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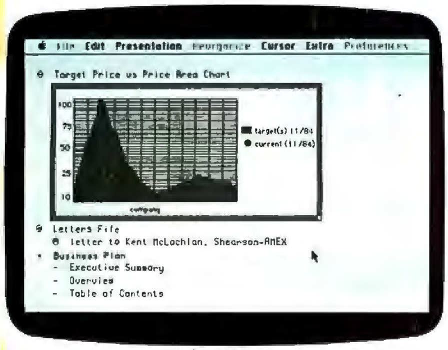
BYTE

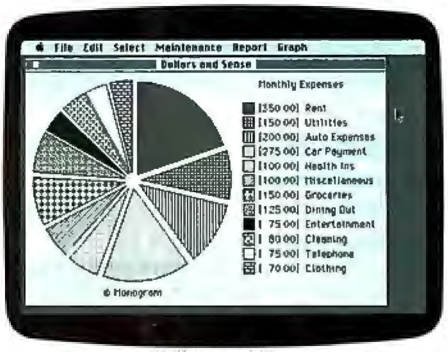
THE SMALL SYSTEMS JOURNAL

BARGAIN COMPUTING

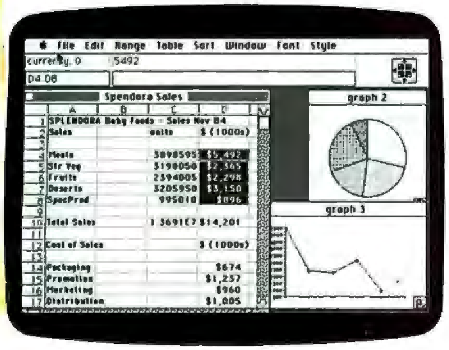
some important programs.



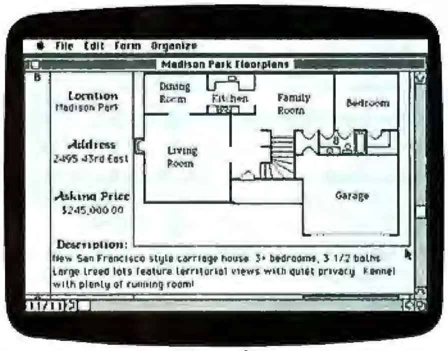
ThinkTank, idea processor.



Dollars and $ense, personal finance.

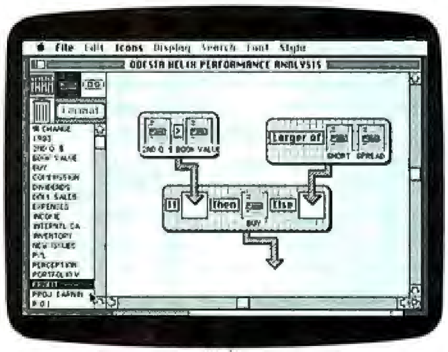


*Lotus Jazz, integrated business software.**

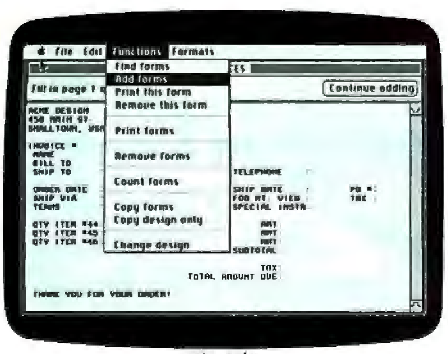


Microsoft File, database management.

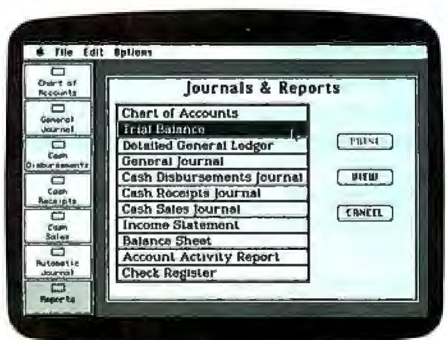
MacTerminal, data communications.



Helix, relational database.



PFS: File, database management.



Peachtree's Back to Basics, accounting package.

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C·O·N·T·E·N·T·S

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COVER ILLUSTRATION BY ROBERT TINNEY

VOLUME 10, NUMBER 3, 1985

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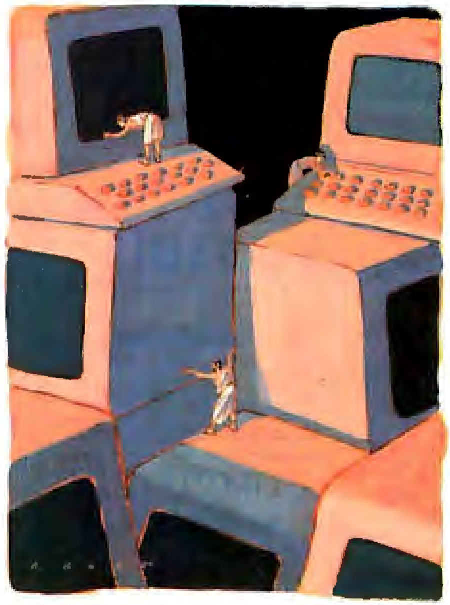

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E·D·I·T·O·R·I·A·L

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. 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, Areté, Sun, Charles River Data Systems, Stride, Altos, IBC, Plexus, Pyramid, 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*

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TENTH ANNIVERSARY ISSUE

BYTE is planning a special section to be published in our tenth anniversary (September 1985) issue, and 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.

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M·I·C·R·O·B·Y·T·E·S

Staff-written highlights of late developments in the microcomputer industry.

IRS 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 embosser. Based on a C. Itoh 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.

NANOBYTES

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 Drivetec. 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.

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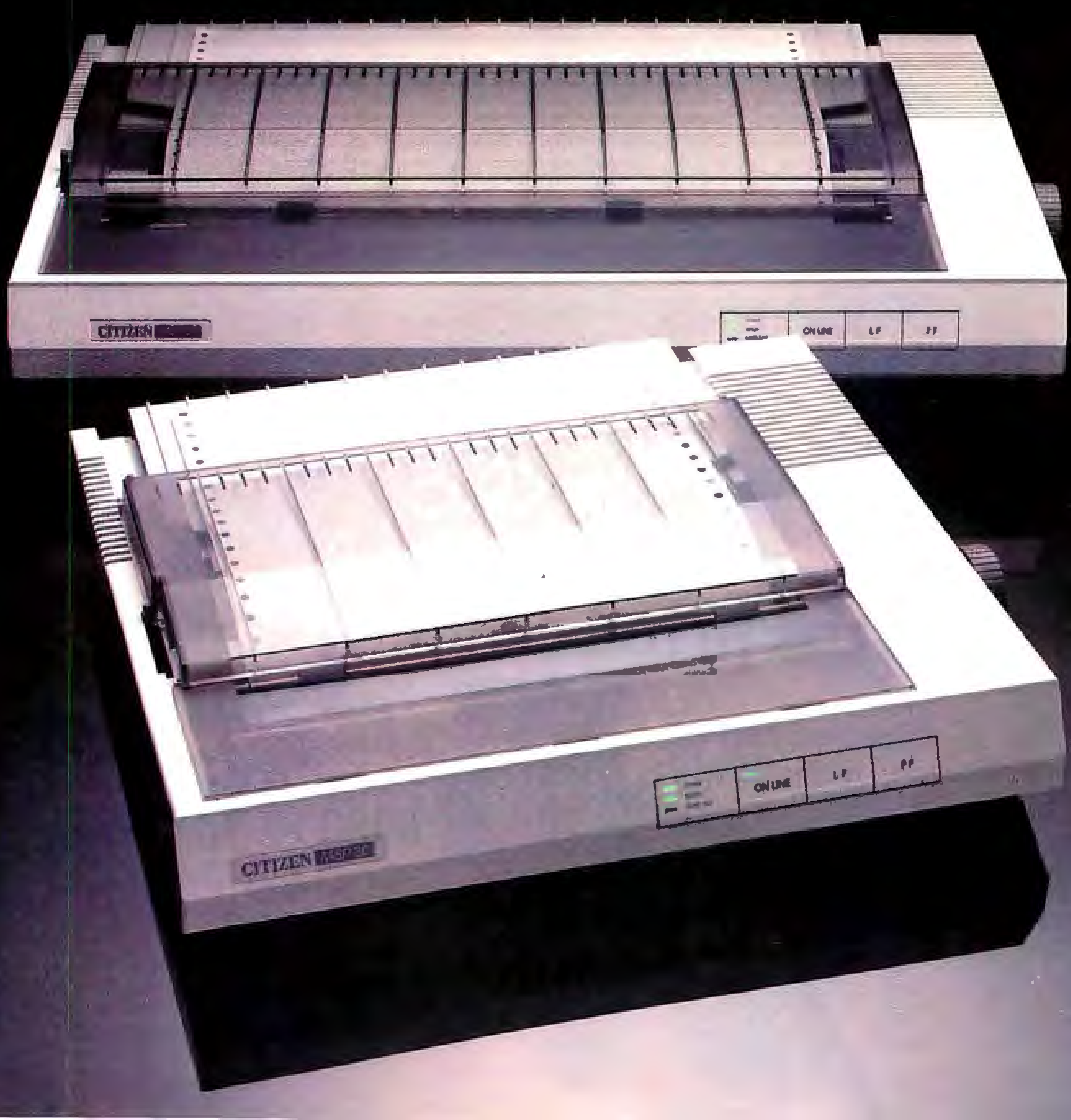

PRAISE FOR PICK

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. Originally 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)

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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 $30–$50/hour system designer to create software for it. Not so the company that spends $5000.

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)

LETTERS

around for putting up business applications fast and easily and having them work right (almost) every time.

I should know. I've been writing business applications on it for years. I would prefer to use a procedural programming language, which obviously BASIC isn't, but Pick's BASIC has been extended in so many valuable ways and interfaces so well with the delimiter-oriented record structure that it is easy to write very transparent, easily modifiable programs in it.

The weird thing is that Pick has no real competition as an operating system, and yet so few people take it seriously. The only thing that comes close to it in sophistication is UNIX, but the operating system is not oriented toward business and is nowhere near as user-friendly as Pick.

The real beauty of the Pick system is that it is idea-based and user-driven. It is the consolidation of a whole bunch of good ideas put into one system. The wonder is that Pick is the only one to have done that. Why don't other systems in that price range have virtual memory, database management built-in, delimiter-oriented records, or hashed files? I've never understood that.

"User-driven" means that the changes and improvements that have been put into Pick over the years originated with the end users. One thing Pick has been very good at is listening to the end users. So if you wonder why so many people are loyal to Pick, it's because Pick has been loyal to them and has given them the friendliest and most powerful operating system in the world for small- to medium-size businesses.

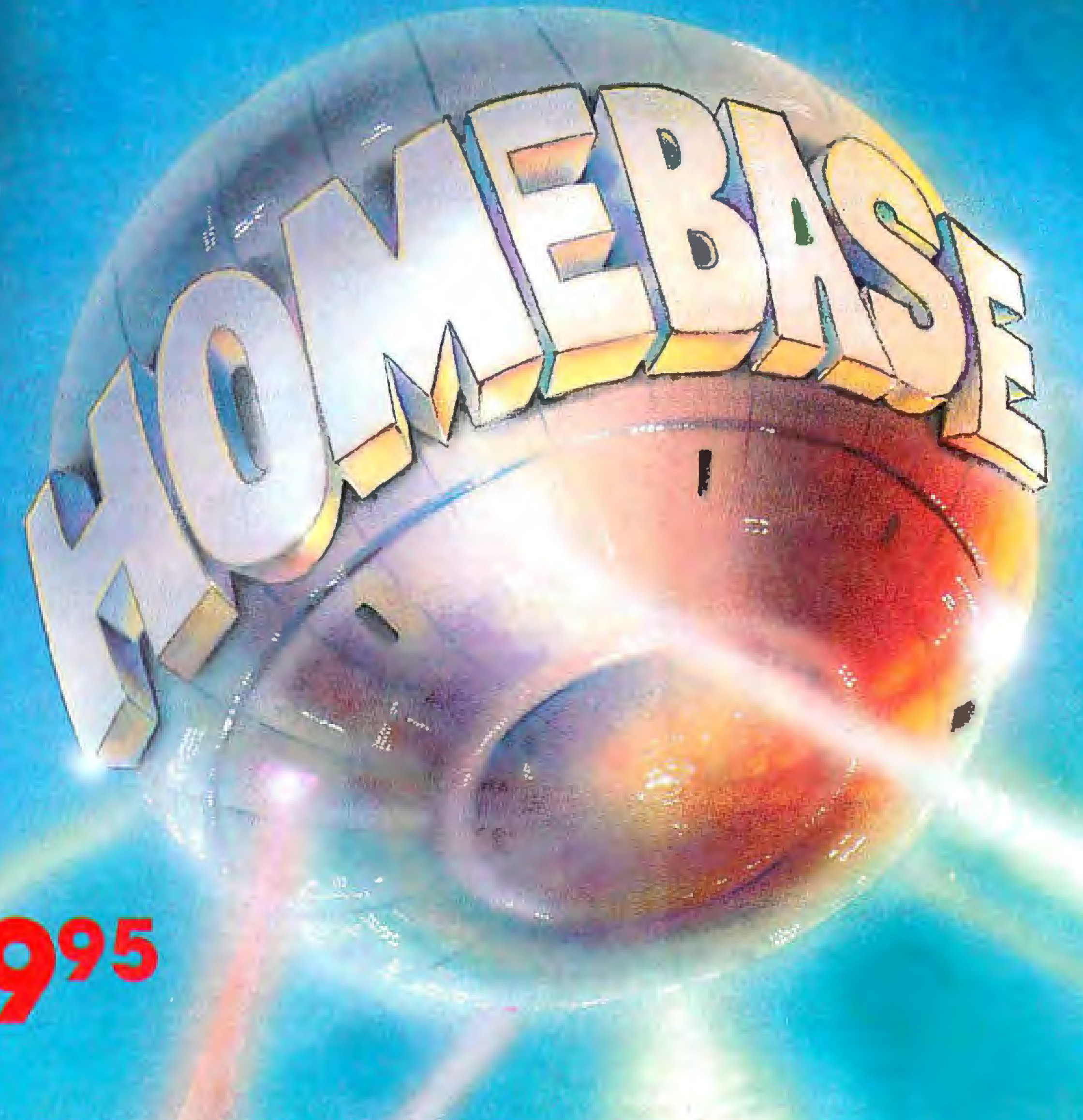
PETE SHEPPARD
Sandy, OR

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

(continued)

THE ADVENTURE CONTINUES . . .



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lovely illustrations. . .which are produced by a computer video display(?) of breathtaking graphic resolution one would wish to know more about.

By altering a few lines in Mr. Sørensen's program, one can gain minor enhancements. For instance, replacing his test condition RND(1) < .5 by RND(1) < P and accessing the P-parameter by an INKEY? instruction in the loop, or the equivalent, 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, $z_{old} = \lambda z_{new}(1 - z_{new})$. 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 $z_{old} = z_{new} = z$, 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_{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.

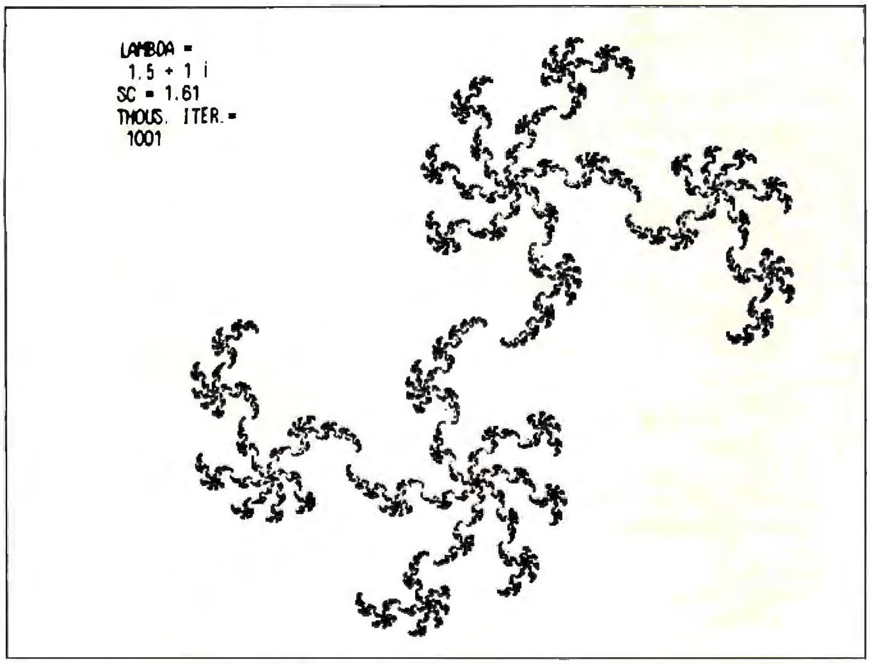

Figure 1: *Dragon curve on the Toshiba T-300 640- by 500-pixel graphics display.*

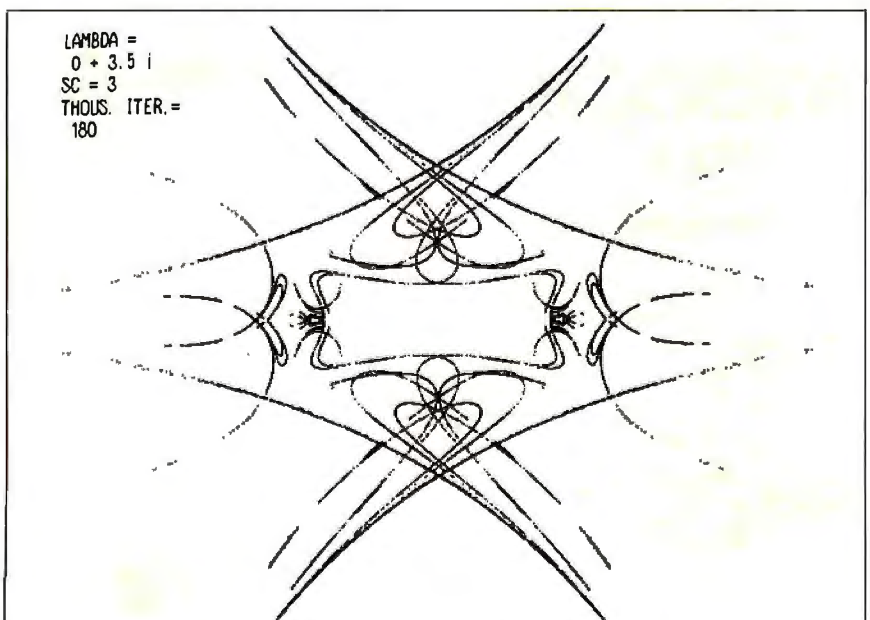

Figure 2: *"The Marxist Mustache" on the Toshiba T-300.*

The parabola provides a takeoff point for generalizations. Any monotonic function of z can be substituted for z_{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 $z_{old} = z_n$ and $z_{new} = z_{n+1}$ we can regroup the recurrence relation as

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

By repeated substitutions this becomes

$$z_{n+1} = \cfrac{z_n/\lambda}{1 - \cfrac{z_n/\lambda}{1 - \cdots - \cfrac{z_n/\lambda}{1 - z_{n+1}}}}$$

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 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 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 $z_n = \lambda z_{n+1}(1 - z_{n+2})$ 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

(continued)

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, 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 255), 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 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

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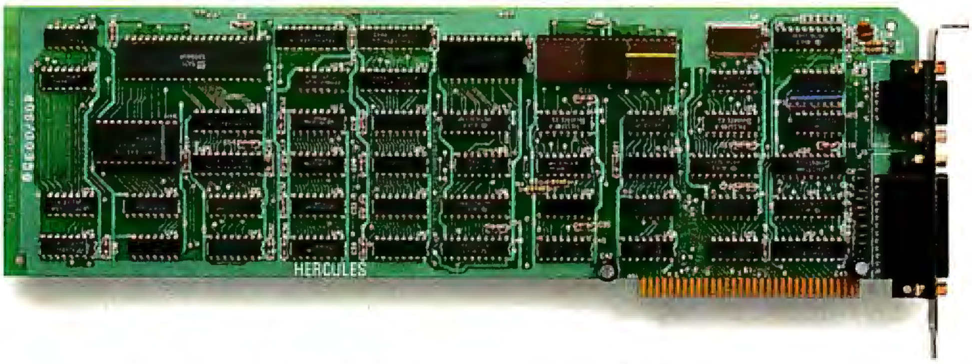

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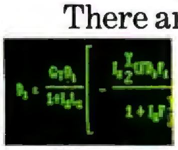

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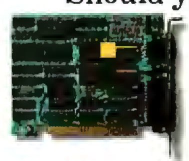

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THE REAL RSA ALGORITHM

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 $(p-1)*(q-1)$. Instead of having to ensure that messages are greater than the n^(1/3), one can choose any encoding key s such that 2^$s > n$ 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:

```
100 INPUT N,D
110 INPUT MS
120 CD=MS^[N]3 : PRINT CD
130 MT=CD^[N]D
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 "182818218" 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 * 98779 = 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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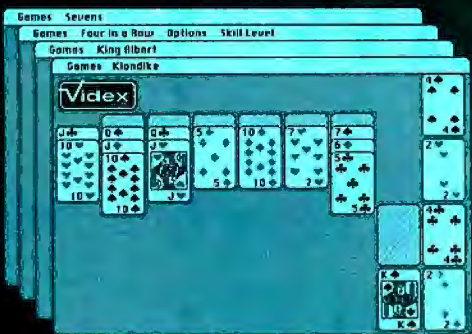

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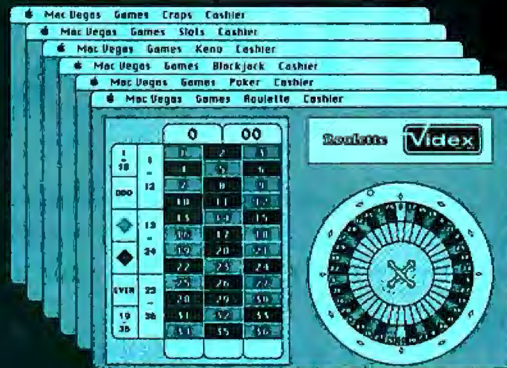

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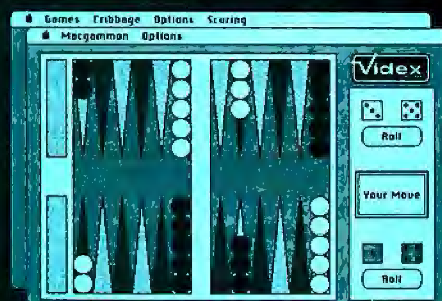

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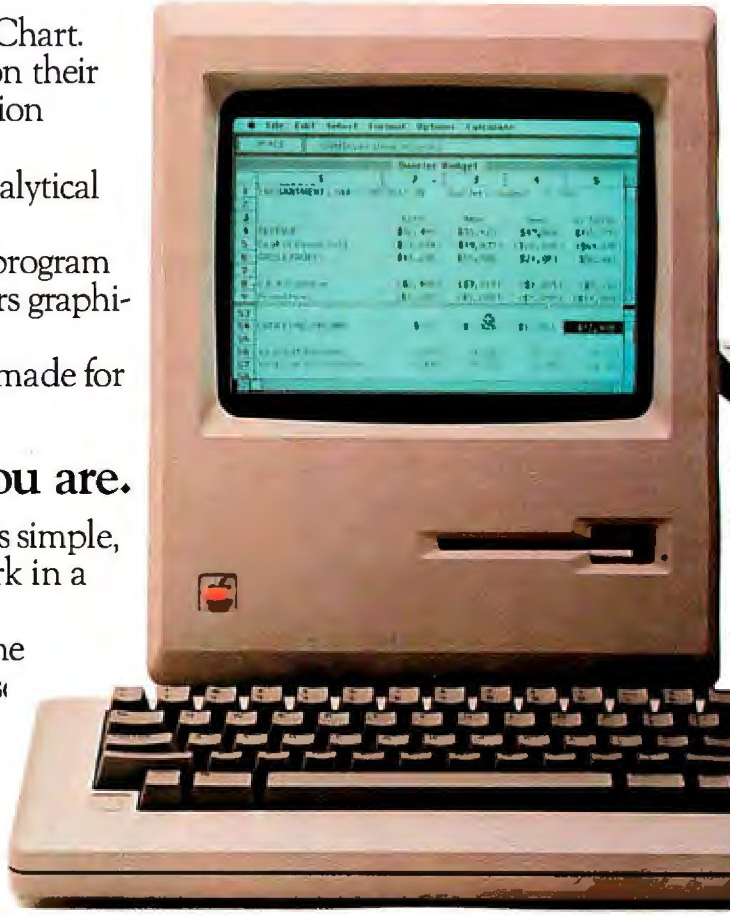

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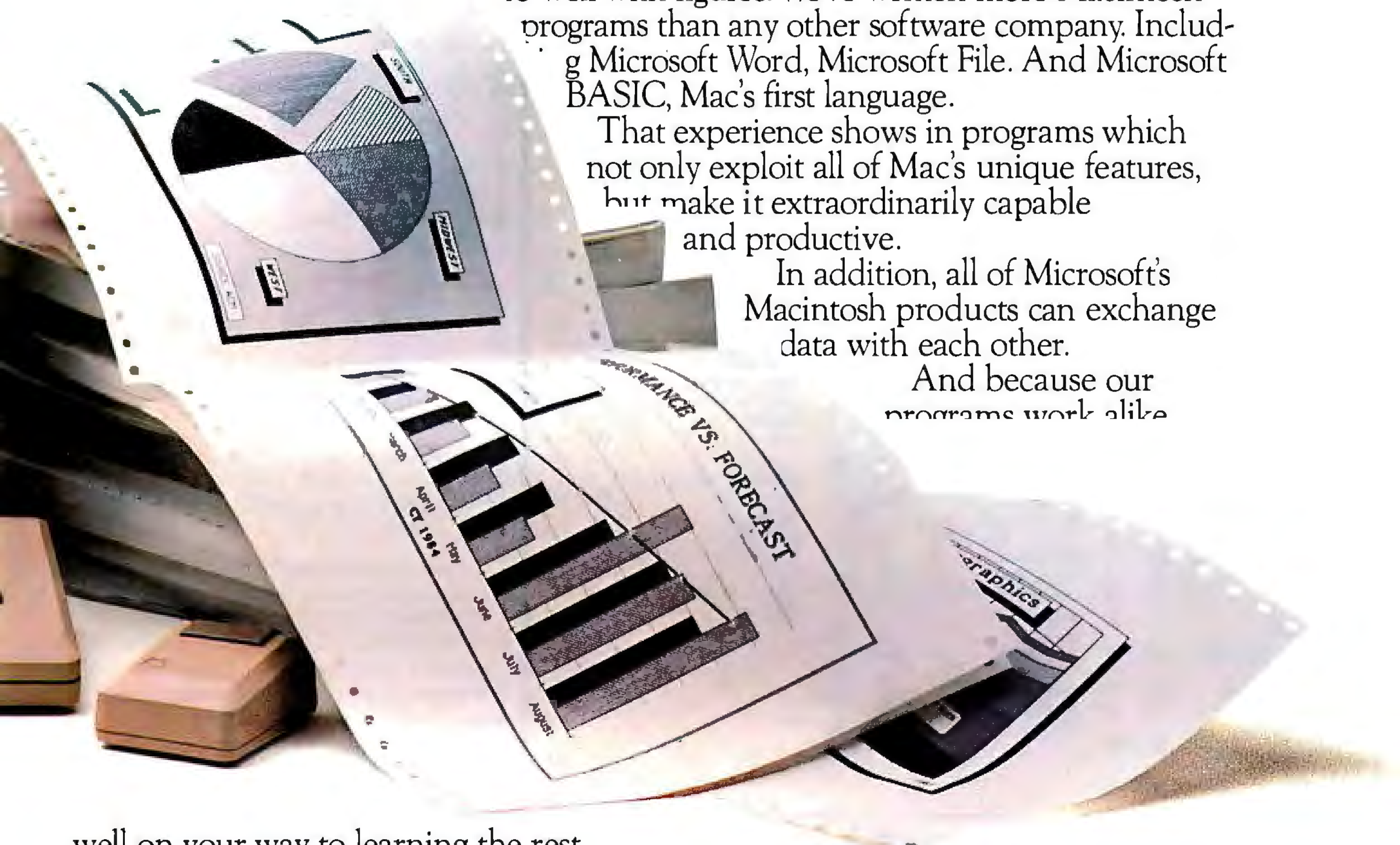

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ski's letter), the algorithm included there for determining a pair d and e can be incorporated into my RSA program by modifying the SETUP *function as follows:*

In place of the line in listing 1 that says

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

put the following coding:

