox PARC (Palo Alto Research Center), but it took Apple’s commitment, investment, and development to demonstrate just how useful and popular these new approaches could be. I give Apple and the Macintosh full credit for pointing the way.

However, now that Apple has shown the way, a number of other companies will rush out to do Apple one better. QuickDraw was a work of genius, a really neat hack, as were other parts of the Macintosh operating system; but now that Apple has blazed the trail, others will not only follow, but forge ahead; and the others will not be so ideologically committed to closed systems. Apple’s MacMotto seems to be, “The stars may fall, but flog you all, you’ll do it my way.”
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"But," protest the true MacTribesmen, "if we do not reward Apple for insight, foresight, and courage, then there will be no one out there to fight the battle against Big Blue. The Macintosh was the first machine designed with users in mind. It was superb in conception. There were some problems with the way it was done." Here the voices drop. "We'll admit that Steve Jobs made some mistakes. He shouldn’t have insisted on much of what he did. But," and the voices rise again, "we have to stay with Apple because they’re for the people, and only Apple can really bring about the micro revolution you keep saying you’re for."

I don’t know how to answer that. I could say, "I see no reason to lie to my readers in order to save the world from IBM. The Macintosh is a closed system. Apple simplified the computer for the rest of us as much as possible, then passed the savings along to the stockholders." That seems unduly harsh. There is a lot of good stuff in the Macintosh. and Lord knows people like Capps and Atkinson are sincere and dedicated and in this for much more than the money.

On the other hand, the Macintosh does suffer from too few chips. For another hundred dollars per Mac Apple could have put in a disk controller, memory and screen management, and better ways to expand the machine’s capability. The company chose not to do that: now the rumors are flying about “SuperMac,” “Bloomed Mac,” “HyperMac,” “Turbo Mac,” and so forth. Will early Mac purchasers be left hung out to dry? If Apple had a reputation for generosity to those who early on supported the company, the dilemma wouldn’t be so serious; but, alas, you can often tell the pioneers by the arrows in their backs.

The Macintosh is fun. It’s easy to learn, and it certainly does attract people who wouldn’t touch another computer. There are enough Macs, both in total sales and in the hands of hackers, to give reasonable assurance of a continuing supply of soft-
ware. It's difficult to write software for the standard Mac, but the 512K-byte and hard-disk conversions take care of much of the problem. Most software doesn't work as well on the Mac as its counterpart does on other machines—but some stuff is spectacular and can work only on the Macintosh. When the Mac is good, it's very, very good.

It remains overpriced and difficult to expand, magnificent in conception but flawed in execution. It blazed a trail that others are eager to follow. Loyalty to Apple can be costly; you'll have to decide for yourself if it's worth it.

THE HACKER ETHIC

One constant discussion topic at Hackercon was what Steve Levy has called “the hacker ethic.” Roughly stated, it is that “information ought to be free. Programs should be published in source code. Hackers should be able to get at problems and fix them with a minimum of paperwork and fuss and permissions.”

It's a position I have much sympathy for. In the early days of the micro revolution—say, before 1980—we all traded programs, published sources, and generally helped each other out. These little machines were wonderful, and we couldn't wait to show our friends and help them get started.

Even now, as I play with the game of Life they gave me at Hackercon, I think of improvements I'd like to make. Ways to store patterns and bring them back so you can test subtle variations in starting positions. A counter on the number of generations. If I had the source code I could do that, and send the improvements to friends, and . . .

The hacker ethic was not shared by all those at Hackercon. Robert Woodhead has made considerable money from computer games. He works hard, produces great games—and wants to make more money from them. He stated in one open meeting that what he wanted most of all was “a program that would win an argument with Jerry Pournelle”; what we argued over was copy protection, which he favors and I oppose. Woodhead is not the only programmer who believes that intellectual property rights are more important than any semimystical “hacker ethic.”

Indeed, the “true hackers” from the old “give-it-away” school were a minority—respected, but definitely a minority—even at Hackercon. Everyone agreed that the idea is to create a better future, but the agreement ended there. For some, the essence of hacking is sacrifice: which makes more sense than you might at first think, since the early hackers couldn't have worked unless someone provided them with very expensive hardware. The sacrifice atones for that.

Example: no one has helped my career more than Robert A. Heinlein. I once asked how I could pay him back. “You can’t,” he replied. “You pay it forward. Help someone else.” Which I try to do. Many of today's wealthy programmers are successful because of the efforts of early hackers they've neither met nor heard of; should they not add to the community resources? Like most altruistic theorems it all sounds wonderful—and forgets that communal life based on sharing and sacrifice has historically worked only within religious communities. So long as hacking was a small fraternity of the dedicated, the hacker ethic could prevail. Now—well, now there are some pretty tricky questions.

The goal is to create a better future—but how? If Apple hadn't developed the Macintosh and QuickDraw, it wouldn't be around for others to hack; doesn't Apple deserve profits? Indeed, for a while the conversation seemed pegged to a single thought: we want Apple to be around for 20 years. We do not want to see IBM rip off QuickDraw. Corporate gray-flannel button-down IBM should
not profit from the work of the Brotherhood.

It's an understandable position—but a cause that seems irretrievably lost.

Woz

I considered most Hackercon discussions off the record. I was there to meet friends and colleagues, not to catch them off guard. I don't like that kind of journalism even at press conferences. Therefore, I took the trouble not only to verify quotes but also to be sure the person quoted knew it would be reported.

Steve Wozniak, designer of the first Apple computer, known to all as Woz, didn't stay in the barracks; but he was at Hackercon every day and participated fully in both public and private discussions. Woz and his latest project—sometimes called the Apple Ix—have been the subject of dozens of rumors. We're told on the one hand that he's actively developing Apple's newest machinery; on the other that no, he's only got a wish list of what he'd like to see in an Apple machine.

I can't help with the rumors. Woz said nothing on the subject that I'd care to quote. He did, however, want one comment put on the record. Apple ought to give legal releases for products that Apple isn't interested in developing. Hewlett-Packard did that for Wozniak: Apple ought to do it as well.

When I asked why Apple wasn't doing it, he said, "Sometimes you don't have any control. I don't have control of that."

COMDEX

From the Fort Cronkhite barracks to The Sands in Las Vegas is quite a jump in comfort level; but it's nothing compared to the attitude adjustment required to leave Hackercon and go to the Computer Dealer's Exposition, otherwise known as COMDEX.

The 1984 COMDEX was the largest convention ever held in human history: more than 100,000 people came to a marginally inhabitable desert to see something like 1500 exhibits...
hbits; and although some space was taken by mainframes and minicomputers, nearly all was devoted to microcomputer products. Such is the revolution the hackers have wrought.

Two warnings. With so many exhibits, there's no way to see it all. I try to pick out the most interesting stuff, but there's bound to be much of importance I overlooked. Second, this is a show report. I can tell you what I saw, but until I have it here at Chaos Manor I can't guarantee it works as I saw it. I'm not unduly suspicious, but I do recall the show when I found the VAX hidden behind the curtains . . .

**MACGOODIES**

The Macintosh story continues. At NCC there was a flood of MacSoftware due to be released "immediately." Most of it is still due Real Soon Now.

Stoneware's DB Master for the Mac exists, and at COMDEX it looked pretty good. I brought a copy home; while I haven't thoroughly tested it, I do have a bit more information than I saw at the show.

DB Master is written in Pascal, meaning that Stoneware can modify it and add features with considerable ease. It is the first higher-language program I've seen that was fully integrated with the Macintosh way of doing things. Pascal is said to be slow, but the DB Master I saw at the show was about as fast as anything else the Macintosh does. If I had to run a business off a Macintosh, I'd run, not walk, to get the 512K-byte upgrade and a hard disk.

DB Master is not copy-protected. That's a big plus. On the other hand, the first page of the document says, in boldface, that I am "legally obligated" to fill out the "license agreement" card, and that until I do that I cannot legally use the program. The card wants my telephone number and some marketing information. This "legal obligation" is so silly as not to require comment.

On the other hand, the license agreement actually makes good sense. Stoneware doesn't guarantee that the program will work, but for 90 days will replace the disk. The company tries to claim that it is protected both by copyright (which would mean that I own my copy; you sure own any copy of a book that you buy) and by this agreement (which leaves Stoneware "title" to the software); but all Stoneware really wants is for you to agree that you'll use the program on only one machine at a time, which is perfectly reasonable.

The program isn't copy-protected, but the Mac sure makes it hard to make copies—at least hard for me to do it. That's not the fault of DB Master, of course. It's my stubborn insistence to act as if the Macintosh were a logical machine. I suppose one day I'll learn.

I have two disk drives for the Mac. They tell me the way to copy one disk onto another is simply to drag the disk icon of the source onto the disk icon of the destination and let fly. Hah. Even with two disk drives you get odd demands from the Mac unless you've booted up with the disk you're copying. I'm used to having a systems-master disk to start my machine with and leaving it on most of the time. Hah. If you do that, the Macintosh insists on having the original boot disk inserted during a copy operation. I am never sure at all that I've really made a copy since when it wants the original boot disk the "Dialog Box" tells me that there's still a file remaining to be copied.

Once the copy has been made, it still takes skill to make the machine believe that you don't want the boot disk any more. The simplest procedure is to put your new copy in the internal drive and turn the damned thing off, then back on. I find that ludicrous. Furthermore, if you try starting up with a disk in the external
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drive, it will not copy onto that. True to Apple's motto, the Macintosh wants me to do everything precisely its way. Eventually, with patience and grim determination, you can make a copy of the DB Master disk. Do not name it "DB Master"; the master disk supplied already has that name, and both you and the Macintosh will get completely confused if you have two disks by the same name, since the Mac does not tell you which of the two is in which drive.

Remove the master from the internal drive and put it away. Then insert the copy, turn the machine off, and let it boot up again. Otherwise, somewhere along the line the Macintosh is going to demand that you insert the original boot-up disk.

Once all that's done you're ready to use DB Master, which is really quite a nice program, well integrated in the Macintosh operating system. You can make a "Create" disk and a "Use" disk to get more disk room. Even if you throw away both the Create file and all the fonts you don't think you'll be needing, you won't have more than 200K bytes of room left, which may not be enough for a database. Fortunately, DB Master knows how to flow across more than one volume.

The Create utility lets you design all kinds of interesting screens using different type fonts. You can then access the data and build reports in various ways and combinations. I haven't used it much, but I didn't have any trouble creating a small database and playing around with it. The documents seem clear enough, and there are examples.

When I watched this in use at the show it looked good enough for most business use: DB Master and Microsoft's Multiplan (the newest one with the bugs removed) go a long way toward making the Mac useful to business. From everything I've seen, Stoneware has come up with a good and useful MacProduct.

The machine still needs a good word-processing capability. MacWrite simply is not good enough, nor are any of the others I've seen. None has a spelling checker, indexer, footnoter, and all the host of utilities I've come to expect with my CP/M and PCom-patible machines.

FAST FINDER

Mike Lehman, the original author of Pascal MT+, has left Digital Research to do programs again. (Many people of stature seem to have left or are leaving Digital Research. DR had better get its act together. But that's for another report.)

Mike's first program is a new finder for the Macintosh. The finder is the master disk-file program that does (continued)
A shelf loaded with software is impressive, but one simple program loaded with capabilities is better.

To get a lot out of your printer, you need a lot of programs, right?
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Printworks enhances over 90 dot-matrix printers. LETOH Prowriter (8510), 1550, 7500 all with the letter "E" included in the model number; CENTRONICS Horizon (480, H134x); EPSON FX-80/100, FX-85/100, FX-80-85; LO-9500, MX-85/100 (with Griffin Plus), IBM Graphics Printer; INFORRUNNER Related (Plus, Blue Plus. 16/4), NCP Printer (P2.3, P3.3), OKNO DATA (ML 84 Sig. 2), ML 85 and 90 wish or without Plug In Play Kit, Pacemaker 2200 and 2410, and STAR (Zarina 10S/10X, Radix 10/15, Delta 10/15). For the IBM PC, PC-AT, PC-XT, PCJ, Compaq and many other IBM compatible. Needs 128K and DOS 1.1 or later.

Sideways is a trademark of Funk Software, Inc. Fancy Font is a trademark of SoftCraft. Facelift is a trademark of Companion Software, Inc.
most of the work for the Mac. I hate it. Indeed, I don't know anyone who actually likes it. Atkinson and Capps didn't even seem too happy with it. Anyway, Mike Lehman has written a new one called Fast Finder (not to be confused with Factfinder, a database program). They had it running at the Corvus booth—Corvus has both networking and a hard-disk system for the Macintosh—and from everything I've seen, it’s wonderful. Lehman’s Fast Finder is fast, can handle up to 12 volumes on line (making it really good for use with a hard disk). It’s fast, it can show the contents of a file without leaving the finder (i.e., has a command similar to the “type” command of CP/M). It’s fast. It has ways to do batch processing. It’s fast, and you can add your own keyboard commands as equivalents to pull-down commands, meaning you have the option of doing anything from the keyboard you can do mucking about with the mouse. And it’s fast.

When Pascal MT+ came out I was an enthusiast but had my reservations about the documents; indeed, I spent some time showing Mike Lehman precisely what I thought was wrong with them. He seems to have learned a lot; the Fast Finder documents look clean and clear enough to me. Of course, I may have learned a lot. He has also set up batch files for installation of Fast Finder; it looks very simple.

Lehman’s finder does not yet contain tools to allow novice users to modify the Mac. It will be helpful to developers; I think it will be helpful to me in simply using the Mac. He promises a much more detailed package for developers. At present I have the documents but not the program; I’m supposed to have it all before the end of 1984. More when I learn more; but assuming it works as well as I expect it to, Lehman’s Fast Finder looks like the best software improvement I’ve ever seen for the Macintosh.

A SHORT INTERVIEW

After we looked at his new finder, I got Mike off in a corner to get some of his comments. He has been in the micro revolution for a long time. He did early work on UCSD Pascal while a student there; wrote Pascal MT+, which he sold to Digital Research; and worked as chief of the languages section at Digital for a couple of years.

His comment on the Mac: “The problem is they wrote about half of an operating system and left the other half for developers (or as exercises for the users). Everyone does a different other half. My Fast Finder is yet another other half. I just hope it catches on.”

On C compilers: “I’ve used Hippo C, Softworks C, the Digital Research C Compiler, and Aztec C. The best one I’ve found, and the one I use, is the Consulair C.”

On UNIX: “A professional developer’s power tool and a nightmare for casual users.”

HYPERDRIVE

I've mentioned this earlier. The Hyperdrive hard disk for Macintosh looks to be the nicest thing for the Mac since sliced bread. Furthermore, Corvus—the people who brought you Omninet—and Mike Lehman are both talking with the Hyperdrive people and each other. The combination could be dynamite.

Hyperdrive is available from General Computer. The company has promised to get one to my local dealer very quickly; meanwhile, I can only report that I played about with Hyperdrive at COMDEX, and it’s fast. I saw no glitches.

The Hyperdrive people were using another feature I want: a jack on the back of the Mac to allow video output. MicroGraphic Images Corp. manufactures an upgrade kit, called CineMAC, that provides the video output. Of course, the MacOutput can’t go to any ordinary monitor. It
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CHAOS MANOR

will take a really good high-resolution device. That's all right with me. If I start using a Macintosh regularly, I'll have to do something like that. The MacScreen is just too small and positioned too awkwardly for me. With my eye problems, my best bet is a big screen set at eye level; 30 inches from my nose; if I can hack a jack on the back of the Mac. I'll be able to see that up.

ANIMATION, ANYONE?

Another program I brought home but haven't had a chance to use is Animation Toolkit I—The Players from Ann Arbor Software. It lets you build frame by frame animated movies. You can insert frames, edit frames, eliminate frames, and so on. According to the author, if you know how to use MacPaint you'll be able to use the Animation Toolkit.

I've done no more than insert the disk into the machine; but the claims seem true enough. If you like playing in doing animation with it, you probably ought to look into this one. Incidentally, Scott Wiener, the program's author, says Ann Arbor Software has two more MacDevelopment packages coming up, tentatively labeled The Stage and The Dialogue. Sounds good.

OUT IN THE BOONIES

COMDEX allocates space on the basis of seniority at COMDEX; that is, the firms that have been around long enough to be at previous shows get first choice on the exhibit space. If you change your booth size, you go to the back of the line again. I gather there are some exceptions. This is AT&T's first Fall COMDEX, and its people had approximately the space of the Forrestal's flight deck right at the main hall entrance.) Anyway, the result is that old established—often boring—outfits fill the main Las Vegas Convention Center Exposition Hall. Up-and-comers like CompuPro and Stride Micro (Stride: the really great computers with the really ugly name) go into the Hilton, which isn't too bad since nearly everyone passes through the Hilton exhibit space on the way to the main hall. Start-ups and newcomers get cast into the outer darkness of the MGM Grand and Caesar's Palace, two miles from the Convention Center.

Our strategy this year was to cover the main hall first, then, toward the end of the week when exhausted, try to get to the MGM and Caesar's. Bad move, space cadet.

The most interesting exhibits are likely to be the start-ups. Sure, there will be some turkeys, but the real excitement, the newcomers with really

(continued)

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Screenshooter(s) @ $175
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Shipping and handling @ $1.75 per item
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Screenshooter(s) @ $175
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new ideas, the people who need me because they sure can't afford big ads—all those are out in the periphery, visited only by the Little Sisters of the Poor.

Some, of course, aren't starving: Borland International, complete with a junior employee made up to look like the Sidekick character and wearing a name tag proclaiming himself "Frank Borland, Owner," was over in the MGM Grand.

Mycroft Labs, which produces MITE, the communications program I've used for the past four years, was in Caesar's Palace. MITE now works on CP/M-80, CP/M-86, MS-DOS, PC-DOS, and the Apple Macintosh and with nearly every extant kind of modem, from an ancient 8-bit S-100 PMMI (which I'm still using), I blush to say; I have yet to get a new modem, preferably 1200 bits per second (bps) to the latest 300/1200/2400-bps devices. If you're looking for painless communications, I have no hesitation in recommending that you get hold of Mycroft or one of its dealers.

There were other good things. I saw a start-up company with high-resolution graphics boards that certainly rival the Hercules. The Morgan Computing folks have new versions of their Professional BASIC and, best of all, have cut the price to $99, a move I heartily approve. Their Professional BASIC with its integrated debugging system saves a lot of time when you're writing PCompatible BASIC programs. The only thing I don't care for is that it won't run with Sidekick: I hope Morgan and Borland can get together and fix that.

There was as much good stuff in the boonies as in the main hall. I'll be getting more from them over the next few weeks. Exciting things still happen in microland.

**KEYBOARD! A REAL KEYBOARD!**

The MicroPro booth was between the BYTE booth and the Corvus booth. Corvus has a hard disk for the Mac and a smooth and reliable networking system that will couple Apples, CompuPros (although Corvus doesn't push the S-100 network card), and PCs. Corvus also let David Ramsey come to COMDEX this time. David is the Corvus software engineer I'd formerly met only by phone; until recently he was kept chained to his desk. Alas, Corvus didn't allow his fiancée and co-worker Mary Boetcher to come with him, so I've yet to meet her. I get the distinct impression that a lot of "his" software is a joint effort.

Anyway, I made several trips to the Corvus booth, each time passing the MicroPro display where they were showing off the new WordStar 2000. The new WordStar looks pretty good; they've even got a software switch to let you turn off the entire status line.

(continued)
It's easy to make points when you're a pro.

POINT . . . The Houston Instrument DMP-41 plotter meets the needs of the serious or professional user, yet it's easy to operate.

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*suggested US retail $2,995

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installed, according to MicroPro's Chief Programmer Charlie Stevenson, just for me. I'm told that Microsoft top man William Gates was impressed with the new WordStar. I'll have a comparison of WordStar and the new Microsoft Word as soon as I have the latest versions of both.

On Saturday evening, my last day at COMDEX, as I scurried—I never seem to stroll at COMDEX—past the Micro-Pro booth, Charlie Stevenson dashed out and grabbed me. "Look!" he commanded. He unlocked a storage compartment and took out a keyboard for the IBM PC.

It was—well, it was a little like a dream. This keyboard has the heft, touch, and feel of the genuine original IBM PC keyboard—but what a difference! The keys are laid out like a Selectric. The function keys run across the top of the keyboard. The Ctrl and Alt keys are in sensible places. There are little lights for the Num Lock and Caps Lock keys. The Shift and Return keys are oversize and properly placed. Escape is in the upper left corner. The keys feel right. Best of all—up in the upper right-hand corner is a trackball.

"Great chu!" I exclaimed. "Who makes it? Where?"

"Wico. The game-control people. They're way off over there in the corner. down by the far wall." Charlie pointed; there were about a mile of booths between me and that one.

"One problem," I said. "Caps Lock and the Control key are interchanged. Darn:"

"I said that too," Charlie grinned and pointed to a key above the trackball.

"Program key. Use that to reprogram any key on the board. Including Caps Lock and Control; you can swap them, and if you do, the Caps Lock light will still work properly."

"Yeah—hey, thanks. I gotta go—"

"They're down that way:"

I ran. Wico. Do I know anyone at Wico? No. No one: I thought, they'll probably send me one. but how do I get one now?

There they were, way off in the far corner. I dashed up, wondering what to do next. "Hi, Jerry!"

It was Henry Cohen, a colleague in both science fiction and computer writing. "Henry? What are you doing here?"
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PC-SLAVE/16 transforms your IBM PC into a multi-user, multi-processor system with shared data access and communication between users. All you need is a dumb terminal and a PC-SLAVE/16 board for each user.

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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.
“Waiting for you. I figured you’d hear about it. I’ve got your keyboard right here. Want to just take it, or shall I show you first?”

It turns out that Wico did it right: hiring a professional writer as consultant in the keyboard design Henry has turned out a lot of words. He’s met deadlines. He knows what writers need—and it shows.

They call it the Wico Smartline Smartboard. I could think of a better name, but my early impression is that it would be hard to design a better board. There is only one feature I would add: up by the trackball I would put a button, placed so that as your hand rests on the ball your finger rests on the button. It would substitute for the mouse button.

Otherwise—otherwise hell. Unreservedly, this is the best keyboard I have ever used. I love it. I can’t comment on how long it will stand up: I’ve had it only a bit over a week. On the other hand, I have written letters on it, used it to play Star Fleet I, pounded on it, spun the ball, and (alas) dropped it on the floor. The only incident was that when I dropped it one of the batteries popped out and I had to reprogram.

Programming the board is simple. Key swapping is simple. A mode-select key lets you toggle between six different banks of memory; you can have a bunch of different key programs. You can program the response speed of the trackball. Batteries keep your programming intact when the power’s off. More features: an electronic key click that you can turn on or off as you like; Dvorak keyboard mode if you like; an expansion port that lets you plug in paddles, digitizer pads, or even the original IBM PC keyboard to use simultaneously with the Smartboard.

There’s an Apple-compatible version. I do love it.

**CD ROM**

There’s more at COMDEX than shows on the floor. Sometimes the best stuff is hidden away in hotel rooms. It certainly was this year.

Item: both Sony and Hitachi have optical laser-disk storage systems. The one we saw was Sony. I’m told the Hitachi system is essentially the same. Sony, Hitachi, and other companies have apparently standardized on calling this marvel CD ROM (read-only memory), and I believe the two systems are compatible: Hitachi readers can read Sony disks and vice versa.

The CD ROM drive looks a lot like a standard IBM PC full-height hard-disk drive. It holds a shiny laser disk, the one that laser-disk hi-fi records come on. The disk isn’t delicate. You can get fingerprints on it. Mild scratches don’t hurt. It’s archive quality. This disk can hold more than 500 megabytes of digital data.

That is a lot of data. For example, it’s all the text of the *Encyclopaedia Britannica*. If you want the illustrations in color, then each disk will hold about one volume with room left over for some music.

The CD ROM will present digital data in picture format at 60 frames per second; that’s enough for real live animation. It will hold programs. It will hold animation and programs simultaneously, meaning that it will not be long before we have home versions of Dragon’s Lair and other interactive games that use visuals.

The reader will sell for “certainly under $300 in quantities.” If you want disks made, you give Sony (or Hitachi) the electronically readable data; and in quantities of 10,000 they cost $5 each.

**WRITE ONCE**

There’s a related marvel. Information Storage Inc. (ISI) of Colorado Springs has a Write Once laser-disk system. Formatted Write Once blank disks cost $60 retail. The Write (continued)
The World's Easiest Income Tax Program.

All forms look just like the real IRS forms.
Highlighted cells indicate where to enter information.
Only 4 keys to remember (MENU, CALC, GOTO, IN-PUT).
Automatic supporting statements for detailed entries.

Menus allow multiple options for printing.
Data automatically posted to other forms.
Input from menus or directly to the forms.
Two options for ALL IRS approved printouts.

TaxTime is a highly integrated tax preparation program for use as a template with Lotus 1-2-3 or Symphony. Not only is it the easiest tax program to use but it is also extremely fast. All forms are calculated in under 10 seconds, and you can move from one form to another in 1/2 second. Because TaxTime resides on a single disk, there is no time-consuming diskette swapping.

All forms are in one worksheet and are integrated to allow one entry on one form to be properly posted to the others as needed (except for Schedules C, F, and the 4562 which are standalone for multiple copies). A two line “window” at the bottom of the screen always shows you subtotals from the main form allowing rapid “what if” results.