```
D: NXPRIME(P+Q),
LOOP
  D: NXPRIME(D+1),
  XO: (P-)*(Q-1),
  X1: D,
  A0: 0,
  B0: 0,
  A1: 0,
  B1: 1,
  LOOP
    QU: QUOTIENT(X0,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,
      E: 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 these 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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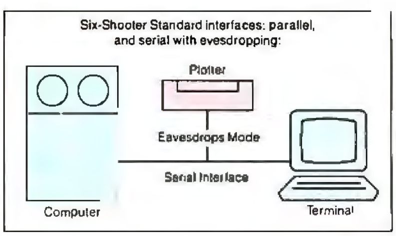

Source notes *Yankee Group, The Technical Office, Vol III 1983
**Wharton School Study, September 1981

Sweet-P is a high quality American made precision machine. It's fast. It plots 14 inches per second. It's beautiful for office and technical work. Plot perfect A-size slides for business presentations. Or big B-size block diagrams. Every office, every Quality and Production Manager and every Engineer should have one.

Over 100 graphics software packages drive the Six-Shooter—world famous packages like Lotus 1-2-3™ and ISSCO™, Tel-A-Graf™ and Disspla™

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Inquiry 381 for Dealers.
Inquiry 382 for End-Users.

MAKEBAT.ASM (pages 143–144). After several hours of scratching my head, I began to see the light. The problems I was encountering had nothing to do with the logic of the program but a nightmare unleashed by an unsuspecting and no doubt befuddled typesetter. I submit the following corrections for the other novices like myself who are perhaps a little less intuitive and lucky.

```
TRAILL  LABEL  NEAR
        CMP    BYTE PTR ES: [DI] [–], ' '
.........................................
;---------------DRIVE & ":"
        MOV AL,FCBRES.DRIVE__NUMBER
.........................................
;---------------MOVE ENTIRE FILE EXTENSION
         MOV CX,(SIZE FILE__EXTENSION)
         MOV SI,OFFSET FCBRES.FILE__EXTENSION
```

DANIEL C. KLINE
West Bend, WI

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.

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

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 $\frac{3}{16}$-inch mounting screws on the rear apron of the chassis located at the corners of the supply. Slide the supply toward 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)

READ  ONLY

A review of the IBM Personal Computer Family. Vol. 2, No. 1

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.

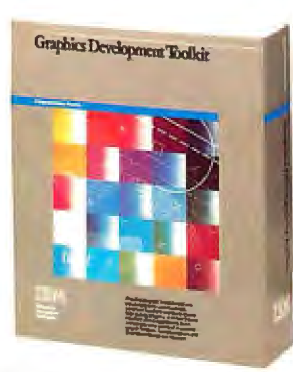
The Graphics Development Toolkit allows you to program bit-map graphics to a 32K x 32K addressable point window and to combine graphics and text capability on a variety of graphics devices. The device drivers necessary for information exchange with existing IBM PC graphics devices are included in the Toolkit, as are a driver for the IBM PC*jr* 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

IBM Personal Computer Enhanced Color Display



IBM Personal Computer Graphics Development Toolkit

IBM Personal Computer Professional Graphics Display 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 PC*jr* Speech Attachment is a step in that direction.

It's a side-attached option for the PC*jr* 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 PC*jr* diskette.

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

*Developed by Dr. John Henry Martin.

WHAT'S THE PROGRAM?

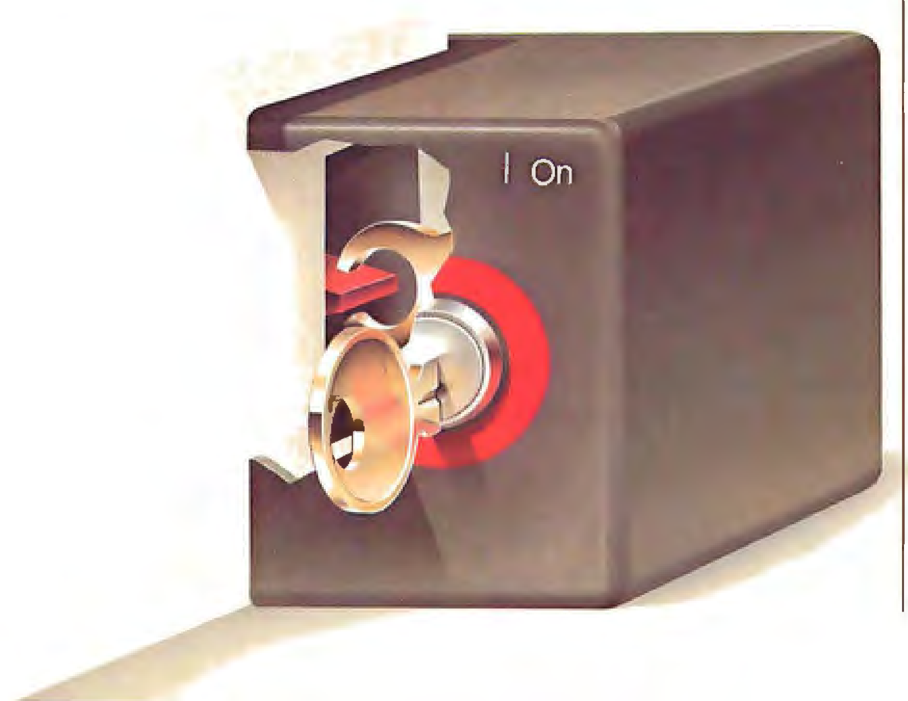
Retrieval. Whether you work with pen and paper or the latest word processing software, writing documents is only half the battle. Try finding them again a month later.

We don't claim to have discovered a better system for paper filing. But a new software package from IBM—Office Correspondence Retrieval System (OCRS)—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.

OCRS can help in two ways. First, it makes document abstracts and stores them in a summary file for future reference. OCRS 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 OCRS 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.

OCRS 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 Docum Content Architecture (RFTDC Documents can be converted RFTDCA data format by IBM I playWrite 1 and 2 and PCWriter.

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

Evolution. Like their human langu counterparts, computer langua and operating systems change a evolve. Occasionally, an entirely r dialect crops up, such as the IBM P sonal Computer XENIX® Operat System.

IBM Personal Computer XEN is derived from the UNIX® Tin Sharing System. Several enhance ments 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 pacl ages 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) operat-ents. Second, there's BM Personal NIX Text Formatting that can help implify 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 8087 and 80287 Math Co-processors. Other additions include a new more powerful Linker, a Library

Office Correspondence Retrieval System Software from IBM

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.

BUDDING USER GROUPS

etting started. Ever considered orming a group to exchange ideas bout using your IBM Personal Computer, but never got around to sorting ut all the start-up details? Or, once ast that first stage, does your group nd it difficult to come up with new nformation, presentation materials, nd 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 1,000 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.

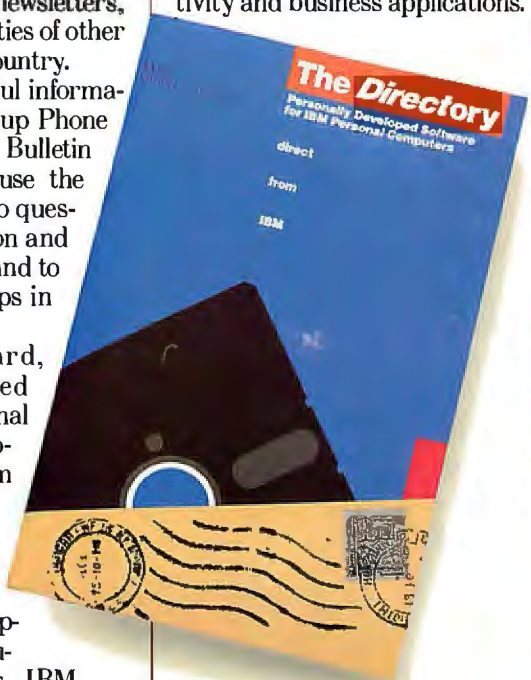
*The availability and frequency of guest speakers depend on the size of the group, its location, and meeting night.

HARDCOPY

Hidden talent. Think of the many entertaining and useful programming ideas that must exist out there but never find their way to market.

The IBM *Directory* of Personally Developed Software gives you direct access to some of that hidden talent. It's a catalog of new programs developed by individuals for the IBM Personal Computer Family.

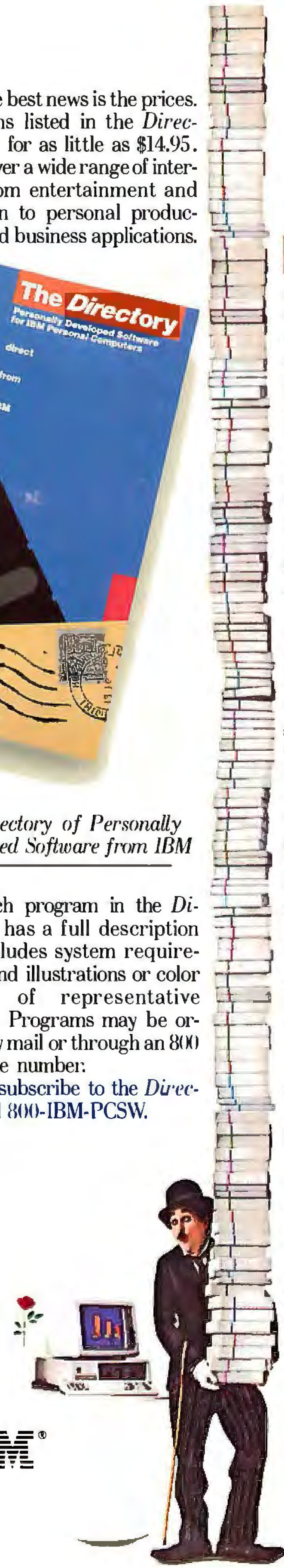
The best news is the prices. Programs listed in the *Directory* sell for as little as $14.95. They cover a wide range of interests, from entertainment and education to personal productivity and business applications.



The Directory of Personally Developed Software from IBM

Each program in the *Directory* has a full description that includes system requirements and illustrations or color photos of representative screens. Programs may be ordered by mail or through an 800 telephone number.

To subscribe to the *Directory* call 800-IBM-PCSW.



IBM®

TIPS AND TECHNIQUES

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 color.com
File not found (ignore this message)
-rcx
:20
-e 100 2b c0 1e 50 b8 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
writing 20 bytes
-q
```

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.

F·I·X·E·S A·N·D U·P·D·A·T·E·S

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 129.)

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. Of the 4000-odd possible pairs in the character set we used, perhaps 600 will actually appear in a fairly long text, and the 20 or so most common of these will account for nearly one-quarter of all digram occurrences."

Listing A: *This change of strategy enhances the speed of the Travesty generator by a factor of five. (Please note that lettered lines follow their corresponding numbered lines.)*

```
24a   Hash = 19;          {may be anywhere from 2 to 93}
24b   Hashm1 = 18;        {hash minus 1}
28    FreqArray : ARRAY['  '..'¦'] OF INTEGER;
28a   StartSkip : ARRAY['  '..'¦', 0..Hashm1] OF INTEGER;
57    WRITELN  ('What Order?   <3-', maxpat, '>');)
59    UNTIL  (PatLength  IN  [3..MaxPat]);
179    j, k  :  INTEGER;
181a  FOR  j  :=  0 TO Hashm1 DO
182   StartSkip[ch, j]  := TotalChars  + 1;
185a  k  :=  ORD(BigArray[j + 1] MOD Hash;
186   SkipArray[j]  :=  StartSkip[Ch, k];
187   StartSkip[Ch, k]  :=  j;
202a  Ch2  :  INTEGER  {second char—after hash}
205a  Ch2  :=  ORD(Pattern[2])  MOD Hash;
206   i  :=  StartSkip[Ch1, Ch2]  – 1;
```

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 reinstated Seattle font.

BYTE'S BITS

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, Mail Stop 9, Washington, DC 20208.

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 machine and computer manufacturers for $399 to $2190, depending upon licensing agreement. Proximity Technology Inc. has its headquarters at 3511 Northeast 22nd Ave., Fort Lauderdale, FL 33308, (305) 566-3511.

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.

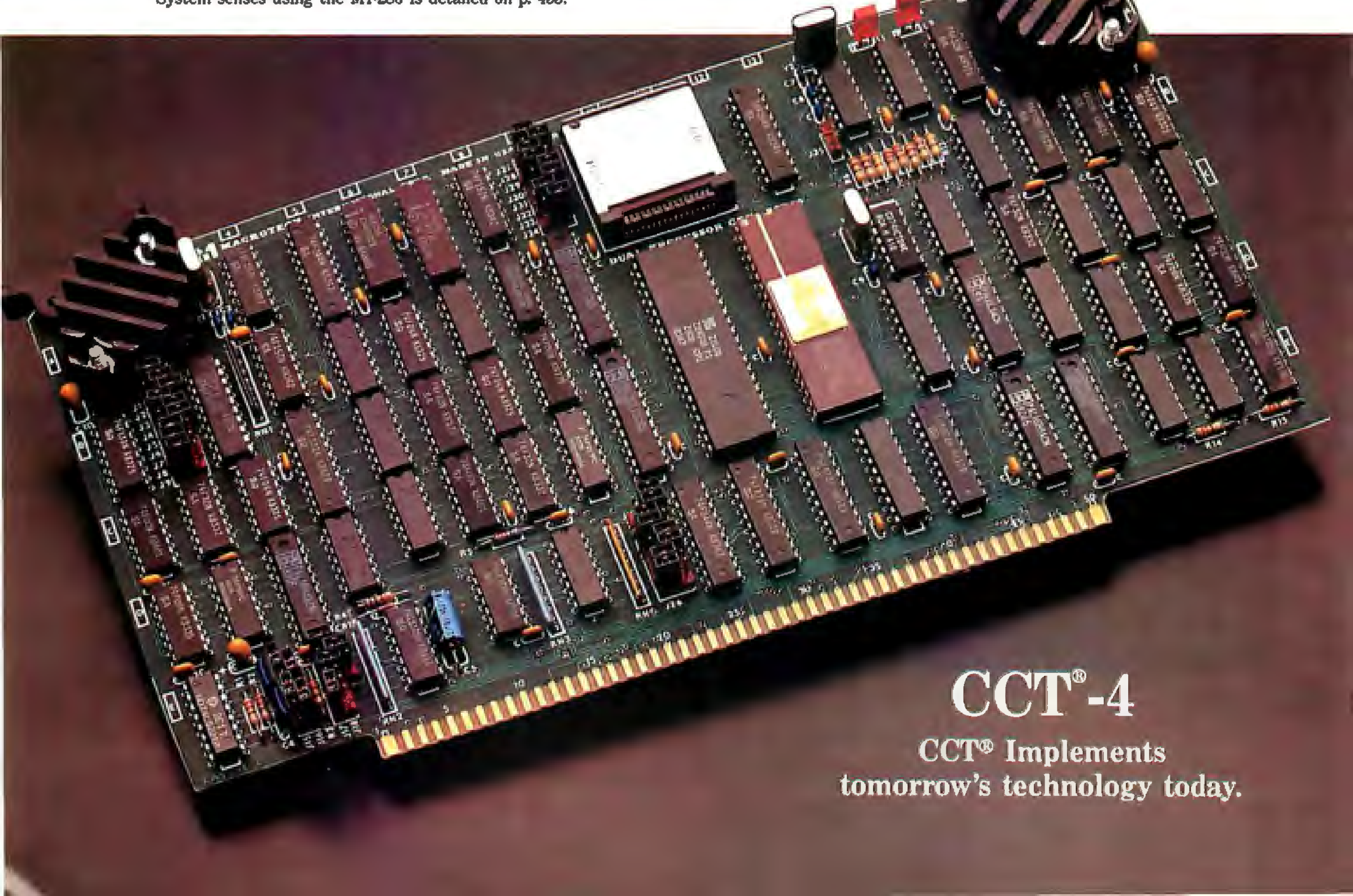
The 80286 and Z-80H. The MI-286 is the first dual-CPU board using the new, high speed Intel 80286 coupled with a Z-80H. It is designed for use with a variety of operating systems, including MP/M 8-16. It will support all your current 8086/88 and Z-80/8085 software. It can accommodate an optional 80287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

Macrotech International Corp.
9551 Irondale Avenue
Chatsworth, CA 91311
Phone: (818) 700-1501
Inquiry 102

System senses using the MI-286 is detailed on p. 453.

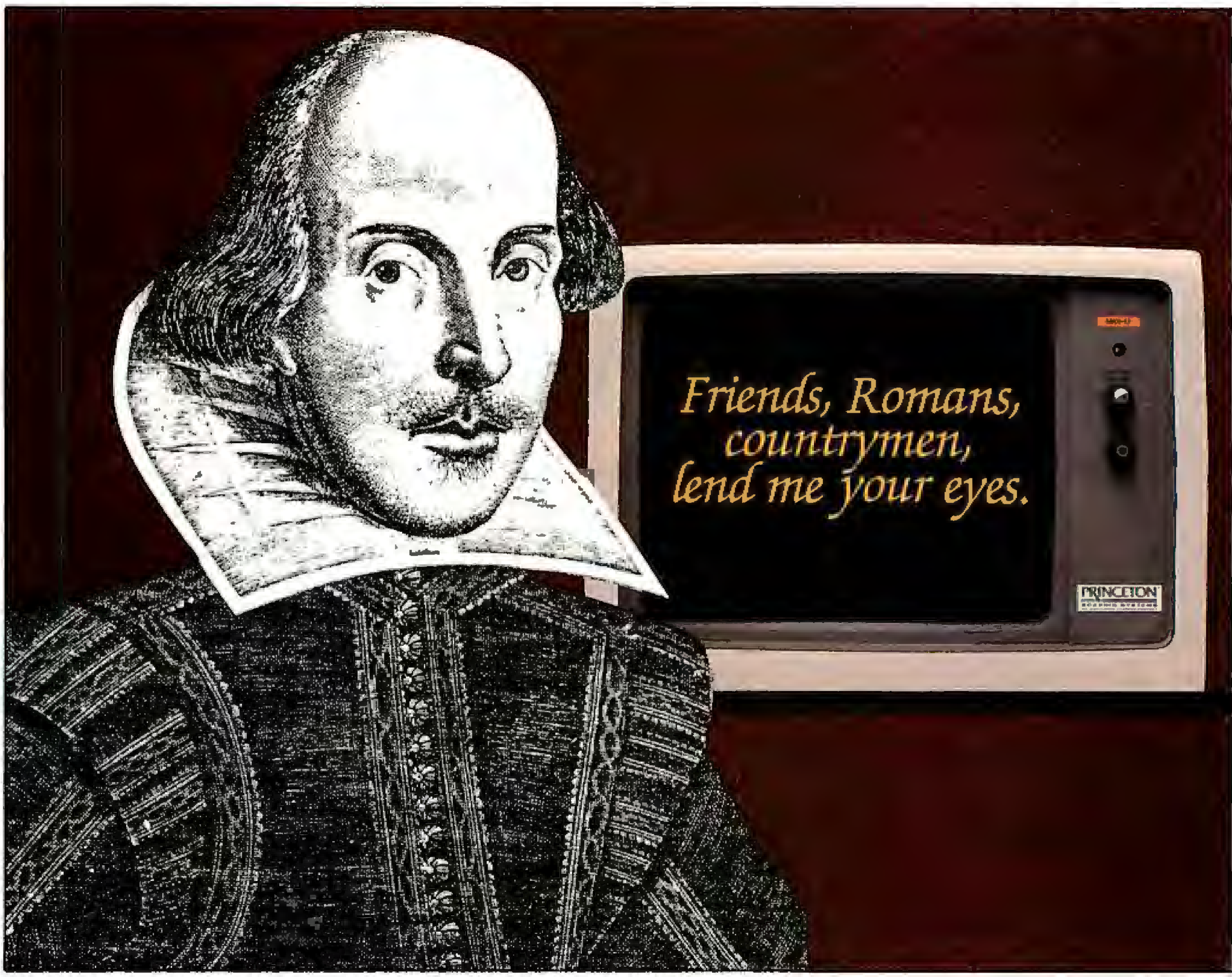


Great Ideas look even better on a Princeton monitor

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.



W. Shakespeare composing Great Ideas on a Princeton Monitor

Things you should know about monitors

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

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

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

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

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

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

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

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

Do it soon. You and your Great Ideas deserve the best.

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

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TLX 821402 PGS Prin

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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.

C. Itoh
DIGITAL PRODUCTS

hart

Inquiry 54 for Dealers. Inquiry 55 for End-Users.

Two New Color Computers from Atari

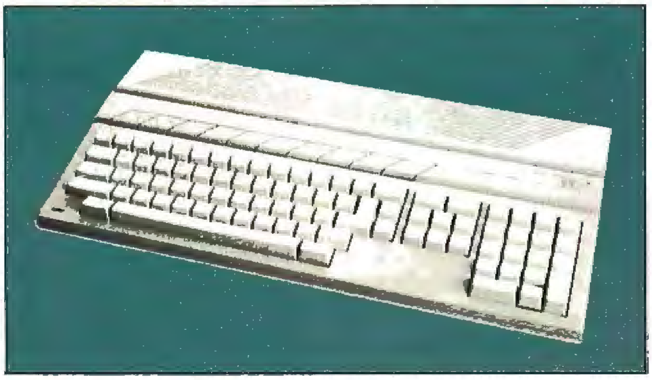
Atari has two new color computer lines: the 68000-based ST and the 800-compatible XE.

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 it to musical instruments and synthesizers.

The 128K-byte Model 130ST will sell for approximately $400, and the 512K-byte Model 520ST 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 Atari 130ST comes with GEM and color.

The Model 65XE, with 64K bytes of RAM, will cost $120. The $400 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**.

Integrated 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/Systems Group Corporation, Infinity 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**.

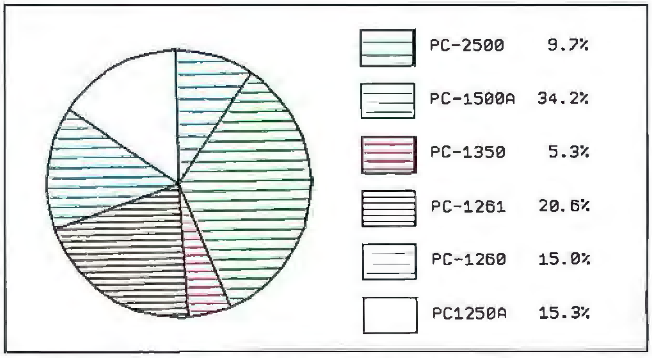
Sharp Computer Has Four-Color Plotter

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**.

(continued)



Sample output produced with the PC-2500's color plotter.

Commodore Unveils 3-Pound Portable

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 $39.95, and the latter is $99.95.

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.

Contact Epson America Inc., 2780 Lomita Blvd., Torrance, CA 90505, (213) 539-9140.
Inquiry 606.

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 strike-through, 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 keep/follow 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.

If you purchase Word 2.0 and HP's LaserJet printer prior to May 15, 1985, you will receive a LaserJet font cartridge valued at $225 free of charge. Contact Microsoft Corp., POB 97200, Bellevue, WA 98009, (800) 426-9400; in Washington, (206) 828-8088.
Inquiry 604.

(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	TURBO 2.0	TURBO 3.0
COMPILATION SPEED	206 sec	16 sec.	8 sec.
EXECUTION SPEED	20 sec.	13 sec.	9 sec.
CODE SIZE	35K	12K	12K
BUILT-IN INTERACTIVE EDITOR	NO	YES	YES
ONE STEP COMPILE (NO LINKING NECESSARY)	NO	YES	YES
COMPILER SIZE	300K+	35K	35K
TURTLE GRAPHICS	NO	NO	YES
BCD OPTION	NO	NO	YES
PRICE	$295.00	$49.95	$69.95

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 I/O redirection.
- For the IBM PC versions, we've even added "turtle graphics" and full tree 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 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."*

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.

(*) **Benchmark** run on an IBM PC using MS Pascal version 3.2 and the DOS linker version 2.6. 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 128) with a 3 dimensional non-singular matrix and a relaxation coefficient of 1.0.

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 $124.95. 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 Turbo87 original *disk* for $59.95. 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 1st, 1985).

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I Use: ___ PC-DOS ___ MS-DOS
___ CP/M 80 ___ CP/M 86

My computers' name/model is: ________

The disksize I use is:
☐ 5¼" ☐ 8" ☐ 3½"

For update: original Turbo disk must accompany order

YES! I want the Best!
Please send: Quantity

Pascal 3.0 $ 69.95 ____
Pascal w/8087 $109.90 ____
Pascal w/BCD $109.90 ____
Pascal w/8087 & BCD $124.95 (SAVE $24.90) ____

*These prices include shipping to all U.S. cities. All foreign orders add $10 per product ordered.

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COD's and Purchase Orders WILL NOT be accepted by Borland. California residents: add 6% sales tax. Outside USA: add $10 and make payment by bank draft, payable in US dollars drawn on a US bank.

Inquiry 46

BORLAND INTERNATIONAL

Software's Newest Direction
4113 Scotts Valley Drive
Scotts Valley, California 95066
TELEX: 172373

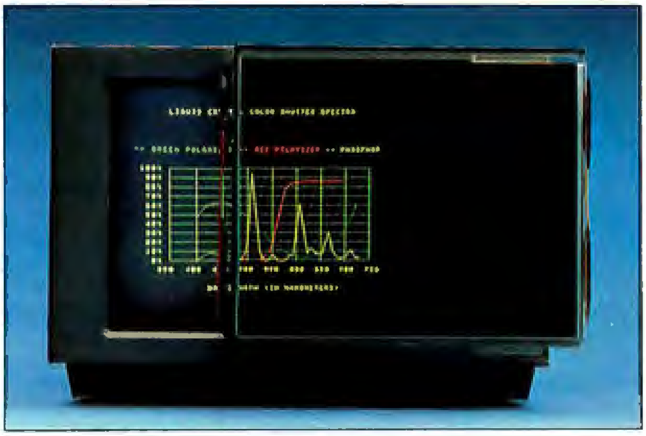
LCS Technology Converts Monochrome CRT to Colorful Display

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



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

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.

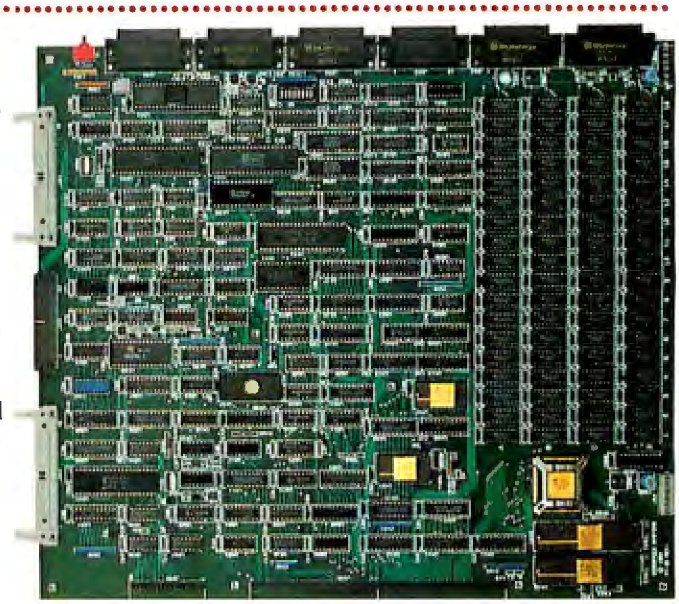
The 7-inch LCS display will work with either raster or vector displays, and it accommodates either magnetic or electrostatic deflection systems. The 7-inch LCS and a complementary monochrome CRT will be sold on a contract basis only. The single-unit price is $200; volume discounts are offered. Write on company letterhead to Liquid Crystal Shutter, Tektronix Inc., POB 500, M/S 02-100, Beaverton, OR 97077, or call (503) 627-5000.
Inquiry **607**.

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



A power supply, drives, terminals, and the GS-32 create a 32-bit micro.

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.

The GS-32 measures 13 by 15 inches. Single-unit pricing begins at $5500. The manual alone is $50. UNIX 4.1 will be available. Contact Goodspeed Systems Inc., POB 29, East Haddam, CT 06423, (800) 243-8160.
Inquiry **608**.

(continued)

Footmouse Frees Your Hands

The Footmouse doesn't need special boards or software.

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, Ivy, 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

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, reentrant 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 recompiling 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 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 Digitalk Inc., 5200 West Century Blvd., Los Angeles, CA 90045, (213) 645-1082.

Inquiry 611.

Peripheral Boosts the Mac's Versatility

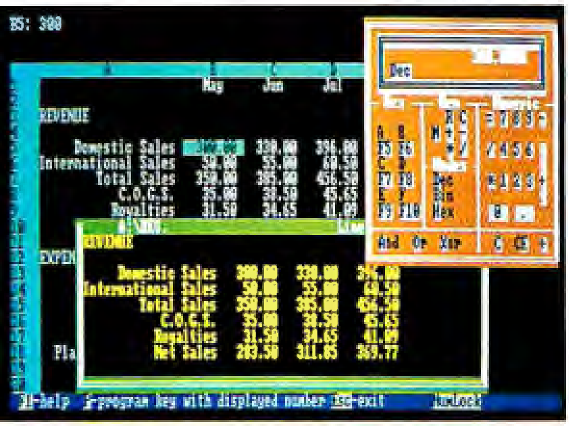
MacEnhancer from Microsoft lets you add three different peripherals to Apple's Macintosh. Requiring a single Macintosh RS-422 port, MacEnhancer gives you two RS-232C serial ports and a parallel printer interface.

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.

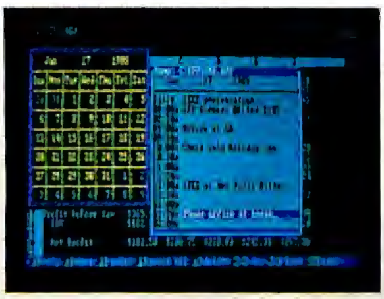
(continued on page 435)

Borland's SideKick™ 1984 Product of the Year*



Here's SideKick in action with Lotus® 1-2-3 running underneath. Data has been imported from Lotus to SideKick's **notepad**, shown in the lower portion of the screen. The notepad is a full-screen editor that lets you import and export data; it utilizes WordStar commands to let you time- and date-stamp notes and save them to disk. The SideKick **calculator**, shown at the upper right, offers memory capability, nested parentheses, and the ability to convert decimal to hexadecimal or binary. It even lets you transfer resulting figures to your underlying application.

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.



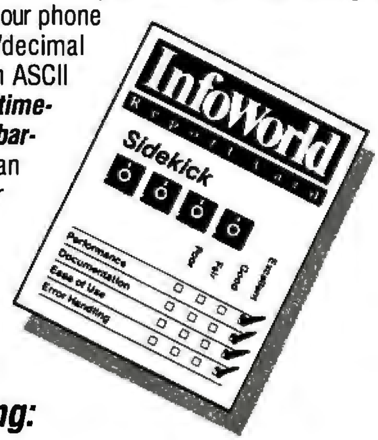
The **calendar** can record appointments, records and notes—yours or those of the entire department—up to the year 2099. Here the dialer is running on top of Lotus.

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.

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."*

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Yes, I want the Best. Please send me SideKick!

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*These prices include shipping to all U.S. cities. All foreign orders add $10 per product ordered.

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State: ____ Zip: ____

Telephone: ____

815

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Inquiry 48

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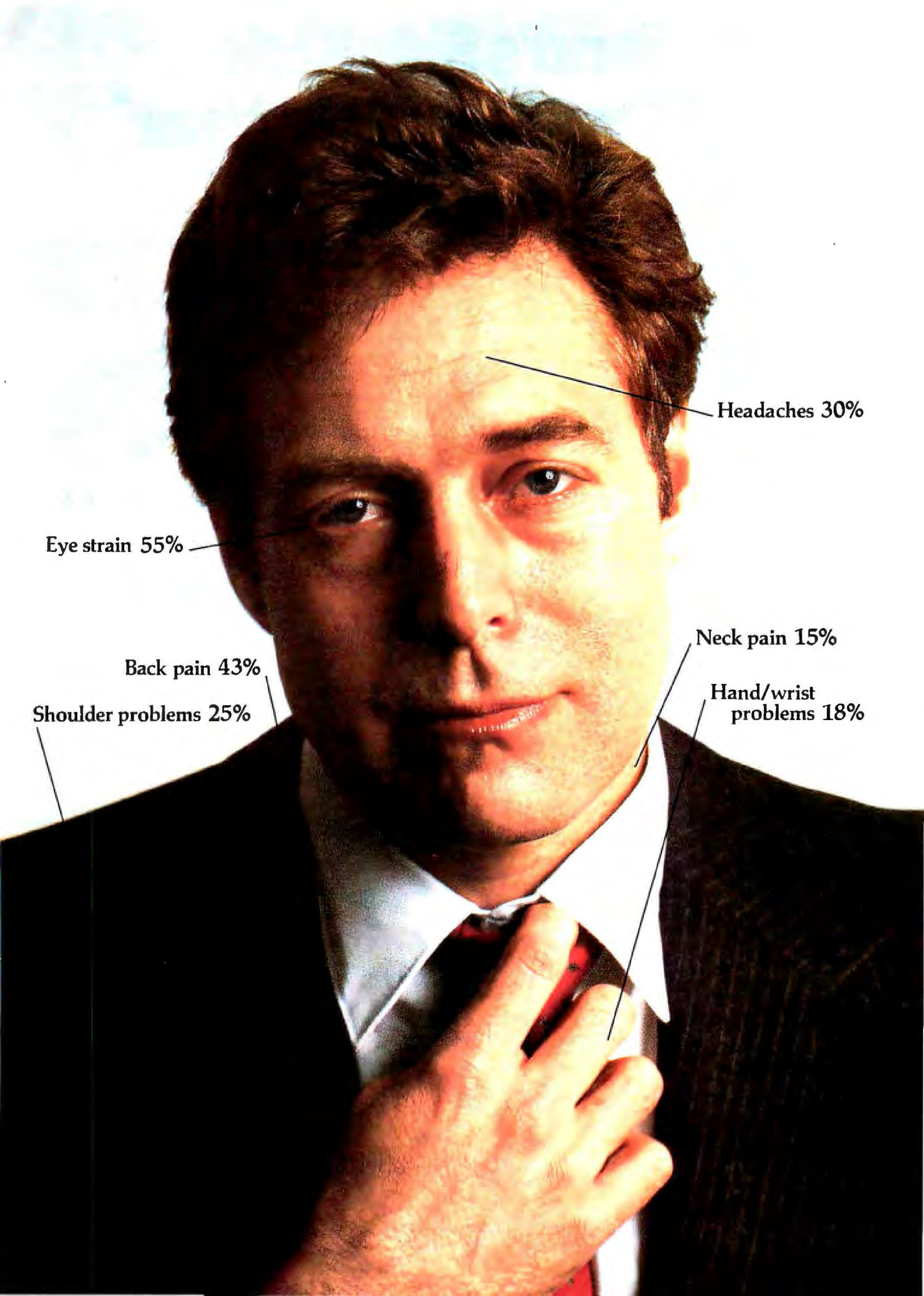


Headaches 30%
Eye strain 55%
Neck pain 15%
Back pain 43%
Hand/wrist problems 18%
Shoulder problems 25%

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.

Computer-induced	
Eye strain	55%
Back pain	43%
Headaches	30%
Shoulder	25%
Hand/wrist	18%
Neck pain	15%

(Source: "Ergonomic Principles in Office Automation" Pub. 1983 by E.I.S. AB, Sweden.)

(Source: "Ergonomic Principles in Office Automation." Pub. 1983 by E.I.S. AB, Sweden.)

Before you dismiss them as trivial, consider two things:

First, more than twenty states are now preparing legislation to protect computer users from problems like these.

Second, it's not just a people problem.

It's a business problem.

Because computers do what they're told.

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.

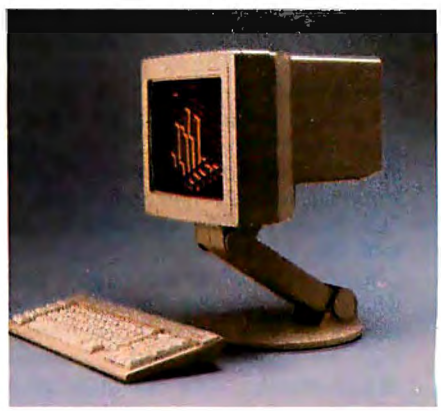
3 Free Offers.

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.



ERICSSON

Inquiry 142

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 nondocument mode, using the ^QQ^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 2.1 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."—Steve

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 H&E Computronics 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

Compute! *and* Compute!'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)

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 (0–5-V) signal levels instead of the ±12-V levels needed by EIA-compliant modems. The C64 "USER PORT" is a 24-line male edge connector that brings out 9 V AC as well as the TTL signals. It would seem fairly straightforward to rectify the 9 V 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

It is fairly straightforward to achieve RS-232C levels on a Commodore 64. In fact, an article on this subject appeared in the May 1983 BYTE. "The Enhanced VIC-20, Part 4: Connecting Serial RS-232C Peripherals to the VIC's TTL Port" by Joel Swank describes a method very similar to the one you suggested. While written for the VIC-20, the application is identical for the Commodore 64 computer.—Steve

Code Translators

Dear Steve,

I am looking for a program that converts the instructions of the program (i.e., converts Z80 assembly-language commands to 8088 assembly-language commands). If you could inform me of any program that can accomplish this task, I would be most grateful.

Chris Dietrich
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 machine-specific. 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 Quces 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 8304B. Should you desire to develop your own software, you may substitute

(continued)

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

Inquiry 199

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RAMs (2112s) for the ROMs. If you do so, the memory power-down feature must be disabled and the R/$\overline{W}$ 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 Ortman 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 & Floegel, published by IJG 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

Computerized 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)

ASK BYTE

you can give me will be greatly appreciated. Thank you.

RICK BUCCHI
Plainville, CT

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

A safe approach would be to string twisted pairs of cables throughout the house to enable connection of any device. The twisting will offer a means of noise rejection without the expense of shielding, but shielded twisted pair is better. A 75-ohm coaxial cable, run along with the twisted pairs, will allow for cable television, monitors, terminals, or high-frequency devices.

As you know, I am interested in computerized control of the home. Beginning in April, I will present an article using the BSR home controllers for controlling all the functions in a home. Watch for it!
—Steve ■

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

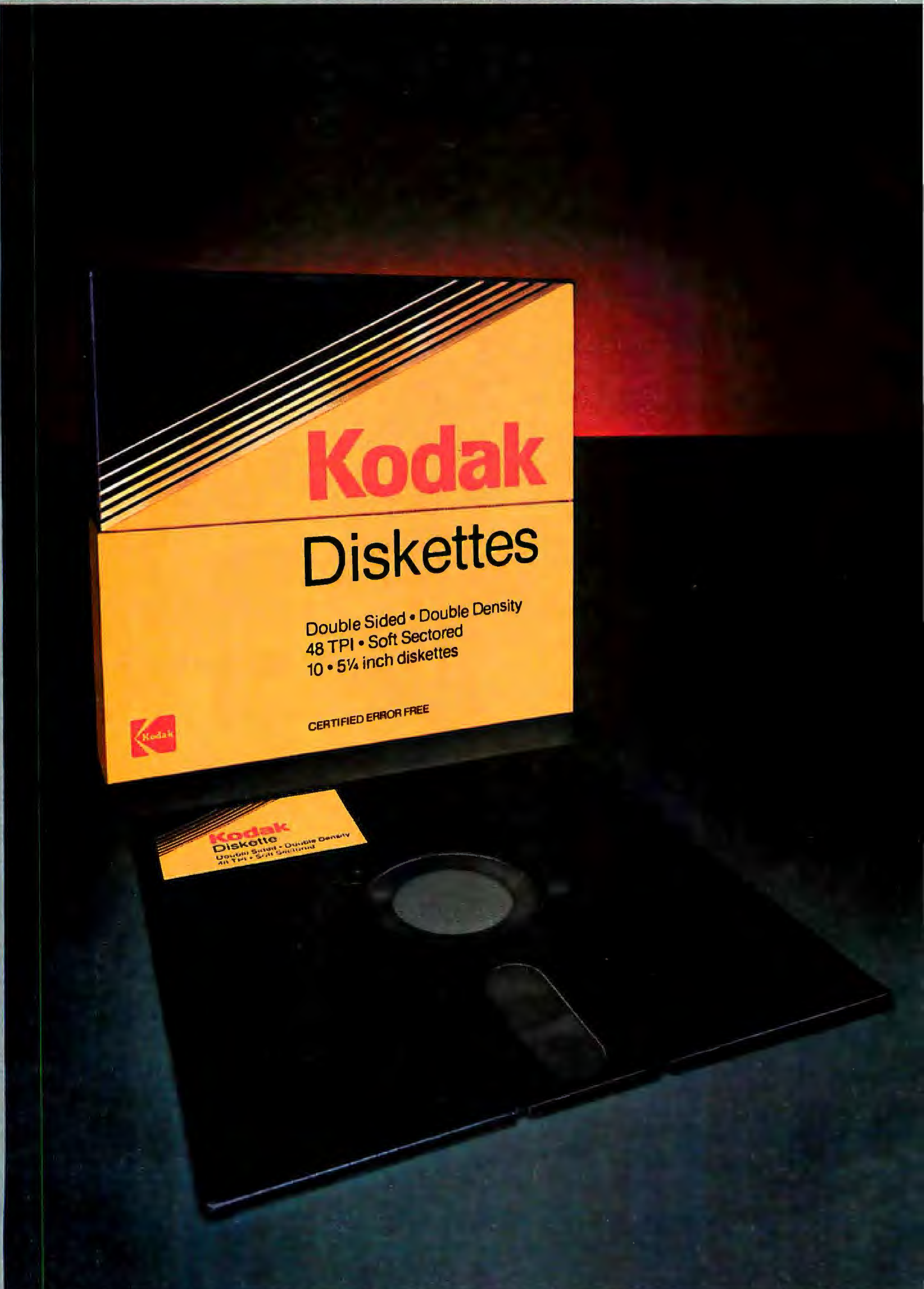
If you would like to share the knowledge you have on microcomputer hardware with other BYTE readers, joining the Circuit Cellar/Ask BYTE staff would give you the opportunity. We're looking for additional researchers to answer letters and gather Circuit Cellar project material.

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

IN ASK BYTE, Steve Ciarcia answers questions on any area of microcomputing. The most representative questions received each month will be answered and published. Do you have a nagging problem? Send your inquiry to
Ask BYTE
c/o Steve Ciarcia
POB 582
Glastonbury, CT 06033

Due to the high volume of inquiries, personal replies cannot always be given. All letters and photographs become the property of Steve Ciarcia and cannot be returned. Be sure to include "Ask BYTE" in the address.

The Ask BYTE staff includes manager Harv Weiner and researchers Bill Curlew, Larry Bregoli, Dick Sawyer, and Jeannette Dojan.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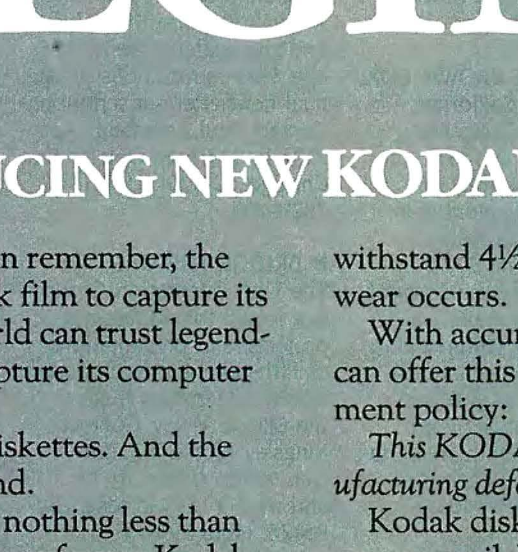

KODAK.
The name says it all.

Inquiry 134

C·L·U·B·S & N·E·W·S·L·E·T·T·E·R·S

● MEDICAL COMPUTING BBS—The Minnesota Medical Computing Consortium (MMCC) operates a 24-hour bulletin-board service at (612) 434-6315, focusing on medical computing issues. The consortium also offers shows and tutorials. The $15 annual membership fee includes a subscription to the bimonthly newsletter. Write David De Fontaine, 2221 Southeast University Ave., Minneapolis, MN 55414.

● 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 10 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 on line; nonmembers register through the mail. To contact the KAY*FOG sysop, call Bond Shands at (415) 285-2687. 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 Darnielle 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 Rod LaFond, 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 Fred Sutton, 1230 South Helberta Ave., Redondo Beach, CA 90277, (213) 316-4406.

● 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 5810-1, 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., Widefield, CO 80911, (303) 392-9826.