Additional features of the TaxTime PRO include calculation of: taxable amounts of social security benefits (new), state and local tax refund, deduction for unemployment compensation, investment interest limitation automatically apportioned to Schedule A or Schedule E, capital gain exclusion & capital loss carry-forward, taxable pensions and annuities, property IRA contributions, automatic earned income credit, tax bracket, regular tax, and averaged tax, proper deductions for medical expenses, charitable and political contributions, etc. It will also calculate correct Form 2210 underpayment penalty, actual date, and correct “income as adjusted” loss for Schedule F.

Two keystrokes allow you to printout just the forms you need or specify individual forms by letter/number and page.

All versions of TaxTime are in the public domain. Automatic supporting statements for SchA.

**FEDERAL**

<table>
<thead>
<tr>
<th>1040 (REGULAR 256K)</th>
<th>1040 (PRO 320K)</th>
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<td>820</td>
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1-2-3 and Symphony are trademarks of Lotus Development Corporation.

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**TABLE:**

| 720 | 119 |

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**SCHEDULES:**

| 4562 | 2210 |

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**Notes:**

- The authors of TaxTime (Ken, Del, and Bill) thanks to: RMP, Del Ray, 1-2-3.
Once reader, which looks exactly like an IBM PC hard-disk drive, fits into a PC and uses the PC power supply. With software it will cost about $600 in quantities, say, $1500 to the consumer.

Each disk holds 100 megabytes of digital data. The system is not yet up to color pictures and hi-fi; but it will store programs, still pictures, text data, and indeed anything you can now store on hard disks.

The ISi software is impressive. Files are given a sequence number. The system is write-once: when part of the disk is used, it is used forever. If you save a second file with the same name as the first, the sequence number is incremented. In that room did get the latest—although you can also retrieve an earlier version. The directory will hold a lot of files; naturally you don't want to write it every time, so it's kept in RAM and stored on a normal disk.

You could store programs with this, but I think I'd rather use it for text and source code until I'm sure they've shaken the bugs out. Still in all—it's an impressive system.

The implications of this system and a CD ROM taken together are staggering. The "Library of the Month Club" is truly here. You could get your atlas, complete with color maps, population shifts, etc., updated annually or even monthly, at low cost. You can keep the entire U.S. telephone-directory system, complete with yellow pages and advertisements, on one CD ROM disk.

With Write Once you can pull enormous chunks of data off on-line databases, archive your books, store—well, think up your own applications. Lots of data, electronically readable, readily accessible from the CD ROM: the ability to extract reports and manipulate data, then store that on line, at low cost; combine the two and we have the information revolution.

**THE BIG PARTY**

A week before COMDEX I got a phone call. John Dvorak wondered if I'd like to host a party with him. "I'll call the writers," William Randolph Hearst III, publisher of the San Francisco Examiner, would provide the suite and pay for refreshments. "Sounds good to me," I said.

So came to pass the best party of COMDEX, and one of the most interesting parties I've ever been at.

There were no formal invitations. I don't know how Dvorak worked his end: I just told people if I saw them. Whatever happened, Will Hearst's suite was full. Half the people who had been at Hackercon were there. So were most of the writers. At one point it occurred to me that if everyone in that room had behind any given product, we could make it an instant best-seller. Of course, there wasn't much chance that we'd all agree.

It was quite a party. Far more came than Will Hearst had prepared for. We soon ran out of refreshments—only to find that hotel room service was stacked up for more than an hour. My son Alex was pressed into service and sent after St. Pauli Girl beer—a favorite of Tony Pietsch, who was there with a contingent from CompuPro, and who maintains my system—and a dozen other special orders.

Shortly after Alex left, Philippe Kahn, president of Borland International, showed up and proclaimed this the first anniversary of the sale of the first copy of Turbo Pascal; and that called for celebration. He sent down

(continued)
It's a simple fact that your small computer can compute a lot faster than your printer can print. A problem that becomes even more frustrating in business, when your computer is tied up with your printer while you're ready to move on to other work.

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for 20 bottles of champagne, an order of sufficient rarity and magnitude that room service was shocked into instant compliance. Philippe drank at least two bottles himself. Alex arrived before the champagne was gone, and room service was back to normal shortly after that.

It was a big party. I do understand the hotel isn’t as pleased as they might be. It will be interesting to see if they say anything about it to Mr. Hearst.

WAIT FOR THE SECOND EDITION

One thing marred the party. While we were at Hackercon they sold copies of Stewart Brand’s Whole Earth Software Catalog. They were the first I’d seen. I didn’t buy one. I seldom buy computer books because I get more review copies than I can read anyway. Even so, I might have bought Brand’s, but I was hardly going to carry books to COMDEX. Thus, I hadn’t read Brand’s book when I left Hackercon. I hadn’t met Brand before Hackercon, but he was certainly friendly enough, and I invited him to our COMDEX party.

At Hackercon I did look through the section on text editors and noted with some surprise that they hadn’t reviewed WRITE. After all, I’m not the only one who uses the program. Art Naiman not only rated WRITE the top text program in his book but admitted that he wrote his WordStar manual using WRITE. It seemed a bit odd that a lot of the big, highly visible text editors were covered by Whole Earth but not some of the smaller—and in my judgment better—ones. Still, I thought nothing of that.

Then on my first day at COMDEX a friend showed me what Brand had written about me in the Whole Earth Software Catalog. It was part of the BYTE review. He’s not too happy with BYTE.

“Software coverage is techie-interesting, but less useful to the buyer than others, and often late in the game.” That seemed pretty unfair; I think BYTE’s reviews are pretty good, and I know darned well that mine are sometimes the very first observations about new software to appear anywhere. Still, they’re entitled to their views.

Brand’s commentary on BYTE continues: “The controversial columnist here is science fiction writer Jerry Pournelle, whose writing is regarded by Tony Fanning as a ‘truly irritating extended advertisement for himself, his family, and his friends, who just happen to be business associates.’”

If Brand thinks my writing is truly irritating he’s welcome to his opinion, although I don’t know why he quotes Tony Fanning—apparently one of Brand’s employees—rather than saying so himself. If he objects to my mentions of my books and my family, that’s fine too, although most columnists do it; writing as if one were sending letters to friends is the essence of a columnist’s style.

The statement that I review lots of stuff from my friends has some substance, but it puts the cart before the horse: I tend to look up and make friends with people I admire. After my first review of CompuPro equipment (which I had bought at full list price), Bill Godbout telephoned me, and we didn’t meet for another six months after that; and that’s a pretty typical story. I want to make friends with people who make equipment I can recommend. Why shouldn’t I?

If Brand had left it there, I’d never have mentioned it; but he didn’t leave it. He also said that my friends are

(continued)
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business associates; and that’s both unfair and untrue. Damn it all, not liking my writing is one thing; saying I’m on the take is quite another. The fact is that I have no business associates. I don’t own any computer stocks or indeed any stocks at all; what investments I have are in real estate and municipal bonds. It’s not that I couldn’t have computer stock. I’ve been offered stocks, limited partnerships, consultancies, seats on boards, and every other perk you can imagine; but I have no business except writing and editing. Anything I have a business interest in has my name on the cover.

I explained all this to Brand at the party. He didn’t say much, but the next day I got a letter of apology from him and an assurance that the next edition of the Whole Earth Software Catalog will carry a correction.

WINDING DOWN
I’m out of time and space and I still haven’t covered all of COMDEX. More on that next month.

The book of the month has to be Steven Levy’s Hackers. It’s better on the very early days at MIT than it is on the micro revolution, but it’s all readable. The game of the month would be Wizardry for the Macintosh if I had it: even at the Hackers’ Conference I got sucked into playing it longer than I should have.

Meanwhile, Arthur Clarke and Frank Herbert are both in town for the openings of movies made from their works; I’m off tomorrow to Colorado Springs for a space conference and coming back to chair my own next week; and the micro revolution gallops along. Stay well, and go see 2010 and Dune. I think you’ll like them, even if they were written by my friends.

Jerry Pournelle welcomes readers’ comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE Publications, POB 372, Hancock, NH 03449. Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply.
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PROLOK-PLUS

Dear Jerry,

Boy are you gonna love this one. It seems that Vault Corp., makers of the "unbreakable" copy-protection scheme Prolok (you remember, the one that remained unbroken for a good 10 minutes after the first pirate got ahold of one), has come up with a new scheme, Prolok-plus. This one will randomly destroy data if you use a pirated copy and are detected.

I have a vision of loading my genuine original real McCoy copy of Locust 6% in my drive, rebooting, and at the same time getting a phone call. Twenty minutes later I return from the phone, carrying the note reminding me to get milk on the way home tonight, and find that a read error has fooled Prolok-plus into believing my copy was unauthorized. Further probing shows my accounts receivable file has been shambled and my 6% disk no longer boots.

Going back to the original package I read, "The makers of this product don't warrant it to do diddly-squat and assume no liability, expressed, implied or otherwise for damages resulting from the use of this product, etc., etc." In short, too bad. So sad, we've got your money, and you've been had.

I agree with you, Jerry, there's no way in hell that software is going into my machine.

Burch Seymour

Anyone putting that stuff in his machine has got rocks in his head. This copy-protection business has got completely out of hand!—Jerry

COPY-PROTECTION ETHICS

Dear Jerry,

On the ethics of publishing in BYTE techniques enabling readers to circumvent publishers' copy-protection mechanisms: Don't do it.

Emotionally explosive as the software-piracy issue is, probably no one can claim a rational stance on the subject. Since most people seem unable or unwilling to differentiate between ethicality and fairness, this is eminently understandable. When the crass unscrupulousness of most of the publishers gets stirred in, or at least users' perception of it, it is difficult indeed not to succumb to the emotional need to get even. I am not overly prone to the "turn the other cheek" syndrome myself, but it is important here to make the above differentiation. What is fair is not always ethical; ethics rises above fairness.

I stand amongst the pots assailing the color of the kettles. We educators have got to be the single largest group of software thieves by several orders of magnitude. More incredibly, we are able to rationalize our illegal behavior and even claim somehow to have the moral right to copyright infringement.

That is the first reason I urge you to refrain. Someone has to start setting the proper example. If one enters an agreement in acquiring a product to limit use of that product in certain ways, then once is bound to that commitment. Period. If you want the role of leadership in thisethically chaotic industry, it should not be in the position of helping or teaching people to violate their covenants. The fact that the information is available elsewhere is irrelevant. We all knowingly implement hopelessly inadequate security systems, such as bicycle locks that will pop open with the tap of a hammer, simply as a deterrent.

Another way you might want to look at the issue is to inquire more deeply into the reasons you are considering publishing this information. Information that your expressed concern itself indicates you feel is dubious or at least questionable. Obviously, the reason is that you want to make it easier for your readers to avail themselves of "useful" information that is in fact available anyway through other less commonly accessed channels. But the fact is that the reason you folks publish anything at all is the perceived benefit it brings yourselves, i.e., your business. If you agree with that, then you can ask yourself, "Do I want to gain by teaching people or making it easier for people to behave unethically?"

You thereby have one reader's position on the issue: take the high road.

Tim Kelley

Ashland, OR

The high road is fine, but I fear the issue isn't quite as clear-cut as you make it. I'm on the author's side in all this: what's best for authors is often what's best for publishers as well—but not always.

A "covenant" that is not meant to be taken seriously, indeed is impossible to comply with, is not worth taking seriously.

Best.—Jerry

BORLAND'S POLICY

Dear Jerry,

With regard to the copy-protection discussion, I got the fire two months ago, and that is why we at Borland released a version of Sidekick that isn't copy-protected. We probably will end up selling only this version.

As you mentioned, the only reason we copy-protect Sidekick is because it does not need a manual. People can rest assured that no matter what happens we will always offer versions of our software that are not copy-protected. We listen to our customers.

Philippe Kahn

Scotts Valley, CA

I'm glad someone has seen the light. Things are particularly bad with the Macintosh because it's so easy to do copy protection. Sigh.

Keep up the good work.—Jerry

CP/M

Dear Jerry,

This message is of interest to owners (and prospective owners) of Andy Johnson-Laird's superb The Programmer's CP/M Handbook (Osborne/McGraw-Hill) and is based on recent correspondence from the author.

In the original edition, about two pages of a listing were not printed. The missing part is lines 04628 through 04919 (see pages 261-262). Anyone who wants the missing lines can get them from the author's office: Johnson-Laird Inc., 6441 SW Canyon Court, Portland, OR 97221. Send a SASE with a note on what you want (continued)
want. Johnson-Laird said the book went into its second printing in January 1984 and that the missing material should be in that version. But he is out of the country on a project and tells me he has not seen the second version.)

Other errors in the book:
- page 64, figure 4-3, location 0153, correct to read
  /M CTPX (instead of MB CTPX)
- page 149, seven lines from the bottom, a reference to CCP+6. That reference should be CCP+0. The letter from the author said that there may be other such erroneous references because CCP+6 is a CP/M-86 convention and thus the source of the error, but he has not found other such errors.
- page 258, line 03828, change this line to read
  STA MOBSCharacter
- page 282, after line D970, insert
  LXI H:Disk$Control$5
  (after inserting that line the byte references will be offset by 3 bytes if you type it all in and assemble it)

Finally, Johnson-Laird wants to know about any other bugs, typos, errors, and what have you that anyone may spot. Since he's not on ARPANET, you may send such information directly to me (STORK at MTP-MC), and I'll relay to Johnson-Laird.

If you have not yet seen the book, look at it. If you buy it, you'll probably not lend it out—it's too valuable to do without for anyone who has any notion about playing around with 8080 assembler and CP/M in general.

ERIC STORK
Cambridge, MA

Thanks. I agree about the book. If you do CP/M programming you really need it.
-Jerry

THE EARLIEST BUG

Dear Jerry,

The story about le saufard (October 1984, page 330) is amusing, but I doubt that it represents the origin of "bug" as meaning "gremlin" or "a difficult-to-identify source of trouble." Cute acronyms like DDT notwithstanding, "bug" appears to have had this meaning before it meant "insect." The Oxford English Dictionary gives uses of bug as early as 1388 to mean "an object of terror, usually an imaginary one: a bugbear, hobgoblin, bogey, a scarecrow." For example, the OED quotes Thomas More's Comfort Against Troublation (1529):

"Lest there happe to be such black bugges in dede as folke call devilles." There are even earlier citations for related words like "bugaboo." This from a French source circa 1200:

O puis d'infer iras o Bugibu
Auec ton Dieu Mahom et Cahu.
(0 then from hell you went, O Bugaboo.
With your God Mahomet and Cahu.)

The OED gives related entries under "bog," "boggy," "bogward," "boggard," "bogle," and "boggle." Incidentally, the use of "bug" to mean "annoy" or "provoke" is older than the 1960s. Under "bog" the OED quotes from the State Papers of Henry VIII (1546): "The Frenchmen bogged us so often with departing;" and from Cicero's Offices (1553): "A frenchman whom he (Manlius Torquatus) slew, being bogged by hym;" (continued)
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tech toys, I must allocate my time. I don’t have the urge to “feel the bits and registers between my toes” or even play with a building-block set like C or FORTH. If software doesn’t exist for an application, I want a complete and friendly compiler, perhaps like CB-80 with some of the extensions of other high-level languages and a built-in programming environment like Turbo Pascal. My favorite language at this time is S-BASIC, even though the compiler could use some fine-tuning.

ROGER WEISS
Arlington, WA

For someone who programs a lot, C is probably the language of choice; at least a good case can be made for that. However, I find that after a couple of weeks I do not remember what my own code does if I wrote it in C, while I can read Modula-2 quite well even if I didn’t write it.

I think the Modula-2 language has the potential to be outstanding: but I have always been careful to add, “when we get good compilers.” The Logitech compiler is quite nice. I understand Borland will have one shortly. And there is a Modula-2 for the Macintosh, which may be the salvation of that machine yet.

I do not believe one must have hardware specially adapted to the language. I do know that kludges are possible. As Larry Niven’s fond of saying, “There is no cause so noble that idiots will not adhere to it.”

Thanks.—Jerry

WHEN WILL ADA ARRIVE

Dear Jerry,

Because of the continuing discussion in your column and in letters to Chaos Manor about “the programming languages of the future,” I thought you would be interested in part of a conversation I had recently on a plane en route from St. Louis, the home of McDonnell Douglas Corp., to Washington, DC. About the same time that I noticed my seatmate doing what looked like pseudocode programming, he noted that I was reading a copy of BYTE—your column, in fact. So we got chatting a little about computers and computing, and it turned out that he worked on the F-18 fighter jet, which has an entirely digitally based control system. The beauty of this approach, he explained, is that the aircraft can be modified by simply reprogramming the control computer (either into RAM or by replacing an EPROM) rather than by re-engineering and rebuilding the hydraulics system. The project he was working on, in fact, was such a modification.

“That’s very interesting,” I said. “You’re writing in a language I’m not familiar with. Is that Ada?”

It was, and it wasn’t, he replied. “The Navy can’t support Ada just yet, so I do my programming in Ada or pseudocode that can be converted easily into Ada. Then I turn it over to another programmer who converts everything I do into assembly language. We do all our work in Ada so that it will continue to be usable when we actually get Ada.”

“I see. And just when is that supposed to take place?” I inquired.

“Real Soon Now . . .”

We also talked a little about the next generation fighter, which is already on the drawing boards, as you might expect. It too will be entirely digitized, and all the digital processes will be performed by identical black boxes. This should ease maintenance problems in the field, he said. It should also keep a lot of programmers employed, since it sometimes takes a lot of software to simulate a little bit of specialized hardware.

This new fighter should be an interesting plane to fly if it’s ever in a combat zone where they set off The Big One and the resulting electrical pulse turns all the inards of those black boxes back into sand.

LEWIS M. PHELPS
San Francisco, CA

I suspected something like that was happening.

As to electromagnetic pulse (EMP), I hope they’re designing to accommodate that. Faraday cages and the like will do wonders, you know.

Best.—Jerry

MAGAZINE INFORMATION

Dear Jerry,

Has anyone else heard of the Microcomputer Index? It’s a slick publication that indexes the 25 major nonacademic computer magazines (BYTE, Creative Computing, Personal Computing, etc.) by brand name (e.g., Apple II) and by general subject (Accounting Software) and contains an abstract of the indexed article in the same issue. It’s ideal for someone who has to research specific brand names. The publication has recently changed ownership, and shipment of back issues, which go back to January 1980, is sporadic at present. Anyway, for what it’s worth: Microcomputer Index Company, POB 50549, Palo Alto, CA 94303, (415) 948-8304.

A note to computer companies: Want to break into the elementary and high school teacher personal computer market—without having to offer deep discounts to educational institutions? There’s an easy way. All you have to do is design a peripheral device that machine-grades multiple-choice tests (the sort where you blacken little circles with a number 2 pencil) and that plugs into a gradesheet program. Once teachers get used to your DOS, the school’s choice of a personal computer for institutional use will be a foregone conclusion. You will of course complete the destruction of the American educational system by eliminating the essay test, but that never stopped you before, right? Go to it.

D. L. FRUEHLING
Kansas City, MO

Thanks for the reference to the Index. Your suggestion is intriguing; and your prediction is pretty close to right. I get more and more illiterate letters from college graduates: I don’t know where it will end. At least small computers make it easier to rewrite if you want to.—Jerry

INTERSTELLAR DRIVE

Dear Jerry,

We have been running Pion Inc.’s Interstellar Drive for a few years (it has served us faithfully using both CP/M and TurboDOS). It has recently come to our attention that Pion has moved or become defunct. Although source code for the CP/M and TurboDOS drivers was included, source code for the FORMAT and diagnostic routines was omitted. It happens that the FORMAT routine will not run under TurboDOS version 1.3+. If you have information about how to correct this minor bug, please pass it on.

Thank you.

KEITH H. BIERMAN
Canoga Park, CA

Alas, I fear Pion may be dead: we have heard nothing from them for a while. Anyone able to help?—Jerry

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MANNESMANN TALLY
Hackers gather together and a new product from Digital Research

BY JOHN MARKOFF, PHILLIP ROBINSON, AND EZRA SHAPIRO

The evolution of hackers can actually be broken into three generations. The first generation was described in Steven Levy's book "Hackers: Heroes of the Computer Revolution," (Double-day, 1984). They emerged in the early 1960s at Project Mac at MIT, then at Stanford University's Artificial Intelligence Lab, and later at Xerox Palo Alto Research Center. The second generation was composed of "hardware hackers," such as the members of the Homebrew Computer Club who designed the low-cost first personal computers. More recently, the third generation of hackers has written the software for the personal computer mass market.

HACKERS' CONFERENCE

In November BYTE attended the by-invitation-only Hackers' Conference, held at an old army base on the Marin Headlands across the bay from San Francisco. The conference was the brainchild of the editors of Stewart Brand's Whole Earth Software Catalog. Many of those assembled were luminaries of the personal computer "revolution," including: Steve Wozniak, Lee Felsenstein, Charles Moore, Bill Atkinson, Bob Frankston, Bob Albrecht, Ted Nelson, Robert Woodhead, Stewart Brand, and others.

The conference included discussions, demonstrations, arguments, and more. There were demonstrations of software designed by Macintosh programmers Bill Atkinson and Andy Hertzfeld, the Community Memory public bulletin-board system, and Xanadu's Hypertext running on a Sun Workstation.

There were many areas of disagreement, particularly about what the term "hacker" means and whether the concept of a "hacker ethic" (as identified in Levy's book) actually exists. During one session many definitions of "hacker" were presented, ranging from the word's origin at MIT—"hackers' stayed up all night, while 'tools' went to class"—to more philosophical views—the hacker drive represents the children in us, according to Steve Wozniak. One person claimed that there is no hacker 'ethic,' but rather "a hacker 'instinct,' like the baby duck's attraction to its mother."

Not everyone was totally approving of the concept of a hacker ethic. UNIX hacker Brian Harvey said that there was a dark side. "Once the rockets go up, who cares where they come down? That's the hacker ethic too" And Richard Stallman called on hackers to take more responsibility for their work. "IBM, DEC, and AT&T are all engaged in an arms race. You are . . . [the] soldier[s] in that arms race."

Everyone agreed that the term "hacker" has been misused by the press. Computer-security specialist Donn Parker of SRI International publicly apologized to the group for using the term in a pejorative sense in A Manager's Guide to Computer Security (Reston, VA: Reston Publishing, 1983). Parker then claimed that he has now broken hackers into three categories: benign, unsavory, and malicious. The revised definition was greeted skeptically by the audience. Parker also claimed to be working with an associate who had identified a nationwide list of 570 "malicious" hackers but then admitted that only 135 of them were over 17 years of age. Parker took part in a panel discussion with the famed "Cap'n Crunch," John Draper, author of the EasyWriter word-processing software, and Cheshire Catalyst, editor of the TAP newsletter for "phone phreaks." During the discussion, Catalyst, who professed to be a "role model" for young programmers, tore off his coat-and-tie "disguise" to reveal a "Hacker" T-shirt.

The computer-security session was summed up in one line by a participant who noted, "I can teach a lawyer computers . . . a lot faster than I can teach hackers law."

The most heated and interesting debate during the conference concerned the issue of whether or not software should be (continued)
placed in the public domain. FORTH programmer John James said that he considered the public-domain nature of FORTH to be "both its soul and its curse." MIT hacker Richard Stallman, who is working on a public-domain version of UNIX called GNU, argued for the creation of a "loving software-sharing community."

Not everyone agreed. Some said that hackers needed to be able to make a living from their work and the free copying of software would prevent that. Programmer Robert Woodhead said that there is a difference between products and tools. "My soul is in that product. I don't want anyone changing that. [However,] if someone sees my stuff and likes it, I will tell him how I did it in a moment."

Others evidenced corporate loyalty. Macintosh designer Bill Atkinson responded that "Hackers want me to give this QuickDraw code away, but there is this thing called IBM and I want Apple to be around in 20 years." Macintosh hardware designer Burrell Smith bemoaned the maturity of the personal computer industry. "One of the complexities of hacking is that we wanted a pure model. Now the world is more complicated. We have stock options and salaries to worry about."

Falling somewhere in between the public domain and private hackers were software hackers like Andrew Fluegelman and Bob Wallace who coined the terms Freeware and Shareware, respectively, to represent their ideas. Fluegelman believed that hackers needed to be able to give software away and requesting a donation. Fluegelman added that he believes only about one in ten people who find the programs of value to them to send a contribution to the author. Wallace called his Shareware a "marketing hack" and said that his company, Ouicksoft, has made $2,500,000 during the past year by giving away and requesting a donation. Fluegelman said that he was leaving to write a personal computer that he now envisions as the "Tom Swift Terminal" or "A Convivial Cybernetic Device." The personal computer that he now envisions would be similar to the Macintosh but in the public domain, and it would be expandable and available in kit form.

Another Macintosh designer, Steve Capps, suggested that the next hacker's frontier lies in homebrew chips. Sophisticated design tools that run under UNIX on advanced workstations are now available in the public domain. This means that it is possible for an individual or group to specify a VLSI (very-large-scale integration) design and then send it over a packet-switching network to one of several silicon foundries for fabrication.