● 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 $35 annual membership fee. Contact Jerry Schwartz on The Source at STA373 or at the Champion Users Group, POB 724921, Atlanta, GA 30339, (404) 952-7336.

● SOCIETY FOR ENGINEERS—The American Society for Engineering Management (ASEM) serves the public interest by advancing engineering management in theory and practice, maintaining a professional standard for its members, and promoting the development of engineering management through meetings, contacts, reports, papers, discussions, and publications. Annual membership is $35. For an additional $20, you can receive *Engineering Management International*, a quarterly publication from Elsevier Science Publishing. To see if you are eligible for membership, contact Daniel Babcock, American Society for Engineering Management, 301 Harris Hall, University of

(continued)

CLUBS & NEWSLETTERS *is a forum for letting* BYTE *readers know what is happening in the microcomputing community. Emphasis is given to electronic bulletin-board services, club-sponsored classes, community-help projects, field trips, and other activities outside of routine meetings. We will continue to list new clubs and newsletters. Allow at least four months for your club's mention to appear. Send information to* BYTE, *Clubs & Newsletters*, POB 372, *Hancock*, NH 03449.

Missouri, Rolla, MO 65401, (314) 341-4560.

● 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*, POB 232, Seymour, CT 06483.

● CATCH CANADIAN PCS
The Saskatoon PC Users Group (SPCUG) meets on the second Tuesday of each month to hear speakers and to discuss IBM PCs and compatibles. Members benefit from a monthly newsletter, a public-domain software library, and a bulletin-board service at (306) 242-3134. Annual membership is $30 (Canadian). Contact the Saskatoon PC Users Group, 65 Arts Building, University of Saskatchewan, Saskatoon, Saskatchewan S7N 0W0, Canada.

● TI PUBLIC DOMAIN AT WORK—Owners, users, and programmers of the TI 99/4A can market their own software programs in a software newsletter, *SPM*, devoted to expanding the usefulness of Texas Instruments computers. Advertising is free for those people who subscribe for $18 a year. For an information package, send $2, which will be deducted from the subscription fee. Contact R. Clark, *SPM*, RD #4, Box 90-A, Bath, NY 14810.

● 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.

● 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 73336,1545; or at EICUG, Suite 3F, 69-16 164th St., Flushing, NY 11365.

● RAINBOW IN PHILADELPHIA—*The Delaware Valley DEC Personal Computer User Group News* is a newsletter from the DEC PC User Group of Philadelphia. The club is for users of all DEC computers, including Rainbows and the Professional series. Quarterly meetings comprise guest speakers, business discussion, and a question-and-answer forum. Meeting times and locations are announced in the newsletter produced one month prior to the meetings. The membership fee is $10 a year. An exchange of newsletters with other DEC users groups is requested for further organizational prospects. Contact Tom Deahl, Microdoc, 815 Carpenter Lane, Philadelphia, PA 19119, (215) 848-4545. ■

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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

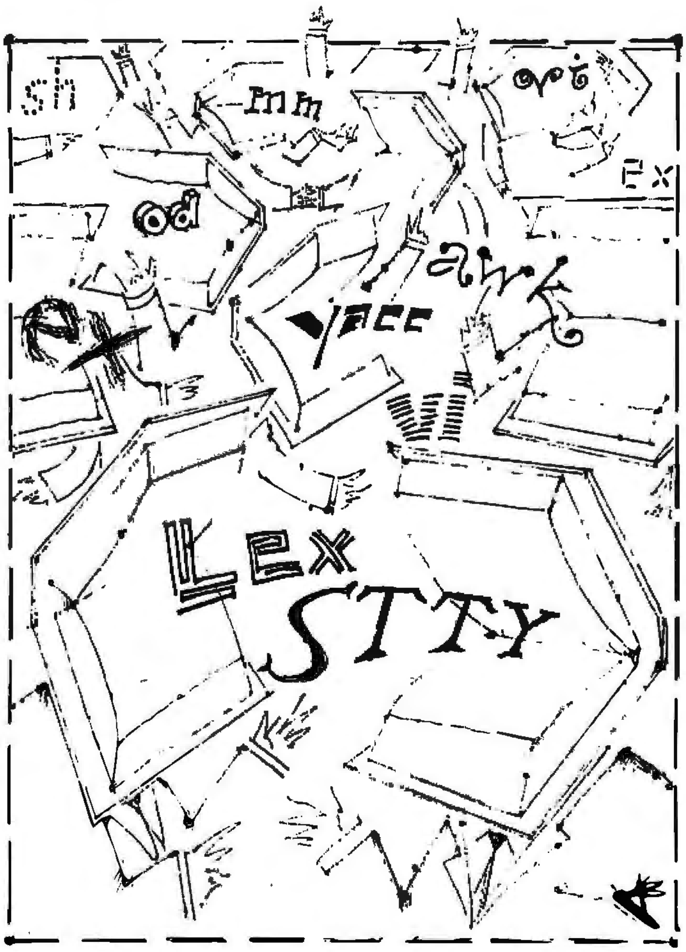
UNDERSTANDING UNIX: A CONCEPTUAL GUIDE
Paul Weinberg and James R. Groff
Que Corporation
Indianapolis, IN: 1983
240 pages, $17.95

A PRACTICAL GUIDE TO THE UNIX SYSTEM
Mark G. Sobell
Benjamin-Cummings
Menlo Park, CA: 1984
428 pages, $21.95

THE UNIX PROGRAMMING ENVIRONMENT
Brian W. Kernighan and Robert Pike
Prentice-Hall
Englewood Cliffs, NJ: 1984
357 pages, $19.95

THE UNIX SYSTEM
Stephen R. Bourne
Addison-Wesley
Reading, MA: 1983
351 pages, $16.95

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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ILLUSTRATED BY MACIEK ALBRECHT

then added phrases like "This may seem strange, but. . . ." The book is very reassuring.

This primer includes quick references for vi and UNIX. Both references include only simple commands, but they are quite useful while working through the exercises in the book. My one problem with the UNIX command reference card is that it does not distinguish commands unique to Berkeley UNIX, making it frustrating to use on a Bell Laboratories UNIX system.

The text begins with a clear description of what UNIX can do, including electronic-office applications and programmer's tools. The description of an operating system and discussion about why UNIX is such a pleasant one to use is full of analogies that make it easy to comprehend.

The authors cover electronic mail, files and directories, editing, manipulating files, languages, file management, adjusting the environment, C-shell, and information processing. The tutorial is for beginners, but some of the more difficult (and powerful) commands, such as grep and awk, are covered.

I have handed this book to many users of our system at work as they began to play with UNIX, and they all have found it a delightful learning tool.

THE BUSINESS GUIDE TO THE UNIX SYSTEM

Jean L. Yates and Sandra Emerson have written *The Business Guide to the UNIX System* for the businessperson; they have not tried to satisfy the endless curiosity of the programmer. They preface each lesson by telling you how many minutes it will take to complete. The goal is not the creative use of UNIX but efficient use in the business environment.

The book begins with a section on terminology and avoiding problems, leading to actual use of a system. The authors do not assume any familiarity with computers: for example, they stress that turning off your terminal does not log you out. Lessons are grouped by function, such as "Reviving a Stalled Terminal."

The Business Guide is entirely practical. Yates and Emerson provide step-by-step guides to using the utilities. The priorities of business use are reflected: half of the book describes text processing and communications utilities. No application packages are described. This book is an introduction to using UNIX utilities for business tasks; it is not a guide to business applications.

The one chapter that makes this book essential for a business user is entitled "System Management and Maintenance." No other introductory book covers the role of the system manager, and in small business settings, the person in that role is not likely to be a computer or UNIX expert. The chapter is organized by task, beginning with what the system manager does and who does system management. Yates and Emerson clearly explain the tasks of adding new users, shutting down the system, maintaining security, and making backups.

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 Christian'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 multiuser 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.

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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. His

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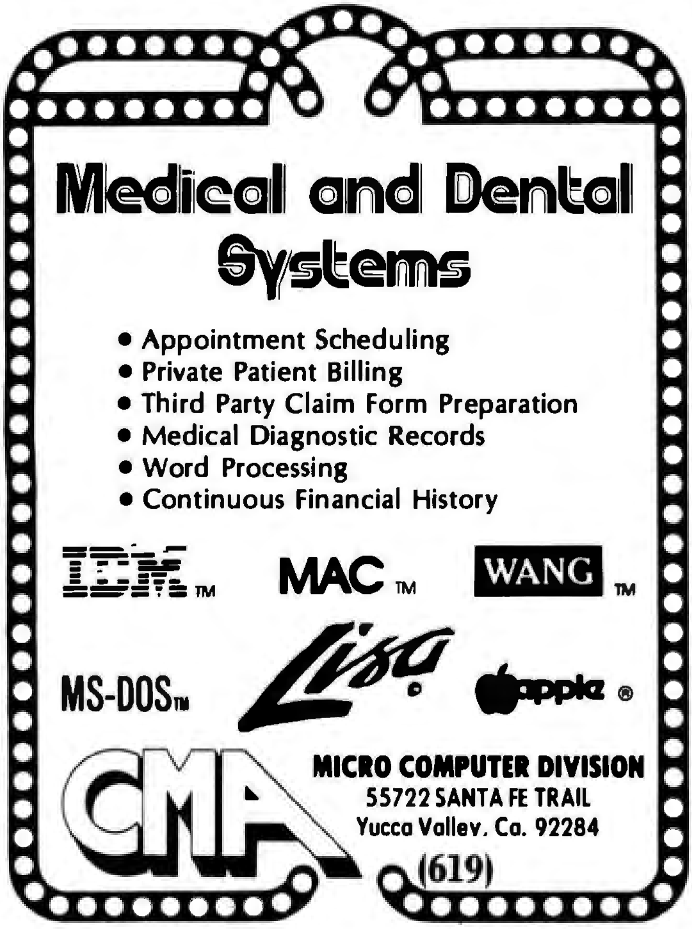

description of operators and the objects they act on is the clearest of any presentation of vi I have read.

The level of difficulty of the book takes a jump with a chapter on programming with the Bourne shell. Since I had not played much with the Bourne shell, I decided to learn it from this book.

I was frustrated. I typed in the example from the book: once I remembered I was in C-shell and it was a Bourne shell script, it worked. Rather than teach through stimulating experimentation, the book presents information. There are no exercises. I prefer a book that guides me in a little deeper and intrigues me with possibilities.

I was also disappointed a few times with oversimplification that led to inaccuracy. For example, while trying to make the point that the editor accepts one sort of command and the shell another, Sobell says, "You cannot run other UNIX programs, such as passwd, while you are running the editor." This is false. One of the greatest strengths of the editors ed, vi, emacs, and ex is that it is so easy to run UNIX commands without leaving the editor. The point Sobell tries to make is an important one: new computer users often have trouble understanding where they are—shell, editor, or application—but it's misleading to stress that UNIX commands can't work from the editor.

The strengths of Sobell's A *Practical Guide* are its coverage of both Bell and Berkeley UNIX, the range of topics covered, the clear explanations, and the appendixes. His is the only one of the introductory books useful as both a tutorial and a reference. It will not be quickly outgrown.

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 appendixes listing all the commands discussed (with options), system calls, C subroutines, ed, vi, sh, troff, and editing macros.

The approaches are different. Bourne presents the material like he's writing a manual—comprehensive and

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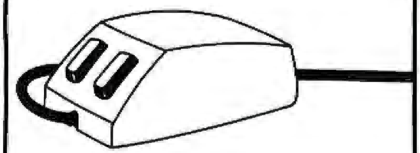

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terse, with no exercises and short examples. I use Bourne's text when I am stuck: it is slightly less terse than manuals, yet I can find what I'm looking for.

Kernighan and Pike write in a friendlier style; their many examples 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 empowered to create my own tools through a more innovative 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 between 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 meanings for /) 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 programs, such as phone and mail lists. Information on creating more usable programs comes later.

Kernighan and Pike discuss frequently used filters: programs 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 developing programs, the authors chose to develop a language interpreter as their sample large program. Yacc, make, and lex are included. Chapter 9 covers document preparation. 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 programs are actually written. Rather than list a finished debugged version, they start out with an idea and a simple 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

Stephen R. Bourne's *The UNIX System* is terse and comprehensive. It has been around since 1982, and I have

(continued)

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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:

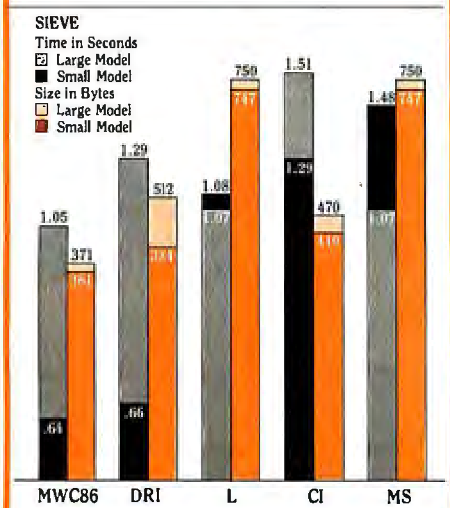
"Of all the compilers reviewed, MWC86 would be my first choice for product development. It compiles quickly, produces superior error messages, and generates quick, compact object code. The library is small and fast and closely follows the industry standard for C libraries."

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.



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- 52 page User Manual

8086/88 Assembler with Translator

Available for MSDOS, PCDOS, or CPM/86! This fully relocatable macro-assembler will assemble and link code for MSDOS (PCDOS) AND CPM/86 on either a CPM/86 or MSDOS machine. This package also includes:
- An 8080 to 8086 source code translator (no limit on program size to translate)
- A Z-80 to 8086 translator
- 64 page user manual
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  - –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, 8003 and 8004 based machines on a Z-80, Z-8000 or 8086 machine. This powerful package includes:
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- 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.

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Include files supported—

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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—

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6502—Standard syntax or Z-80 type syntax supported, all addressing modes supported.

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, stty, 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 appendixes. 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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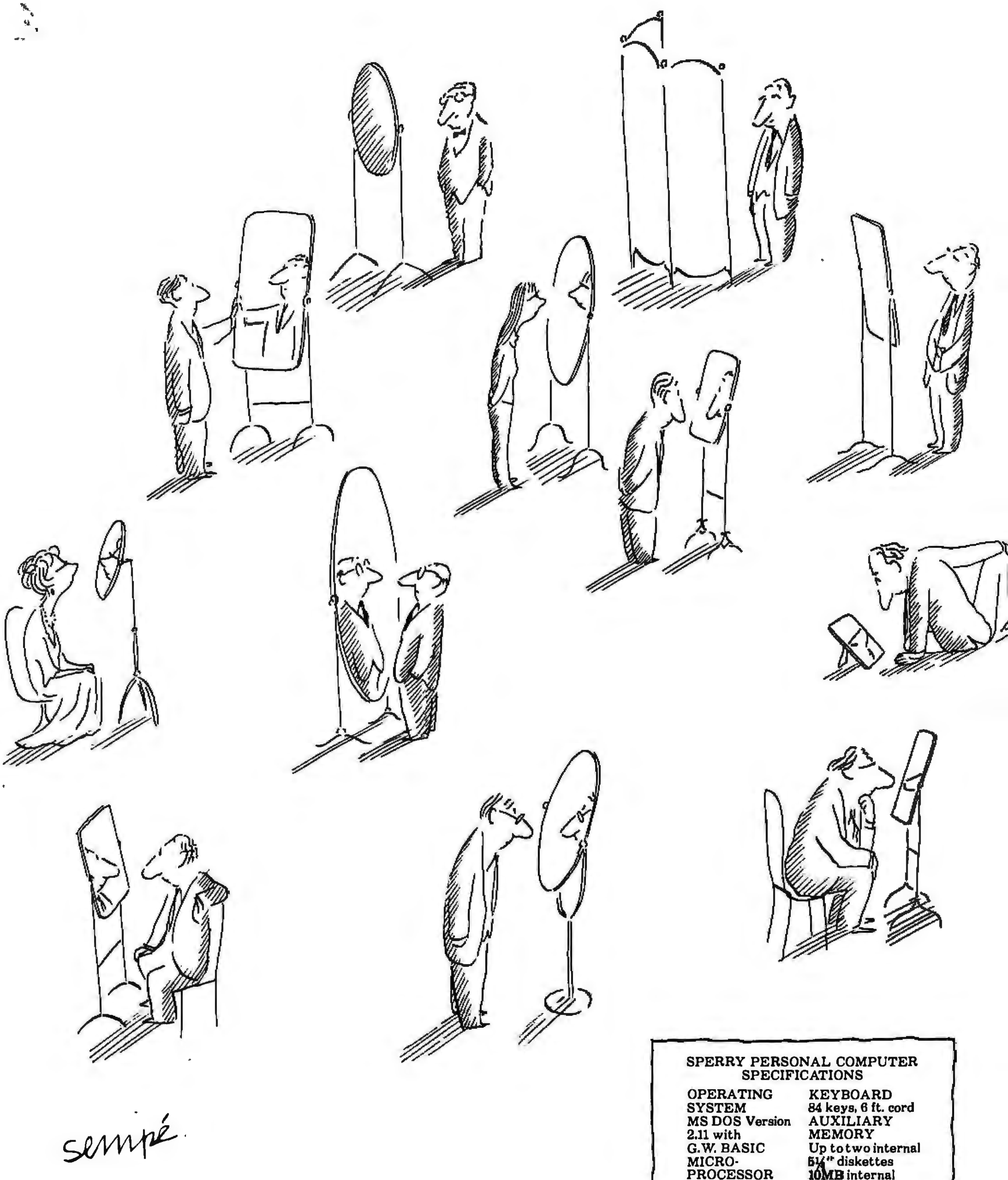

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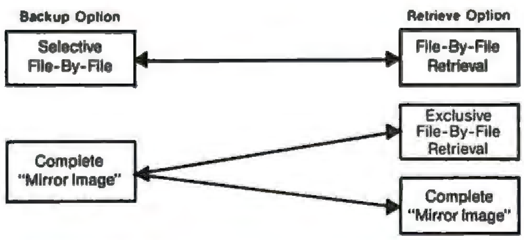

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● DESIGN SHOW
The 1985 National Design Engineering Show, McCormick Place, Chicago, IL. More than 600 CAD/CAM system and electronic component companies will exhibit products. Contact the Show Manager, National Design Engineering Show, 999 Summer St., 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 work 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

● DATACOMM 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 Glasgal 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, B/300-40E, Hopewell Junction, NY 12533, (914) 894-7142. *March* 13–15

● PERSONNEL SYSTEMS SEMINAR—HRSP 101: Introduction to Human Resource Information Systems, Allgauers Fireside Hotel, Chicago, IL. The principles of personnel systems will be explored. Contact Susan G. Goldenberg, Association of Human Resource Systems Professionals Inc., POB 8040-A202, Walnut Creek, CA 94596, (415) 945-8428. *March* 14–15

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

● SHOW IN DELAWARE
The Seventh Annual Delaware Computer Faire, Delaware State College, Dover. Current technology for 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 MICROS—Public Awareness 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 MICROS 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, Infomart, 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

(continued)

IF YOU WANT *your organization's public activities listed in* BYTE's *Event Queue, we need to know about them at least four months in advance. Send information about computer conferences, seminars, workshops, and courses to* BYTE, *Event Queue*, POB 372, *Hancock*, NH 03449.

● EDUCATION AND COMPUTING—Educational Computing Today, Westin Hotel, Renaissance Center, Detroit, MI. Kindergarten, elementary, high school, and college educators will share educational computing experiences. Contact Michigan Association for Computer Users in Learning, MACUL/ICCE Conference, POB 628, Westland, MI 48185, (313) 595-2493. *March* 21–22

● ELEMENTARY COMPUTING—University of Delaware Second National Conference: Computers and Young Children, University of Delaware, Newark. The emphasis is on programs for children 4 to 8 years of age. Contact Dr. Richard B. Fischer, Division of Continuing Education, University of Delaware, Newark, DE 19716, (302) 451-8838. *March* 21–22

● WINTER COMDEX COMDEX/Winter, Convention Center, Anaheim, CA. One of the largest shows in the microcomputer industry. Contact The Interface Group, 300 First Ave., Needham, MA 02194, (800) 325-3330; in Massachusetts, (617) 449-6600. *March* 21–24

● DATABASE SYMPOSIUM The Fourth Annual ACM SIGACT/SIGMOD Symposium on Principles of Database Systems, Portland, OR. Theoretical and practical aspects of database systems. Topics include the application of artificial-intelligence techniques to database systems, data models, and data structures for physical database implementation. Contact David Maier, Department of Computer Science, Oregon Grad Center, 19600 Northwest Walker Rd., Beaverton, OR 97006. *March* 25–27

● OPTICAL STORAGE TECHNIQUES—The Third Annual Conference on Optical Storage of Documents and Images, Shoreham Hotel, Washington, DC. Contact Technology Opportunity Conference, POB 14817, San Francisco, CA 94114-0817, (415) 626-1133. *March* 25–27

● INTEGRATION, COMMUNICATIONS, COMPUTERS IEEE INFOCOM '85, Washington, DC. Papers will address such issues as architecture protocols, gateways, and support. Contact Tom Stack, IEEE INFOCOM '85, POB 639, Silver Spring, MD 20901, (301) 589-8142. *March* 25–28

● MICROS FOR EDUCATION—The Twenty-Sixth International Conference of the Association for the Development of Computer-based Instructional Systems, Adams Mark Hotel, Philadelphia, PA. General sessions will cover major issues in computer-based instruction for educators at all levels. Contact Gordon Hayes, Western Washington University, 409 Miller Hall, Bellingham, WA 98225. *March* 25–28

● DBM AND FOURTH GENERATION—Database Management Systems and Fourth Generation Languages for Personal Computers, Denver, CO. Topics include approaches to managing data, operational considerations, and management issues. The fee is $795. Contact Software Institute of America Inc., 8 Windsor St., Andover, MA 01810, (617) 470-3880. *March* 27–29

● DECISION SUPPORT SYSTEMS—Decision Support Systems for Practical Applications, Los Angeles, CA. The fee is $795. Contact Digital Consulting Associates Inc., 6 Windsor St., Andover, MA 01810, (617) 470-3870. *March* 27–29

● JOINT CONFERENCE IN MINNESOTA—Updata '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 94542. *March* 28–29

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

● COMPUTERFEST The 1985 Greater Baltimore Hamboree and Computerfest, Maryland State Fairgrounds, Timonium. Exhibits, flea 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 21903-0095, (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 exhibits-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

● TELECONFERENCING SEMINAR—Teleconferencing in the Marketplace, International Conference Centre RAI, Amsterdam, The Netherlands. A seminar for users and suppliers of teleconferencing services and facilities. Contact International Congress and Convention Association, POB 5343, 1007 AH Amsterdam, The Netherlands. *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)

EVENT QUEUE

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

● UNIX EXPO UNIX Systems Exposition '85, Paris, France. An exhibition covering UNIX hardware and software. A conference program is planned. Contact Network Events Ltd., Printers Mews, Market Hill, Buckingham, MK18 1JX, England; tel: (0280) 815226; in France, Gin Piau, 272 rue de Faubourg, Saint Honore, 75008 Paris, France; tel: (1) 776 75 06. *April 2–4*

● MODULA-2 ENGINEERING—Software Engineering with Modula-2, Atlanta, GA. A course emphasizing methods for building large-scale software systems in Modula-2. Prerequisite: knowledge of Ada or Pascal. The fee is $495. Contact Elaine Hadden Nicholas, Department of Continuing Education, Georgia Institute of Technology, Atlanta, GA 30332-0385, (404) 894-2547. *April 3–5*

● SYSTEMS DEVELOPMENT AND FOURTH GENERATION—Structured Techniques Using Fourth Generation Languages, Chicago, IL. This seminar explains how to use fourth-generation languages in a structured systems-development environment. Contact Digital Consulting Associates Inc., 6 Windsor St., Andover, MA 01810, (617) 470-3870. *April 10–12*

● PERSONNEL SYSTEMS SEMINAR—HRSP 101: Introduction to Human Resource Information Systems, Marriott Hotel-Northwest, Atlanta, GA. See March 14–15 for details. *April 11–12*

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

● GRAPHICS Computer Graphics '85, Dallas, TX. Tutorials and technical sessions on architectural and engineering computer graphics, artificial intelligence, business graphics, and CAD/CAM. Contact National Computer Graphics Association, Suite 601, 8401 Arlington Blvd., Fairfax, VA 22031, (703) 698-9600. *April 14–18*

● TELECOMMUNICATIONS EVENT—Intelexpo '85, Washington, DC. A conference and exhibition for the telecommunications industry. Contact United States Telecommunications Suppliers Association, Suite 1618, 333 North Michigan Ave., Chicago, IL 60601, (312) 782-8597. *April 15–18*

● ACQUIRING EXPERT KNOWLEDGE—Knowledge Acquisition for Expert Systems: An Applications Perspective on Planning and Developing the Prototype, Washington, DC. A workshop

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EVENT QUEUE

offering an approach to knowledge acquisition for building expert systems. The fee is $1950. Contact Expert-Knowledge Systems Inc., 6313 Old Chesterbrook Rd., McLean, VA 22101, (703) 734-6966. *April 15–19*

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

● TRAINING AND TECHNOLOGY—The Third Annual Technology in Training and Education (TITE) Conference, Antler's Hotel, Colorado Springs, CO. Contact Lt. Colonel McCann, TITE Conference, USAFA/DFSR, USAF Academy, Colorado Springs, CO 80840-5751, (303) 472-4195. *April 16–19*

● DBM AND FOURTH GENERATION—Database Management Systems and Fourth Generation Languages for Personal Computers, Atlanta, GA. See March 27–29 for details. *April 17–19*

● 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 Hannover Fairs Information Center, Route 22 E, POB 338, Whitehouse, NJ 08888, (800) 526-5978; in New Jersey, (201) 534-9044. *April 17–24*

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

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

● COMPUTER FESTIVAL The Tenth Annual Trenton Computer Festival, Trenton State College, Trenton, NJ. 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 CN 550, Trenton, NJ 08625, (609) 771-2487. *April 20–21*

● EDUCATIONAL AIDS AEDS/ECOO '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 (ECOO). Contact AEDS/ECOO '85, c/o OISE, 252

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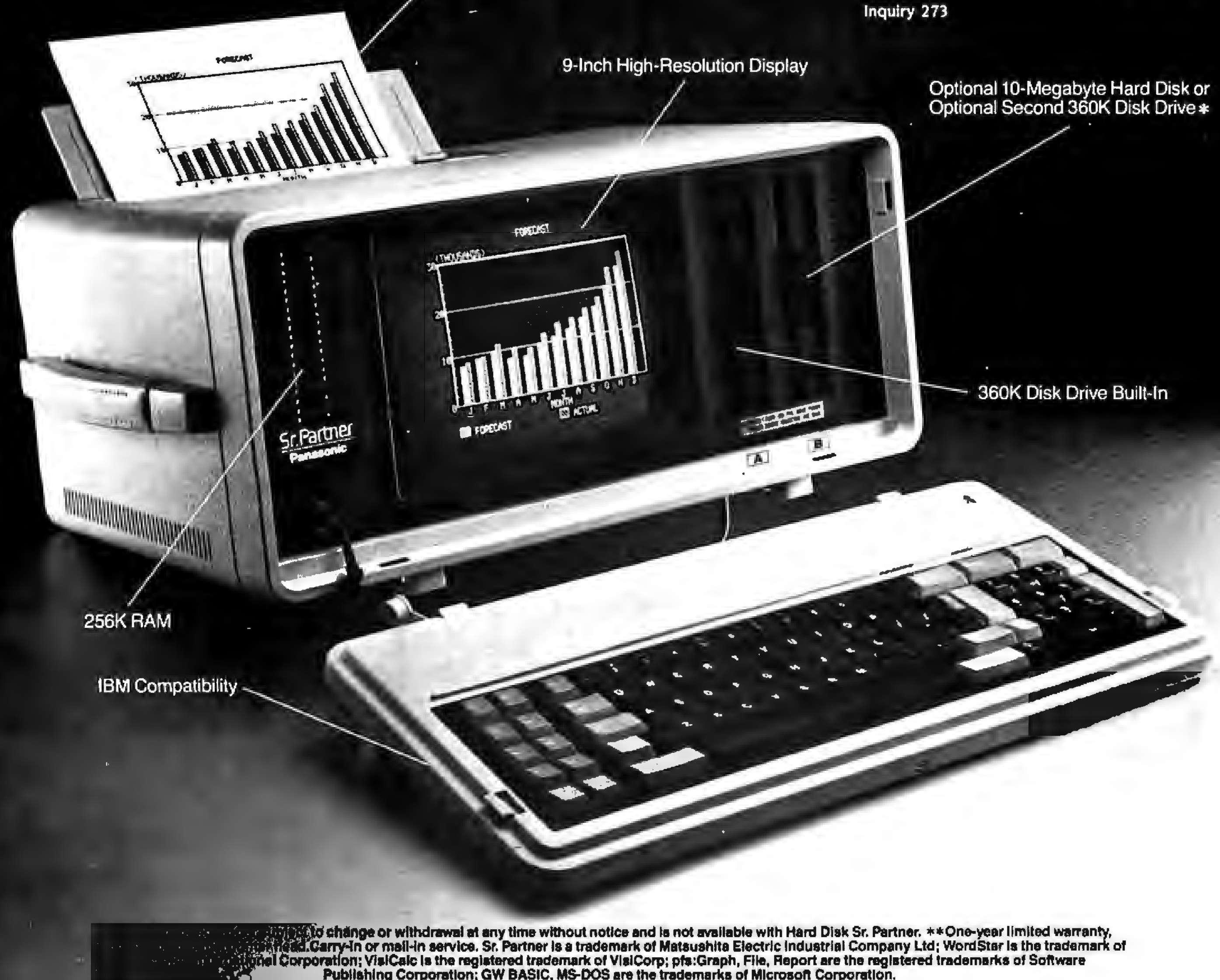

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EVENT QUEUE

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 Gracie 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 operations of a packet-switching network and its implementation. International standards are also covered. The fee is $795. Contact Elaine Hadden 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; Telex: 22836 ITKR BG. *April 23–26*

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

● VIRGINIA COMPUTING
The Fourth Annual Virginia Computer Show and Software Exposition, Pavilion, Virginia Beach, VA. Contact Ann Katcef, CompuShows, POB 3315, Annapolis, MD 21403, (800) 368-2066; in Annapolis, (301) 263-8044; in Baltimore, (301) 269-7694; in the District of Columbia, (202) 261-1047. *April 25–28*

● EQUIPMENT SALE
Produx 2000: Wholesale Expo '85, Civic Center, Philadelphia, PA. Six hundred booths of computers, communications devices, and business equipment for sale. Contact The Vertical Marketing Corp., POB 557, Bala Cynwyd, PA 19004, (215) 457-2303. *April 26–28*

● 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) 593-5241. *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*

May 1985

● SCIENTIFIC COMPUTING AND AUTOMATION—The First Scientific Computing and Automation Conference and Exposition, Convention Center, Atlantic City, NJ. For practitioners and managers in analytic chemistry, biotechnology/biomedical research, clinical chemistry, and engineering. Product displays. Contact Expocon Management Associates Inc., 3695 Post Rd., Southport, CT 06490. *May 1–3*

● SPECIAL EDUCATION SOFTWARE—National Conference on Special Education Software, Radisson Mark Plaza, Alexandria, VA. The theme is "DISCover the Possibilities." Product displays and demonstrations. Registration: $50. Contact Elsa Glassman, The Council for Exceptional Children, Department of Professional Development, 1920 Association Dr., Reston, VA 22091, (703) 620-3660, ext. 261. *May 2–3*

● COMPUTERS AND WRITING—UCLA Conference on Computers and Writing: New Directions in Teaching and Research, University of California, Los Angeles. Contact Dr. Lisa Gerrard, UCLA Writing Programs, 371 Kinsey Hall, UCLA, Los Angeles, CA 90024, (213) 206-1145. *May 4–5*

● 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 M8W 3Z8, 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-

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lege of Engineering, University of Texas, Austin, TX 78712, (512) 471-3506. *May 13–14* and *May 15–17*

● OFFICE ENVIRONMENT Workspace '85, Moscone Convention Center, San Francisco, CA. The theme is "Space as Function: Space as Image." Program areas include telecommunications, ergonomics legislation, and management policies and office design. Contact Charles Yourd, Technology Conference Group, 5th Floor, 44 Montgomery St., San Francisco, CA 94104, (415) 931-8255. *May 14–15*

● TEST, MEASUREMENT EXPO—The 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—AAMSI Congress 1985, Hilton Hotel, San Francisco, CA. Papers, sessions, and demonstrations. Contact American Association for Medical Systems and Informatics, Suite 402, 4405 East-West Highway, Bethesda, MD 20814, (301) 657-4142. *May 20–22*

● COMPUTER GRAPHICS FOR PRODUCTIVITY—The 1985 Trends and Applications Conference, Sheraton Northwest Washington, Silver Spring, MD. Using computer graphics for greater productivity. Contact Trends and Applications '85, IEEE Computer Society, POB 639, Silver Spring, MD 20901. *May 21–22*

● 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*

● MANAGE PROGRAMS Configuration Management of Software Programs, Washington, DC. Methods for controlling the costs of development, maintenance, and operation of software. Contact Stod Cortelyou, Continuing Engineering Education, George Washington University, Washington, DC 20052, (800) 424-9773; in the District of Columbia, (202) 676-8520. *May 29–31*

● COMPUTER INTERFACING—Personal Computer and STD Computer Interfacing for Scientific Instrument Automation, Virginia Tech, Blacksburg. See March 14–16 for details. *May 30–June 1* ■

Features

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

PHOTOGRAPHED BY PAUL AVIS.

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 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.*

		High Group			
		Column 0 1209 Hz	Column 1 1336 Hz	Column 2 1477 Hz	Column 3 1633 Hz
Low Group	Row 0, 697 Hz	1	2	3	A
	Row 1, 770 Hz	4	5	6	B
	Row 2, 852 Hz	7	6	9	C
	Row 3, 941 Hz	·	0	#	D

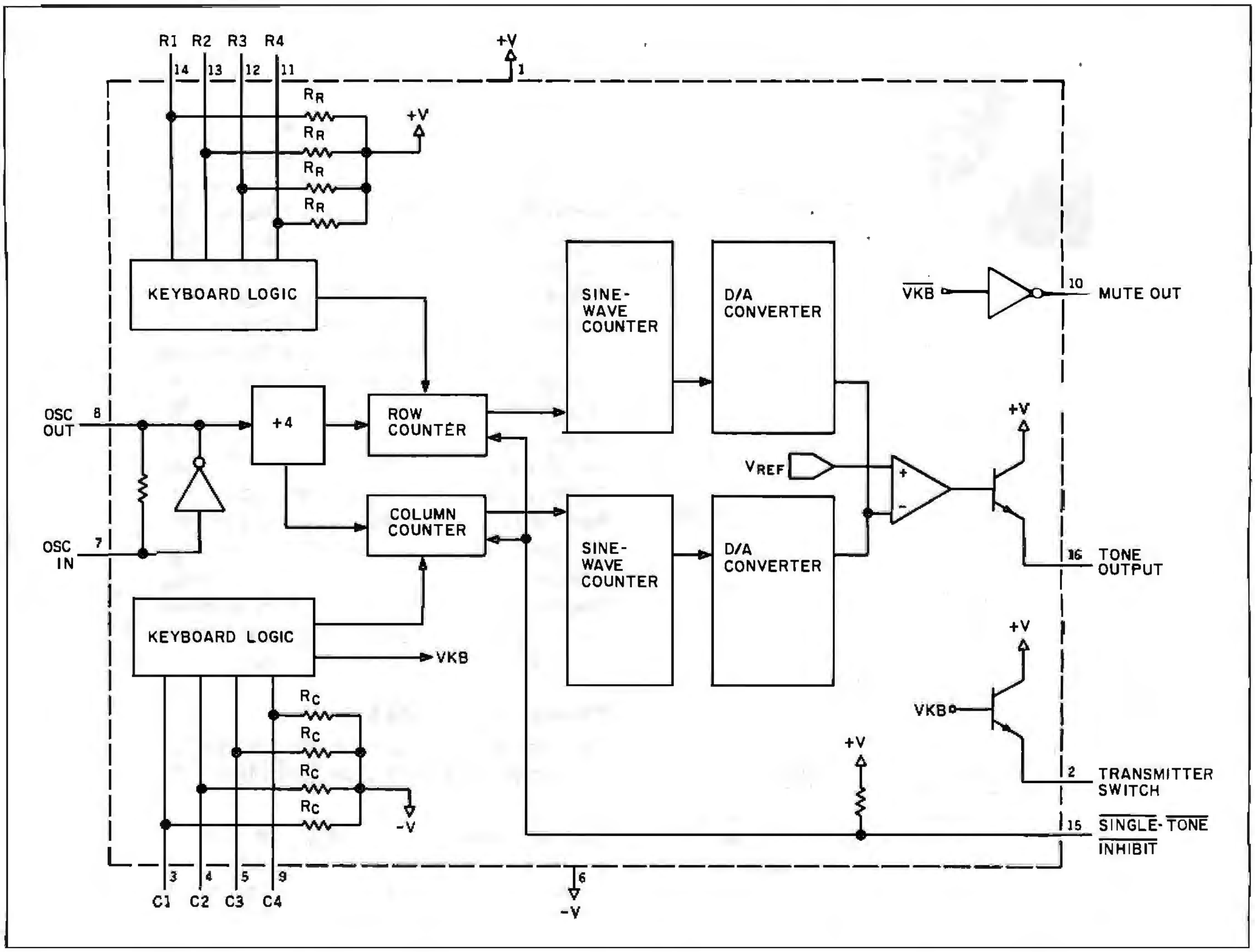

Figure 1: *Block diagram of the* Mostek MK5087 DTMF-*signal encoder.*

tance-capacitance.)

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 the 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 D/A (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 JP1 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 JP1 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 DTMF decoder board with a remotely located encoder chip. Together, they form a simple 2-wire 16-function remote-control system. Further enhancement could be provided by substituting an infrared transmitter/receiver pair for the wire (see the references).

INTERACTIVE MESSAGE SYSTEM

Now that we have the essential component developed, we can continue discussion of the DTMF communication system I started telling you about. For illustrative purposes, I will call it TIMS, for Touch-Tone Interactive Message System. It works without an ASCII terminal and is designed to

(continued)

Table 2: SSI 204 *output codes.*

Digit	OUTPUT CODE D8	D4	D2	D1
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
0	1	0	1	0
*	1	0	1	1
#	1	1	0	0
A	1	1	0	1
B	1	1	1	0
C	1	1	1	1
D	0	0	0	0

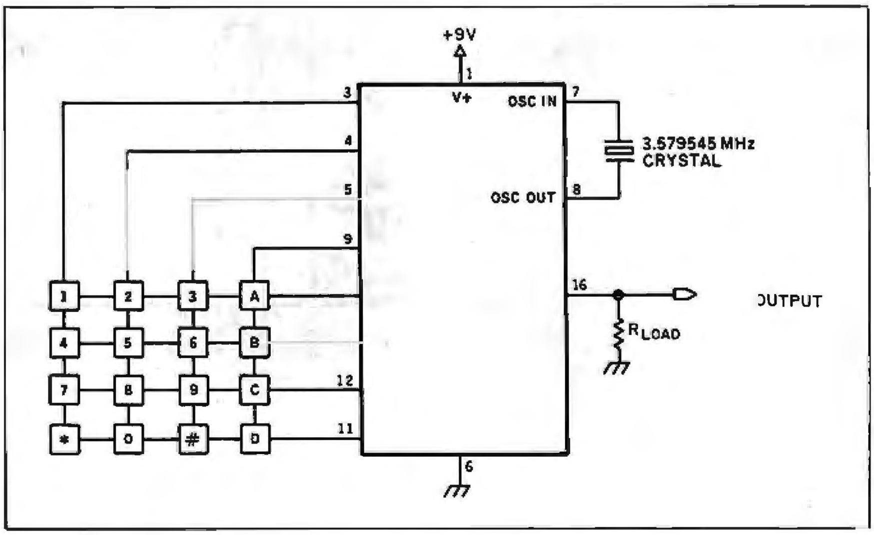

Figure 2: *Schematic diagram of a* DTMF-*encoding circuit.*

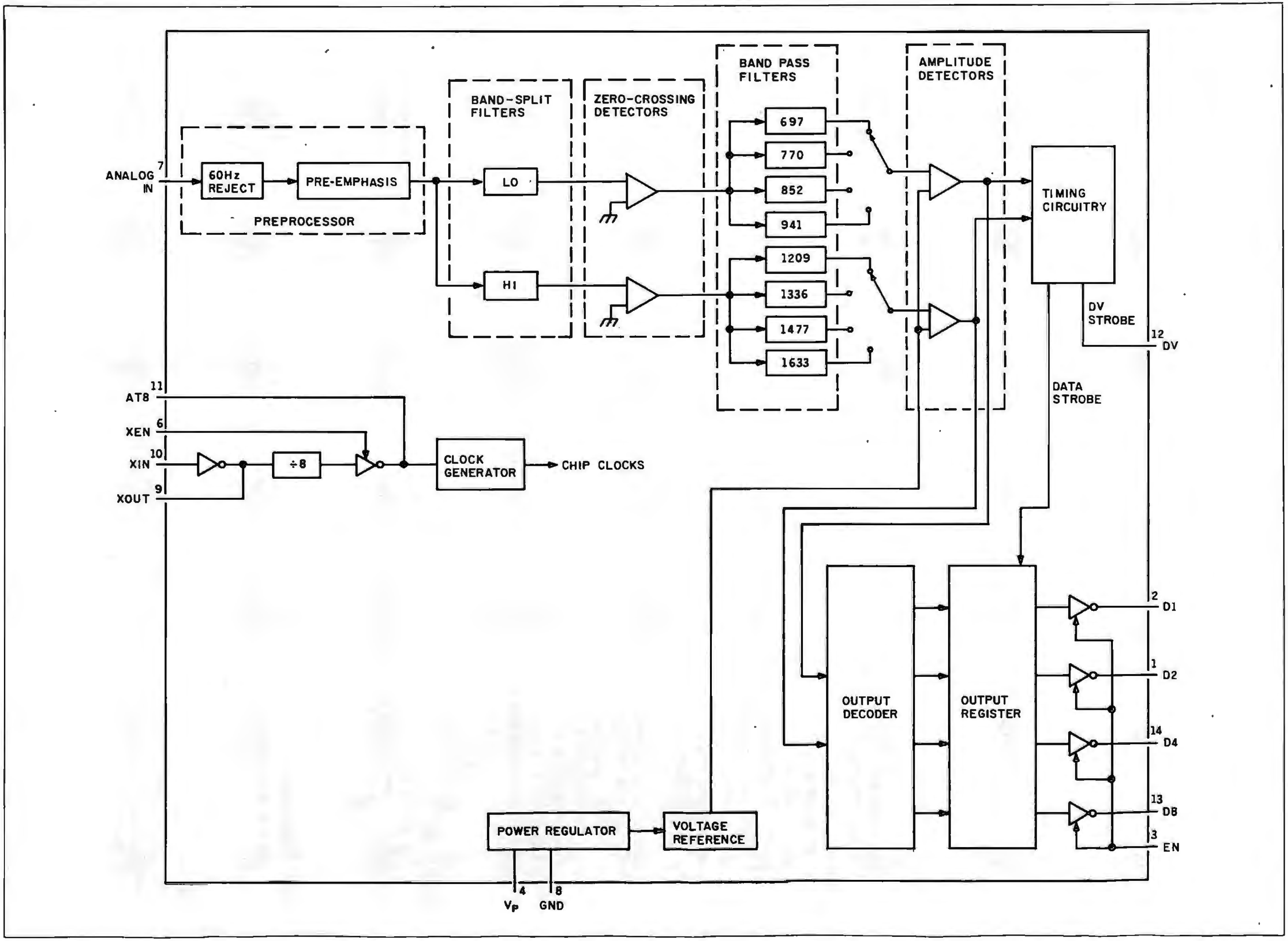

Figure 3: *Block diagram of the SSI 204 DTMF decoder.*

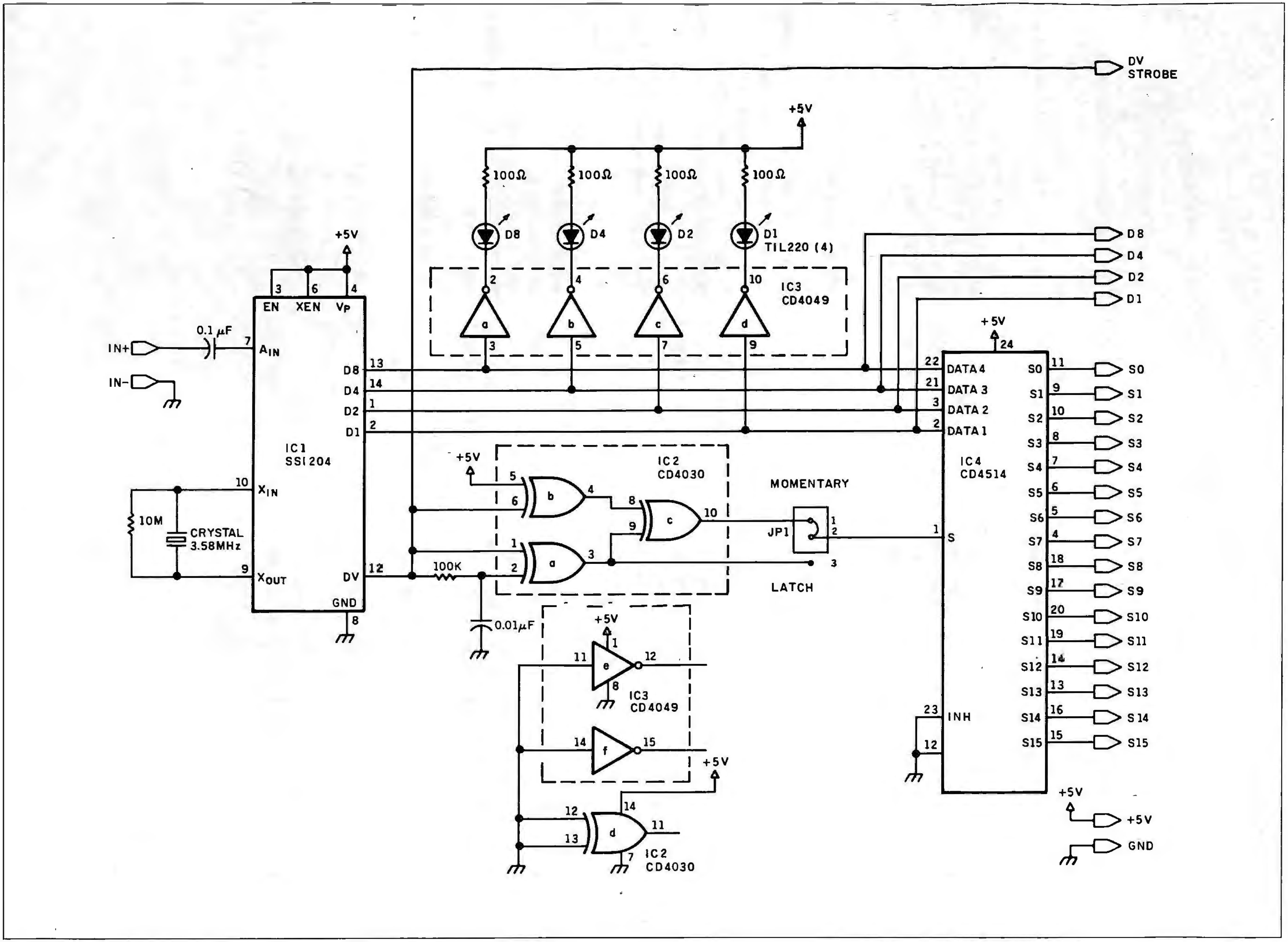

Figure 4: The Circuit Cellar DTMF decoder board.

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 transferral. In addition to giving 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 computer-specific. 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-

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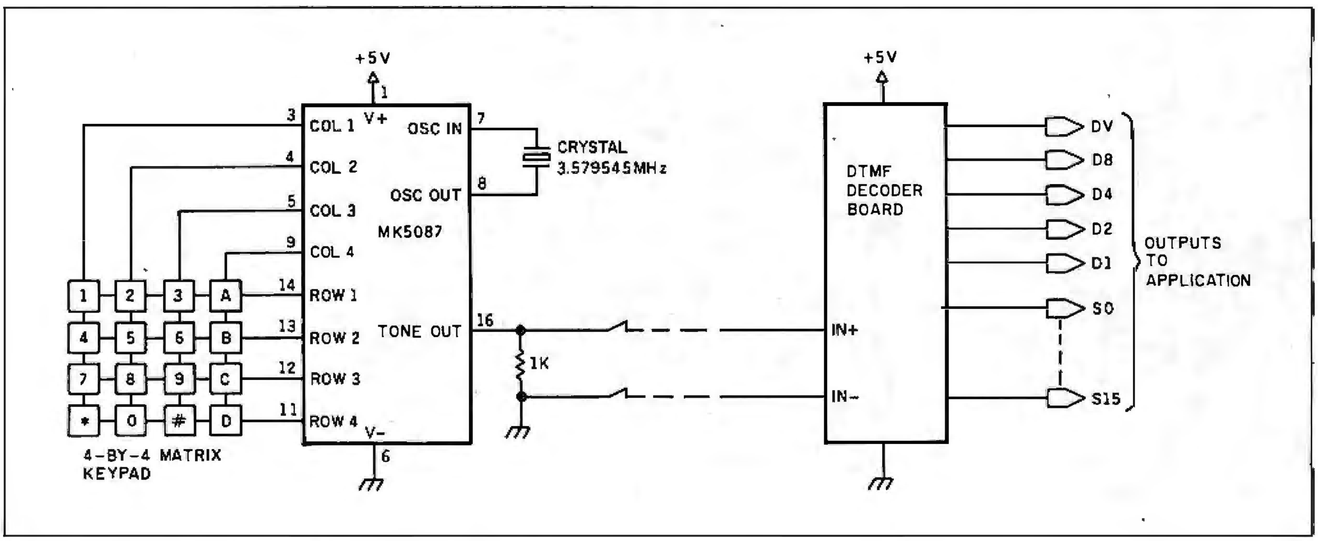

Figure 5: DTMF *encoder/decoder remote-control circuit.*

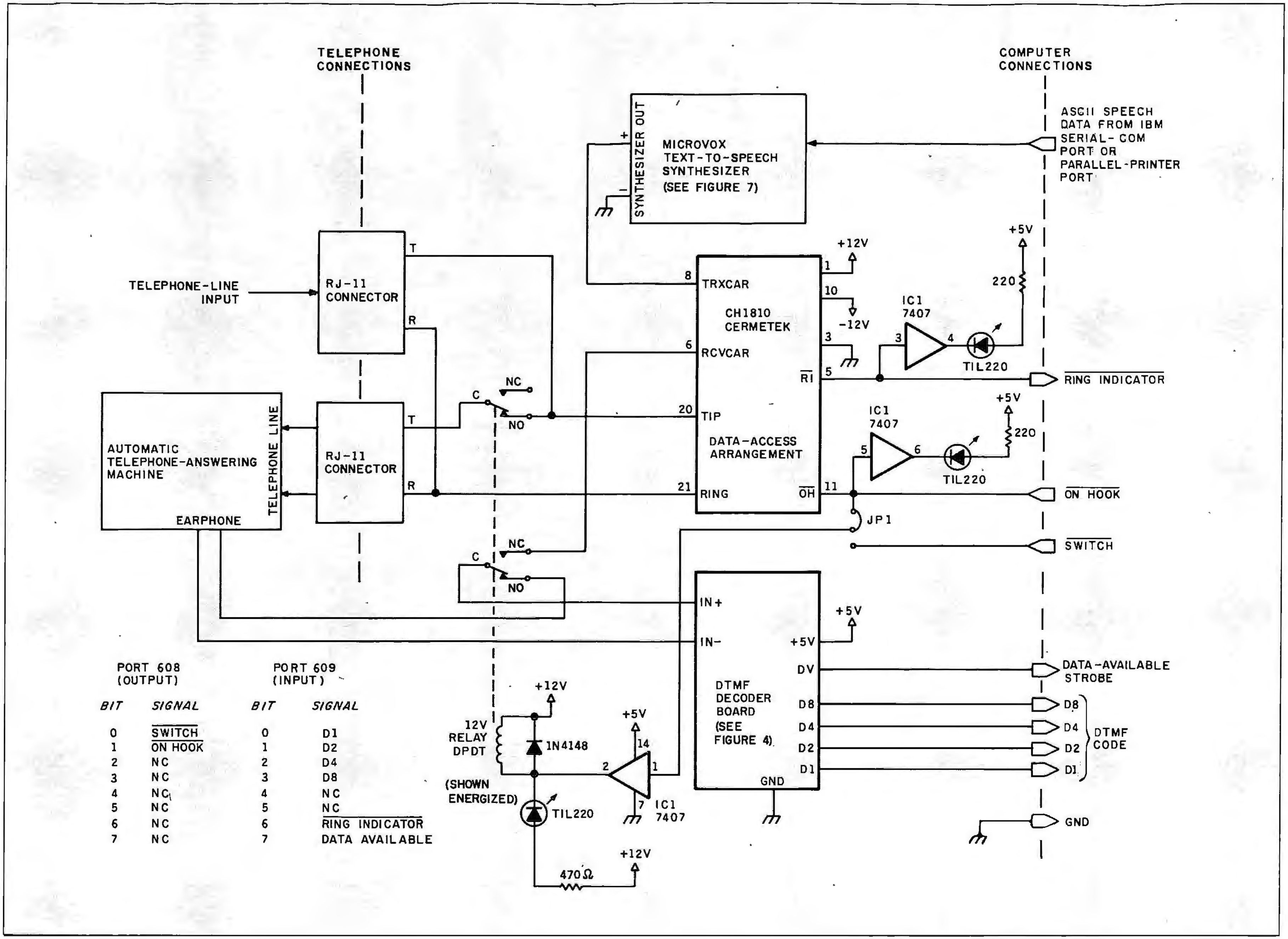

Figure 6: *The Circuit Cellar Touch-Tone Interactive Message System.*

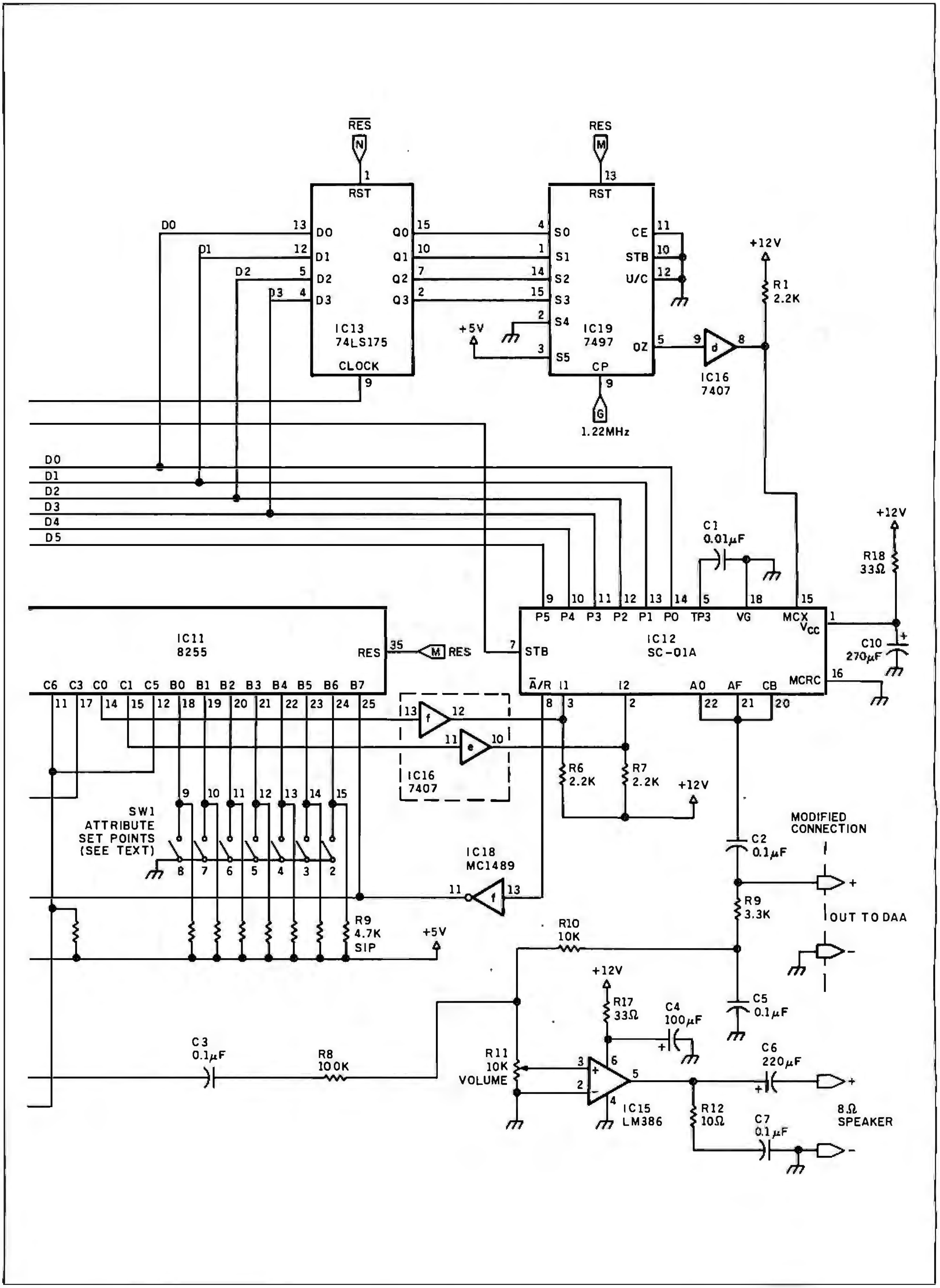

Figure 7: *Modified Microvox output circuit. This schematic appeared in its original form in the September 1982 BYTE.*

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

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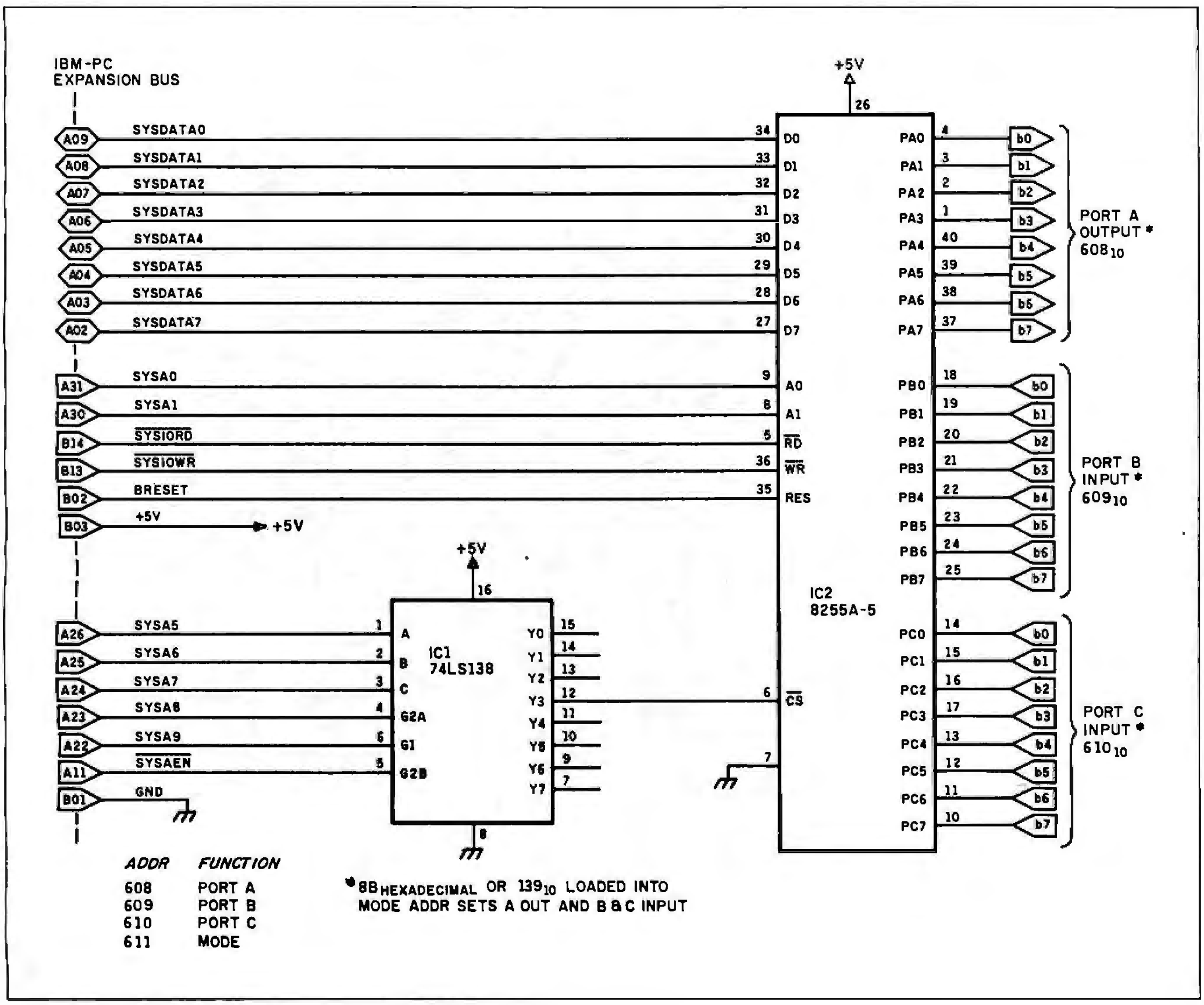

Figure 8: *Parallel port for the* IBM PC.

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

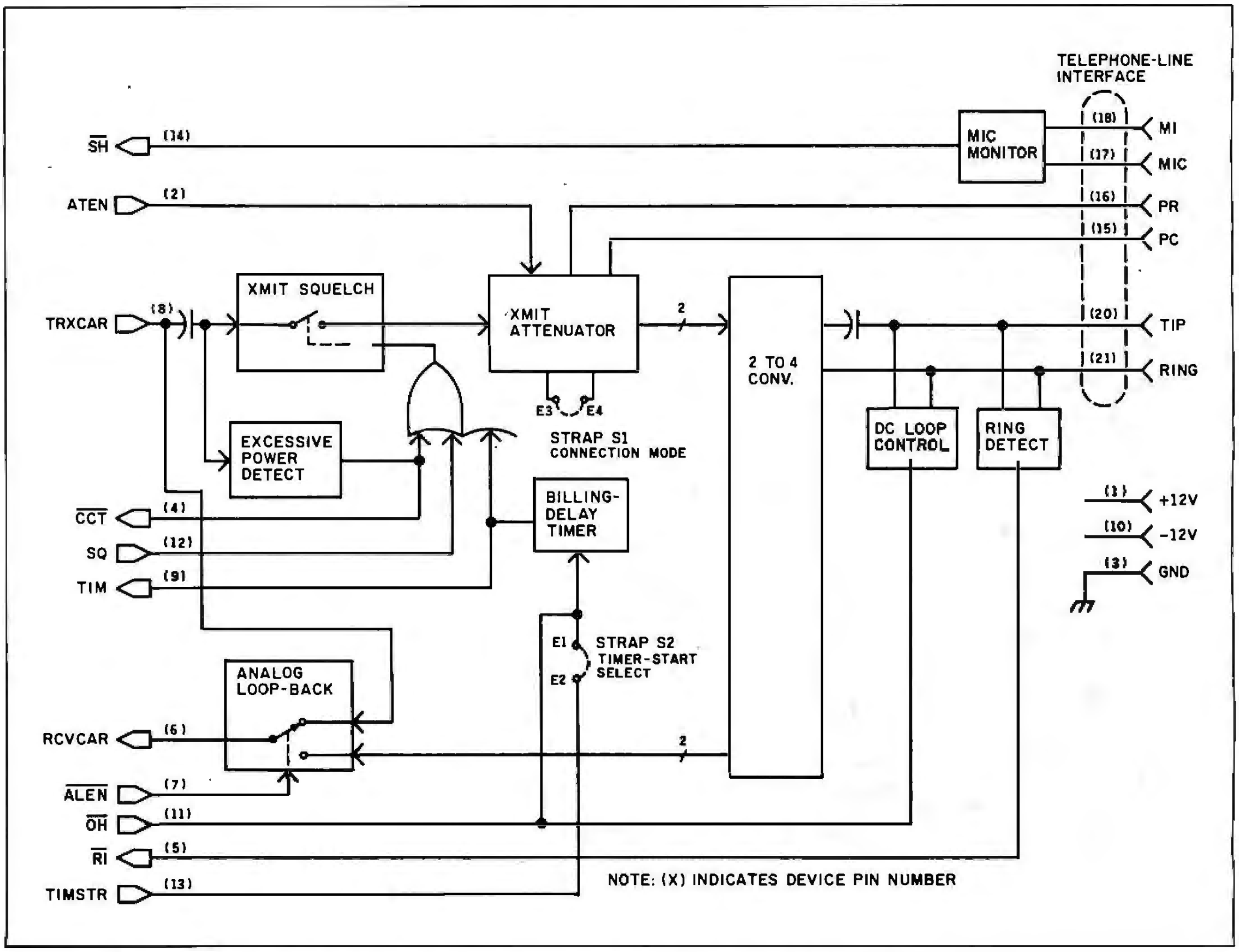

Figure 9: *Block diagram of the CH1810 direct connect protective hybrid telephone-line interface.*

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 $\overline{\text{ALEN}}$ is a high logic level, this audio is asserted at the RCV audio-output pin, RCVCAR. When $\overline{\text{ALEN}}$ 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 $\overline{\text{OH}}$, 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 $\overline{\text{OH}}$ line has established an off-hook condition, the $\overline{\text{OH}}$ line can be pulsed for automatic dialing.

$\overline{\text{OH}}$ 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 $\overline{\text{OH}}$ 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 $\overline{\text{RI}}$ (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 $\overline{\text{SH}}$. 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 $\overline{\text{SH}}$ 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)

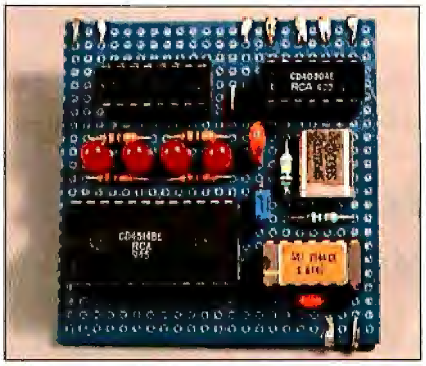

Photo 1: *Prototype of the* DTMF *receiver board.*

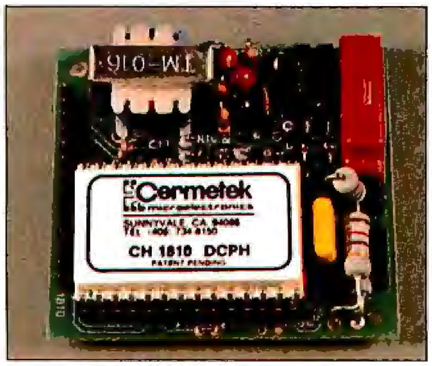

Photo 2: *Cermetek* CH1810 DAA.

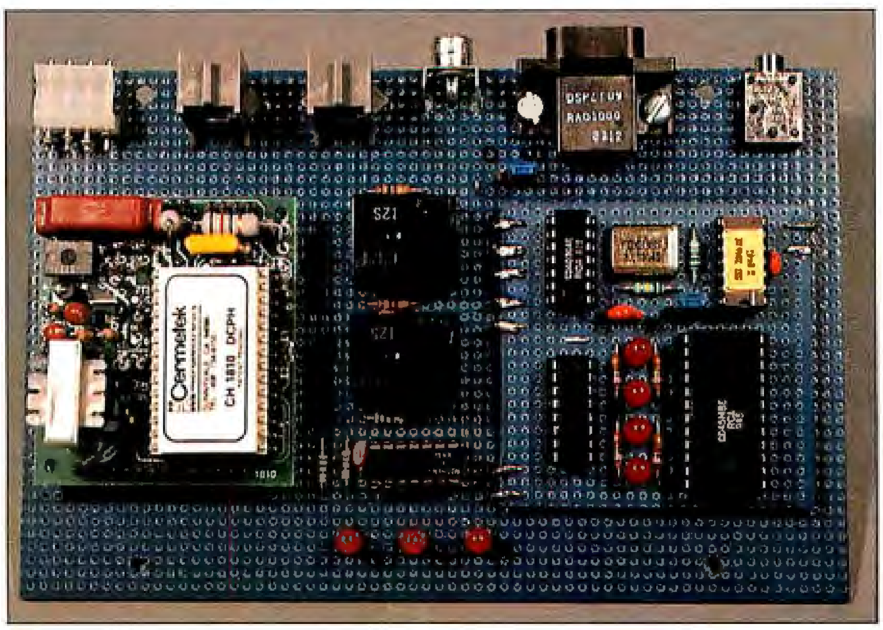

Photo 3: *Prototype of the Touch-Tone Interactive Message System. The connectors from left to right are the power supply, answering-machine connector, telephone-line input, Microvox speech-synthesizer output, parallel I/O interface to computer, and the answering-machine earphone output.*

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 [single-pole, double-throw] and operate in parallel. A DPDT [double-pole, double-throw] relay should be used. These were chosen for size.)

With the relay unenergized, both the recorder and the DAA receive the incoming call. When the telephone rings, the $\overline{\text{RI}}$ signal to the computer (port address 609, bit 6) goes low. Unless you wish to intercede and go off hook on the DAA, the recorder continues to count incoming rings. When it gets to the preselected quantity (usually selected by a dial on the side of the machine), it automatically answers (goes off hook) and speaks its message.

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 DV 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: $\overline{\text{SWITCH}}$ and $\overline{\text{ON HOOK}}$. With JP1 in the opposite position as shown, the relay and the DAA are separately controlled. A logic 0 on the $\overline{\text{SWITCH}}$ input energizes the relay, and a logic 1 to $\overline{\text{ON HOOK}}$ causes the DAA to go off hook. Life is simplified by tying the DAA $\overline{\text{OH}}$ line to the relay (with JP1) 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 ($\overline{\text{ON HOOK}}$). 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-timer delay—the 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 XMIT attenuation from 0 to −12 decibels (dB).

$\overline{\text{OH}}$: On-hook input. When asserted low, telephone-line loop current is broken. Pulse dialing may be done through this input.

$\overline{\text{RI}}$: Ringing indication output. It is asserted low during the typical 2-second telephone-ringing period.

TIM: Billing-delay timer squelch output. When $\overline{\text{OH}}$ 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.

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

$\overline{\text{ALEN}}$: 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.

MI/MIC: MI/MIC inputs. These two pins connect through the telephone cable and jack to the dataphone voice/data mode contacts.

$\overline{\text{SH}}$: Switch-hook output. Reflects the state of the MI/MIC contact inputs. If there is a contact closure between MI and MIC, $\overline{\text{SH}}$ is asserted high.

TIMSTR: Time start input. When strap S2 is inserted, this input is connected to the $\overline{\text{OH}}$ 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 this 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.

Listing 1: 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 RI 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.....PLEASE HELP ME TEST YOUR
    PHONE....."
190 LPRINT"PRESS A NUMBER BUTTON AND I WILL GUESS IT......"
200 LPRINT"OR..PRESS THE ASTERISK..TO END.THIS CALL"
210 GOSUB 280
220 IF DTMF=11 THEN LPRINT"THANK YOU.GOOD 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
```