One of the weekend's surprises was the group's positive reaction to the Macintosh. Aside from BYTE columnist Jerry Pournelle, who continued to grumble that the Mac was a toy and not a true computer, the consensus appeared to be that Macintosh was a genuine hacker's machine and in a sense comprised a good portion of the original hacker's vision. (For another view of the Hacker's Conference, see "Computing at Chaos Manor" by Jerry Pournelle, page 313.)

Ted Kaehler, a designer of the Small-
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The GEM Desktop is similar to the Mac user interface.

talk language and a computer scientist at Xerox's Palo Alto Research Center, called for experimentation in computer ecosystems by using personal computers to model software "organisms" that would be able to evolve and mutate in previously unknown ways.

By the third day no one really seemed to be sure what the significance of the conference was. However, there was a good feeling and a sense of community. Anyone attending would instantly have realized that the stereotype of computer hackers as isolated individuals is nowhere near accurate. Ted Nelson, author of Computer Lib and a member of the Xanadu Project, compared the gathering in Woodstock, saying that the meeting was "where it was at" for personal computer designers.

At the end, Robert Woodhead concluded during a "blue sky" session on Sunday morning: "What I want is a computer program that will argue with Jerry Pournelle and win."

DR JOINS THE PARTY

The bitter "window wars" being fought for dominance in the user interface arena are continuing. Digital Research (DR) has started off 1985 with a new entry of its own called GEM, for Graphics Environment Manager. This is a fancy way of saying that the product does windows.

Designed to simulate the Apple Lisa/Macintosh environment on computers built around the Intel 8086 and Motorola 68000 families of microprocessors (including IBM, Atari, and others), GEM features the pull-down menus, bit-mapped graphics, mouse control, and multiple type fonts common to the descendants of the pioneering Xerox Star. It will work on a standard bit-mapped monitor, though it does contain drivers for some of the new higher-resolution graphics card/monitor combinations.

As an OEM (original equipment manufacturer) product bundled with computers, GEM will include a Desktop application along with the interface routines and drivers. The Desktop application is similar to the Macintosh user interface, with it you can perform standard maintenance and file operations in exactly the same style as you can on the Mac, although you'll have access to all your other software. When you call up a non-GEM program, the GEM Desktop exits and lets the application take over the screen; when the application is finished, the Desktop reclames the display. However, programs written to be used with GEM can call on GEM's graphics and screen-handling routines to provide a fast windowing interface with a handsome appearance.

GEM is an environment, not an operating system. On 8086 machines, it will work with MS-DOS and PC-DOS without modification, as well as with any of DR's newer operating systems functioning in DOS mode. As such, it is not a multitasking product—concurrency is seen as an operating-system feature. GEM is much closer in concept to its predecessor, GSX, an operating-system extension that provided graphics drivers for a wide variety of printers, plotters, input devices, and high-resolution monitors.

GEM and MS-DOS together take up a little under 128K bytes of RAM (random-access read/write memory).

How does DR intend to get software developers to write for GEM? Easy. For a one-time fee of about $500, any programmer can receive DR's Programmer's Toolkit (software, utilities, and documentation), telephone hotline support, and unlimited distribution rights to GEM. Obviously, the hope is that software authors will decide to use GEM as a shortcut in interface design of their products.

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Multitasking FORTH

Two British versions and a FORTH-based computer

BY DICK POUNTAIN

Though the FORTH language was invented and developed in the United States, it now has practitioners all over the world, thanks to the unflagging efforts of FIG (the FORTH Interest Group). Interest in FORTH is particularly keen in the U.K. and Germany. I've been programming in FORTH for several years and have a strong interest in the language and its development.

FORTH has always been the least academic of computer languages: its users tend to be engineering-oriented, and many computer science departments still don't seem to have heard of it at all. Because many professional FORTH users are involved with control applications (process monitoring and control, instrument control, etc.), much attention has been paid to the provision of real-time and multitasking capability (doing more than one thing at once, by the clock). This is crucial if most of your programming activity has to interface with real-world events: time and tide wait for no man, still less for a computer.

It turns out that multitasking is easy to accomplish in FORTH, due to its simplicity of structure, and multitasking systems can be implemented on very small machines, such as the Commodore 64 and Sinclair ZX81, which would not normally be considered very promising hosts for multitasking. A couple of multitasking FORTH systems have been written recently in Britain.

THE FORTH MACHINE

From one point of view, FORTH can be regarded as a p-code system like UCSD Pascal. The interpreter/compiler/interpreter “sandwich” that we call FORTH produces lists of addresses that ultimately point to executable instructions via more or fewer levels of indirection according to the threading scheme used in a particular implementation (see “Faster FORTH” by Ronald L. Greene, June 1984 BYTE, page 127). These executable instructions are not processor instructions, as would be the case with a native-code compiler for Pascal or C, but are the primitive routines that make up the kernel of FORTH. They can be regarded as constituting the instruction set of a virtual FORTH “machine” that runs FORTH programs.

This “machine” is much simpler than existing microprocessors. It’s stack-based, like the UCSD p-machine, and uses no registers at all. The instructions are “zero-address,” as all arithmetic is performed on data held on the stack, and all parameter passing is done via the stack. The FORTH machine has two stacks, one for data and one to hold return addresses so that FORTH knows what to do next when an operation is completed. The total number of instructions is small (typically less than 50) and most of them are concerned with manipulating data on the stack: for example, DUP duplicates the stack top item, and SWAP swaps the top two items.

Of course in a real FORTH system running on a real microprocessor, such as the Z80 or 8088, the FORTH machine instructions are subroutines written in the host’s machine code, and processor registers are used to maintain the stacks and perform arithmetic operations (though there now exists at least one version of a real hardware FORTH machine, which I’ll mention again at the end of this article).

TASK SCHEDULING

The simplicity of the structure of the FORTH “machine” makes multitasking easy compared to more conventional languages. The simplest conceptual scheme is to merely “clone” the machine, giving each task its own stacks, some private memory, and a slice of processor time, hence its own machine. The context of any task is defined by the contents of its stacks, so context switching becomes a matter of making each task point to the task whose turn is next in a circular queue; the so-called “round-robin” method of task scheduling.

(continued)
Any task running in such a multitasked system can expect one of three fates. It can run to completion if it's lucky, in which case it merely passes control over to the next task in the round robin and goes to sleep. If running to completion would take so long that the other tasks couldn't get a look in, the task could hand over to its neighbor at some convenient point in mid-execution. In this case the task gets put back to the end of the queue and can start where it left off the next time around. In the third case, the task may need some resource that isn't available yet, such as data from another task or—more likely—some slow external device like a printer or input from a port. This task also goes to sleep and must be awakened when the resource is ready; this might be done by an interrupt routine or by a message from another task.

Since FORTH is an interactive system like BASIC, one task, called the "terminal task," is normally in charge of the keyboard and screen, and any other tasks are "background tasks" which don't use keyboard or screen directly. The background tasks get run while the terminal task is waiting for input (which is most of the time). You interact with the terminal task, usually without any noticeable degradation of response if the tasks are well designed. You could, for instance, be editing a program or processing your experimental results while a background task is reading in and storing results from an instrument every 100 milliseconds.

FORTH Inc.'s polyFORTH (the current version of Charles Moore's original FORTH) has used a simple scheme of this type for many years to provide full multitask multiprogramming on minicomputers and more recently on the IBM Personal Computer (PC). In a multitask system, each user has his or her own terminal task.

The single FORTH word PAUSE does virtually all of the scheduling mentioned above: when nothing's happening PAUSE runs around the task queue looking for something to do. When any task becomes active it gets a turn on the central processing unit (CPU). If any includes a call to PAUSE in its definition, it then hands over the CPU and gets rescheduled.

PC/FORTH from Laboratory Microsystems Inc. uses an even simpler (though more limited) version of the scheme, using only one pair of stacks; in this system you must make sure that any background tasks leave both the stacks exactly as they found them or you're in trouble.

xFORTH 2.0

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CP/M jobs, in preference to my C compiler. Pascal, or BASIC. xFORTH was written and distributed by Cambridge mathematician Alistair Mees (at a price that ranks it with BDS C and turbo Pascal as one of the great software bargains of our time). Mees has recently departed for Australia to take up the Chair of Mathematics at Perth.

xFORTH is a CP/M 2.2 system conforming to the FORTH-79 standard (published by the FORTH Interest Group) with a host of extensions. xFORTH provides facilities that are somewhat similar to Laboratory Microsystems' Z80 FORTH, that is, a powerful full-screen editor with search-and-replace, a proper CP/M file system, and floating-point math. It allows you to write applications as stand-alone .COM files (with command-line arguments if you wish) and uses very extensive vectoring to let you customize the system; you can compile a whole new system onto a small supplied machine-code kernel.

Mees also included the source code for most of the high-level parts of the system.

The xFORTH file system is particularly special: it divides CP/M's 8-megabyte disk address space into eight 1-megabyte virtual-memory segments, each of which can have a separate file attached for multifile working. Packages are available for sequential (nonblocked) I/O (input/output) and matrix manipulation. xFORTH is also fast, turning the BYTE version of the Sieve of Eratosthenes around in 77 seconds (for 10 iterations) and Ray Duncan's version in 43 seconds on my 4-MHz Z80 system.

Just before going "down under," Professor Mees completed version 2.0 of xFORTH. Version 2.0 is direct-threaded (hence 15 percent faster) and incorporates perhaps the fullest version of multitasking currently available in an implementation of FORTH. To the simple round-robin scheduler described above, it adds real-time delays and communication between tasks by means of multistate semaphores. This allows the programming of "demons," tasks that sleep until a specified event wakes them up (ideally, with a flash and a puff of white smoke!).

The syntax you use for multitasking in FORTH is clear and simple. In xFORTH 2.0, you create tasks like ordinary colon definitions but using TASK: thus

```
TASK: TEST 12 minutes
  DELAYFOR "At last!"

This task will do nothing at all until you start it by typing TEST START. It does nothing for 12 minutes more and then prints "At last." The word DELAYUNTIL works in a similar way but delays until an absolute clock time.
```
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PAUSE is the main scheduling loop as described above, so a task like

```
TASK: ALARM
BEGIN temperature @
100<
WHILE PAUSE
REPEAT
BELL . "It's Boiling!!" ;
```

could be used to check the value of a variable "temperature" and sound the alarm when it reaches 100. The task runs concurrently with other tasks, and the PAUSE guarantees that the others will get a share of processor time. Whenever ALARM gets its turn to run, it begins where it left off, so it sees REPEAT and loops back to take another temperature, terminating only when the temperature is greater than 100.

Tasks in xFORTH may be normal or background. The terminal task \{user\} takes control after boot-up and behaves as the usual FORTH interpreter. Any other normal task can call all words in the main dictionary and use \{I/O\}, but since its private dictionary is small, it should not compile code. Background tasks occupy less space: they have no terminal-input buffer, smaller stacks, and are defined using BTASK:. The number of tasks is limited only by memory, processing power, and prudence.

Tasks can communicate through semaphores. Semaphores are data structures, declared like variables, that contain a variable and queue. Normally the variable is used only as a flag (a "two-state semaphore"); the word WAIT reads this flag. To control access to a printer from several concurrent tasks we could define a semaphore in the following way:

```
SEMAPHORE printer
```

and then a task that uses the printer would contain code like

```
TASK: job1 some code ...
printer WAIT
some printing code ...
printer AVAILABLE
etc . . . .
```

When printer WAIT is executed, WAIT checks the semaphore flag. If it is "go" then job1 gets the printer (and sets the flag to "stop" to hold off other tasks). When it's finished with the printer, printer AVAILABLE takes job1 out of the queue. If WAIT had found the flag to be at "stop," then job1 wouldn't get the printer but would be put on the back of the queue to try its luck the next time around. AVAILABLE doesn't actually pass control to the next job in the queue; you have to do that explicitly with PAUSE.

By using a full 16-bit variable inside its semaphores, xFORTH allows for having more than the two states "stop" and "go." Such multistate semaphores can be used to count how many times a resource is accessed. SIGNAL is used instead of AVAILABLE to increment the count by one at each access; such counting semaphores can be used to manage buffers effectively.

Demons are programmed as background tasks that use a semaphore to keep them in a WAIT when there's nothing for them to do. A good example of a demon is the clock monitor in the xFORTH system that reads the hardware clock for timing delays. This monitor task does nothing at all if no delayed tasks exist. As soon as you create a delayed task, the monitor wakes up and schedules itself to time the task. This approach makes for more efficient use of the processor than having a monitor that runs all the time or, worse still, making every individual task read the clock itself.

As you can see, the multitasking in xFORTH is rather more sophisticated than the simple round-robin with which we started. There may be several different queues (delayed tasks, semaphore queues) apart from the main one, but xFORTH manages all the queues invisibly to the programmer. Think of it as a merry-go-round, with people standing in line to get on at different points around its circumference.

xFORTH is now being handled by Cambridge System Software at Shelford Road, Trumpington, Cambridge, England. There is at the moment no version for the 8088 microprocessor, but one is rumored to be in the works.

64TH

64th (you have to say it aloud to catch the pun) is a multitasking FORTH system for the Commodore 64 written by Matthew Woolf, a computer science student at Aberystwyth University. A devoted 6502 hacker, he originally wrote 64th on a Commodore PET at a time when he couldn't afford to buy a version of FORTH. It can run from cassette but is obviously much better from disk.

Though 64th is quite unorthodox in some respects (for example, the editor uses the Commodore built-in screen editor), 64th largely conforms to FORTH as described in *Starting FORTH* by FORTH Inc. and Leo Brodie (Prentice-Hall, 1982). 64th has many extensions to support the 64's special features such as sprites, sound, and the IEEE (Institute of Electrical and Electronics Engineers) disk file system.

The philosophy behind the 64th multitasking ability is quite different from the "round-robin" software scheduler we've been looking at so far. 64th uses an interrupt-driven system. Each task that is running receives an equal time slice on the processor, controlled by a timer interrupt. The size of this time slice can be varied by the programmer through a system word called setrate. The default value is 16.667 milliseconds per slice.

Task types are somewhat different from those in the systems I've mentioned so far. You can make any colon-defined word into a task by typing task anyword submit
which puts "anyword" onto the task list and executes it. Up to 120 such tasks can be submitted. The foreground program is any ordinary FORTH program and is not considered a task. Another way to look at it is that all tasks are background tasks, but without any restriction on their use of I/O, etc.

64th only uses the two normal FORTH stacks and all tasks share

(continued)
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them. A task can leave values on the parameter stack, which can be picked up by the next task to execute; when all tasks on the list have completed, any data left on the stack is automatically discarded.

You can optimize multiple tasks by adjusting the start rate after you have written and debugged them. Increasing the time slice gives more time to the foreground program (speeding it up), and less to the tasks, while reducing it does the converse. Certain time slices have special significance; for instance, 19,655 milliseconds is the video-frame rate. and using this value also allows you to write and debug turn

generated effect on the mind when de

slices have special significance; for in

time slice gives more time to the event of error. 'Taken together. the user cannot get into FORTH even in

and since it provides a facility to include in-line machine code in FORTH definitions, you can pep it up where required, eg., in inner loop words. It also allows you to write and seal turn

key (i.e., autostart) programs so the user cannot get into FORTH even in the event of error. Taken together, these features make it feasible to write games in 64th. Combining the use of sprites with multitasking has a wonderful effect on the mind when designing games; it's often very natural to take the activities of a particular sprite and make them into an independent task.

The Commodore 64 is a very rewarding machine to run any FORTH on, given the plethora of exotic (and memory-mapped) devices it contains. And running FORTH on it is much better than using its BASIC. For one thing you get much more effective workspace than in BASIC (41500 bytes with 64th), and FORTH code is much more compact. You can write nice little

graphics and sound-authoring languages using almost natural English syntax instead of those reams of PEEKs and POKEs.

You can obtain information on 64th from Logic 3 Ltd., Mountbatten House, Victoria Street, Windsor, England.

Several other multitasking FORTH systems have been written over here, including a ROM (read-only memory) based one for the tiny Sinclair ZX81 but I'll have to keep them for a future time slice.

THE FORTH MACHINE AGAIN

On the average microprocessor, a FORTH program will tend to run about 10 times slower than equivalent machine code and usually 2 to 4 times slower than fully compiled C or FORTRAN. Serious FORTH programmers often daydream about a machine that would directly execute FORTH without this speed degradation. I'm not referring to a conventional microprocessor with FORTH in on-chip ROM, but a true stack-based computer whose architecture embodies the FORTH virtual machine.

Such a machine has been built by Metaforth Computer Systems of Hull, Yorkshire, but since it is currently the subject of several patent applications I can't at present write about its detailed workings. All I can say is that it is a single-board processor built in Bipolar logic (with some custom devices), and it uses fast 35-nanosecond NMOS (high-performance metal-oxide semiconductor) RAM (random-access read/write memory) chips as its hardware stacks. It has 16-bit memory words and data paths and a 32-bit address bus. The architecture is extremely simple and elegant, to a point where many microprocessor engineers would have trouble recognizing it as a computer at all.

I've witnessed the prototype running at 2 million FORTH instructions per second with a 10-MHz clock, and the production version, with an improved architecture, should be capable of at least 5 million instructions per second. Bear in mind that FORTH instructions typically require between 10 and 50 280 instructions. In other words, it will run FORTH programs over 100 times faster than a Z80 (roughly equivalent to a high-end superminicomputer).

The chief designer, Dr. Alan Winfield, has demonstrated that the machine can support a full FORTH-79 system (and hence run any program) with a minimum set of 27 instructions, which would make the Berkeley RISC (reduced instruction set computer) look almost baroque. In practice though, it's desirable to microcode some theoretically unnecessary primitives for the sake of speed, so the final instruction set will include closer to 40.

An interesting feature is that part of the microcode-control store is writable, so that designers can add (a few) new primitives to optimize special applications; for instance, in a graphics-processor role you might add RasterOps (see February BYTE U.K., "Realizing a Dream," page 379). The feature could also make it easier to write optimized compilers for other languages such as C or LISP in FORTH to broaden the machine's appeal.

The design would lend itself well to a single-chip LSI (large-scale integration) implementation (the number of devices is tiny by today's standards), but Hull is not Palo Alto, so that remains for the future.

At present Metaforth Computer Systems is in the process of raising funds to manufacture a single-board version (dubbed MF16LP) for delivery late this year. Anyone who might find such a device useful can get more information from Dr. A. Winfield, Metaforth Computer Systems Ltd., Unit 2b, Newlands Centre, Inglemire Lane, Hull, England.
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One of these days I'm going to get organized! Instead of working on my often-postponed text-editor project and the backlog of software I want to write, this month I checked out the new IBM JX personal computer from IBM Japan Ltd., went to the Asahi 1984 Personal Computer Show, listened to MicroPro's long-awaited announcement of its new WordStar 2000 package, and attended the International Conference on Fifth Generation Computer Systems in Tokyo. I also had the chance to sneak away for a long weekend to enjoy the colors of the autumn leaves in the mountains of north-central Japan between Toyama, on the Sea of Japan's coast, and Tateyama, at the base of the Japanese Alps. Didn't think about computers for three whole days!

**TURBO TRIBUTE**

Before I tell you what's new, I want to join the rest of the throng paying compliments to Borland International. About a month ago I bought Borland's Turbo Pascal (the CP/M-86 version) for my Fujitsu FM-I1BS. The language is a well-thought-out, fast, useful programming environment for developing Pascal software; the editor alone is worth the program's price (which is darned cheap).

Regular readers of BYTE Japan will recall that I do most of my own development work in C; as a result, I really haven't had much use for Pascal. But the Digital Research C compiler I've been using generates such large object code—a minimum of 14K bytes or so, but typically 20K bytes or more if you use formatted I/O (input/output) functions like printf(), etc.—and offers such scanty (i.e., nonexistent) debugging facilities that Turbo has turned out to be very handy for a couple of quick-and-dirty, one-of-a-kind projects. It became even handier after Borland sent me the English-language manual, although the Japanese-language manual isn't bad, which is rare for Japanese documentation.

I do have one recommendation to anyone who's considering buying Turbo Pascal or who already uses it or another Pascal system—pick up a copy of Brian W. Kernighan and P. J. Plauger's book, *Software Tools in Pascal*, and implement their "standard environment" for Pascal programs. It's not only a useful way to learn and get used to Turbo Pascal, but it also builds up a set of handy programming tools that give you some of the more useful features of a C language environment.

In future columns I'll have more to say about various compilers; one package that sounds appealing to me is a new version of Optimizing C-86, which supplies a fairly extensive library of Japanese-language I/O and string routines, in addition to other development-support features. I hope to be able to evaluate and report on it soon.

**MEGABIT RAMs**

In the news this month are two important developments. The first is Toshiba's just-announced 1-megabit dynamic RAM (random-access read/write memory) chip, although the company hasn't yet set dates for delivering samples or for volume production of the chip. The new chip supposedly has an access time of only 70 nanoseconds. It can keep up with some of the newer microprocessors running at speeds in excess of 10 MHz. Power consumption isn't bad either: 270 milliwatts during operation and 15 milliwatts on standby, about the same as the old/new 256K-byte chips just now being shipped to manufacturers. The power consumption per byte of memory will decrease by a factor of almost four. In the alphabet-soup nomenclature of the microelectronics industry, the 1-megabit chip is a ULSI (ultra-large-scale integration) circuit using circuit lines only 1.2 microns wide: it packs the equivalent of over 2 million transistors into an area of less than a tenth of a square inch.

In software news, it looks as if the UNIX
The IBM JX is a Japanese product for the Japanese.

operating system has finally gained a significant foothold in Japan. One of the avowed goals of the fifth-generation computer project here is to improve software productivity, which is much lower in Japan than in the U.S. Operating systems have been part of the problem. AT&T’s Japanese arm is now adding Japanese-language (kanji character) capability to UNIX in an effort to create a new industry standard. This version of UNIX will be used as the main operating system in the embryonic government-sponsored software-development project that starts next year. The effect is bound to be beneficial, judging from the acceptance UNIX has achieved.

THE PC-UX CONNECTION

There was more evidence of UNIX’s growing popularity at the Asahi Personal Computer Show. Owners of the NEC PC-9800 series of personal computers can now buy the PC-UX, a "Japanized" version of UNIX System III. It requires at least 384K bytes of memory and a 10-megabyte hard disk; therefore, the most likely buyers will be owners of the PC-9801F3, the latest version of the most popular 16-bit personal computer in Japan. The F3 has one 640K-byte 5¼-inch floppy-disk drive and one 5¼-inch, 10-megabyte hard disk in the main unit (instead of the dual floppy-disk drives of the F2), and comes with 256K bytes of memory. It uses an 8086 microprocessor running at 8 MHz. The price of the PC-UX is steep by Japanese standards: on top of roughly $3150 for the PC-9801F3, the PC-UX operating system sells for about $1300, including $50 for the optional 30,000-word kanji dictionary files.

I’ve been asked several questions concerning compatibility between the PC-9801F3 (and the F2) and the nearly equivalent NEC APC III sold in the U.S. Apparently, the various NEC divisions on both sides of the Pacific don’t communicate very well; I haven’t yet found anyone who has been able to describe the machines’ differences in detail. But the two are not the same. As far as I can tell, the biggest difference between them is that the machines now being sold in Japan use 640K-byte floppy-disk drives and the APC III uses 360K-byte drives. The different disk formats may inhibit the transfer of software between the two machines. The Japanese machines supposedly include the ability to read (but not write) disks in the IBM Personal Computer (PC) format. I haven’t checked this out, but this ability might provide the means for achieving at least some compatibility between the U.S. and Japanese NEC computers.

Of course, the Japanese machines include extensive Japanese-language features not present in the APC, such as kanji ROM (read-only memory).

PC ADOLESCENT?

As was inevitable, IBM Japan has introduced a new personal computer for the Japanese market. The new machine, called the JX (see photo 1), is not a copy of either the IBM PC or the PCjr, although it incorporates some of their better features and provides some software compatibility to them. The machine is a Japanese product for the Japanese; its price and capabilities reflect its target market. The JX is available in four versions, ranging from a stripped-down model with no disk drives and 64K bytes of memory for about $675 to a 256K-byte model with two 720K-byte 3½-inch microfloppy-disk drives for about $1525. A two-drive version with 128K bytes of memory costs about $1350. You can add memory up to 512K bytes, and you get a choice of colors: white or dark gray. Not surprisingly, the central processing unit is an 8088 microprocessor running at only 4.77 MHz, the same speed as the IBM PC. A total of 236K bytes of ROM is standard. The ROM contains the BIOS (basic input/output system), BASIC, and kanji-character support for over 1000 characters (in addition to the standard alphanumeric and kana character sets), plus software for converting phonetic alphabets (either kana or roman letter) to the kanji equivalents at the operating-system level. An expansion unit and a 5¼-inch floppy-disk drive are avail-

(continued)
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able, although relatively few users are likely to buy them because of the additional cost (approximately $550). Unfortunately, the RS-232C interface is not standard; you can add one for about $65.

Like the PCjr, the JX accepts software cartridges. In addition to the microfloppy-disk drives, the front of the system unit has two cartridge slots. If you plug in an English-mode cartridge costing about $80 you will have a machine that behaves like a cross between a PCjr and a PC. Without the cartridge, but with the optional 5¼-inch disk drive, the JX is compatible with the Japanese-made IBM 5550 workstation. This is unlikely to be much of an advantage because of the 5550's comparatively poor performance (especially its slow Japanese text processing). In English mode, the JX operates under a version of PC-DOS that, according to IBM Japan, is software-compatible with the IBM PC. However, I won’t swear to complete compatibility before I thoroughly check out the JX system.

The keyboard has a nice feel and conforms, sensibly, to the Japanese standard keyboard layout. Like the PCjr, the keyboard has cordless infrared coupling, which works fine unless there's another JX in the room. A keyboard cable is available and probably will be widely used; Japanese homes and work environments are small and often crowded, and many people will want to put the main unit under the table rather than under the monitor.

When you buy a computer in Japan, you buy the monitor separately. Usually there is a choice of several sizes, and most manufacturers sell both monochrome (either white or green) and color displays in both standard and high-resolution models. For example, I now use a high-resolution (400-line, or 640- by 400-dot) black-and-white display. Standard resolution is 200 lines, which means that if you put 25 lines of text on the screen, each character can be 8 dots high. However, space between lines is desirable, so characters are typically only 7 dots high. A high-resolution 400-line display doubles the resolution, giving really crisp characters; a 200-line display is acceptable, but not ideal, for English-language applications. However, it really isn’t adequate for any but the most casual Japanese-language processing tasks.

IBM offers three displays for the JX: 12-inch high-resolution monochrome, 12-inch low-resolution color, and 14-inch high-resolution color. The high-resolution displays offer 720-by-512-dot resolution, instead of the more common 640-by-400-dot resolution. The 14-inch display gives you either high resolution with 2 colors or low resolution with 16 colors—not both. And there’s a catch: to take advantage of the high-resolution capability, you have to buy an “expanded display mode” cartridge that costs about $150.

Curiously, the expansion slots (there are only two) accept PCjr cards but not the hundreds of standard IBM PC boards available in the U.S. As a result, I suspect that the JX has neither defined nor will it dominate the open-ended and expanding Japanese market like the IBM PC did in the U.S. Rather, the inclusion of joystick ports and an eight-octave sound generator/synthesizer suggests that IBM Japan is hedging its bets by pursuing a share of the easily saturated video-game sector.

Unlike the IBM PC at the time of its introduction in the U.S., the JX faces several strong competitors (NEC, Fujitsu, Sharp, and others) who are offering technologically more advanced products at competitive prices through excellent distribution networks. My prediction is that the JX will enjoy, at best, a modest and short-lived success—it's too little, too late.

I predict the JX will enjoy a modest and short-lived success.

WORDSTAR 2000 IN JAPAN

MicroPro recently released WordStar 2000, its candidate for the ultimate word-processing program. Kirk Hurford, managing director of MicroPro Japan, met several dozen Americans who make up the local IBM PC users group to explain the features of the new program (which isn’t yet available in Japan). The number of questions from the audience showed that interest in the program is strong, although the audience was generally unsympathetic to Hurford’s account of the troubled development of the new product as well as to his claim that the decision to copy-protect the new product was forced on the company as a matter of survival. For the moment, the key question is whether demand justifies another high-priced word processor. MicroPro obviously thinks it does.

MicroPro also claims to be working on a Japanese-language version of WordStar 2000. It will be interesting to compare it with some of the home-grown word processors. The company won’t say anything about the Japanese price for either the English or the Japanese version of WordStar 2000; the current (English-only) version of WordStar sells in Japan for $500. This price is much higher than that of many popular Japanese-language word processors. If MicroPro maintains the same pricing policy for the Japanese-language WordStar 2000, the program may have trouble competing here. Also, since the new program will initially run only on the IBM PC and compatibles, which don’t offer Japanese-language capability and are not plentiful in Japan, it won’t have any future here until a generic MSDOS or CP/M-86 version is developed so that more people can use it.

COMING UP

Next month I’ll describe Japan’s progress in its efforts to develop a fifth-generation computer, and I’ll look at some of the other national and international efforts in that direction.
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A magic square is an array of numbers, usually consecutive, arranged so that the sum of each row, column, and main diagonal is a constant. A 4-by-4 (or order-4) magic square is shown in figure 1; its constant sum is 34.

How are magic squares constructed? If we were to try to create a 4-by-4 magic square by "brute force," we could program a computer to examine all possible 4-by-4 arrays of the numbers 1 through 16. Eventually, this would produce all possible order-4 magic squares. Unfortunately, the number of possible arrays is 16! = 1×2×3×...×14×15×16 > 2×10^{13}. If the computer could examine one array per microsecond, it would take eight months to complete the project.

Perhaps we'd be better off using a little mathematical intuition and some trial and error. Let us construct an order-3 magic square without electronic aids. The numbers 1 through 9 are placed in a 3-by-3 array. Wherever they are placed, the average value of each entry is 5, the middle number of the series. Any particular row, column, or diagonal contains three numbers, each with an average value of 5. Therefore, their sum will be 15, the constant sum for an order-3 magic square.

In general, a magic square of order $N$ contains $N^2$ numbers whose average is $(1+N^2)/2$, the average of the smallest and largest numbers. Any row, column, or diagonal has $N$ such numbers; their sum will be $N(1+N^2)/2$.

In our order-3 magic square, it is fairly obvious that the middle number, 5, should be in the center cell (figure 2a) and that the other eight numbers should be paired so that their sum is 10: (1,9), (2,8), (3,7), and (4,6). These pairs will be located in diametrically opposite cells. Suppose the "1" were placed in a corner cell, say a. The "9" will then be in cell i (figure 2b). We find that the "8" cannot be entered. It cannot be placed in cells c, f, g, or h, making the sum of the right column or bottom row exceed 15. If the "8" is in cell b (or d), cell c must be "6," and the right column exceeds 15. This means the "1" must not occupy a corner cell. Place the "1" in cell b and the "9" in cell h (figure 2c). The "7" cannot be placed in g or i, making the bottom row exceed 15. Nor can it be in a since we will be compelled to place another "7" in cell c because $7+1+c$ must equal 15. The "7" must therefore be in the second row, say at d. Inspecting figure 2d, we can easily fill the remaining cells: the "8" must be at c, the "2" at g, and so on. The completed order-3 magic square is shown in figure 2e.

Magic squares of larger order will require even more trial and error, making a more orderly procedure desirable. For example, the order-4 magic square can be constructed as follows: recite the numbers from 1 through 16, reading from left to right in the array, and enter numbers only in the cells lying on the two main diagonals (see figure 3). Starting at the last (lower right) cell, count from 1 through 16 again, moving backward through the array, and enter numbers in the empty cells only. The result will be the order-4 magic square shown in figure 1. Unfortunately, this procedure works only for order-4 magic squares.

Is there a more general procedure that works for as many different orders of magic squares as we please? In this column, I'll present some algorithms for constructing any odd-order magic square. The approach won't work for even-order squares, which lack a center square and therefore behave very differently.

The odd-order magic-square algorithms are elementary and easily programmed. The outline for the procedure follows:

1. Select a starting cell and enter the "1."
2. Select the move, a repeated maneuver used to enter the "2," the "3," and so on.
3. Write an edge-guard routine to prevent moving off the array.

(continued)
4. Determine the break-move, a second maneuver used when progress is blocked by an already-filled cell.

In choosing the starting cell, only the center cell is forbidden. For our first example, use the middle cell of the top row. For a magic square of order $N$, this position would be $ROW = 1$, $COLUMN = (N+1)/2$ in an $N$-by-$N$ array. Our example will be an order-5 magic square.

For the move, we will use the northeast diagonal move. In figure 4a, the "I" is in the starting cell. Moving in a northeasterly direction, we enter the other numbers into the empty cells. When we move off the edge of the array, we reenter at the opposite edge. We continue in this manner until we encounter an already-filled cell. When this occurs, the break-move is performed, interrupting our diagonal progress briefly. For our present example, the break-move is down-one. That is, place the next number in the cell directly below the last cell that was filled. In figure 4b, the numbers "1" through "5" have been entered; the "6" is blocked by the "I" in the next diagonal cell. Using the break-move, we enter the "6" directly below the "5" (the last cell filled, not below the "I"). We continue diagonally until we are blocked again and so on. The completed order-5 magic square is shown in figure 4c.

Some observations: every cell is filled. Each row, column, and diagonal has the same sum of 65. The final entry, 25, is diametrically opposite the first entry, 1. The middle number, 13, occupies the center cell. These conditions are necessary for a magic square of odd order and should be checked after each construction.

You may wish to run the sample program (see listing 1) before reading these detailed comments. [Editor's note: The listing for Magic Square is available for downloading via BYTExet Listings. The telephone number is (603) 924-9820.]

Line 200 creates the northeast move. The computer is told to move up-one, right-one from its present position in the array.

Lines 210 and 220 are the edge-guard statements for this move, preventing off-the-array movement at the top and right edges.

Line 240 is a retreat-move that is required just before the break-move in line 250. Recall that the break-move (down-one) is performed when an already-filled cell is encountered, and it is performed from the last-filled cell. In figure 4b, the "5" is in the cell at (2,2), and the computer performs line 200 (moves northeast) and considers the cell at (1,3). That is, the computer is "at" (1,3) already. This cell fails the test at line 230 since it does not contain zero, so the "6" must be entered below the "5." The computer is told in line 240 to retreat to the last-filled cell (down-one, left-one) and then to perform the break-move (down-one) in line 250. Of course, these two lines can be combined into one statement (down-two, left-one). However, as you modify and expand the program to include a variety of moves, starting cells, and break-moves, you may find it convenient to separate the retreat-move from the break-move.

![Figure 1: A 4-by-4 magic square. Each row, column, and main diagonal adds up to 34.](image1)

![Figure 2: Steps in the construction of a 3-by-3 magic square by trial and error.](image2)

![Figure 3: The counting-algorithm construction technique for a 4-by-4 magic square. The figure shows the square after finishing the counting-forward step.](image3)

![Figure 4: (a) The northeast diagonal move for constructing odd-parity magic squares from the top-row, middle-column position. (b) The break-move for this square’s construction. (c) The completed magic square.](image4)

![Figure 5: The shortest path for an off-center starting position.](image5)
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Listing 1: The Magic Square program.

```
10 "MAGIC SQUARE PROGRAM"
20 "by Bob Kurosaka"
30 DIM ARRAY(SIDE,SIDE)
40 CLS
50 ROW= 1: COLUMN= (SIDE + 1)/2 'LOCATE STARTING CELL
60 ARRAY(ROW,COLUMN)=1 'initialize first value
70 REM ARRAY-FILLING ROUTINE
80 FOR I=2 TO SIDE^2
90 ROW=ROW-1:COLUMN=COLUMN+1 'NORTEAST MOVE
100 IF ROW<1 THEN ROW= ROW+ SIDE 'WRAP AROUND THE EDGES OF THE ARRAY
110 IF COLUMN<1 THEN COLUMN= COLUMN+ SIDE 'WRAP AROUND THE EDGES OF THE ARRAY
120 IF ARRAY(ROW,COLUMN)= 0 THEN 280 'IF CELL IS EMPTY, FILL IT
130 ROW= ROW+1:COLUMN= COLUMN-1 'OTHERWISE, RETREAT
140 ROW= ROW+1 'AND MAKE THE BREAK-MOVE
150 IF ROW>SIDE THEN ROW= ROW- SIDE 'CHECK FOR EDGE-WRAPPING CONDITIONS
160 IF COLUMN<1 THEN COLUMN=COLUMN+SIDE 'CHECK FOR EDGE-WRAPPING CONDITIONS
170 ARRAY(ROW,COLUMN)= I 'FILL THE CELL
180 NEXT I
190 REM PRINT THE SQUARE
200 PRINT "MAGIC SQUARE, ORDER";SIDE
210 PRINT "EACH ROW, COLUMN, AND DIAGONAL ADD UP TO";SIDE*(SIDE^2+1)/2
220 PRINT
230 FOR ROW= 1 TO SIDE
240 FOR COLUMN= 1 TO SIDE
250 PRINT USING "####";ARRAY(ROW,COLUMN);
260 NEXT COLUMN
270 NEXT ROW
280 END
```

Listing 2: Changes to the program to use a northwest move.

```
200 ROW=ROW-1; COLUMN= COLUMN-1 'Northwest move
220 IF COLUMN<1 THEN COLUMN= COLUMN+ SIDE 'new edge-guard statement
240 ROW=ROW+1; COLUMN= COLUMN+ 1 'new retreat-move
270 IF COLUMN>SIDE THEN COLUMN= COLUMN- SIDE 'new edge-guard statement for the new retreat-move
```

Listing 3: A complete edge-guard subroutine.

```
410 IF ROW<1 THEN ROW= ROW+ SIDE
420 IF ROW>SIDE THEN ROW= ROW- SIDE
430 IF COLUMN<1 THEN COLUMN= COLUMN+ SIDE
440 IF COLUMN>SIDE THEN COLUMN= COLUMN- SIDE
450 RETURN
```

(continued)
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and the break-move for clarity.

For variety, the northwest move may be used with a few changes in the program (see listing 2).

For even more variety, a different starting cell may be chosen. This, however, dictates a new break-move in line 250, and we must alter its edge-guard statements accordingly.

Here is the method for determining the break-move for any permitted starting cell. Once the "1" is placed in the starting cell, the final cell is also determined: it is always diametrically opposite the "1". The shortest path from the final cell to the starting cell will be the break-move.

In figure 5, the "1" is left of center in the top row. The "25" will be right of center in the bottom row. The shortest path from "25" to "1" is down-one, left-two (ROW = ROW+1; COLUMN = COLUMN-2). After entering "1" through "5" with a northeast move, the "6" is blocked. The break-move causes the "6" to be entered down-one, left-two from the "5".

Try experimenting with other starting cells and other diagonal moves to discover which starting cells permit which diagonal moves. Hints: The four corner cells may not be used as starting cells. The center cell is always forbidden. If the starting cell is adjacent to the center cell (to its left or right, above or below), any of the four diagonal moves may be used.

With this large choice of moves and break-moves, a complete edge-guard subroutine may be in order (see listing 3). Then lines 210 and 220 could be replaced by GOSUB 410, as could lines 260 and 270.

If you require a challenge beyond diagonal moves, try the Knight's move, the L-shaped move used in chess. Move two cells in any direction, turn 90 degrees, and move one cell. For example, one Knight's move is right-two, up-one, or its equivalent, up-one, right-two (ROW = ROW-1; COLUMN = COLUMN+2). Variations of the Knight's move (such as up-one, right-three) may also be used.

Knight's moves offer both challenges in programming and variety in the results. We may use nearly any starting cell, even the corners, and choose from up to eight different Knight's moves. (You will learn, however, that most starting cells will not permit a choice of all eight Knight's moves.)

I hope this brief lesson has demystified the magic square for you and that you feel inspired to experiment further. In the meantime, welcome your responses: questions, comments, criticisms, improvements, insights, conjectures, and suggestions for future columns.
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Conducted by Steve Ciarcia

ETCHED MEMORY ARRAY
ON BOARD

Dear Steve,

I have been thinking seriously about building the Trump Card board to go with my PC clone. In the article, you said that you wire-wrapped the prototype’s control section on a board with an etched memory array. That sounds like a practical way of doing it, since memory arrays tend to work better over reasonably solid ground and Vdd planes, and they tend to be somewhat glitchy when executed in wire-wrap. (Then, too, there is the boredom factor.) Where did you find such a board? Do you have any left? Want to sell one or two?

BARRIE G. BRITTON
Riverside, CA

The wire-wrap board with the etched memory array shown in the Trump Card article (May and June 1984) is a prototype board, and I have no spares of that type available. You can purchase a similar board with a 256K-byte memory layout at one end of the board from Computer Parts Galore, 56 Harvester Ave., Batavia, NY 14020. (716) 343-6193. Also try Computer Shopper magazine, which advertises parts and equipment for the computer homebrewer.—Steve

SIEVE PROBLEM

Dear Steve,

I have been following your Trump Card project in BYTE with great interest. One thing that disappointed me was the result of the Sieve benchmark. The program, as listed in the June 1984 BYTE, ran in 2.2 seconds on a Zilog System 8000 Model 21, compared with the Trump Card result of 3.2 seconds. The System 8000 runs a 28001 at 5.5 MHz, and I would have expected better results from a clock-stretched, fast-memory, 10-MHz 28001 implementation!

Upon reflection and a look at the benchmarks in the January 1983 BYTE, it occurred to me that you may have run the benchmark without register variables declared. The System 8000 benchmarks runs in 48 seconds without register variables. This tallies with the results of the January 1983 BYTE benchmarks.

I therefore surmise that the Sieve benchmark should run in a little more than 1 second on the Trump Card, unless the C compiler is a little inefficient. I imagine that the C compiler was derived from Zilog’s C, which would be great, since it would make it easier for us to port some of our applications from Zilog UNIX (ZEUS) to the Trump Card. Did I guess right?

CHRIS MARTINUS
Randburg, South Africa

The Sieve of Eratosthenes benchmark used for the Trump Card test is shown in listing 4 in the June 1984 BYTE. The register variables are declared in line 7 of the program, and the program was run with these register variables declared. I reviewed the original Sieve of Eratosthenes program in the January 1983 BYTE and found a difference between that program and the program used for the Trump Card. Line 16 of the program in the January 1983 BYTE appeared as

```c
/*
 * print("%d",prime);
 */
```

The program line in the June 1984 BYTE is written

```c
/*
 * printf("%d",prime);
 */
```

The change of the end comment symbols from */ to // causes a significant change in the run time of the program. With the end comment written as */ the program takes 3.2 seconds to run. Changed to // the program took only 2.2 seconds to run. Make sure that your benchmark program is written exactly as shown in the Trump Card article before making a direct comparison.—Steve

TRUMP CARD INTERFACING

Dear Steve,

I have just finished reading the article about your Trump Card. It seemed to me it might be possible to interface a card such as this with an Apple IIe or a DEC Rainbow. If this is so, have you any intention of publishing a subsequent article with this information?

I bought an Apple IIe recently and am in the process of trying to teach myself some assembly-language programming, having spent some time familiarizing myself with BASIC and dBASE II programming. However, one of my main interests is fooling around with the design and construction of hardware. I have done a fair amount of work on line (primarily radio) circuits but have had little experience with digital circuits. Most of my circuits utilized printed-circuit boards (homemade and acid-etched). While I find printed circuits very convenient to design and work with, I gather this is not too practical with digital circuits, since most appear to use double-sided boards. Is this so? If so, is wire-wrapping the way to go? Could you recommend a good reference on interfacing techniques?

TED THOMAS
Pittsford, NY

I have no formal plans for a follow-up article on the Trump Card. However, with all the requests I have been receiving for interfacing the Trump Card to other computers, a follow-up of some kind might be warranted. More information on this subject may be presented in a future Circuit Cellar Feedback column.

Homemade, acid-etched, prototype boards are not the most convenient way to construct digital circuits of any size. Wire-wrapped boards are one alternative that works very well, but the wire-wrap sockets are expensive, and discrete components must still be soldered into the circuit. When I construct a prototype board, I use wire-wrap wire and a low-wattage soldering iron for point-to-point soldered connections from the pins of standard printed-circuit-board sockets. Discrete components are also soldered into the circuit in this manner. Once you are familiar with this type of construction, you can produce a prototype circuit that is almost as reliable as one constructed from a printed-circuit board.

Many texts have been written about computer interfacing and microcomputer chips. Microprocessor Interfacing Techniques by Rodny Zaks and Austin Lesea covers both the hardware and software techniques needed to interface peripherals to microprocessors. It can be obtained from Priority One Electronics.
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—Steve

TRUMP CARD AND HARD DISKS

Dear Steve,

I enjoyed your article on the Trump Card. Is it a useful item where the IBM PC has a hard-disk system? Also, is there any equipment on the market that can make the IBM PC a multiuser system?

Are there any controller boards available that would enable a North Star Horizon user to be able to access both hard- and soft-sector disks without changing the board? The Morrow DI/DMA board will do that but only in CP/M. I would want to continue to use North Star BASIC programs where applicable.

MALCOM H. AUERMAN
Newport, IN

The value of the Trump Card does not depend on the type of disk-drive system you have. A hard disk will offer greater speed of disk-related I/O functions, since it is quite a bit faster than a floppy disk. The value of the Trump Card is realized after the program is transferred from the disk to the Trump Card memory.

Recently, a number of companies have designed products to allow an IBM PC to be used in a multiuser environment. These products usually take the form of a card or several cards that plug into the PC. These cards allow the PC to become part of a local-area network (LAN) with other PCs or allow the PC to become a master that controls several slave terminals. LAN cards are manufactured by a number of companies, including IBM. Some of them are:

Advanced Digital Corp.
5432 Production Dr.
Huntington Beach, CA 92649

AST Research Inc.
2121 Alton Ave.
Irvine, CA 92714

Orchid Technologies
47790 Westinghouse Dr.
Fremont, CA 94539

Quadram Corp.
4355 International Blvd.
Norcross, GA 30093

Advanced Digital Corp. produces the master/slave-type cards for the PC. I don't know of a board that will allow you to run both hard- and soft-sector disks, but articles have been written that describe how to run North Star BASIC in a CP/M environment. One article that reviewed some software packages for this purpose appeared in the May/June 1982 Microsystems Journal.—Steve

HARD DISKS AND CP/M

Dear Steve.

I have a DEC VT-180 Robin computer, which is a VT-100 video terminal with an add-on Z80 CP/M board and two 169K-byte disk drives. I would like to put a Winchester disk on it but do not want to spend the money (about $2500) for a Corvus 6-megabyte system. Corvus will sell the interface board and necessary

(continued)
software for $300, and I can get a Seagate 5-megabyte hard disk cheap.

Do you know of anyone who may have a circuit and/or board for a Seagate 5/10-megabyte hard-disk controller? I am sure that if I get my hands on such a circuit, I can make the Corvus interface board work with the Seagate hard disk. Second, do you know how to make CP/M-80 2.2 boot a named transient program from cold boot? I have been successful in making it execute built-in commands such as DIR B: but 95 percent of the transient programs (STAT, PID, etc.) do a warm boot on starting (DDT is an exception, but it loads below the TPA).

PETER G. INGRAM
Genolier, Switzerland

I have not seen a circuit or a board for a Seagate hard-disk controller, but I can tell you where you can find some excellent information on interfacing hard disks in general. A three-part article in the March, April, and May 1983 issues of BYTE, "Building a Hard-Disk Interface for an S-100 Bus System," described how a hard-disk drive and disk controller work and how to use them with the CP/M operating system. More recently, an article in the October 1984 issue of Computer Shopper described how to assemble a hard-disk system from surplus market items. These two references should provide you with enough information to interface your hard disk to your system.

You can set up a version of CP/M to autoload a transient program from a cold boot by patching the name of the transient program you want toautoload. As an example, suppose you want to autoload MBASIC and run MYPROG. In this case, use the DDT "s" command to place the character string MBASIC MYPROG into the area where the 20s are. Then do a dump at location OA00 again, and the result should be as shown in Listing 1. The string of 20s in line OA10 is where you put the name of the transient program you want to autoload. As an example, suppose you want to autoload MBASIC and run MYPROG. In this case, use the DDT "s" command to place the character string MBASIC MYPROG into the area where the 20s are. Then do a dump at location OA00 again, and the result should be as shown in Listing 1. The string of 20s in line OA10 is where you put the name of the transient program you want to autoload. As an example, suppose you want to autoload MBASIC and run MYPROG. In this case, use the DDT "s" command to place the character string MBASIC MYPROG into the area where the 20s are. Then do a dump at location OA00 again, and the result should be as shown in Listing 1. The string of 20s in line OA10 is where you put the name of the transient program you want to autoload. As an example, suppose you want to autoload MBASIC and run MYPROG. In this case, use the DDT "s" command to place the character string MBASIC MYPROG into the area where the 20s are. Then do a dump at location OA00 again, and the result should be as shown in Listing 2. CP/M must also know how long the input string was. This value is held in location OA07, where the 00 value is now shown. The length of the input string in this case is 13 bytes. Using the "s" command, put a 0D into location OA07. You can place an input string all the way to location OA0F in this manner if you like. The last part of the recipe is to save the new copy of MOVCPM.COM. First, exit DDT by typing G0 or CTRL-C, then save as follows:

A>save 39 myprog.com

Now prepare a new system disk using SYSGEN that contains MYPROG.BAS and do a cold boot. MBASIC should be called automatically and the program MYPROG run under MBASIC—Steve

Over the years I have presented many different projects in BYTE. I 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.

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INTEREST IN factoring large numbers has been revived recently by the growth in popularity of public-key ciphers for security. In its simplest form, a public-key cipher is a large number (N) that has two prime-number factors (p and q). The idea is that N is so large that it is impractical to factor it.

I took up the challenge implicit in the public-key-cipher approach and wrote Hyper (see listing 1), a program that quickly factors large numbers. [Editor's note: The listing for Hyper is available for downloading via BYTEnet Listings. The telephone number is (603) 924-9820.] After searching through The Art of Computer Programming: Semi-Numerical Algorithms by Donald Knuth and running my algorithm by some computer science professors, I believe that my approach is original. Because I wrote Hyper in Microsoft interpreted BASIC, the precision is insufficient for breaking real ciphers. But it is adequate to break the number 94,815,109 (used in "Public Key Cryptography," January 1983 BYTE, page 198 as a sample encryption key) in less than 15 seconds on an IBM PC. (A compiled version of Hyper completes the 234 iterations required to factor this number in about 2 seconds on the IBM PC.) For real-world keys, extended-precision software like muMath would be necessary. (See "Implementing Cryptographic Algorithms on Microcomputers" by Charles Kluepfel, October 1984 BYTE, page 126.)