Circuit Cellar Feedback

This month's feedback begins on page 390.

Next Month

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

Diagrams specific to the CH1810 are reprinted courtesy of Cermetek Inc.

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

The CH1810 data-access arrangement is available through authorized distributors or from

CERMETEK MICROELECTRONICS
1308 Borregas Ave.
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(408) 734-8150

The following items are available from
THE MICROMINT INC.
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1. DTMF decoder board as described in figure 4. Complete kit, including all parts. DT01, $59
2. Microvox text-to-speech synthesizer, assembled and tested..... MV01, $349
3. Microvox text-to-speech synthesizer, complete kit............ MV02, $269

DTMF boards and chips are available in OEM quantities.

Please include $4 for shipping and handling in the continental United States, $10 elsewhere. New York residents please include 8 percent sales tax. Connecticut residents please include 7.5 percent sales tax.

Editor's Note: Steve often refers to previous Circuit Cellar articles. Most of these past articles are available in reprint books from BYTE Books, McGraw-Hill Book Company, POB 400, Hightstown, NJ 08250.

Ciarcia's Circuit Cellar, Volume I covers articles that appeared in BYTE from September 1977 through November 1978. *Volume* II covers December 1978 through June 1980. *Volume* III covers July 1980 through December 1981. *Volume* IV covers January 1982 through June 1983.

To receive a complete list of Ciarcia's Circuit Cellar project kits, circle 100 on the reader-service inquiry card at the back of the magazine.

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7. Ciarcia, Steve. "Build the Microvox Text-to-Speech Synthesizer." Part 1: Hardware, BYTE, September 1982, page 64. Part 2: Software, BYTE, October 1982, page 40.
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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.

A flexible, text-oriented database

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 *(continued)*

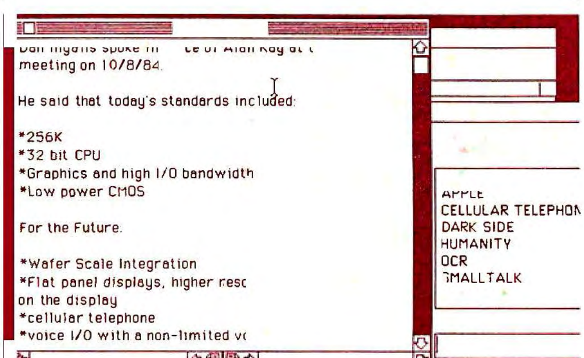

Figure 1: Factfinder's text-entry screen, similar to Macwrite, features an "elevator bar" on the right, and "browse" and "zoom" buttons on the bottom.

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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.

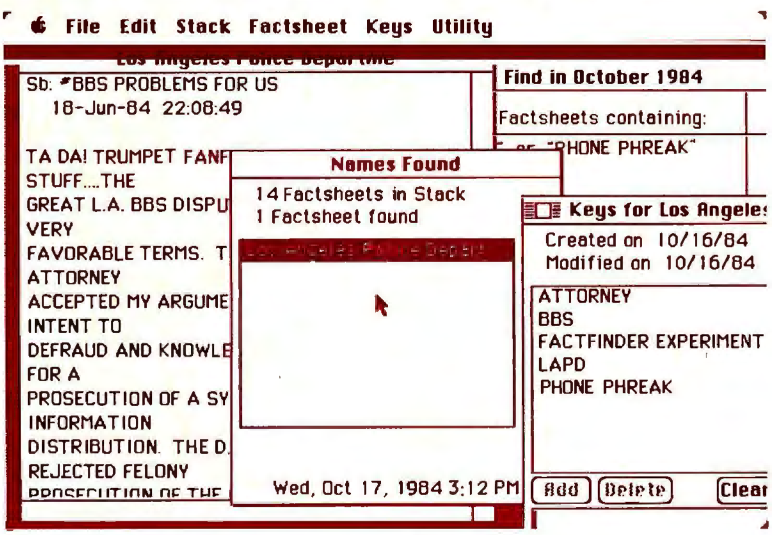

Figure 2: Factfinder responds to queries that you enter in the Find window (top right) with a list of factsheets that contain the keywords (middle), the first such factsheet (left), and all the keywords for that particular factsheet (bottom right).