Traditional approaches to factoring begin with a table of prime numbers. Because the public-key ciphers are based on large primes, however, this is inefficient. With Hyper, I begin the search for factors at approximately the square root of N and work down. Of course, this means that if N has small factors, the approach is less efficient than traditional approaches. On the other hand, the program does not require the generation or storage of a large table of prime numbers, making it memory-efficient. When Hyper finds factors, it does not guarantee that they are prime. To determine that, you must rerun the program with the factors as arguments to see if further factoring is possible.

If you want to use Hyper for general factoring of large numbers, it might make sense to test the number to be factored to determine if it is divisible by, say, the first 12 primes. Most numbers are factorable by the first few primes, so this would eliminate long waits for trivial factors.

The rest of this article will explain the derivation of the Hyper algorithm. The two equations from which it was constructed are (1) \( pq = N \), where \( N \) is the number to be factored, and (2) \( (p-1)(q-1) = \phi \). (I use \( \phi \) because, when \( p \) and \( q \) are prime numbers, equation (2) is known as Euler's totient function and returns the number of numbers less than \( N \) that are relatively prime to \( N \). This value is traditionally called \( \phi(N) \).)

These equations define hyperbolas (figure 1), which is where the program got its name. Notice that \( N \) is the only known value in these two equations. The first requirement for Hyper to work is that \( N \) is not divisible by 2 (i.e., that \( N \) is odd). Also, since there is no point in going to a lot of trouble if \( N \) is a perfect square, we will check to

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Programming Insight

Listing 1: Microsoft BASIC version of Hyper.

```basic
10 10 PRINT "HYPER FACTORS OR TESTS PRIME BY INTERSECTING"
20 20 PRINT "TWIN HYPERBOLAS X*Y = N AND (X-1)*(Y-1) = FE"
30 30 BEEP: INPUT "ENTER SMALLEST CREDIBLE PRIME FACTOR =";MIN%
40 40 REM ESTIMATE LOWER BOUND OF FE
50 50 FECR4# = INT(FECR4#)
60 60 REM FIND CRITICAL VALUE OF FE/4 FOR TWO REAL INTERSECTIONS
70 70 PRINT "CONSTANTS: A = ";A#;"B = ";B#
80 80 REM SELECT PERFECT SQUARE. THAT MAKES X,Y INTEGERS
90 90 RDEC# = ROOT#- INT(ROOT#)
100 100 ROOT# = SQR(Z#)
110 110 TRIAL# = C1%
120 120 REM UPPER BOUND IS SOMETIMES A SOLUTION FOR FE. TRY IT FIRST
130 130 FE4# = FECR4#- C1%
140 140 REM ESTIMATE LOWER BOUND OF FE = ";FE4#*C4%
150 150 REM PREDICT MAX REASONABLE TRIALS FOR FE
160 160 MAX# = 1 + FECR4# - FE4#
170 170 IF RDEC# < = TOL THEN 590
180 180 Z# = B# - FE4#*(A# - FE4#)*C4%
190 190 REM SELECT PERFECT SQUARE. THAT MAKES X,Y INTEGERS
200 200 ROOT# = SQR(Z#)
210 210 REM AFTER FAILURE, REVISE FE/4 FOR NEXT ROUND
220 220 IF RDEC# < = TOL THEN 590
230 230 IF (ROOT# - INT(ROOT#))> TOL THEN 230
240 240 PRINT "ENTER ALLOWABLE TRIALS < = MAX. ALLOW= ";ALLOW#
250 250 IF (HALF# - INT(HALF#))< = TOL THEN 90
260 260 FE4# = FE4#- C1%
270 270 REM INQUIRY 339
280 280 IF (HALF# - INT(HALF#))< = TOL THEN 90
290 290 IF (HALF# - INT(HALF#))< = TOL THEN 90
300 300 REM REJECT N IF PERFECT SQUARE
310 310 REM MAY INSERT UPPER LIMIT ON N HERE
320 320 PRINT "UPPER BOUND OF FE = ";FE4#*C4%
330 330 REM ESTIMATE LOWER BOUND OF FE
340 340 FEMN4# = A#/C2% - (MIN% + N#/MIN%)/C4%
350 350 FEMN4# = INT(FEMN4#)
360 360 PRINT "ESTIMATED LOWER BOUND OF FE = ";FEMN4#*C4%
370 370 REM PREDICT MAX REASONABLE TRIALS FOR FE
380 380 MAX# = 1 + FECR4# - FEMN4#
390 390 PRINT "MAX REASONABLE TRIALS = ";INT(MAX#)
400 400 REM AFTER FAILURE, REVISE FE/4 FOR NEXT ROUND
410 410 IF ALLOW# < = MAX# THEN 400
420 420 REM UPPER BOUND IS SOMETIMES A SOLUTION FOR FE. TRY IT FIRST
430 430 IF ALLOW# < = MAX# THEN 400
440 440 REM INQUIRY 339
450 450 REM CALCULATE POLYNOMIAL Z (R=2) WHICH IS SCALED BY 1/4
460 460 Z# = B# - FE4#*(A# - FE4#)*C4%
470 470 REM SELECT PERFECT SQUARE. THAT MAKES X,Y INTEGERS
480 480 ROOT# = SQR(Z#)
490 490 REM AFTER FAILURE, REVISE FE/4 FOR NEXT ROUND
500 500 IF ALLOW# < = MAX# THEN 400
510 510 REM INQUIRY 339
520 520 REM CALCULATE POLYNOMIAL Z (R=2) WHICH IS SCALED BY 1/4
530 530 REM INQUIRY 339
540 540 REM INQUIRY 339
550 550 REM INQUIRY 339
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make sure that it is not. For the purposes of what follows, let $p$ be greater than $q$. It doesn't matter which is larger; it just simplifies the statement of the derivation. Because $N$ is odd, $p$ and $q$ must also be odd. Therefore, $p-1$ and $q-1$ are both even, and $\phi$ is divisible by 4. Further, since both $p$ and $q$ are odd, $p+q$ must be even. If we expand equation (2), we get

$$(3)\quad pq-p-q+1=\phi$$

Subtracting (3) from (1) gives

$$(4)\quad p+q-1=N-\phi$$

Rearranging (4) gives

$$(5)\quad p+q=N+1-\phi$$

Because $p+q$ is even, the average of $p$ and $q$ is a whole number. That is:

$$(6)\quad \frac{p+q}{2}=\frac{N+1-\phi}{2}$$

Let us rewrite equation (1) using $w$ and $r$:

$$(9)\quad (w+r)(w-r)=N$$

Expanding (9) gives

$$(10)\quad w^2-r^2=N$$

Rearranging (10) gives

$$(11)\quad r^2=w^2-N$$

Since $w=(p+q)/2=(N+1-\phi)/2$, we can substitute $(N+1-\phi)/2$ for $w$ in (11), giving

$$(12)\quad r^2=\left[N+1-\phi\right]/2=2-N$$

Expanding and simplifying (12) gives

$$(13)\quad r^2=\left[N-1\right]/2-\phi\left[N+1\right]/2-\phi/4$$

$\left[N-1\right]/2$ and $\left[N+1\right]/2$ are known constants for any $N$ being factored. Instead of having to divide $N$ by a large table of primes, the program need only search for a value of $\phi$ that makes the right side of equation (13) a perfect square in order to find $p$ and $q$.

(continued)
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The last question we need to address is what the largest possible value of \( \phi \) could be so we know where to start our search. Equation (13) offers an indication of what values for \( \phi \) are possible. In order for \( r \) to be a real number, \( r^2 \) must not be a negative number. Therefore, from (13):

\[
\left( N-1 \right)/2 < r^2 < \left( N+1 \right)/2 - 6/4
\]

If we expand (14), rearrange the terms, and multiply through by 4 to get rid of the fraction, we get

\[
\phi^2 - 2(N+1)\phi + (N-1)^2 = 0
\]

Using the quadratic equation to solve for \( \phi \), we see that

\[
\phi \leq N+1 \pm 2\sqrt{N}
\]

Going back to equation (2), we see that \( \phi \) must be smaller than \( N \). Therefore, the sign in (16) must be negative, and we obtain

\[
\phi \leq N+1 - 2\sqrt{N}
\]

We can refine our starting value of \( \phi \) by recalling that it must be divisible by 4. We decrement the value calculated from (17) until our first guess for \( \phi \) is divisible by 4, plug that value for \( \phi \), and try again.

To determine the lower bound of \( \phi \), take the smallest possible factor of \( N \) (call it Min) and calculate \( \phi_{\text{max}} \) from equation (2) by \((\text{Min}-1)/N/\text{Min}-1\). In general, Min will be 3. In public-key ciphers, however, you may be able to determine the minimum number of digits in the factors of a valid key from, for example, the modulus. The number you use for Min does not have to be prime.

As a matter of interest, you can derive factoring methods from other equations related to (2).

For example:

\[
(2A) (p+1)\phi + (q+1)\psi = \psi
\]

will work but overflows sooner than (2). You could also mix plus and minus signs in (2), but then you have to fudge away an unwanted minus sign. I therefore prefer using equation (2).
AN ASSEMBLY-LANGUAGE EMULATOR PROGRAM
BY JOHN R. ROBBINS

A simple introduction using BASIC

Understanding how computers (or microprocessors) handle numbers can be a real advantage in mastering higher-level languages. Knowledge of machine-language instructions and how they manipulate data makes concise programming easier and promotes full use of a language's features. In order to understand machine-language programs, however, you first have to understand the hexadecimal number system as well as the sometimes complex addressing modes of a particular microprocessor. While teaching college-level FORTRAN programming classes I used a very simple decimal-based machine-language emulation to teach the basics of machine language without the above-mentioned problems. I wrote the MAC10 program described in this article to provide this same capability on a home computer. Although this was written in TRS-80 BASIC and makes use of a line printer, the statements are easily adapted to almost any BASIC computer with a minimum of memory and I/O (input/output) devices.

The MAC10 computer, as emulated by the program, consists of 100 memory locations, an accumulator, and an arithmetic logic unit. The computer can move numbers between memory and the accumulator, add, subtract, or compare numbers, accept data from the outside world (READ), and send numbers to the outside world (WRITE). The memory cells are numbered from 00 to 99 and each can contain a three-digit number and a sign (+ or -). Memory can be used for program instructions or for data storage. Normally the instructions are executed sequentially, but both conditional and unconditional jumps are available. The program tells the MAC10 how to manipulate the data. The MAC10 language consists of 10 commands (or op

<table>
<thead>
<tr>
<th>CODE</th>
<th>NAME</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>1nn</td>
<td>READ</td>
<td>read a value into the accumulator (nn not used)</td>
</tr>
<tr>
<td>2nn</td>
<td>WRITE</td>
<td>print the number in the accumulator (nn not used)</td>
</tr>
<tr>
<td>3nn</td>
<td>LOAD</td>
<td>move the contents of nn into the accumulator</td>
</tr>
<tr>
<td>4nn</td>
<td>STORE</td>
<td>move the contents of the accumulator into nn</td>
</tr>
<tr>
<td>5nn</td>
<td>JUMP</td>
<td>jump to the instruction in memory cell nn</td>
</tr>
<tr>
<td>6nn</td>
<td>JPN</td>
<td>jump only if the accumulator is negative</td>
</tr>
<tr>
<td>7nn</td>
<td>JPZ</td>
<td>jump only if the accumulator is zero</td>
</tr>
<tr>
<td>8nn</td>
<td>ADD</td>
<td>add the contents of nn to the accumulator</td>
</tr>
<tr>
<td>9nn</td>
<td>SUB</td>
<td>subtract the contents of nn from the accumulator</td>
</tr>
<tr>
<td>0nn</td>
<td>STOP</td>
<td>stop execution (nn not used)</td>
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Table 1: The MAC10 language commands and operations.

(continued)
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Listing 1: The MAC10 program listing.

5 REM ••• "MAC10BAS" ••• DECIMAL BASED MACHINE LANGUAGE EMULATION
7 REM ••• BY: JOHN R. ROBBINS, HUNTSVILLE, ALABAMA
10 DIM M(99)
20 CLS
30 T$="--- -- ---- --
40 T=0
50 INPUT "DO YOU WANT A TRACE (Y/N)";A$
60 IF LEFT$(A$,1) = "Y" THEN T=1
70 READ A$
80 CS=LEFT$(A$,3)
90 IF CS="RUN" THEN 70
100 IF CS<="LOA" THEN 150 REM INITIAL STATEMENTS MUST BE LOADED THEN RUN
110 XX=VAL(M$(A$,6,2)) REM GET MEMORY LOCATION
120 A=VAL(M$(A$,9,4)) REM GET VALUE TO BE LOADED
130 GOSUB 470
140 GOTO 70
150 PRINT "INVALID INPUT - ";A$
160 STOP
170 PC=0 REM SET PC TO 0 THEN CHECK IF DEFINED BY RUN
180 IF LEN(A$)>4 THEN PC=VAL(M$(A$,5,2))
190 PRINT "EXECUTION STARTED AT PC"
200 IF T=0 THEN 260
210 LPRT "INITIAL STATE OF MEMORY" : LPRT
220 GOSUB 770
230 LPRT "EXECUTION STARTED AT PC : LPRT"
240 LPRT "PC CMD VAL ACC"
250 REM ••• LOOP FOR RUNNING PROGRAM STARTS HERE •••
260 V=M(PC) REM GET VALUE OF NEXT PROGRAM INSTRUCTION
270 C=INT(V/100) REM GET OP CODE NUMBER
280 XX=V-C*100 REM GET MEMORY CELL NUMBER
290 IF C=0 THEN 700
300 CN C GOSUB 350,390,430,470,510,540,580,620,660
310 IF T=0 THEN 260
320 LPRT USING T$;PC,C,XX,A$,CS
330 GOTO 260
340 REM ASSIGNMENT OF CS TELLS PURPOSE OF SUBROUTINE
350 CS="READ A VALUE INTO THE ACCUMULATOR"
360 READ A
370 PC=PC+1
380 RETURN
390 CS="OUTPUT THE VALUE IN THE ACCUMULATOR"
400 LPRT : LPRT "OUTPUT VALUE = "A : LPRT
410 PC=PC+1
420 RETURN
430 CS="LOAD CONTENTS OF"+STR$(XX)+" INTO A"
440 A=M(XX)
450 PC=PC+1
460 RETURN
470 CS="STORE CONTENTS OF A IN"+STR$(XX)
480 M(XX)=A
490 PC=PC+1
500 RETURN
510 CS="JUMP TO"+STR$(XX)
520 PC=XX
530 RETURN
540 CS="IF A<0 THEN JUMP TO"+STR$(XX)
550 PC=PC+1
560 IF A<0 THEN PC=XX
570 RETURN
580 CS="IF A=0 THEN JUMP TO"+STR$(XX)
590 PC=PC+1
600 IF A=0 THEN PC=XX
610 RETURN
620 CS="ADD CONTENTS OF"+STR$(XX)+" TO A"
630 A=A+M(XX)
640 PC=PC+1
650 RETURN
660 CS="SUBTRACT CONTENTS OF"+STR$(XX)+" FROM A"
670 A=A-M(XX)
680 PC=PC+1

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value in the program counter after execution of the command. The initial and final states of all the memory cells are also printed in the TRACE mode. The LOAD and RUN commands must be given in the format shown below:

5000 DATA LOAD nn sxxx : REM comments as desired
5010 DATA RUN nn
5020 DATA ii

where mn is a memory-cell number, s is the sign of the number (± not required), xxx is the instruction or data (with sign, s) to be loaded in that memory cell, and ii is an input value to be read with an op code of 1. The memory-cell number in the RUN statement allows the program to be started at a specified location. For my TRS-80 Model 12, I write the programs using the editor and read them from a disk file. Other methods can be used to suit various computers. The program given in listing 1 includes a sample MAC10 program that reads in a number, N, then reads N sets of three numbers (A, B, and C), calculates A - 2 × B + C, and prints the answer. Listing 2 shows the output from this program with the trace option. When you have mastered a simple program such as the one shown, try multiplication, division, or a simple sort routine. You will learn a lot about how a computer handles numbers and will more easily understand assembly- and machine-language programming, as well as higher-level languages.
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THE SUBMIT UTILITY provided with the CP/M operating system is useful for repetitive tasks, such as compiling programs; however, some improvements could be made. I have written two short assembly-language programs to make the Submit process a little easier to use.

HOW SUBMIT WORKS
Submit uses an undocumented feature of the CCP (console command processor) in CP/M to process a command file. When you enter Submit Sample (where Sample is the name of a command file), the Submit program reads the text lines from Sample into memory. It then creates a file named $$$.SUB. The program inserts any parameters that you may have specified into the command lines and left-justifies the lines into 128-byte records. These lines are written to the output file in reverse order; that is, the first line of your command file is in the last record of the $$$.SUB file. When all of the lines have been processed, the system executes a warm boot.

This is where the CCP comes in. When the system executes a warm boot, the CCP looks for a file on drive A: with the name $$$.SUB. If found, the CCP reads the last record using the Read Random function. Then, it subtracts one from the record count of the file, making the file one record, and thus one command line, shorter. The file is written backward for this reason. Next, the CCP puts the command line in its default buffer and calls the code that executes the command line. When the CCP finds that the file is zero length, it deletes the filename from the directory. The result is a simple, elegant means of batch processing.

SOME PROBLEMS AND SOLUTIONS
This system has a few small problems. I use Submit with a Pascal compiler, and sometimes I have difficulty striking the correct keys (usually around 3:00 a.m.). Most compilers do not like being fed a nonexistent filename or a name that may have invalid characters. If I start the batch process and walk away, the process may run for quite a while before the compiler gives up. Other nasty things may happen, such as running out of disk space or garbage files being created. To solve this problem, I wrote a program called 'testfile (see listing 1). I include this program in the first line of my command file, passing to the command file the parameter for the corresponding name of the source file. The program simply tests for the presence of the file and exits if it is in the directory. If the file does not exist, 'testfile kills the $$$.SUB file and then exits, effectively aborting the batch job. Exiting this way has saved me from numerous faulty batch runs.

The second program, Pause (see listing 2), puts breakpoints in your batch stream. It simply prints a message on the console terminal, then waits for the user to press a key. If you press the capital A, the $$$.SUB file is deleted, aborting the batch. I use Pause between the compiler and (continued)
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**THE SUBMIT UTILITY**

Listing 1: The Testfile program, originally developed on a North Star Advantage microcomputer, checks for a specified file before allowing a batch process to proceed. It is available on BYTEnet listings (603) 924-9820.

```
TESTFILE — Aborts Submit if file is not present
Mark Anacker 08/18/83

Equates
0000 = BOOT EQU 000H ; warm boot address
0005 = BDOS EQU 0005H ; CP/M function call address
005C = FCB EQU 005CH ; default File Control Block
0007 = BELL EQU 7 ; ASCII bell
000A = LF EQU 10 ; ASCII line feed
000D = CR EQU 13 ; ASCII carriage return

Code area
0100  ORG 0100H ; standard start of CP/M programs
0100  0E11 START MVI C,17 ; "SEARCH FOR FIRST" function
0102  115C00 LXI D,FCB ; point to the filename
0105  CD0500 CALL BDOS
0108  FEFF CPI 0FFH ; true if file not found
010A  CA1001 JZ ABORT ; nope, not here
010D  C30000 JMP BOOT ; file is here, continue with batch
0110  0E09 ABORT MVI C,9 ; give the error message
0112  114F01 LXI D,MSG1
0115  CD0500 CALL BDOS
0118  112B01 LXI D,SUBFCB ; point to our filename
011B  0E13 MV1 C,19 ; "DELETE FILE" function
011D  CD0500 CALL BDOS
0120  0E09 MV1 C,9 ; give confirmation message
0122  117101 LXI D,MSG2
0125  CD0500 CALL BDOS
0128  C30000 JMP BOOT ; and exit to CP/M

Data area
012B  01 SUBFCB DB 1 ; drive A:
012C  2424242020 DB 'SSSS SUB' ; submit processor file
0137  DS 24 ; the rest of the FCB
014F  0D0A0A07 MSG1 DB CR,LF,LF,BELL
0153  2A2A204669 DB •• File is not present!! ••',CR,LF,'$'
0171  0D0A MSG2 DB CR,LF
0173  4261746368 DB 'Batch processing ABORTED!',CR,LF,'$'
018F  END START ; starting address of program
```

(continued)
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Pause puts breakpoints in the batch stream so I can abort if the compiler finds errors in my code.

linker programs, so I can gracefully abort if the compiler finds errors in my code. Although it is possible to abort a batch job by pressing Control-C, this requires some tricky timing.

The following is an example command file, which I use with the Pascal/MT+ compiler from Digital Research. It shows how I use Testfile and Pause in a batch file:

```
; Pascal/MT+ compile
TESTFILE B::$1.SRC
; source file found, batch continues
MTPLUS B:$1 #RB OA EA TB Z V
PAUSE
; no errors, link the program
LINKMT B:$1=B:1,A:UTILMOD/S, A:PASLIB/S
; end of batch job

In the file above, lines beginning with a semicolon are comments and are ignored by CP/M.

Both the Testfile and Pause programs are written in the standard assembly language that comes with nearly all CP/M systems. The listings are output from the assembler and include the hexadecimal codes that constitute the program. If your system for some reason does not have the assembler, you should be able to use BASIC or a debugger to create a .COM file. I hope that you find these programs useful, and I encourage you to experiment with your system.

---

Listing 2: The Pause program can be used to insert a breakpoint into a batch process. It is available on BYTEnet listings (603) 924-9820.

```
PAUSE — Breakpoint for Submit files

Mark Anacker 08/18/83

; Equates

0000 = BOOT EQU 0000H ; warm boot address
0005 = BDOS EQU 0005H ; CP/M function call address
0007 = BELL EQU 7 ; ASCII bell
000A = LF EQU 10 ; ASCII line feed
000D = CR EQU 13 ; ASCII carriage return

; Code area

0100 ORG 0100H ; start of program area
0100 0E09 START MVI C9 ; 'PRINT STRING' function
0102 115401 LXI D,MSG1
0105 CD0500 CALL BDOS
0108 0E01 MVI C1 ; 'CONSOLE INPUT' function
010A CD0500 CALL BDOS
010D FE41 CPI 'A' ; did we get a big A?
010F CA1D01 JZ KILLIT ; yup
0112 0E09 MVI C9 ; nope, continue with the batch
0114 118801 LXI D,MSG2
0117 CD0500 CALL BDOS
011A C30000 JMP BOOT ; warm-boot the system
011D 113001 KILLIT LXI D,FCB ; point to our filename
0120 0E13 MVI C19 ; 'DELETE FILE' function
0122 CD0500 CALL BDOS
0125 0E09 MVI C9 ; say that we did it
0127 11AC01 LXI D,MSG3
012A CD0500 CALL BDOS
012D C30000 JMP BOOT ; and exit to CP/M

; Data area

0130 01 FCB DB 1 ; drive A:
0131 2424242020 DB '$$$' SUB ; submit processor file
0133 24 DB 24 ; the rest of the FCB
0134 00D0A7 MSG1 DB CR,LF,BELL
0135 5072857373 DB 'Press A to abort batch,' 1
0136 06E206187920 DB 'any other key to resume $'
0138 00D0A0A7 MSG2 DB CR,LF,BELL
013C 4261746368 DB 'Batch processing continuing...',CR,LF,'$'
0140 00D0A0A7 MSG3 DB CR,LF,BELL
0146 4261746368 DB 'Batch processing ABORTED!',CR,LF,'$'
014C END START
```

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In the section on formatting the disk, a critical step was omitted if you want to boot from the hard disk. Once the hardware has been properly installed, three steps are required to install a hard disk in the system.

1. Run the FDISK program. This will install the DOS partitions into the BIOS. Accept all of the default choices.
2. Format the hard disk using the standard floppy FORMAT C: command. This will erase all existing data and prepare the disk to receive data.
3. Install the system on the hard disk. This step must be performed prior to placing any data on the hard disk if you want to boot from the hard disk. Do this by typing SYS C:.

When an IBM with both floppy and hard disks is started, it will come up in one of three possible modes. As soon as the system passes the power-on self-test, the operating system will attempt to boot from the floppy disk. If the disk door is left open, the system will attempt to boot from the hard disk. Failing that, the operating system will run the ROM BASIC.

If you have properly installed the system onto the hard disk and you leave the floppy-disk-drive door open, the operating-system ROM will boot from the hard disk every time.

In the section on hard-disk care, Mr. Lambert states that the use of an XT power supply is the way to solve the PC's limited-power problem. This is certainly a viable solution, but there are drawbacks to it. The IBM XT power supply sells for $290, which is over three times the cost of an add-on supply. Most people may not want to spend an extra $2000 when they don't need it. The XT supply is not available from the IBM Product Center or from most IBM dealers. It can be obtained from IBM Parts Distribution. The XT supply dissipates its losses on the outside of the PC case. A PC with a hard disk runs very warm, and anything you can do to drop this temperature is worthwhile and will contribute to the long life of the system. For those who want an internal supply, there are several sources of XT look-alike supplies that sell for about one-half the cost of the XT supply.

Mr. Lambert suggests the use of the IBM BIOS and DOS. One of the key themes of my article was compatibility. The reason for stressing the requirements for compatibility is so that the IBM BIOS and DOS can be used. Some of your readers will want to experiment, but almost everyone will want to be able to run IBM's DOS.

Mr. Lambert feels that I left a step out of the section on formatting the disk. Perhaps he is not familiar with the ability of the Format command to both set up the disk and transfer the boot and system to the disk. To do this you type FORMAT C:/S/V. The /S transfers the three system modules to the disk. The /V may be included to let you place a volume label on the disk. It is not necessary to use the SYS command that Mr. Lambert suggests.

Next he addresses the issue of parking the heads. He suggests using the Shipdisk program supplied with the XT. That is fine if you have the IBM program and you have a standard-configuration disk. My listing 2 shows how to park the heads if you don't have the Shipdisk program. It produces the same results except that you have the option of changing your mind with my program. IBM's program keeps you from doing anything useful but turning off the power. Mine allows you to perform other tasks or to continue using the system. Of course, you must reexecute the program if you reference the hard disk before turning power off. Normally, DOS does not read the disk when a program is terminated. It does if the command interpreter portion of DOS is overwritten or if the PROMPT command is used. My program does not overwrite the command interpreter, but you may want to ensure that the head is not moved. If you do, then replace the Return instruction in my listing with the Halt instruction (HLT op code F4). I agree that extreme care should be taken to protect against shock. When running, a shock of 2 Gs may cause damage or loss of data. When turned off and parked, this increases up to as much as 30 Gs depending on the particular disk. Some, however, are still sensitive to shocks of several Gs. I see little use for the shock sensors suggested. The real test is whether your disk still reads and writes reliably, not that 23 Gs or more have been experienced.

The last point is the filtering of disks. Mr. Lambert states that there is no air entrance of any kind. The typical Winchester uses two filters. Air is circulated between two chambers in the drive. The purpose of this is to maintain a uniform temperature. The air is passed through a very fine filter between the two chambers. The outer chamber contains a second filter called a Breather Filter. This filter allows pressure equalization with the outside world. It is unlikely that smoke particles would get through both filters, but I prefer not to take any chances. The higher the level of imp-
Charles A. Whitney's article ("Generating and Testing Pseudorandom Numbers," October 1984, page 128) should be very useful to BYTE readers. As one who uses random numbers regularly in teaching and research, I have some experience that may also be helpful.

The $X^2$ statistic suggested by Whitney is a multiple of the usual chi-square statistic, whose use usually requires a chi-square table. The approximation suggested by Whitney to avoid this table is rather rough, however. A better approximation would use the normal approximation of the chi-square and compute

$$W = \left( \frac{1}{E} - n \right) \sqrt{2n}$$

rejecting the hypothesis of randomness if $|W| > 2$ (which occurs under randomness with probability approximately .95) or $|W| > 2.58$ (with probability .01).

A second comment refers to Microsoft BASIC for the IBM PC. I had also noticed the same deficiencies in the random-number generator, getting 32 diagonal running "strips" when throwing random points on the screen. After some effort I was able to determine that the random-number generator is not, strictly speaking, linear congruential. In Whitney's notation $I_i = \lfloor a (I_{i-1}) \mod 2^{16} \rfloor + c \mod 2^{14}$, for $a = 214013, c = 13,523,655$. Thus the cycle is $2^{16} - 65,536$. The mod $2^8$ was evidently added by Microsoft to save space or time. A colleague's earlier PC does not have the same problem.

Letters to IBM and Microsoft concerning this have been essentially ignored.

JAMES STAPLETON
Professor
Department of Statistics and Probability
Michigan State University
East Lansing, MI

Charles A. Whitney replies:
Professor Stapleton's comments make a nice footnote to my article. His quantification of the simplified version of the chi-square test briefly described in my article is both powerful and easy to apply. As for the rather mediocre Microsoft BASICA random-number generator in the IBM PC, I can only add that Stapleton is to be commended for his ingenuity in ferreting it out of its ROM.

TRANSFERRING SOFTWARE TO A HARD DISK

The utility of the personal computer is in serious jeopardy due to the incompatibility of two principal computer products: copy-protected software and hard-disk drives. Until now, it was perhaps inconsequential that users had to always use a floppy disk to run their application software. But volume production of hard-disk drives has arrived, and affordable priced units are within reach of many of us. This

(continued)
LETTERS

is a natural evolution of computer technology. The hard disk provides tremendous speed and utility to the user. But of what use is the hard-disk drive if software can't reside on it? The buyer of a hard disk will quickly and sadly realize that many of his expensive programs cannot be transferred to the hard disk because the programs are copy-protected.

There is a proliferation of copy-protected software. Most of the software advertised in magazines is copy-protected, ostensibly to prevent unauthorized reproduction and use. I suggest, however, that most of this software is not worth what is asked for it and the reason for copy protection is to present an “image” of something valuable. The inflated retail prices are needed to pay for expensive advertising. In the end, we all lose.

One noteworthy exception to the above is Borland’s Turbo Pascal. Here’s an example of software that is worth the $50 asked for it. Incidentally, $50 is not cheap! From what I read, Borland has been tremendously successful in selling this product. Essentially the product quickly “earned” a good reputation. Magazine reviews were all favorable. We all benefited! To the contrary, there are numerous educational programs debuting for the retail price of $30 to $40. All of these programs are copy-protected. What a waste! We all end up with a pile of disks, sore fingers, worn-out floppy-disk drives, and a hard-disk drive gathering dust. On the light side, perhaps software publishers should bundle a low-cost floppy-disk drive with their software. Then we could all have a bank of 15 to 20 floppy-disk drives each holding copy-protected software.

Seriously, I call for the following actions:

1. Software publishers should seriously reconsider their distribution policy and allow their programs to be transferred entirely to a hard disk. At least, consideration should be given to providing “unprotected” versions to those who make special requests. This is done by some companies.

2. We, the buyers, should avoid purchasing copy-protected software if at all possible.

3. Magazine publishers should bite the bullet and tell us if software is copy-protected. Of course, advertisers of copy-protected software don’t want this fact to be known and will leave it out of their paid advertisements. However, your listings and reviews should tell all! We want and need to know.

Perhaps software companies are not concerned about the success of the hard-disk-drive industry. But hard-disk drives represent the expansion of computer technology as a whole. And if the software remains incompatible with the hard disk, the entire industry will suffer.

DAN W. WELLER JR.
Silverdale, WA

GENERATING TRAVESTIES

I was very interested in Hugh Kenner and Joseph O’Rourke’s Travesty program (“A Travesty Generator for Micros,” November 1984, page 129). I had just been thinking about writing a program based on the article I remembered from Scientific American a year earlier, and BYTE arrived at precisely the right moment.

OCTOBER 1984
I don't speak Pascal, but I wrote a similar program in C based on the procedures the authors described. Since they talk a lot about the difficulty of getting a program like this to run at any decent speed, I thought comparison with a C version might provide an interesting benchmark.

Running on a Gifford 8085/8088 system under Concurrent MP/M 8-16, the compiled C program is considerably faster than the VAX running Berkeley Pascal under UNIX. The "system constant" described in the article is about 4 (as against 10 for the VAX and 62 for the 2-MHz Heath). It accepts a sample text of 16,000 characters with room to spare.

I omitted Travesty's verse-formatting feature, and the data structure I used differed from that in Travesty in one important respect. Rather than maintain a separate array of "next locations" for each letter, I loaded the sample text into an array of structures, each containing a character and a pointer to the next occurrence of that character.

I ought to add that once I had the thing running, I was somewhat disappointed with the stuff it produced. Isolated samples may possess beauty, humor, and charm, but when you see a lot of statistically synthesized text there's a certain sameness—the predictability of its unpredictability. Four- and five-order transformations seem best; they give a good mix of the plausible and the unexpected. In light of the high ratio of junk to gems, I called my program Gibber.

Peter Garrison
Los Angeles, CA

COMMENDING CP/M

I want to take issue with you over the item "A New DR Operating System" ("Happenings," by John Markoff and Ezra Shapiro, December 1984 BYTE West Coast, page 343). While many of your criticisms of Concurrent's MS-DOS are justifiably accurate, two of your points are off the mark.

One need never resort to "lengthy and rather cryptic command lines" to manipulate Concurrent's windows. I move, change the size of, reorder, or change colors in windows, using only the numeric keypad keys on my Compaq. My acquaintances who are IBM PC owners enjoy the same ease of use of the windows on their machines.

Your article states that under Concurrent DOS, multitasking is possible, but that one must watch over memory usage to avoid disaster. In my daily use of Concurrent DOS, I usually run three programs at once. I've never encountered an abnormal response. In my opinion, any discussion on the value of Concurrent's windows is misleading to the point of being

(continued)
ing untruthful. As you must know, IBM selected MS-DOS to be the operating system for the PC. That single decision—not any technical or marketing superiority on Microsoft’s or IBM’s part—caused the decline of CP/M-86 and the ascendancy of MS-DOS. The only trouncing involved is that performed by a supranational company on the possibility of competition in the microcomputer marketplace.

Terry Gibson
San Jose, CA

We wish to take exception with BYTE West Coast “Happenings” This article reflects the obviously inadequate attention the two authors paid to the Digital Research operating system Concurrent PC-DOS 3.2. As users, we are extremely glad to have such a useful and versatile tool at our command.

CPC-DOS 3.2 allows up to six tasks running in four virtual consoles at the same time (with two of those tasks running on remote terminals). This allows you to compile in one virtual console while editing in another virtual console, printing in the third virtual console, and having an application such as a spreadsheet performing computations in the fourth virtual console. By utilizing the full 640K bytes available to most personal computers, this allows an average of 128K bytes per partition. (Note: You can override the default memory allocations for each virtual console.) In the vertical-market applications environment, concurrency is a necessity provided by no other operating system (including the much-touted TopView).

In addition to the tremendous advantages of concurrent operations, the operating system comes with several built-in programs. The authors mentioned the electronic card file and EDIX. They neglected to mention File Manager (a DOS shell providing cursor-controlled execution of most DOS commands), which allows easy access to your files, especially those utilizing subdirectories for both DOS and CP/M. There is also DR ‘Talk’, which allows one PC to communicate with any other PC running under the same operating system. As for the claim that the windows are difficult to set up, nothing could be easier than using WMENU, provided with the system. By using the cursor controls on the numeric keypad, windows may be set up for foreground and background colors, size, and location. These set-up parameters may be written to a file by using the same menu. There are no lengthy or cryptic command lines to enter at all.

This operating system can internally discriminate between an IBM PC XT and an IBM PC AT (when running on a PC AT, the operating system can format the high-density disks used on the PC AT). With its built-in programs and reliability, we feel Concurrent PC-DOS 3.2 is one of the best bargains to be offered to the modern personal computer user.

M. R. Wilkes
Hal Combs
Harrison, AR

Checking Floppy Disks

I found “Comparing Floppy Disks” by Robert Rodina (September 1984, page
Robert Rodina replies:

I neglected to mention that I performed a test similar to that requested by Steven Burick prior to my interchangeability tests. I had no tracks/sectors bad or locked out on any of the brands tested.

I would also like to add that, contrary to my understanding that each disk company surveyed manufactures its own disks, some of these companies obtain their finished media from other manufacturers and use just their own jackets. I guess that my idea of manufacturing was totally different from the people who represented the companies I talked with on the telephone.

**CP/M: ON THE WAY OUT?**

Several days ago a friend and I were discussing the history of CP/M (we both are avid CP/M users). The conversation drifted toward new software written for CP/M. We could not think of anything that had been newly developed in the past 18 months. Is CP/M on the way out? We then made a quick count of CP/M-80 machines still being manufactured, and we came up with roughly 32, with several new machines to be introduced in early '85.

With all the apparent interest in the CP/M operating system, why isn't software being developed for it? I suggest that the software producers remove their blue sunglasses long enough to take a serious look around! We CP/M users are a very large group: we also have money to spend.

JERRY D. GRANT
Mt. Vernon, WA
was not sign-extended to hex ff in the ax register. Consequently, the test for i equal to -1 in lookup always failed and the program ran until a bdos error returned to the cc.

MARVIN L. WATKINS
Los Altos, CA

INCOMPATIBLE IBM PC “COMPATIBLES”

Our company chose to develop our new software in BASIC in order to achieve the widest possible market for those products. We developed them using IBM PC BASIC.

However, recent testing on a number of the “compatibles” has uncovered an extremely serious problem among the various BASICS. It appears that the content of direct-access records, written by BASIC on some machines, cannot be retrieved.

The following test program illustrates the problem.

```
100 REM Compatibility Test Program
110 REM Establish an eight-character field
120 OPEN "R", #1, "TESTFILE", 8
130 FIELD #1, 8 AS F1$
140 REM Define any number
150 TEMP = -5
160 REM Make a double-precision string
170 TEMP$ = MKD$(TEMP)
180 REM Left-set the string into the field
190 LSET F1$ = TEMPS
200 REM PUT the record and CLOSE the file
210 PUT #1, 1
220 CLOSE #1
230 REM Re-OPEN the file and GET the record
240 OPEN "R", #1, "TESTFILE", 8
250 GET #1, 1
260 REM convert it back to a number
270 Ti = CVD(F1$)
280 REM Print the number
290 PRINT Ti
300 END
```

Actually, the problem is with a fundamental concept in the scope of the FIELD statement. In the IBM PC and in many of the compatibles, a FIELD statement, once it is established, continues for the duration of the program. Thus it has a global scope.

On the other hand, some of the compatibles treat the FIELD statement as having a local scope. So that when a FIELD statement is encountered for a file, the FIELD statements with the same file number are terminated as well. Variables that had been available from the FIELD statements are no longer accessible with their previous content or definition.

In the example given, those BASICS that appeared to fail no longer had access to FIELDed variables and were attempting to convert a null string (from an uninitialized string variable) into a number, which gave the “Illegal Function-Call” error message. The addition of an identical FIELD statement after line 240 seems to solve the problem.

Our perception to date is as follows:

<table>
<thead>
<tr>
<th>Machine</th>
<th>Scope of FIELD Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Columbia</td>
<td>Global</td>
</tr>
<tr>
<td>Compaq</td>
<td>Local</td>
</tr>
<tr>
<td>Data General DGI</td>
<td>Global</td>
</tr>
<tr>
<td>Eagle</td>
<td>Global</td>
</tr>
<tr>
<td>ITT:Xtra</td>
<td>Local</td>
</tr>
<tr>
<td>IBM PCs (all)</td>
<td>Global</td>
</tr>
<tr>
<td>Leading Edge</td>
<td>Local</td>
</tr>
<tr>
<td>Panasonic Sr. Partner</td>
<td>Global</td>
</tr>
<tr>
<td>Tandy 1200</td>
<td>Local</td>
</tr>
</tbody>
</table>

As a matter of expediency, and in order to circumvent the differences in scopes, we could add additional (but redundant) FIELD statements every time a file is opened, which we may have to do, but doing so would have a significant impact on both program size and execution speed. That is a terrible price to pay for the lack of standardization of BASIC.

We did want to call this problem to your attention in the hope that it may save others the many hours we have spent trying to determine why our BASIC programs, which run beautifully on many machines, would not run on other machines that were supposedly compatible.

MELVIN O. DUKE
YVO International
San Jose, CA

BYTE replies:

“Local versus global FIELD statements is an interesting way to describe what is actually a simple dynamic re-allocation of string space. In its never-ending quest to clean up that portion of memory reserved for strings (known vernacularly as “garbage collection”), the BASIC interpreter may or may not maintain pointers to strings in close file buffers (the pointers are stored in the string space area even though the buffers are located in low memory). A call to Microsoft provided only the advice that some manufacturers change the interpreter to suit their hardware and, therefore, Microsoft could not and does not claim that all its interpreters are identical.

The IBM PC BASIC manual claims that you need to OPEN a file and FIELD a buffer only once in a program that performs both input and output on the same file (Appendix B, page 10). PC BASIC maintains the pointers to file buffer strings. But other MS-DOS BASICS may not in an effort to free up maximum string space. (The buffer must be FIELDed before data can be PUT into a file: data must be PUT into a file before it can be read by a subsequent GET statement.)

Adding additional FIELD statements may marginally increase the size of programs, with a subsequent reduction in execution speed, but it would be hard to imagine that such a slowdown could be critical. If that were the case, you would choose to compile your BASIC or move to another compiled language.

FOUR ALGEBRAS

In the September 1984 article “Fractals” by Peter Sørensen (page 157), the statement was made that there are only three algebras: real numbers, complex variables, and quaternions. There are, in fact, four algebras or so-called division rings in this set. The fourth is an obscure eight-dimensional algebra that is known as the “Cayley Algebra,” invented by Cayley around 1875. It was subsequently shown that all such algebras must lie in spaces of order 2^n (i.e., 1, 2, 4, 8, 16, etc.). A couple of years later it was proved that only the first four exist.

Since the author has found quaternions of interest, he may find it fruitful to investigate the Cayley Algebra. To my knowledge, no practical application of the Cayley Algebra has been reported. MacDuffee’s book, An Introduction to Abstract Algebra (Wiley, 1940), is one good reference.

DR. MICHAEL K. BROWN
Murray Hill, NJ

Murray Hill, NJ
Music Computer with FM Sound

Yamaha’s CX5M, a Z80A-based music computer, features an FM sound synthesizer, 46 preprogrammed 8-note polyphonic FM voices, and an automatic accompaniment section so that you can play music immediately. The CX5M produces sounds through a video monitor with speaker, your home stereophonic equipment, or through a musical instrument amplifier.

Sounds can be recorded and played back using the CX5M’s memory, which can accommodate up to 2000 notes. Notes are entered from the computer keyboard displayed on screen, and played back instantly.

A separate FM voice program is available for additional voices. Optional 44-key mini or 49-key full-size piano-like keyboards turn the CX5M into a music synthesizer, and a programmable keyboard split screen lets you play two voices simultaneously. The CX5M has a MIDI interface that lets you connect it to most professional music synthesizers, such as Yamaha’s DX series.

The CX5M has 32K bytes of ROM and an equal amount of RAM. It has audio, joystick, printer, video monitor, and cassette hook-ups as well as a cartridge slot. The video specifications are 32-line by 24-character display, 16 colors, and 256-by-192-dot graphics. Microsoft’s MSX BASIC is built in. The computer keyboard is standard ASCII. Five shiftable function keys are furnished.

Several software cartridges are offered as options. One cartridge controls music composition and orchestration, while another lets you create new voices and modify the CX5M’s standard voices. The FM Music Macro cartridge lets you access the FM sound synthesizer through MSX BASIC for voice selection, composition, and automatic performance.

The suggested retail price is $469. The mini keyboard is $100, and the full-size board is $200. Software cartridges sell for $50. Contact Yamaha International Corp., POB 6600, Buena Park, CA 90622. Inquiry 614.

Communications, Word-Processing Software in Portable

Talbot Computers’ Limited’s Dialtex-4 is a portable word-processing and communications terminal. This 64K-byte computer has a Z80-compatible CMOS microprocessor and is outfitted with a 40-line by 8-column LCD. Its full-size typewriter keyboard is augmented with 10 programmable function keys.

System software is made up of CP/M, Microsoft BASIC, and word-processing and communications programs. In addition to traditional editing capabilities, the word processor has the ability to output manuscripts to a printer or storage device. The communications feature which can be used to link with electronic mail systems, stores correspondence for later transmission and accepts messages.

Standard interfaces, such as RS-232C, cassette, and Centronics parallel, are supplied. The Dialtex-4 also has a slot on the right-hand side of the display for optional equipment.

Dialtex-4 draws power from three sources: main lines, rechargeable batteries, or dry-cell batteries. For communications with field representatives, it can be easily linked to Talbot Computers’ remote receiving terminals.

Options include a 40-column thermal printer, a microcassette drive, and RAM disk storage. The basic Dialtex retails for just more than £600. The fully equipped version, the Dialtex-10, is £2000. Contact Talbot Computers Ltd., 293 Charminster Rd., Bournemouth, Dorset BH6 90W, England: tel: (0202) 519282. Inquiry 615.

Tandy Replaces Model 16s

The Tandy 6000, the XENIX 3.0-based successor to the Radio Shack Models 16 and 16B, is equipped with a 68000 chip and 512K bytes of RAM. Its twin serial ports can handle three users and it can be expanded to six users and 1 megabyte of RAM.

With dual 8-inch floppy-disk drives, the Tandy 6000 costs $4499. It’s priced at $5499 with one floppy drive and a 15-megabyte hard disk. Contact Tandy Corp., One Tandy Center, Fort Worth, TX 76102. Inquiry 616. (continued)
STD Board with FORTH Kernel

The ForthCard from HiTech Equipment Corporation is a single-board computer on an STD bus with a built-in FORTH kernel. This card is targeted at applications that require a simple computer to perform a dedicated function, such as data acquisition.

The heart of the ForthCard is Rockwell's 65F11 microprocessor, which can be obtained in either 1- or 2-MHz versions. It comes with a chip-based FORTH kernel and an expanded 6502 instruction set with bit test, set, and clear.

On the ForthCard are three JEDEC 28-pin sockets for 24k bytes of RAM, EPROM, or EEPROM and a small prototyping area. A pair of 16-bit counter/timers for pulse-width measurement and generation are also on board along with 16 I/O lines, configurable for parallel I/O, interrupt inputs, counter/timer I/O bits, asynchronous, shift register, or multiprocessor serial I/O. Miscellaneous features include auto-start, firmware support of an optional external disk controller, plug jumpers, and solder-masked printed-circuit board with silk-screened component legend. Power requirements are +5 volts at 0.25 amp. Single-unit prices begin at $375 for the ForthCard without memory or manual. With a development ROM, 2K-byte RAM, 2K-byte EEPROM, and manual, it's $5475. The manual alone is $30. Contact HiTech Equipment Corp., 9560 Black Mountain Rd., San Diego, CA 92126. (619) 566-1892. Inquiry 617.

Bilingual Computer Runs IBM Software

Multitech Industrial Corporation has introduced what it calls a fourth-generation Chinese computer. The DCS-570 microcomputer is a bilingual workstation built on the 8088 microprocessor and equipped with a character generator that can display both Chinese and roman alphabet characters on screen.

The DCS-570 emulates a variety of Chinese minicomputer and mainframe terminals. It comes with local networking capabilities and Chinese-language versions of Concurrent DOS and T/Maker, an integrated set of programs for word processing, data management, spreadsheet preparation, and graphics. A database manager is provided.

In addition to the character generator, DCS-570 hardware comprises 512K bytes of RAM, twin 640K-byte floppy-disk drives, six expansion slots for peripherals compatible with the IBM Personal Computer, and single RS-232C and Centronics-type parallel ports. A 15-inch gold-phosphor monitor with a 1024- by 768-pixel density and a 24- by 24-dot Chinese-character pattern is standard.

The DCS-570 is $6250. A model with a 10-megabyte hard-disk drive and one floppy-disk unit is $8000. Contact Multitech Industrial Corp., International Marketing Division, 266 Sung Chiang Rd., P.O. Box 10, Taipei, Taiwan, Republic of China; tel: (02) 551-1101; Telex: "19162 MULTIIIC" Inquiry 618.

16-line Communications Board

The COM16, a single-board communications computer from Microbar Systems, functions as a 16-line communications controller in Multibus systems or as a stand-alone single-board computer in dedicated communications equipment.

With 24 bits of addressing and 8- or 16-bit data transfers (I/O or memory), the COM16 provides a full IEEE-796 bus interface that has eight lines of RS-232C and is expandable with up to eight more lines of RS-232C or RS-422. Each transmit and receive channel has its own programmable data-rate generator offering 32 data-transferral rates ranging from 50 to 56,000 bps. The COM16 runs 16 lines at 9600 bps in full duplex and 16 lines at 19,200 bps in half-duplex mode.

The COM16 supports a variety of configurations. It is based on an 8-MHz 8086 microprocessor that controls four 8274-type MPSCs with DMA, two peripheral controllers for internal and external interrupts, and 4K bytes of static RAM. The COM16's base board has eight serial interface ports. All communications circuitry is on the board, allowing direct cable connection from the computer to local terminals.

The COM16's unit price is $1890. Contact Microbar Systems Inc., 785 Lucerne Dr., Sunnyvale, CA 94086. (408) 720-9300. Inquiry 619.

The COM16 is a single board for multuser communications.
Serial Imager

Apricorn's Super Serial Imager lets Apple II users transfer high-resolution images from screen to printer. Standard control commands let you dump high- and low-resolution images and text screens to the Apple Imagewriter and other serial printers. The Super Serial Imager maintains compatibility with Apple's Super Serial Card.

Another function of this package is communications. The Apricorn firmware contains communications software functions that let you use modems without purchasing special software. Apricorn expects retail price of the Super Serial Imager to be $129.95. Contact Apricorn, 7050 Convoy Court, San Diego, CA 92111, (619) 569-9483. Inquiry 620.