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 keyword 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 trashcan 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 factsheet) can be deleted later.

While Factfinder is nominally an "unstructured" database (that is, it doesn't use predefined fields or records), each factsheet 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. ■

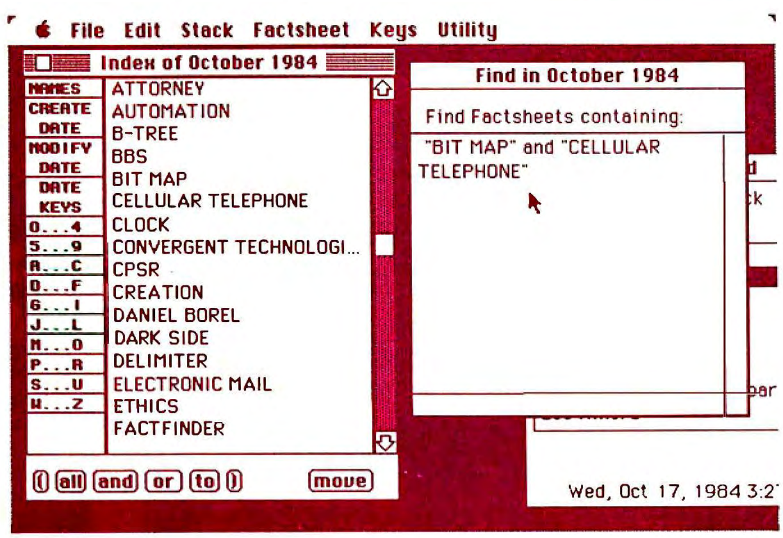

Figure 3: You can build queries either by entering them directly into the Find window, or by double-clicking on a keyword or phrase in a stack's index, which automatically copies the phrase to the Find window.

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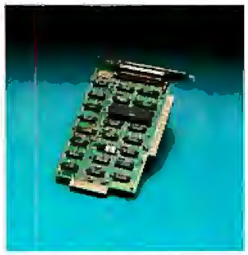

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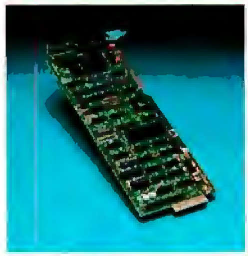

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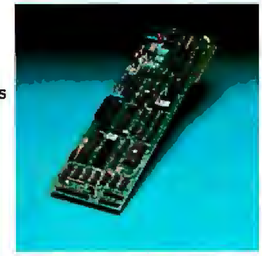

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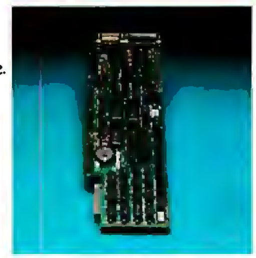

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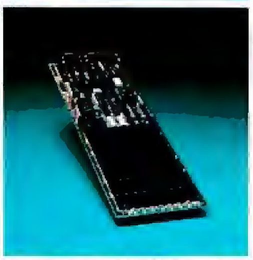

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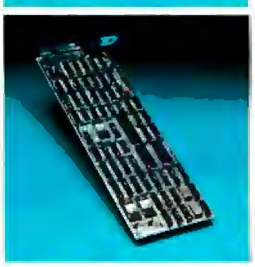

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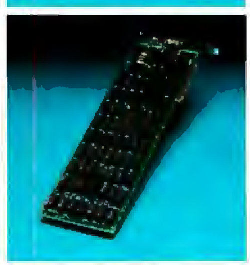

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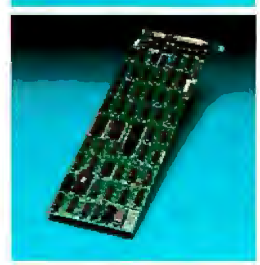

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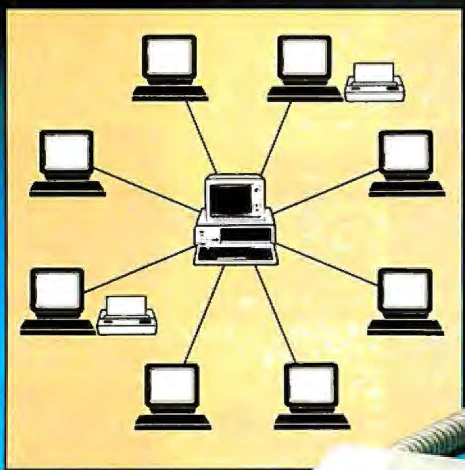

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Inquiry 201

BY PETER RICE

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 × 302,325,855 =
9.140092260148103 D+16

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 arith-

(continued)

Peter Rice (386 Milledge Circle, Athens, GA 30606) *is a professor of mathematics at the University of Georgia and editor of the local* IBM PC *user-group newsletter.*

metic 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:

```
  34,456
  83,509
 -------
 117,965
```

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. The

(continued)

Listing 1: *Four arithmetic operations in* BASIC.

```
1000 ' initialization
1010 DEFINT A-Z
1020 DIM X%(200),Y%(200),Z%(200)
1030 PRINT "ENTER A NUMBER, UP TO 200 DIGITS."
1040 INPUT XX$
1050 WHILE LEFT$(XX$,1)="0":XX$=RIGHT$(XX$,LEN(XX$)-1):
     WEND
1060 PRINT "ENTER AN OPERATION: + - * /
1070 INPUT OP$
1080 PRINT "ENTER A SECOND NUMBER, UP TO 100 DIGITS."
1090 INPUT YY$
1100 WHILE LEFT$(YY$,1)="0":YY$=RIGHT$(YY$,LEN(YY$)-1):
     WEND
1110 XL=LEN(XX$)
1120 FOR I=1 TO XL
1130      X%(XL-I)=VAL(MID$(XX$,I,1))
1140 NEXT I:X%(200)=XL-1
1150 YL=LEN(YY$)
1160 FOR I=1 TO YL
1170      Y%(YL-I)=VAL(MID$(YY$,I,1))
1180 NEXT I:Y%(100)=YL-1
1190 OPERATION=ASC(OP$)
1200 IF OPERATION=43 THEN GOSUB 10000:GOTO 1260 '
     addition
1210 IF OPERATION=45 THEN GOSUB 11000:GOTO 1260 '
     subtraction
1220 IF OPERATION=42 THEN GOSUB 12000:GOTO 1260 '
     multiplication
1230 IF OPERATION=47 THEN GOSUB 13000:GOTO 1260 '
     division
1240 PRINT "DON'T UNDERSTAND OPERATION"
1250 GOTO 1610
1260 IF OPERATION=43 THEN GOTO 1300
1270 IF OPERATION=45 THEN GOTO 1360
1280 IF OPERATION=42 THEN GOTO 1450
1290 IF OPERATION=47 THEN GOTO 1510
1300 ZZ$=" "
1310 FOR I=0 TO Z%(200)
1320      ZZ$=CHR$(Z%(I)+48)+ZZ$
1330 NEXT I
1340 PRINT "THE SUM IS":PRINT ZZ$
1350 GOTO 1610
1360 IF Z%(Z%(200))<0 THEN GOTO 1430
1370 ZZ$=" "
1380 FOR I=0 TO Z%(200)
1390      ZZ$=CHR$(Z%(I)+48)+ZZ$
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$(Z%(I)+48)+ZZ$
1480 NEXT I
1490 PRINT "THE PRODUCT IS":PRINT ZZ$
1500 GOTO 1610
1510 XX$=" "
1520 FOR I=0 TO X%(200)
1530      XX$=CHR$(X%(I)+48)+XX$
```

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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 multiplied.) For example, multiply 78 and 105. The first step is 5 × 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 × 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 × 8 = 8 goes in the second place, and 1 × 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 product 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 performs 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 remainder back into the result, and carries 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 remainder.) This algorithm differs from the manual method only in that, instead 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)

```
1540 NEXT I
1550 ZZ$=" "
1560 FOR I=0 TO Z%(200)
1570        ZZ$=CHR$(Z%(I)+48)+ZZ$
1580 NEXT I
1590 PRINT "THE QUOTIENT IS":PRINT ZZ$
1600 PRINT "THE REMAINDER IS":PRINT XX$
1610 FOR I=0 TO 200
1620        X%(I)=0:Z%(I)=0
1630 NEXT I
1640 FOR I=0 TO 100
1650        Y%(I)=0
1660 NEXT I
1670 GOTO 1030
10000 ' addition
10010 IF X%(200)>Y%(100) THEN Z%(200)=X%(200) ELSE
        Z%(200)=Y%(100)
10020 FOR I=0 TO Z%(200)
10030        Z%(I)=Z%(I)+X%(I)+Y%(I)
10040        IF Z%(I)>=10 THEN Z%(I+1)=Z%(I+1)+1:
              Z%(I)=Z%(I)-10
10050 NEXT I
10060 IF Z%(Z%(200)+1)>0 THEN Z%(200)=Z%(200)+1
10070 RETURN
11000 ' subtraction
11010 IF X%(200)>Y%(100) THEN N=X%(200) ELSE N=Y%(100)
11020 FOR I=0 TO N
11030        Z%(I)=Z%(I)+X%(I)-Y%(I)
11040        IF Z%(I)<0 THEN Z%(I)=Z%(I)+10:Z%(I+1)=-1
11050 NEXT I
11060 IF Z%(N+1)<0 THEN N=N+1
11070 WHILE Z%(N)=0:N=N-1:WEND
11080 Z%(200)=N
11090 RETURN
12000 ' multiplication
12010 FOR I=0 TO X%(200)
12020        FOR J=0 TO Y%(100)
12030               Z%(I+J)=X%(I)*Y%(J)+Z%(I+J)
12040               A=Z%(I+J)\10
12050               Z%(I+J)=Z%(I+J) MOD 10
12060               Z%(I+J+1)=Z%(I+J+1)+A
12070        NEXT J
12080 NEXT I
12090 INDEX=X%(200)+Y%(100)+1
12100 IF Z%(INDEX)>0 THEN Z%(200)=INDEX ELSE
        Z%(200)=INDEX-1
12110 RETURN
13000 ' division
13010 IF X%(200)<=Y%(100) THEN AL=Y%(100) ELSE
        AL=X%(200)
13020 IF X%(AL)>Y%(AL) THEN GOTO 13140
13030 GOSUB 11000
13040 IF Z%(Z%(200))>=0 THEN GOTO 13090
13050 FOR I=0 TO 200
13060        Z%(I)=0
13070 NEXT I
13080 RETURN
13090 FOR I=0 TO 200
13100        X%(I)=Z%(I):Z%(I)=0
13110 NEXT I
13120 Z%(0)=1
13130 RETURN
13140 D=10\(Y%(Y%(100))+1)
```

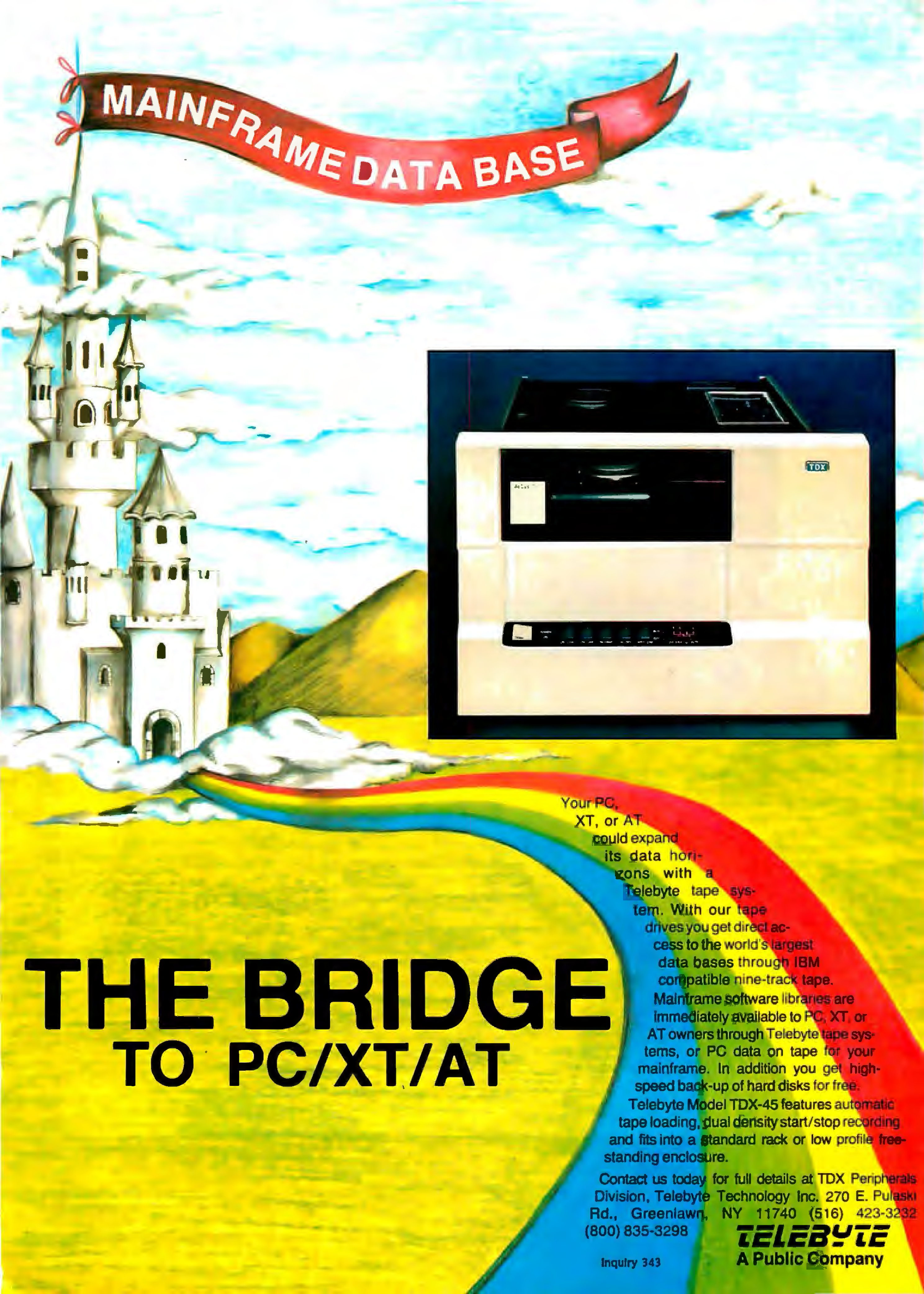
```
13150 IF D=1 THEN GOTO 13340
13160 FOR I=0 TO X%(200)
13170       X%(I)=D*X%(I)
13180 NEXT I
13190 FOR I=0 TO X%(200)
13200       W=X%(I)
13210       X%(I)=W MOD 10
13220       X%(I+1)=X%(I+1)+W\10
13230 NEXT I
13240 IF X%(X%(200)+1)>0 THEN X%(200)=X%(200)+1
13250 FOR I=0 TO Y%(100)
13260       Y%(I)=D*Y%(I)
13270 NEXT I
13280 FOR I=0 TO Y%(100)
13290       W=Y%(I)
13300       Y%(I)=W MOD 10
13310       Y%(I+1)=Y%(I+1)+W\10
13320 NEXT I
13330 IF Y%(Y%(100)+1)>0 THEN Y%(100)=Y%(100)+1
13340 FOR K=X%(200) TO Y%(100) STEP -1
13350       IF X%(K+1)=Y%(Y%(100)) THEN C=9:GOTO 13370
13360       C=(X%(K+1)*10+X%(K))\Y%(Y%(100))
13370       IF C*Y%(Y%(100)-1)<=(X%(K+1)*10+X%(K)-C*Y%
             (Y%(100)))*10+X%(K-1) THEN GOTO 13400
13380       C=C-1
13390       GOTO 13370
13400       M=K-Y%(100)
13410       FOR I=0 TO Y%(100)
13420             X%(M+I)=X%(M+I)-C*Y%(I)
13430       NEXT I
13440       FOR I=0 TO Y%(100)
13450             IF X%(M+I)>=0 THEN GOTO 13480
13460             X%(M+I+1)=X%(M+I+1)+X%(M+I)\10-1
13470             X%(M+I)=X%(M+I)+(1-X%(M+I)\10)*10
13480             W=X%(M+I)
13490             X%(M+I)=W MOD 10
13500             X%(M+I+1)=X%(M+I+1)+W\10
13510       NEXT I
13520       IF X%(K+1)>=0 THEN GOTO 13580
13530       FOR I=0 TO Y%(100)
13540             X%(M+I)=X%(M+I)+Y%(I)
13550             IF X%(M+I)>9 THEN X%(M+I+1)=X%
                   (M+I+1)+1:X%(M+I)=X%(M+I)-10
13560       NEXT I
13570       C=C-1
13580       Z%(M)=C
13590 NEXT K
13600 AL=X%(200)-Y%(100)
13610 IF Z%(AL)>0 THEN Z%(200)=AL ELSE Z%(200)=AL-1
13620 BX=Y%(100)
13630 WHILE X%(BX)=0
13640       BX=BX-1
13650       IF BX=0 THEN GOTO 13670
13660 WEND
13670 X%(200)=BX
13680 FOR I=X%(200) TO 1 STEP -1
13690       W=X%(I)
13700       X%(I)=W\D
13710       X%(I-1)=X%(I-1)+10*(W MOD D)
13720 NEXT I
13730 X%(0)=X%(0)\D
13740 RETURN
```

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.

C, the digit in the quotient, is 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/DY = 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* BYTE*net* Listings. *The telephone number is* (603) 924-9820. *The filenames are* LONGMATH.ASM, LONGMATH.BAS, *and* LONGMATH.TXT *(an explanatory file).*] ■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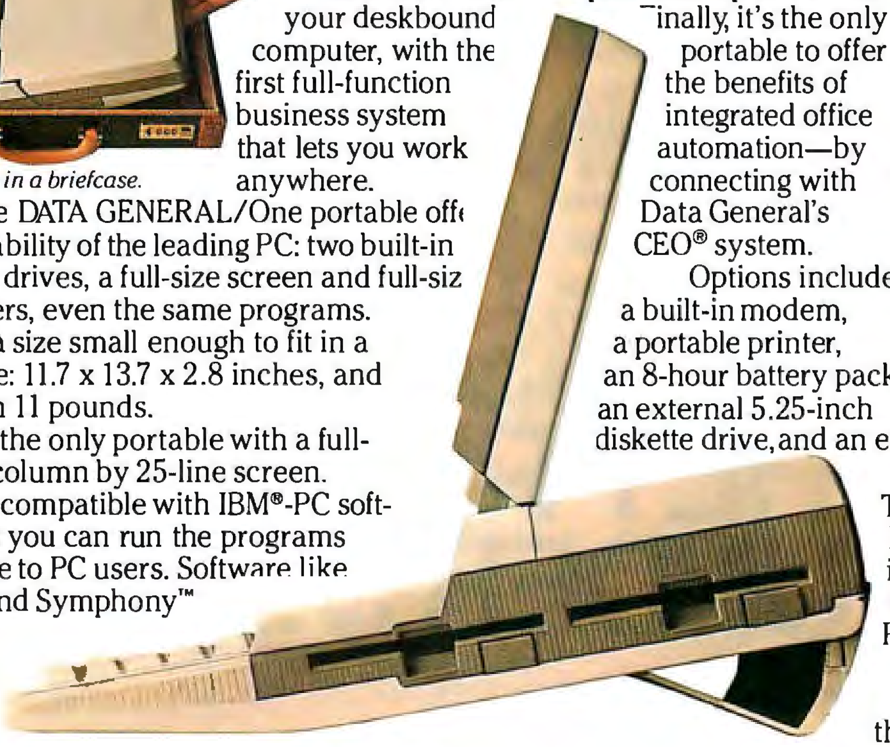

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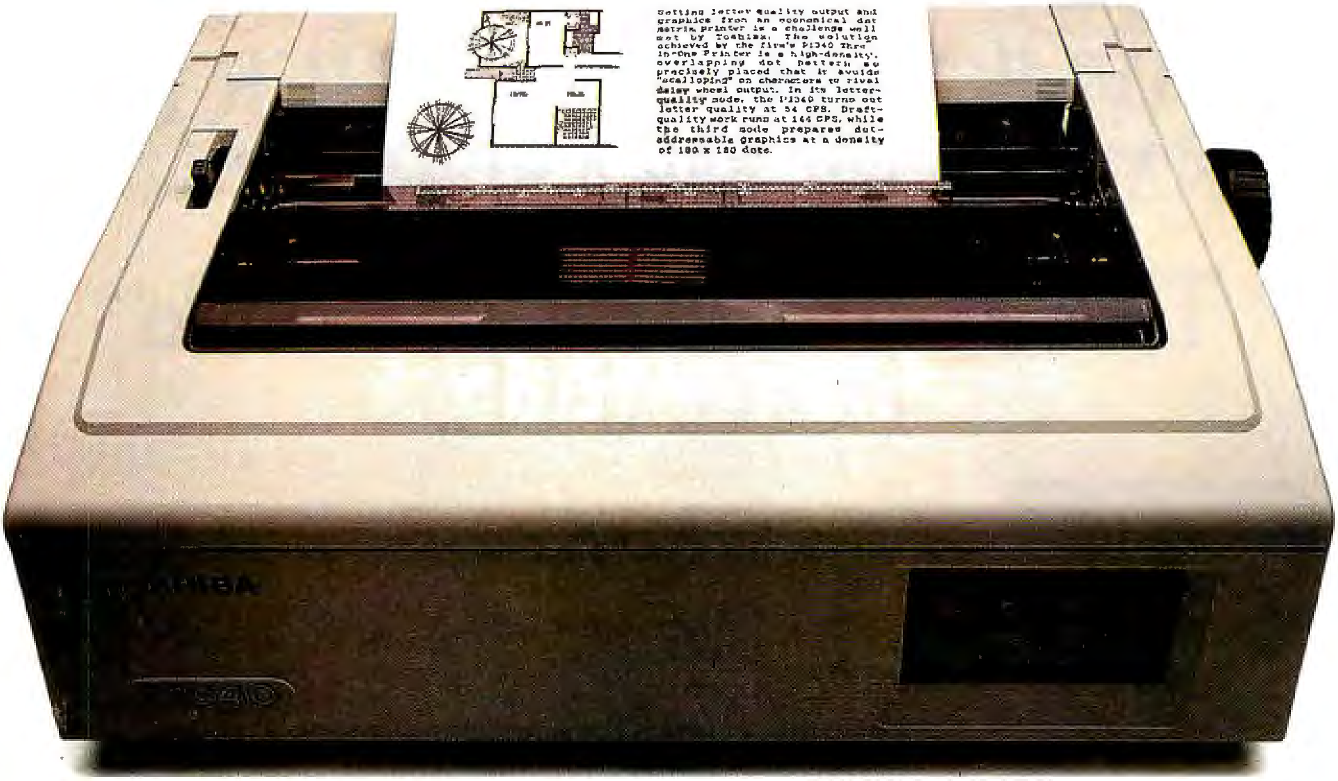