Sprites for the Apple II

The Sprite and Stereo Board adds arcade-style graphics and sound to the Apple II. The package includes over 140 ROM utilities you can call from any language using sprite codes. The video is based on the TMS9918. It supports 32 sprites, maximum resolution of 256 by 192 pixels, and 16K or 64K bytes of memory. Three graphics modes and a text mode are available.

Each of two audio channels has one noise and three voice (tone) generators with programmable amplitudes and a power amplifier that can drive an 8-ohm speaker. The system can produce sound effects or music.

In its 16K-byte configuration, the Sprite and Stereo Board is $249. The 64K-byte version costs $299. Contact Development Devices, RD 3, Box 490, Middlebury, VT 05753, (802) 388-6698. Inquiry 622.

Peripherals

Add-on Numeric Keypad

A 35-key numeric keypad for the IBM PC and PC XT is available from Touchstone Technology. The Touchstone 2 was developed as a productivity tool for spreadsheet, accounting, and other number-intensive applications: it is a two-level keyboard that uses a local shift key to generate 57 different PC-compatible key codes. Enter, addition, subtraction, multiplication, and division keys are located on the far right side of the number pad.

In its unshifted mode, the Touchstone 2 provides one-key access to the 34 most frequently used numeric data keys. Important but less frequently used keys are available in shifted mode; these include all 10 standard PC function keys.

The Touchstone 2 is a numeric keypad for the IBM PC and PC XT.
Image Scanner

Microtek Lab has developed the MS-200, a high-resolution desktop image scanner. The MS-200 accepts documents up to 8½ by 24 inches, digitizes the image at 200 pixels per inch, and transfers the image to host computer memory. Switch-selectable scanning modes include text mode, picture mode, and mixed mode.

Documents load from the top; the MS-200 scans and moves them one line at a time while the optics assembly remains stationary. The scanner performs Group 3 1-D CCITT data compression at a 10 to 1 ratio for text and at a comparable compression ratio for graphics.

The MS-200's interface allows integration with various host configurations for specific computers and communications systems requirements. For high-volume applications, you can add an automatic feeder.

OEM quantity price for the MS-200 is set at under $1000 (evaluation units are available for $1700). Contact Microtek Lab Inc., 17221 South Western Ave., Gardena, CA 90247. (213) 538-5369. Inquiry 624.

Space Tablet: Three-Dimensional Pointer

Soniciture's Space 'Tablet is a three-dimensional pointing device for Apple, Atari, Commodore, and IBM computers. Main components of this system are a pointing device that generates sonic pulses and an enclosure containing three sonic receivers.

The Space Tablet translates the pointer's location into x-, y-, and z-coordinates that can be understood by your computer. It works with any black-and-white or color television or monitor. Existing software for the KoalaPad or Kraft joystick can use the Space Tablet as a two-dimensional pointing device, while other software can be designed to take advantage of the third dimension.

Soniciture provides a software sampler with each Space Tablet. For the Apple II and IBM PCjr, the Space Tablet is $175. The IBM PC version costs $200, and the Atari and Commodore models sell for $150. For more information, contact Soniture Inc., 2146 Paragon Dr., San Jose, CA 95131. (408) 435-0217. Inquiry 626.

IBM PC AT Image Analysis

Digihurst Limited has introduced a version of its MicroScale II image-processing package for the IBM PC AT. This system lets the computer's memory hold a video image in numeric form. The image also appears on screen so you can define the sections to be processed.

The analysis functions include counting and sizing of objects, deriving areas and perimeters, and performing length calculations. These facilities are useful for laboratory experiments.


The MicroScale II package performs image processing for the IBM PC AT.
Desk Management

MyDesk couples a voice-communication interface board with desk-management software to give an IBM PC, XT, AT, or PC-compatible personal communication abilities. The package can interface to all standard PBX systems and does not require a modem. Desk-management features include a telephone directory that you can sort with an integrated relational database, telephone and PBX dialing, appointment and note pads, a calculator, and a billing timer and clock. Upon installation, the package partitions the PC's memory to let you run other programs at the same time.

The MyDesk package for use without a modem costs $199. MyDesk Jr., a version for users who already own a modem, does not include the interface board and costs $99. Contact Third Floor Systems Inc., Suite A1/14, 1630 Oakland Rd., San Jose, CA 95131, (408) 293-3360.

Digital Oscilloscope

The Digital Oscilloscope Peripheral from Rapid Systems is available for IBM, Apple, and Commodore personal computers. To turn your computer into an oscilloscope, you plug in the Peripheral and insert the supplied disk. The Peripheral provides the oscilloscope; your computer supplies intelligent control and analysis.

The Peripheral is a four-channel digital oscilloscope with a 2-MHz sampling rate, 500-kHz analog bandwidth, and diode protection on all inputs. The color-enhanced graphics display uses up to 138 by 288 pixels for data display and four lines of text for initial values of the scope's parameters.

Menu-driven operation allows keyboard control of gain parameters for channels A, B, C, and D; time-base values; number of channels; and trigger mode. Your computer's processing abilities contribute by storing and retrieving waveforms from disk and by analyzing and processing the information.

The Digital Oscilloscope Peripheral for the IBM PC and PC XT and the Apple II, llc, and IIe is $499. The version for the Commodore 64 and SX-64 is $399. Contact Rapid Systems Inc., 5415 136th Place SE, Bellevue, WA 98006, (206) 641-2141.

Inquiry 628.

3½-Inch Disk Drives for Apple IIs

Haba Systems has introduced a 3½-inch external disk drive for Apple IIe and IIc computers. HabaDisk drives can store up to 320K bytes.

Each drive comes with SoftBundle, a set of four business-oriented utility packages: HabaMerge, a form letter and mailing program; HabaTemplates, 54 predefined spreadsheet and database formats; HabaCom, a communications/telephone-dialing program; and Haba Memory Manager, designed to control the individual applications on the disk.

HabaDisk has a suggested retail price of $449.95. An external drive for the Macintosh, which also comes with SoftBundle, has a suggested price of $495. Contact Haba Systems, 15154 Stagg St., Van Nuys, CA 91405, (818) 901-8828.

PenGraph Plots Graphs Without a Micro

Silver-Reed's EB50 Colour PenGraph is a four-color typewriter/plotter that can be used to create bar, line, and pie charts without a computer. PenGraph can be linked with any computer through a standard parallel interface, and it can operate as a portable typewriter.

When in its plotting mode, the PenGraph rotates a single print element to select the proper color pen. Four pens—black, red, green, and blue—are provided. An optional pen set allows corrections to be made when the PenGraph is used in its typewriter mode.

PenGraph has a full 60-key typewriter keyboard, 16 special-function keys, and a 16-character liquid-crystal display. It's powered by five D-cell batteries or an optional AC adapter.

The 5½-pound EB50 Colour PenGraph plotter has a suggested list price of $299. Contact Silver-Reed America Inc., 19600 South Vermont Ave., Torrance, CA 90502, (213) 516-7008.

Inquiry 630.

Microfloppy-Disk Drive

The Model F353-MFD is a 500K-byte, 3½-inch, microfloppy-disk drive from Everett/Charles Marketing Services. It is Shugart-compatible, double-density, and single-sided. The unit employs 80 tracks with 135 tracks per inch and is compatible with 3½-inch floppy-disk drive controllers. The Model F353-MFD uses Sony media and standard IBM format.

A thin hybrid stepper motor is used with a steel belt-drive system for precision during head positioning. The Model F353-MFD also features an automatic power-down control.


Inquiry 632.
Large Characters for the Macintosh

A system of cut-and-paste character sets for the Macintosh, Headline Graphics is designed for people who want to create posters, signs, cards, or flyers. The package features special character sets in 18 points. The computer will sound an alarm or quietly keep time when the device is triggered.

Sentry System

Apple Alarm converts your Apple II or II+ into a sentry system that can detect smoke, fire, intrusion, motion, moisture, and other on/off sensory inputs. You attach your fire alarm, door switch, or other on/off sensor to the paddle but

Package Lays Out Pages for Newsletters and Flyers

ReadySetGo is an interactive page-making package for Apple's 512K-byte Macintosh computer. This program, which automates the page-design and pasteup process, is suitable for user-group newsletters, flyers, and brochures. ReadySetGo builds pages from blocks of text or graphics. It lets you use the Mac's mouse for pushing blocks around a page and for resizing them. A ruler, displayed on screen, tells you your page dimensions, and a specification sheet provides each block's design parameters and allows for accurate positioning.

Mac Database Lets You Customize Files

The 1st Base relational database-management system lets you create database files of your own design and manipulate your data using the Macintosh's editing tools. This program will join files, compute up to 25 fields, and create sub-files. It offers "if... then... else" logic and automatic data entry stored-report requests. Mail-merge functions are furnished. The 1st Base program can run up to 100 fields per record. With 1st Base, you can run 25 computed fields, 10 sorted fields, and 100 list fields per report. It has 17-digit precision, and 1st Base uses all the Mac's user-interface features, including pop-up menus, windows, scroll bars, and the mouse.

NAPLPS Software Decoders Run on Apples

A series of NAPLPS software decoders for Apple IIc and IIe computers has been announced by Formic Videotex Systems of Canada.

SOFDEC supports hard-copy printouts through dot-matrix printers. Designed for the Apple IIc. SOFDEC "C" costs $60. SOFDEC "E" is prepared for the Apple IIe microcomputer. It is a hardware/software combination featuring firmware on an RS-232C serial card. It lists for $340.

Contact Formic Videotex Systems, 8571 St. Denis, Montreal, Quebec H2P 2H4, Canada, (514) 384-2655.
Modula-2 Programming Environment

Designed to speed program development, the Modula-2 Software Development System (M2SDS) makes its first compilations invisibly, line by line, as you are writing your program. The system is built around a syntax-directed editor, an incremental code generator, an object optimizer, and a single-pass linker. These components produce native code said to minimize the need for assembly-language programming. The system corrects for programming errors and provides on-line help functions to aid in correcting undefined variables or data types.

M2SDS fully supports the Modula-2 standard as created by Niklaus Wirth. Eighteen library modules provide the core capabilities of Modula-2 but also include extensions to the standard. These modules supply ISO standard names for ASCII control characters, constants that show how bytes are mapped in 16- and 32-bit words, abstract data types that help solve geometric problems, and a library of floating-point functions, among other functions. Other features are windowing, automatic indentation and formatting, and support of color graphics and sound.

M2SDS retails at $249 with a tutorial, manual, and telephone support. The system runs on an IBM PC, PC XT, PC AT, and compatible machines. It requires 320K bytes of RAM and dual-sided, double-density floppy-disk drives. Contact Interface Technologies Corp., Suite 200, 3336 Richmond, Houston, TX 77098, (713) 523-8422. Inquiry 638.

8087 Support for dBASE II

Gryphon Microproducts has expanded its library of dBASE add-in products with dBRx/87, a mathematics/statistics program that links dBASE II with 8087 and 80287 mathematical coprocessors.

The system, geared toward scientists, engineers, and anyone performing mathematical calculations, provides scientific notation, exponentiation, square root, and other higher math functions. The package also provides several hundred registers for storing temporary totals. According to Gryphon, dBRx/87 performs at 10 to 200 times the speed of other math programs and delivers up to 18 digits of precision.

With dBRx/87, you can set the number of digits to the right of the decimal, accumulate partial totals in up to several hundred registers, and trap errors within your own programs. Written in machine language, dBRx/87 functions are accessed from within dBASE with the SET CALL TO/CALL commands.

The program runs on the IBM PC or PC AT and needs at least 96K bytes. The list price is $150. The software may be purchased with an 8087 chip for $300 or with an 80287 for the AT for $450. Contact Gryphon Microproducts, POB 6543, Silver Spring, MD 20906, (301) 946-2585. Inquiry 639.

dBASE Report Generator

You can connect up to six databases in one report and define reports up to 255 columns wide with Quickerreport, a report generator that works with both dBASE II and III. The maximum number of both sort fields and break fields is 16 each, and you can define as many calculated fields as you need using your own formulas. There is no limit to the number of report lines. Quickerreport can use italic, bold, and condensed fonts, and the program accepts numeric, character, date, and logical data types.

Ease of use is one of the package's main characteristics, the vendor said. You can draw your report on the screen using the program's word processor; you can draw lines and boxes on the screen using the line-drawing characters. Menus automatically prompt you, and on-screen help is available with a single keystroke. Other features include automatic horizontal and vertical scrolling and numeric formatting.

Quickreport runs on the IBM PC, PC XT, or systems that are totally compatible. Requirements include 256K bytes of memory, IBM PC-DOS 2.0 or later, two double-sided disk drives on the PC or a double-sided drive on the XT, dBASE II or III, and any printer.

Quickreport costs $295. Contact Fox & Geller Inc., 604 Market St., Elmwood Park, NJ 07407, (800) 221-0156; in New Jersey, (201) 794-8883. Inquiry 640. (continued)
Transfer and Reformat Data Between PC Programs

A full-screen data editor, PIK'r is designed to bridge the communications gap between incompatible software programs on IBM PCs and compatible machines. PIK'r lets you reformat the data from any report and transfer it between database managers, spreadsheets, and word processors. It allows ASCII files generated by mainframes to be formatted for use by PC applications.

PIK'r supports the CSV format for use with dBASE II and III. Multiplan's SYLK format, DIF (for VisiCalc and other spreadsheets), and PRN, used with Lotus 1-2-3 and Symphony. Simple flat files enable most word-processors to be accommodated. The program features a "Macintosh-style" interface and supports a mouse.

PIK'r retails for $95, which includes documentation and telephone support. Contact Samkhy Software Corp., POB 142, Petaluma, CA 94953, (800) 442-0012; in California, (800) 442-5544. Inquiry 641.

Information-Retrieval System

Sire is an information-retrieval system designed to find the documents you need when you're not sure what words to use to describe them. The program lets you retrieve information by natural language, heuristic word associations, word roots, like documents, full Boolean logic and adjacency, truncation and wild cards, and specific fields. Sire contains several innovative features, including stem matching, an automatic statistical thesaurus, and the use of documents in queries to find similar documents. The package ranks documents according to their probable usefulness.

Field and document length are not limited, and each document can have up to 256 variable-length fields. Also featured are full-text editing and manual indexing.

Sire, written in C, runs under MS-DOS on the IBM PC, XT, AT, and compatibles. It's also available for the DEC Rainbow and 16- and 32-bit computers running UNIX and RSX. The program costs $600; a demonstration disk for the PC and XT costs $25. Contact Cucumber Information Systems, 5611 Kraft Dr., Rockville, MD 20852, (301) 984-3539. Inquiry 641.

Network Operating System

OnX 2.0, a distributed network operating system for the IBM PC, PC AT, and compatibles, integrates the architecture of the local area network into the core of the operating system. At the level of intertask communication, enabling tasks to communicate with other tasks across the whole network. As a result, any program or application can access any serial port, printer, or disk on the network.

ONX supports distributed processing as well as distributed devices. Pure processing elements (computers without keyboards or displays) can be plugged into the network to be used as uncommitted processing resources. It supports a full implementation of X.25, allowing connection to public networks. ONX is available in a form suitable for porting to other 8088/8086/80186/80286 computers. ONX can operate in as little as 128K bytes of RAM. The version for four nodes or less costs $1300; the version for five nodes or more costs $2600. Contact Quantum Software Systems Ltd., Moodie Drive High Tech Park, 215 Stafford Rd., Unit 104, Ottawa, Ontario K2H 9C1, Canada. (613) 726-1893. Inquiry 643.

Multitasking System and Debugger

Raytronics has released two products for the IBM PC designed to provide multitasking capability and full DOS compatibility.

Andromeda, a real-time multitasking system, is intended primarily for automation and monitoring applications. It is DOS-compatible and requires 12K bytes of system memory. Andromeda also can run independently of DOS, a useful feature for system-controller-type applications in which you may install Andromeda in ROM. According to Raytronics, an almost unlimited number of tasks can run concurrently. Tasks are written in C. You can customize provided modules for specific serial terminals and printers and for adding your own executive calls. Andromeda costs $295, which includes a manual and demonstration program; the demo program alone costs $58.

PC-Debug is a stand-alone program that lets you debug your programs independently of DOS, yet it maintains complete DOS compatibility. The program uses a serial terminal connected to a serial port. No debugging information is displayed on the screen, which makes the program well suited for debugging menu and screen programs.

PC-Debug loads and runs any DOS-compatible executive program. The program provides complete disassembly and trace facilities and can set up to 10 breakpoints with multiple passes. You can enter the debugger at any time with Control-C. PC-Debug costs $95.

Contact Raytronics, 7392 Trade St., San Diego, CA 92121, (619) 566-7515. Inquiry 644.
Subset of C for Z80-based Systems

Small-C-80 is a subset of the C language that can generate code for any Z80-based microcomputer. It is designed as a program tool for system and real-time software, utilities, graphics generation, games programs, and other applications requiring compact code, the vendor said.

The compiler turns C source into assembly code, compatible with the Microsoft M80 assembler and running under CP/M. Your system needs only 36K bytes of free memory to compile a substantial program. Features include STATIC local variables, inline assembly code, initialized declarations for "table-driven" programs, standard formatted I/O, and a minimum program size of less than 600 bytes.

A single end-user license is £95 plus tax. For more information about Small-C-80, contact MMG Consultants Ltd., 19 St. Andrews Rd., Great Malvern, Worcestershire WR14 3PR, England; tel: Malvern (06845) 63555. Inquiry 645.

Windows on Sanyo's MBC 550

An MS-DOS program called KSP Windows for CP/M-86 modifies the IBM PC XT version of CP/M-86 so that it boots on Sanyo's MBC 550/555 microcomputers. The replacement BIOS provides four display windows and a twenty-fifth status line.

KSP Windows includes the necessary hardware-dependent programs for formatting disks, copying disks, and copying the loader and programs that manipulate a built-in alarm clock and the windows. The package also supplies a modified HELP:HLP file tailored to the implementation and a copy of Ward Christensen's MODEM? program configured for the system.

Each of the four windows may be any size up to 80 by 24; you can place them anywhere on the screen. Each window supports intelligent display editing.

KSP Windows requires 128K bytes of memory, a color or monochrome display, and a disk drive. A copy of CP/M-86 for the XT must be purchased separately. The package comes with documentation and is priced at $69. A utilities package containing five programs, including programmable function keys and screen dumps, costs $49. Contact Key Software Products, 440 Ninth Ave., Menlo Park, CA 94025, (415) 364-9847. Inquiry 646.

MS-DOS 2.11 for S-100 Systems

Lifeboat Associates has released a version of Microsoft's MS-DOS 2.11 for computers using the S-100 (IEEE-696) bus architecture. The SB-86 operating system, which is compatible with that of the IBM PC, runs on two CompuPro CPU boards: the CPU 8085/88 and the CPU 86/87.

To run SB-86, you'll need one of the aforementioned boards, a CompuPro System Support card with G086 EPROM, at least 64K bytes of 24-bit addressable RAM, and a Disk 1 or 1A controller and disk drive. Although the system is supplied on an 8-inch disk, it will support 5¼-inch disks with an IBM PC format if using Disk 1A.

The price of SB-86 is $275, which also gets you the Microsoft MS-DOS user's guide and programmer's reference manual. Contact Lifeboat Associates, 1651 Third Ave., New York, NY 10128, (212) 860-0300. Inquiry 647.

C Math Library

Micro International's C-Language Mathematics Library supports trig, hyperbolic trig, log, ln, exponentiation, and square root. It consists of an include file that defines mathematical constants and the functions in the library as returning floats; mathematical functions generated using CORDIC techniques; and mathematical functions generated using polynomial approximations.

The CORDIC approximations have an accuracy of approximately five to six digits; the polynomial approximations have an accuracy of six to seven digits. The source files for both the CORDIC and polynomial libraries are included on the disk, along with several assembly-language support routines.

The C-Language Mathematics Library, which costs $100, is available under PC-DOS and MS-DOS and under Flex and OS-9 for use with Lattice, Microsoft, C86, DeSmct, Introl, and McCoss/Microwave compilers. Contact Micro International, POB 47, East Fairfield, VT 05448, (802) 827-3827. Inquiry 648.

File Archive Utility

Archive is a utility program designed to provide savings in disk space when storing, saving, and making backups of files. With this program, you can create an archive file whose contents can be listed, updated, appended, extracted, and deleted. Files can be date- and time-stamped when placed in an archive, and you can add comments about a file. Binary and text files can be archived.

The package supports wild cards for filenames. Special header and trailer records in an archive file can be made to look like comment lines for any high-level language, thus enabling the file to be compiled.

Archive runs on any 8080, 8085, or 286 system with 32K bytes of RAM and requires CP/M-80 2.2. The price is $24.95. Archive-86 runs on any 8086 or 8088 system with 64K bytes of RAM and requires MS-DOS, PC-DOS, or Z-DOS. The price is $34.95. Contact Generic Software, POB 790, Marquette, MI 49855, (906) 249-9801. Inquiry 649.

(continued)
BASIC Compiler for Models III and 4

**NB DB** is a database program for Commodore 64 and 16K-byte VIC-20 micros. Written in BASIC, this program can handle mailing lists, print labels, and track account books or inventories. It uses either tapes or disk for program and file storage.

NB DB features a screen dump capability for note taking, and variable line spacing and tabbing for printing labels. It can sort on any of 30 user-definable fields. You can use any part or complete descriptions of a field when using its search mode. It permits new or existing files, and you can add to, revise, and delete records.

This menu-driven system uses BASIC LOAD and SAVE commands. It comes formatted for the Commodore 1526 printer and with a sample data tape containing a list of VIC and Commodore 64 users groups. It sells for $24.95, which includes instructions and two copies (please specify tape or disk, BASIC or RABBIT). Postage and handling fees for tape and disk versions are $2.50 and $4, respectively. Contact Nissen Bernstein, 510 Little Creek Rd., Lynchburg, VA 24502. Inquiry 691.

**Graphics Development System**

A graphics development system for disk-based 64K-byte Radio Shack Color Computers. Coco Paint is published by Four Star Software. This package gives you a combination of programs and utilities for creating graphics through a keyboard, joystick, mouse, or graphics tablet. Three workpages are available for use at all times, and your creations can be saved to disk, output on a printer, or transmitted to another user over a modem.

Graphics and text can be intermingled in the workspace. You can zoom in on any area of your graphics and, paint with differing textures. Coco Paint's utilities let you devise custom character sets or modify an existing set. You can also develop your own textures or tinker with the 64 textures supplied with the program. Full use of stamps, including the ability to store, recall, move, expand, or shrink, is provided. You can also alter the data rates for your printer or modem from within this program.

Coco Paint supports most common printers with graphics capabilities. With a manual and reference card, it sells for $39.95. Postage and handling is $2.50 in Canada. Coco Paint is $49.95. For more information, contact Four Star Software, P.O.B 730, Streetsville, Ontario L5M 2C2, Canada. Inquiry 652.

**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' interest? and (b) is it new or is it simply a reintroduction of an old item? Because of the volume of submissions, we cannot sort through every month, the items we publish are based on vendors' statements and are not individually verified. If you want your product to be considered for publication (at 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, P.O.B 372, Hancock, NH 03449.

**TI 99/4A Program Line**

Western Properties Investment Company markets a line of programs for the TI 99/4A computer. Programs in this line require Extended BASIC and a data cassette. Printers, disk drives, and memory expansion units are optional.

The File Book II DP database can handle up to 100 records made up of six 28-character items per record. It sorts six fields, and you can search by name, number, word, or letter in any of the fields. Other features include updating, review, delete, full line editing, a field, memory-full and IO error protection, printing facility, and menu-driven operation. The File Book III DP has a suggested price of $39.95.

The Printer Book DPC is for writing letters two pages long. It has built-in mnemonics that give you keyboard control over the printer. Features are word wrap, replace word or line, insert or delete, search, print labels, and record merging. The Printer Book DPC costs $35.95.

Other programs available include accounts receivable and a spreadsheet. For further information, contact Western Properties Investment Co., Software Division, P.O.B 9602, Marina Del Rey, CA 90295. Inquiry 653.
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### IBM PC HARDWARE

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You can boost the low-bass at 31hz, 62hz and/or 125hz, and the mid-bass at 250hz and 500hz to animate specific areas of the musical spectrum.

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You can also boost or cut specific mid-range frequency areas to add or subtract vocal, trumpets, guitars or whatever instrument ranges you prefer.

GREAT FOR 2 TAPE DECKS
You can push a button and transfer all the equalization power to the inputs of two tape decks. So, if you have a cassette deck in your car or a personal stereo that you wear, now you can pre-equalize your cassettes as you record them.

Now you can get all the dramatically enhanced sound wherever you are. This is an especially great feature for bass starved portable and high-end starved car stereos to make them come alive.

And, look at this. There are two tape inputs and outputs, so you can dub from tape deck A to B, or make two tapes at once with or without equalization.

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Just plug the equalizer into the tape ‘in’ and ‘out’ jacks on your receiver. We even supply the cables.

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Z80 Apple IIe ..... 89.00
16K Card ..... 39.95
Cooling Fan ..... 39.95
Power Supply ..... 74.95
Joystick ..... 29.95
RF Modulator ..... 13.95
Disk Drive ..... 169.95
Controller Cable ..... 59.95
Paddles ..... 7.95

MV-915 $44.95

VIEWMAX-80 $149.95
80-column card for Apple II series
- Video Soft Switch
- Inverse Video
- VIDEX's Videoterm compatible

VIEWMAX-80e $119.95
80-column extended video card for Apple II
- 64K RAM, expandable to 128K
- Double-High-resolution circuit
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Compatible for either:
APPLE II and APPLE IIe
OR
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MULTIFUNCTION CARD
- Expandable to 512K
- Parallel Port
- Serial Port
- 1-Year Warranty

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MEMORY CARD

MEMORY EXPANSION KIT

PRINTMAX 59.95
Parallel printer card, Apple II series
- Centronics compatible
- Variable print widths
- Up to 5000 characters/second

APPLE & IBM Compatible DISK DRIVES

DISKETTES 5¼”

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- SS/SD ..... 15.90
- SS/DD ..... 16.90
- DS/DD ..... 22.90

SOFT SECTOR with HUB RING

BULK 5¼” DISKETTES (NO LABEL)

SS/DD ..... 10 for 14.90
100 up ..... 139.00

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APPLE & IBM Special Extended 80-Col. VIDEO CARD $69.95

★ 64K to 128K ★

MULTIVIEW 80/160 249.00
80-160 columns with any monitor!
- Screens: 80x24, 80x32, 80x40, 96x24, 132x24, 132x30, 160x24
- On-screen BOLD and Underline
- Reverse scrolling
- Easy-to-read Wide-angle mode
- Apple II and Ile compatible
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- Upper & lowercase letters

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4164 200ns

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- Shugart mechanism, made in U.S.A.
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MOUSE KITS!

Piper-Mouse

80-Channel electronic circuit. Use the whistle in this kit and Piper-Mouse follows your commands, turning left or right, stopping and starting. Uses 2 AA and 1 9V battery (not included).

MV-915 $44.95

RIBBON CABLE

CONTACTS
SINGLE COLOR
COLOR CODE
11 10 9 8 7 6 5 4 3 2 1
10 4.5 4.3 3.8 3.6 3.5 3.4 3.2 3.0 2.8 2.6
9 3.5 3.3 2.9 2.7 2.6 2.4 2.2 2.0 1.8 1.6
8 2.4 2.2 1.8 1.6 1.4 1.2 1.0 0.8 0.6 0.4
7 1.0 0.8 0.6 0.4 0.2 0.0 0.5 1.0 1.5 2.0
6 1.2 1.0 0.8 0.6 0.4 0.2 0.0 0.2 0.4 0.6
5 1.0 0.8 0.6 0.4 0.2 0.0 0.05 0.1 0.15 0.2
4 0.8 0.6 0.4 0.2 0.0 0.0 0.05 0.1 0.15 0.2
3 0.6 0.4 0.2 0.0 0.0 0.0 0.05 0.1 0.15 0.2
2 0.4 0.2 0.0 0.0 0.0 0.0 0.0 0.05 0.1 0.15
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0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

Checkmate Technology, Inc.

RESISTORS
¾ WATT 5% CARBON FILM
ALL STANDARD VALUES
FROM 1 OHM TO 10 MEGOHM
50 PCS . . . . . . . . . . . 1.25
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Extended 80-Col. VIDEO CARD

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IDEAL FOR OEM MANUFACTURERS, UNIVERSITIES, RESEARCH LABS ETC.

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EXCLUSIVE FLIP-TOP-CASE™
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RUGGED HEAVY GAUGE STEEL CONSTRUCTION

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FEATURES:
• Horizontal Return Key
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• Enter Key for Numeric Keypad

FULL PC Compatibility

FULLY ASSEMBLED AND TESTED WITH ONE YEAR LIMITED WARRANTY

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EXCLUSIVE FLIP-TOP-CASE™

ONLY $149.95

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FULL IBM PC-XT* COMPATIBILITY!
FULL MEGA-BYTE RAM CAPACITY
ON MOTHERBOARD!

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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 mounting
of compatible expansion
cards for easy bus
expansion and custom
configuring) (Board has
60 pin gold plated compat-
ible connector)

Extended ROM
Capability
(Runs all compatible PC
ROMS) (Jumper programmable to accommodate all
popular 8K, 16K, 32K and
64K ROM chips and NEW
EE ROMS! VPP power pin
available for EP ROM
burning!) (External
VPP voltage required)

Full Mega-Byte Ram Capacity!
On board!
(With parity)
□ 256K Bytes using 64K chips
□ 1 Mega Bytes using 256K chips

Hardware Reset
(Overcomes reset flaw
in PC)

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(Full IBM* pinout compatible)

8088 Processor
(Same as PC)

8087 Numeric
Processor
(Same as PC)

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Support Circuits
(Same as PC)

Configuration
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(Same as PC)

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(Same as PC)

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\[\text{Blank board with full assembly}
\text{instructions and parts list.} \]

Includes highest quality PC board
with gold plating, silk screen,
solder mask

\[\text{Board Size} \quad 10.5\ \text{inch} \times 13.5\ \text{inch} \]

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\text{subject to change without notice. Shipping}
\text{and handling charges via UPS ground $5.50.}
\text{UPS air $1.00/lb. Minimum charge $3.00.} \]
The Complete Computer

Here's a 50 character per second, plain paper, dot matrix printer that you can use with virtually any home or office personal computer. It's built really tough to withstand heavy use. It's really easy to use. And, it even prints graphics. Price Slashed to $129.

By Drew Kaplan

Complete your computer. Now you can harness the full power of your computer. From writing letters to listing programs, your computer will be incredibly more useful.

It uses plain paper and it's super reliable. It prints both upper and lower case characters. And, if you aren't using a printer with your computer, read on.

LISTING/INDEXES/LETTERS AND MORE

Experience the thrill of actually writing your letters and reports on your computer. Now you'll be able to use all of your computer's word processing and correcting capabilities to really explore your creative talents.

It's easy. Some of the new word processing programs are so 'user friendly' that you can learn to use them in just about 10 minutes. Change a line, change a word, move a line. Just push a button.

Are data bases a four letter word? Not on your life. Now you can use your computer to organize all your telephone numbers, your stocks, stamps, and recipes.

If you're using your computer for business, you can have a complete, instantly accessible file for each customer by name, what they bought, when, etc.

A database will let you find or organize and print out any information you want, whenever you want.

There's no more complicated programming required. And, inexpensive data base programs are available at any computer store.

PERMANENT RECORD

If you have a modem, you're in for a treat. You can access encyclopedias, stock market reports, and much more. When you sign on a service like CompuServe or The Source, the world is quite literally at your finger tips.

With a printer, you can get a 'hard copy' of all the incoming information. You can get everything from SAT test simulations and IQ tests to loan amortization schedules.

AFRAID OF PROGRAMMING?

You don't need to know the first thing about programming to use this or any printer. But, if you've never typed in and run a program, here's the easiest one I know. Turn on your computer.

Commodore Owners, and Atari Owners, your computer, and most others will say 'Ready'. Just push Control and Reset on an Apple. Then type the following:

10 PRINT "DAK IS WONDERFUL"
20 GOTO 10

RUN

You should type a carriage return at the end of each line. Why not try this program now? Next time, I'll tell you how to get out of the program, and maybe even discuss peeks and pokes.

If the program isn't running, type LPRINT instead of PRINT in line 10.

To you sophisticated programmers, think how easy your life will be when you can print out program lists that you can study at length.

And, you won't have to load a bunch of disks to find a program when you print out a menu for each of your disks.

LOOK AT ALL IT DOES

An ad in several August computer magazines listed a $149 thermal printer (that needs expensive thermal paper) as the lowest priced printer in the U.S.

Imagine a 50 character per second, plain paper, full 80 column dot matrix printer with a built-in standard Centronics Parallel Interface, slashed to just $129.

This printer handles plain old cheap standard fanfold pin feed computer paper from 4.5" to 9.5" wide, with it's built-in adjustable tractor pin feed drive.

It's so powerful you can even use two-part forms for a carbon copy. Plus, there's an impact control for print darkness.

It understands and prints 116 upper and lower case characters, numerals and symbols. And that's not all.

You can even print Double Width characters. And, look at this. This printer has full graphic capabilities with 480 dot horizontal resolution and 63 dot per inch vertical resolution. So, you can print out your pictures, pie charts or graphs.
It prints 10 characters to the inch, six lines to the inch. In short, it's going to make typewriters into dinosaurs. When you make a mistake, you never have to type it over again. If you find an error, just make the correction and let the computer retype your work for you.

The printer is made by C. ITOH/Leading Edge in Japan. It's built to really take heavy use. But in the unlikely event that it should need service, there are approximately 400 service centers nationwide. It takes standard long life inked ribbon cassettes that are readily available nationwide. This is a printer that will give you many years of continuous reliable service and enjoyment.

AND NOW THE BAD NEWS

If you are the president of a large company sending important business letters, you may want a $1000 daisy wheel printer. But for most uses, dot matrix printers are incredibly faster, and there isn't any way to print out a graph or picture on a daisy wheel printer.

There are two things you need to know about this printer. First, it has about the dumbest name I've ever seen. It's built tough and rugged. So, they named it The Gorilla Banana Printer.

Second, like many dot matrix printers, the letters g, p, q, and y are level with the other letters. Each letter is completely formed, but each sits level with the rest of the alphabet.

Upper case letters and symbols are unaffected. So, if you don't want letters that look like they were printed by a computer, this printer isn't for you.

But for most letters, term papers, or reports, this is all that is needed. It transmits all the data bases and information you'll get through a modem, this printer is perfect.

COMPATIBLE COMPUTERS

Any Computer with a standard Centronics parallel port, such as: Apple, Franklin, IBM PC, TRS-80, Osborn, Atari, Commodore, Color Computers, Plus, virtually any other personal computer. Plus, most briefcase portables.

FEAR OF INTERFACES?

Your computer is smart. But, it doesn't know how to 'talk' to other devices. That's why you need an interface.

An interface isn't just a cable. It's actually an intelligent translator that lets your computer talk to other equipment.

Usually the computer manufacturers don't include the various interfaces when you buy your computer, because they don't know if you'll ever add peripherals such as disk drives, printers or modems. You'll probably buy an interface if you don't need, you don't buy an interface until you add onto your computer.

There are two types of printer interfaces. The first allows you to do text processing. For 99% of computer use, this is all that is needed. It translates all the possible letters and punctuation known as ASCII. This printer understands 116 characters and symbols. A second type of interface also allows you to dump pictures or graphics from your screen or memory. This is more complicated because every dot must be transferred into the printer. It involves a "driver program" as it is called, is available in two forms; built into an interface card, or as a program on a disk which you use in conjunction with any standard interface.

Either way, you'll have the printer operating in just a few minutes. And if you already have the same Centronics parallel interface and cable (about 85% of all printers are compatible) should work with this printer.

WHY SO CHEAP

A new model will emerge soon with a different name. Leading Edge had just 28,000 of these remarkable printers which have been selling at discount for as little as $199, left in stock.

DAK bought them all for cold hard cash. And now we're offering them to you for less than the original price we were quoted as wholesale.

The printer is approximately 16½" wide, 9" deep and 7" tall. It's backed by Leading Edge's standard warranty.

ADD PRINTING POWER TO YOUR COMPUTER RISK FREE

Now you can really make use of your computer. 50 characters per second printing on plain paper for just $129. Wow! Now you can print out your programs, notes or your letters. If you're not 100% satisfied, simply return the printer and any accessories in their original boxes to DAK within 30 days for a refund.

To order your 50 Character Per Second Dot Matrix, Plain Paper Printer with a built-in Centronics Parallel Interface, risk free with your credit card, call toll free, or send your check for the breakthrough close-out price of just $129 plus $8 for postage and handling to DAK. Order No. 4101. CA res add 6% sales tax.

Special Note: If you need a serial printer for a computer such as TRS-80 Color Computer, order the identical printer with a built-in Serial Interface for the same price. Use Order No. 4101.

The Printer comes packaged with a long life ribbon. Extra ribbons are available at computer stores. DAK has them for $5, each (8107). Standard Centronics Interface for your computer are available at any computer store. This Printer has its receiving interface built in. You simply need one, complete with its cable, to plug into your computer to 'send' information. Below are our prices for 5 of the most popular computers.

For your Apple, we have Practical Peripherals' text interface for just $49 ($2 P&H) Order No. 9877. We have their graphics interface for just $79 ($2 P&H) Order No. 4104. If you already have a Centronics Parallel Interface, we have a graphics driver program on disk for just $7 ($1 P&H) Order No. 4105.

For your IBM PC, you don't need an interface. It's already built-in. But, you do need a cable. We have a cable, ready to connect this printer to your computer, for just $19 ($2 P&H) Order No. 9878. We have a graphics driver program on disk for just $7 ($1 P&H) Order No. 4106.

For your Atari 800, 800XL, 400, or 600XL, we have a text interface for just $69 ($2 P&H) Order No. 9881. We have a graphics driver program on disk for just $7 ($1 P&H) Order No. 4107.

For your Commodore VIC 20 or 64, we have a text interface for just $39 ($2 P&H) Order No. 9883. We have a Graphics Interface for just $54 ($2 P&H) Order No. 4108.

Special Bonus for Commodore 64 owners. We have a powerful word processing program with editing, including changing a line, a word, or moving a line. Once you've tried computer word processing, you'll never want to look at a typewriter again.

Plus, we have a super data base program that lets you use 8 fields of information up to nine different ways. Then you can search for any part, sort alphabetically or numerically and print out an address book, a list of your stocks or anything you can imagine. They're both yours for just $5 ($1 P&H) with purchase of the printer. Use Order No. 4127 for Disk, or Order No. 4123 for Cassette.

For most TRS-80 Computers, you don't need an interface, just a cable. For the Black and White Computers, we have a Parallel Cable for just $18 ($2 P&H) Order No. 9885. For the Color Computers we have a Serial Cable (you need the Serial Printer as well) for just $18 ($2 P&H) Order No. 4109.

For briefcase-type portables, the Centronics Interface is usually built-in. Just stop by any computer store. All Centronics Printers use the same cable at the printer end, but you'll need a cable that fits your particular computer.

Get hard copy print-outs of your programs or your graphics. Turn your computer into a powerful word processor. Forget retyping ever again. For just $129 you can make your computer complete.

DAK INDUSTRIES INCORPORATED

TOLL-FREE ORDER LINE

For credit card orders call 24 hours a day 7 days a week CALL TOLL-FREE ... 1-800-325-0800
8200 Remmet Ave., Canoga Park, CA 91304

MARCH 1985 • BYTE 479
MONITORS

<table>
<thead>
<tr>
<th>Model</th>
<th>Resolution</th>
<th>Colors Available</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEC JC12015</td>
<td>400 x 240</td>
<td>RGB</td>
<td>Suitable for use with most computers.</td>
</tr>
<tr>
<td>BMC AU9191U</td>
<td>400 x 240</td>
<td>RGB and YPBPR</td>
<td>Suitable for use with VHS equipment.</td>
</tr>
<tr>
<td>Zenith ZVM122</td>
<td>400 x 240</td>
<td>RGB and YPBPR</td>
<td>Suitable for use with VHS equipment.</td>
</tr>
</tbody>
</table>

PRINTERS

<table>
<thead>
<tr>
<th>Model</th>
<th>Print Speed</th>
<th>Interface</th>
<th>Memory</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epson RX-100</td>
<td>120 Char/sec</td>
<td>Serial/parallel</td>
<td>512K</td>
<td>Suitable for use with IBM PCs.</td>
</tr>
<tr>
<td>Epson LX-1500</td>
<td>900 Char/sec</td>
<td>Parallel</td>
<td></td>
<td>Suitable for use with IBM PCs.</td>
</tr>
</tbody>
</table>

TERMINALS

<table>
<thead>
<tr>
<th>Model</th>
<th>Features</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shugart 604</td>
<td>640 Winchester</td>
<td>Suitable for use with any PDP-11 compatible computer.</td>
</tr>
</tbody>
</table>

MODEMS

<table>
<thead>
<tr>
<th>Model</th>
<th>Features</th>
<th>Notes</th>
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<tbody>
<tr>
<td>PROMODEM 1200</td>
<td>1200 Char/sec</td>
<td>Suitable for use with IBM PCs.</td>
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</table>

ASCII KEYBOARD

<table>
<thead>
<tr>
<th>Model</th>
<th>Features</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eagle W-33</td>
<td>118 keys</td>
<td>Suitable for use with most IBM compatible computers.</td>
</tr>
</tbody>
</table>

CONTRAC 9" MONITOR

<table>
<thead>
<tr>
<th>Model</th>
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<tr>
<td>Eagle W-385</td>
<td>9&quot; diagonal</td>
<td>Suitable for use with most IBM compatible computers.</td>
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DIGITGRAPHICS MULTIFUNCTION CARD

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SWITCHING SUPPLY

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SHUGART $159

The Shugart 801R has long been the standard by which all other eight-inch disk drives have been judged. The 801R has traditionally been used by thousands of quality-conscious equipment manufacturers because of their extremely high degree of reliability. These units are currently production rack-mountable LSI tech. The drives are identical to drives currently sold by our authorized distributors at $600.

California Digital has acquired these NEW units as a result of our acquisition of the SHU-801 R. The drives are identical to drives currently sold by our authorized distributors at $600.

Upon request, all drives are supplied with power connectors and manual.

MEMORY

4164 DYNAMIC MEMORY 150ns $3.95

Shipping: First five pounds $3.00, each additional pound $5.50. Foreign orders: 10% shipping, excess will be refunded. California residents add 6½% sales tax. 60-day C.O.D.'s discouraged. Open accounts extended to state supported educational institutions and companies with a strong "Dun & Bradstreet" rating.
SUPER $500,000
Call Toll Free Now!

PRINTERS

OKIDATA
ML150A, Replaces ML9A "New" $329
ML35A, 15 Para., 4800 $539
ML35P, 150 cps, Cont. Quality $359
ML32 IBM Graphics Comp. $359
ML32S, 150 cps, Cont. Quality $485
ML22 Apple Mac 2K Graphics $475
ML32P, 150 cps, Cont. Quality $589
ML33 IBM Graphics Comp. $479
ML35S, 150 cps, Cont. Quality $769
ML4P, 200 cps $679
ML4 IBM Graphics Comp. $579
ML4S, 200 cps $779
Okimate 20 $139

RITEMATE
Ritemate Plus 120 cps w/Tractor $257
Ritemate Blue Plus 140 cps IBM $412
Ritemate 180 cps, BK mem. w/Trac $369
Ritemate 15, 160 cps, 15" cart. $549

QUEM
Letterpro 20 Prop, Spc. Enh Print $497
Sprint 1140 - 3, 2K, 40 cps, 132 col. width $149

STAR MICROINICS
Gemini 10X, 10", 120 cps $249
Gemini 10X P (IBM Comp) $259
Gemini 10X P, 120 cps $349
Gemini 15X IBM (IBM Comp) $369
Delta 10, 10", 160 cps $369
Delta 10 P $369
Powerwrite, 18 cps Par & Ser $349
SG 10, 120 cps (in stock) $497
SG 20, 120 cps (in stock) lowest price

C. ITOH
Prowriter 8510 AP, 120 cps $309
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<td>IBM PC 64K with 1 Drive</td>
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<td>LOTUS 123</td>
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<th>IBM PC 10MB SYSTEM</th>
<th>IBM PC 20MB SYSTEM</th>
<th>IBM PC 30MB SYSTEM</th>
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<tr>
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<td>Basic system includes 256K, one floppy drive, keyboard, 10MB Hard Disk with controller (boots from hard disk)</td>
<td>Basic system includes 256K, one floppy drive, keyboard, 20MB Hard Disk with controller (boots from hard disk)</td>
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<th>FX-80</th>
<th>$389</th>
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<tr>
<td>RX-80F</td>
<td>$279</td>
<td>FX-80F</td>
<td>$359</td>
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<tr>
<td>LO-1500 Parallel</td>
<td>$199</td>
<td>Serial</td>
<td>$199</td>
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<tr>
<td>LO-1500 Tractor/Cutseth Feeder</td>
<td>$56</td>
<td>SF-50/SF-200</td>
<td>$199</td>
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<tr>
<td>NEW JX-80 Color</td>
<td>CALL</td>
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<tr>
<td>OKIDATA 92P</td>
<td>$299</td>
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<tr>
<td>93P</td>
<td>$549</td>
<td>84P</td>
<td>$609</td>
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<tr>
<td>NEW OKIMAX 20 Color/182P</td>
<td>CALL</td>
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<tr>
<td>JUKI 6100</td>
<td>$399</td>
<td>(18 CPS) 13&quot; wide</td>
<td>$399</td>
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<tr>
<td>JUKI 6300</td>
<td>$679</td>
<td>(40 CPS) 16&quot; wide</td>
<td>$679</td>
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<tr>
<td>TOSHIBA 1300P/1351P</td>
<td>$699/519</td>
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<tr>
<td>BROTHER HR-15 XL (20 CPS)</td>
<td>$349</td>
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<tr>
<td>HR-25 (23 CPS)</td>
<td>$599</td>
<td>HR-35 (34 CPS)</td>
<td>$599</td>
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<tr>
<td>Tractor/Sheet Feeder for HR-25/35</td>
<td>$119/519</td>
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<tr>
<td>DM-5 (5 PIN)</td>
<td>$199</td>
<td>DM-40 (24 PIN)</td>
<td>$199</td>
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<tr>
<td>DM-40 Cutseth Feeder SF-50/50-200</td>
<td>$199/249</td>
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<tr>
<td>C. ITON 8510-AP</td>
<td>$309</td>
<td>8510-SP</td>
<td>$499</td>
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<tr>
<td>8510-SC</td>
<td>$589</td>
<td>1550-SP</td>
<td>$789</td>
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<tr>
<td>1550-PC</td>
<td>$689</td>
<td>1550-SCP</td>
<td>$789</td>
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<td>F-10 (40 CPS)</td>
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<td>F-10 (55 CPS)</td>
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<td>$80</td>
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<tr>
<th>DIABLO 630 ECS/IBM</th>
<th>$799</th>
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<tr>
<td>NEC-2FS</td>
<td>$49</td>
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<tr>
<td>P-3</td>
<td>$899</td>
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<tr>
<td>2050</td>
<td>$699/3550</td>
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<tr>
<td>DIABLO 630 ECS/IBM</td>
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<tr>
<td>H-P Thinkjet InkJet Printer 150 CPS</td>
<td>$499</td>
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<tr>
<td>LaserJet Laser Printer 300 CPS serial</td>
<td>CALL</td>
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<td>TEXAS INSTRUMENTS 855</td>
<td>$499</td>
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<tr>
<td>1 MB</td>
<td>$499</td>
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<td>4 MB</td>
<td>$1399</td>
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<tr>
<td>TALL GRASS 20 MB w/Backup</td>
<td>$999</td>
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<tr>
<td>35 MB w/45 MB</td>
<td>$999</td>
</tr>
<tr>
<td>Controller</td>
<td>$120 Cartridge</td>
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<tr>
<td>CALL</td>
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<tr>
<td>QUBIE 10/20 MB Internal or External</td>
<td>CALL</td>
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<tr>
<td>KAMERMAN MasterFlight w/10, 20 or 30 MB HD and 10, 10 or 60 MB streamer tape backup w/controller cards, 5 plug power control, surge protection and lock. Call for Best price for your RIGHT combination.</td>
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<td>SYC GEN</td>
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<td>SYC GEN</td>
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<td>SYC GEN</td>
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<td>GENIE Fixed/Removable Systems</td>
<td>Complete line</td>
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<th>TEAC Half HT FD 55 - DDS</th>
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<td>CDC Full HT Half HT - DDS</td>
<td>$139</td>
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<tr>
<td>TANDON 100-2 Full HT - DDS</td>
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### APPLE GUIDE RESULTS


### WORTHY OF NOTE

The product description of "The Tandy 1000" by BYTE senior technical editor G. Michael Vose is the winning article from December. In second place is Steve Ciarcia's "Build the Power I/O System." Richard S. Shuford, BYTE's special-projects editor, is the author of "An Introduction to Fiber Optics. Part I," which came in third. Jerry Pournelle, "Home Again!" at Chaos Manor, takes fourth in the lineup. And in fifth place is Wayne Rash's review of "The Zenith Z-150 PC." Mr. Rash wins the first-place bonus of $100 because his was the first non-staff-written article to appear in the top five. Therefore, the winner of the $50 second-place bonus is sixth: Kim Maxwell, author of "High-Speed Dial-Up Modems."

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**WORTHY OF NOTE**

The product description of "The Tandy 1000" by BYTE senior technical editor G. Michael Vose is the winning article from December. In second place is Steve Ciarcia's "Build the Power I/O System," Richard S. Shuford, BYTE's special-projects editor, is the author of "An Introduction to Fiber Optics. Part I," which came in third. Jerry Pournelle, "Home Again!" at Chaos Manor, takes fourth in the lineup. And in fifth place is Wayne Rash's review of "The Zenith Z-150 PC." Mr. Rash wins the first-place bonus of $100 because his was the first non-staff-written article to appear in the top five. Therefore, the winner of the $50 second-place bonus is sixth: Kim Maxwell, author of "High-Speed Dial-Up Modems."

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