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BY ROBERT KONG WIN CHANG

BUILD A SERIAL CARD

You'll save $85 by doing it yourself

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.*

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

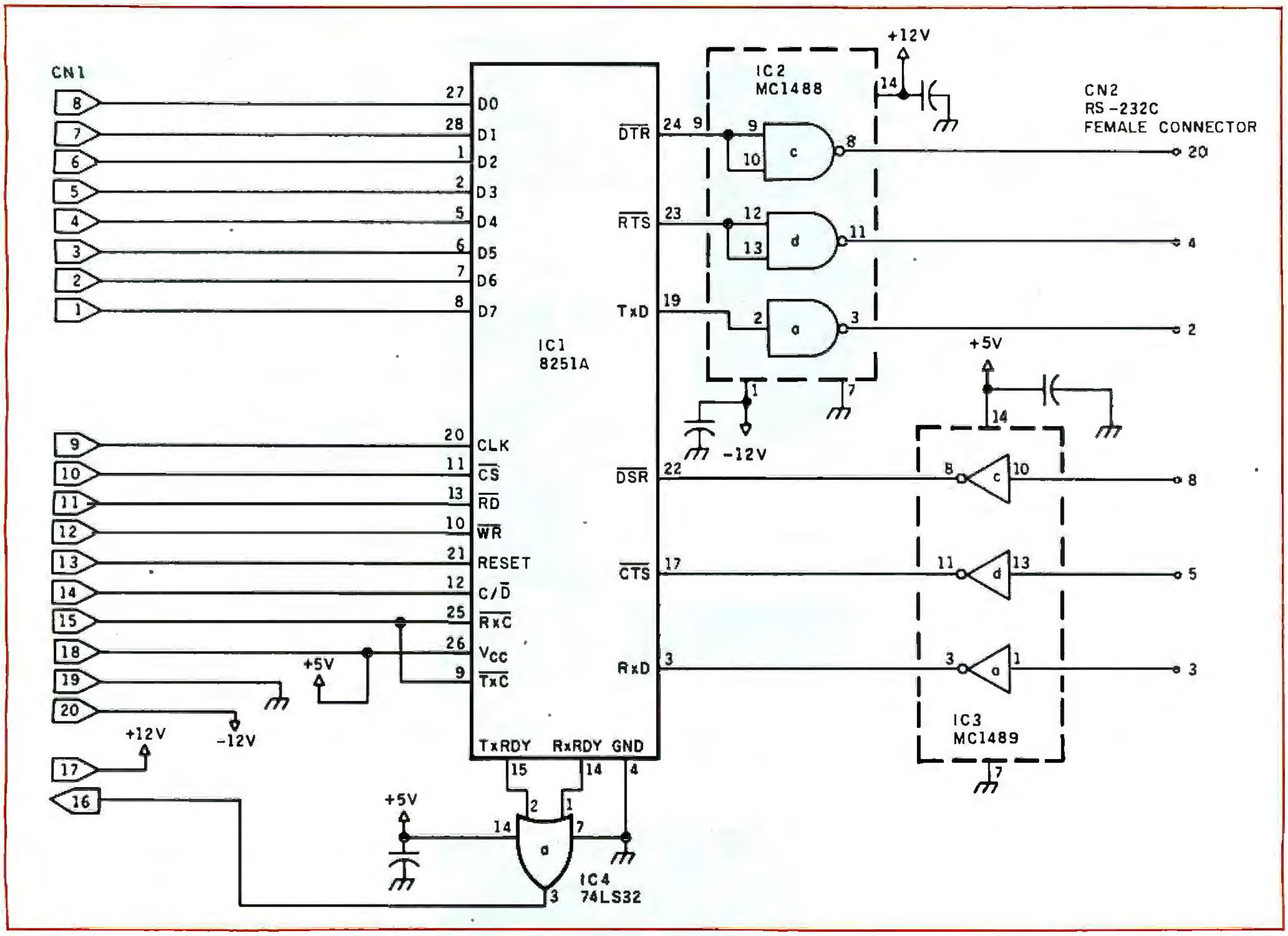
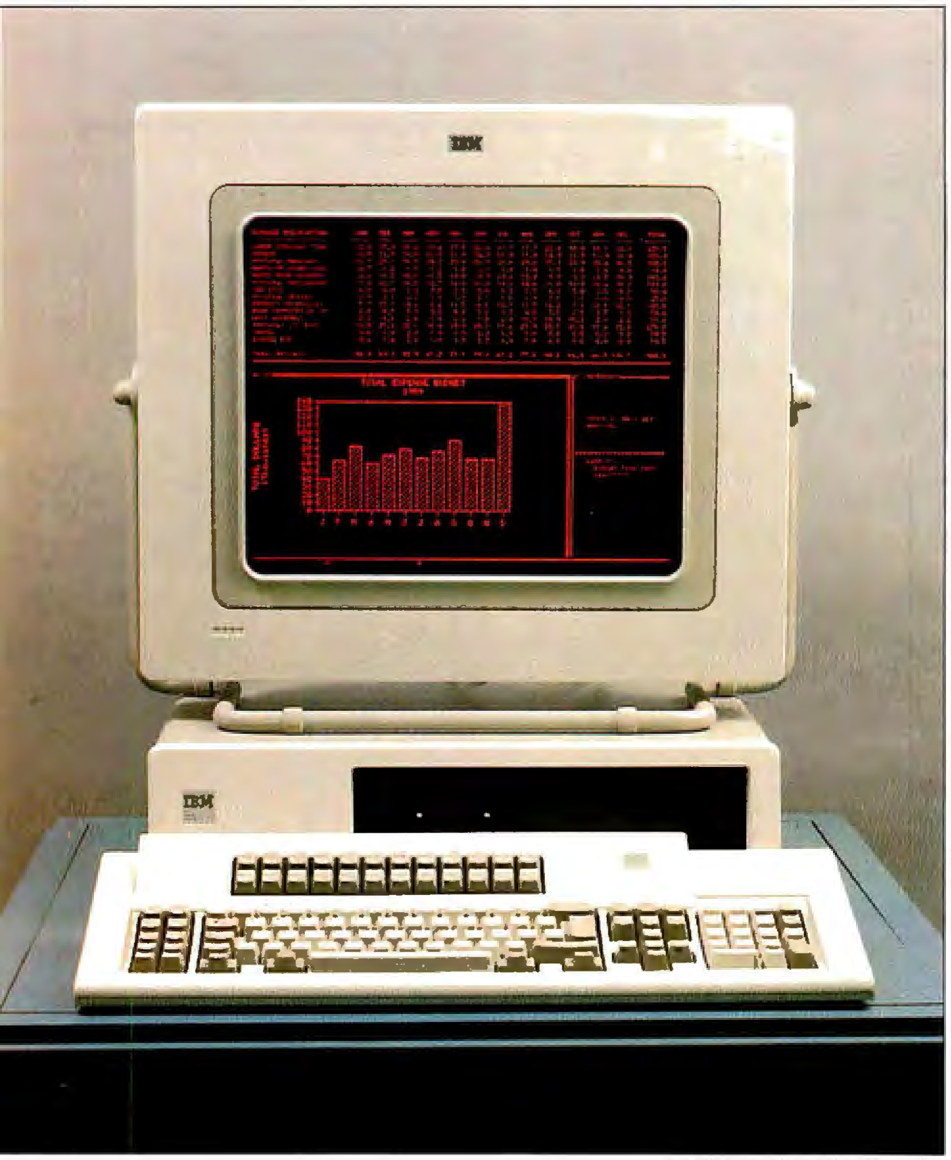


Figure 1: *The serial-card schematic for the Sanyo* MBC 550.

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.



PHOTOGRAPHED BY MICHAEL HICKEY

Photo 1: ***The IBM 3295 Plasma Display Terminal attached to a 3270/PC.***

At present, there are three leading alternatives to CRTs: 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-PLASMA 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 elec-

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Photo 2: The Grid Compass 1100 computer, containing the Sharp AC thin-film electroluminescent display.

tric 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 capacitive. 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 on. (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 $2500 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 $3695.

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.

Other notable manufacturers of plasma displays include NEC (Nippon Electric Company), Beckman Instruments, Electro Plasma, ESSCO Industries, Interstate Electronics, General Digital, Fujitsu, Photonics Technology, Thomson Components, SAI Technology, and Norden Systems.

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

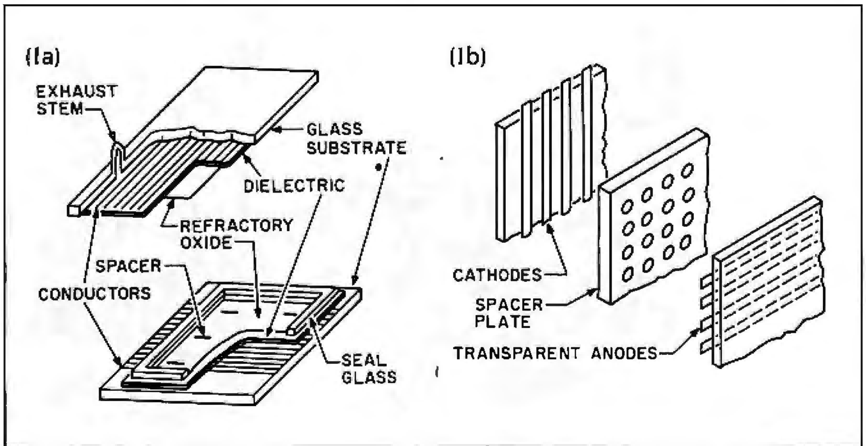

Figure 1: *In both kinds of gas-plasma-discharge display, a glass envelope is filled with a gas (usually neon or a neon/argon mix) at low pressure. Electrons are dissociated from the atoms by the electric field of a high electrical voltage. When the electrons return to a lower energy state, photons are 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.*

largest factor. 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.

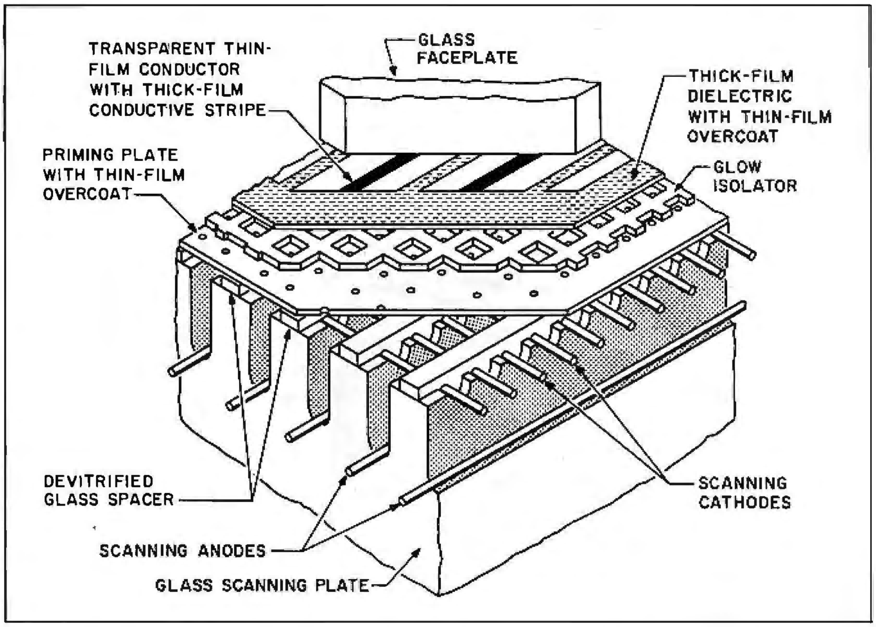

Figure 2: *The hybrid AC/DC gas-plasma display developed by Burroughs Corporation to combine the virtues of the two types. An AC section serves as the display's memory, while the DC section is used for scanning the matrix.*

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

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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 25 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.

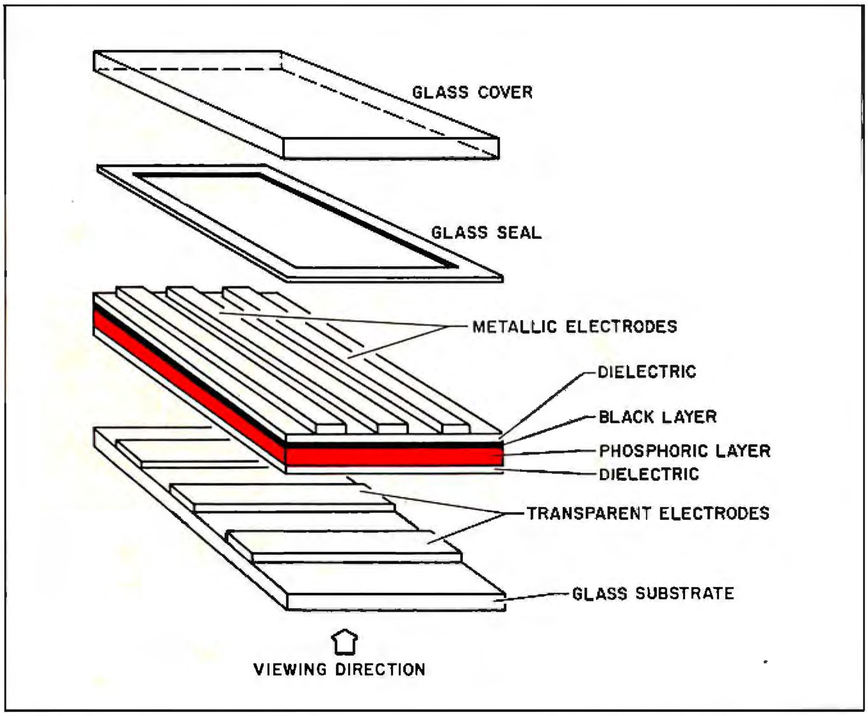

Figure 3: *Cross-section of an ACTFEL display panel. The phosphoric layer glows in response to voltage applied through the matrix of electrodes. Substituting other materials for the manganese dopant changes the color of light given off.*

(continued)

Now Showing In Black And White

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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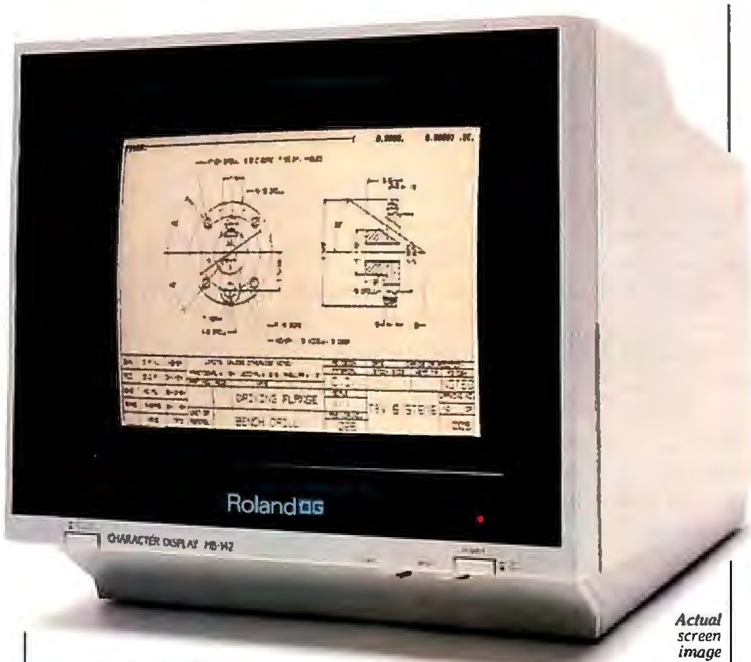

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For more information, contact: Roland DG, 7200 Dominion Circle, Los Angeles, CA 90040. (213) 685-5141.

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Roland DG

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 a concentration of the electric field when the device is operated. With the high voltages involved, the dielectric can then break down, with subsequent punch-through and short-circuiting of the pixel. Thus, for acceptable reliability, the fabrication of the device's layers must be done with extreme precision and care. If the manufacturing precision is only slightly off, the panel will fail the initial tests and must be thrown away. Thus far, these kinds of difficulties are keeping the prices of ELDs high.

On the plus side, the ELD is inherently rugged because there is no cavity—it's entirely solid. And the glass doesn't have to be as thick as in a plasma display, reducing weight. Good gray scales are possible because the luminescence becomes 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. ■

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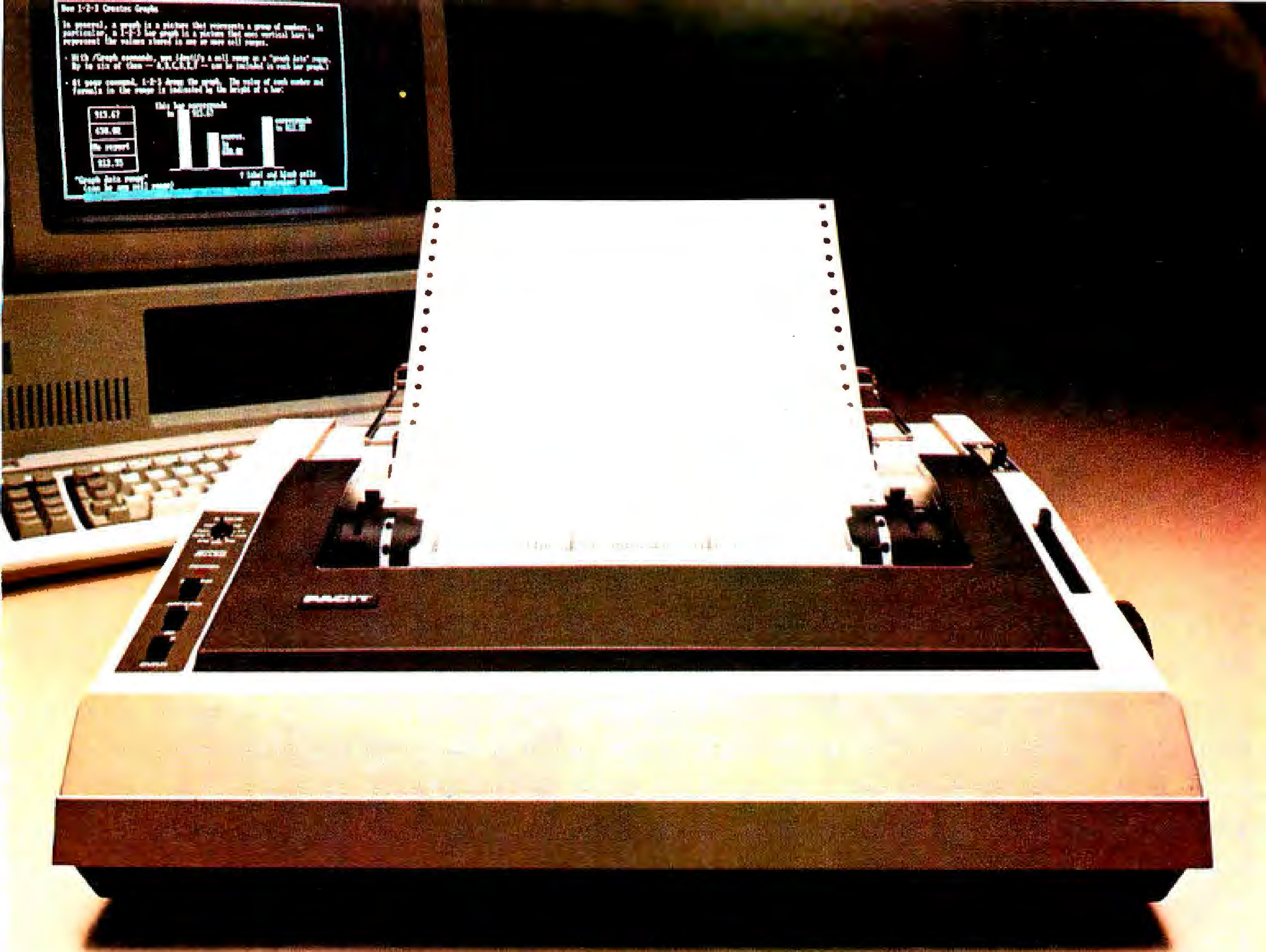

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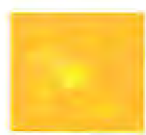

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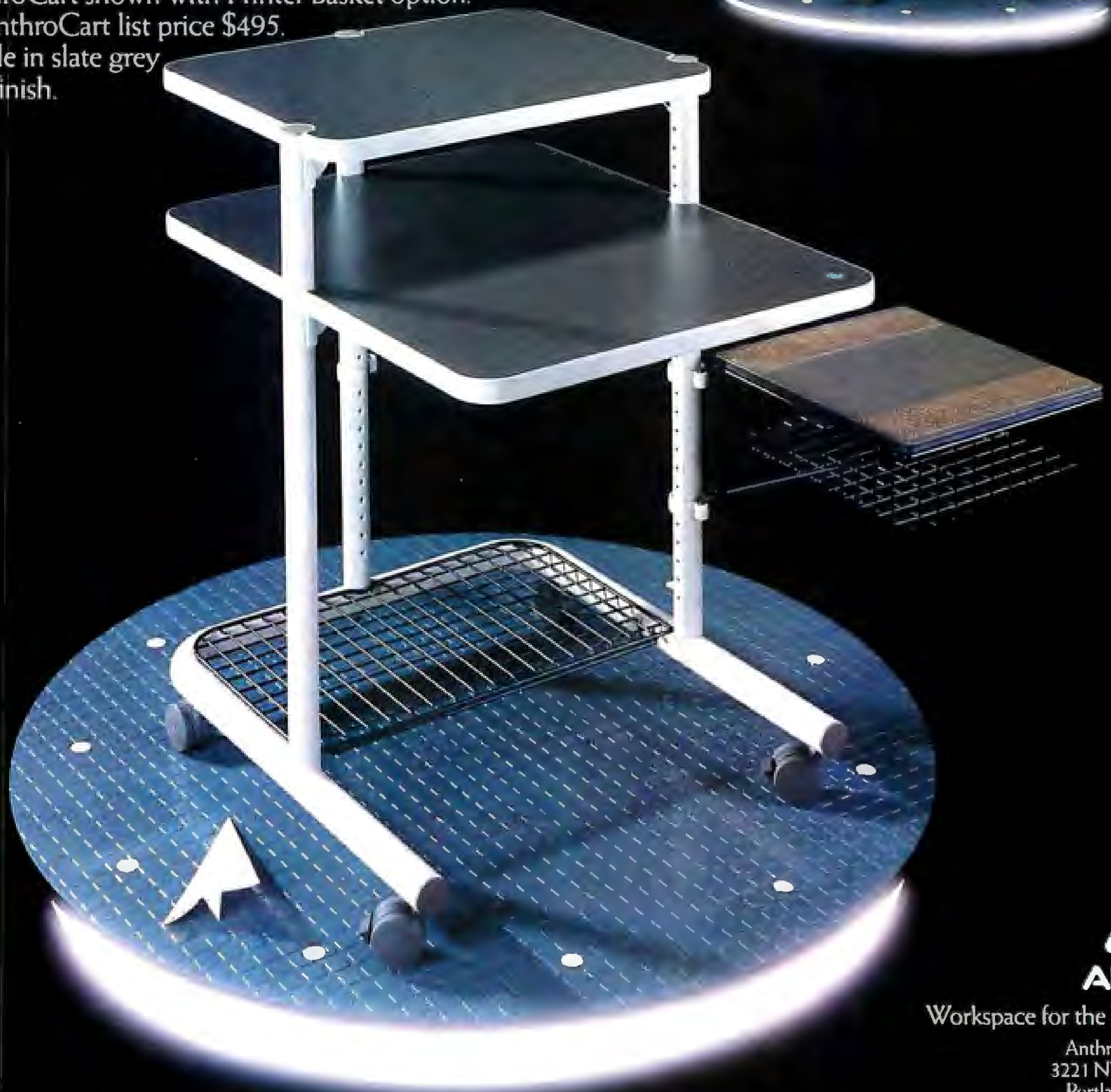

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NAVIGATION

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A number of years ago, I hc'd

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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 navigate. Now, navigators 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.

ILLUSTRATED BY CHRIS SPOLLEN

Ocean Navigation

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 (Ho), 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.)

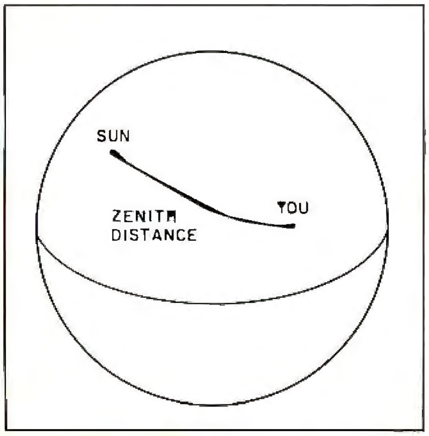

Figure A: *The zenith distance is the angular distance on the earth's surface between you and the sun's image.*

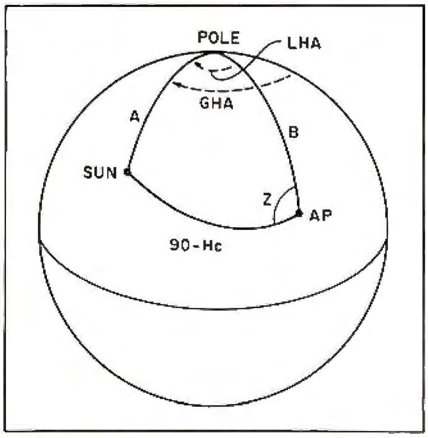

Figure B: *Using the sun's position, your position, and the LHA, you can solve for Hc and Z using site-reduction tables, or formulas from spherical trigonometry.*

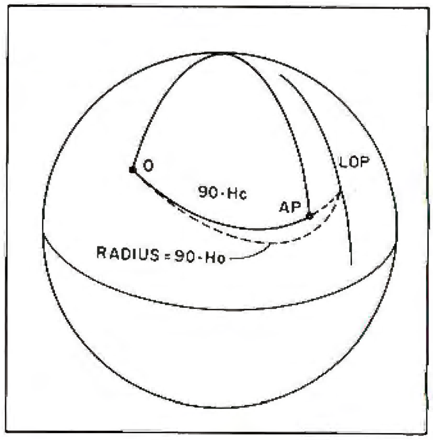

Figure C: *In this case 90−Ho is greater than 90−Hc. Your actual position lies on an arc (LOP) of a circle of center O and radius 90−Ho.*

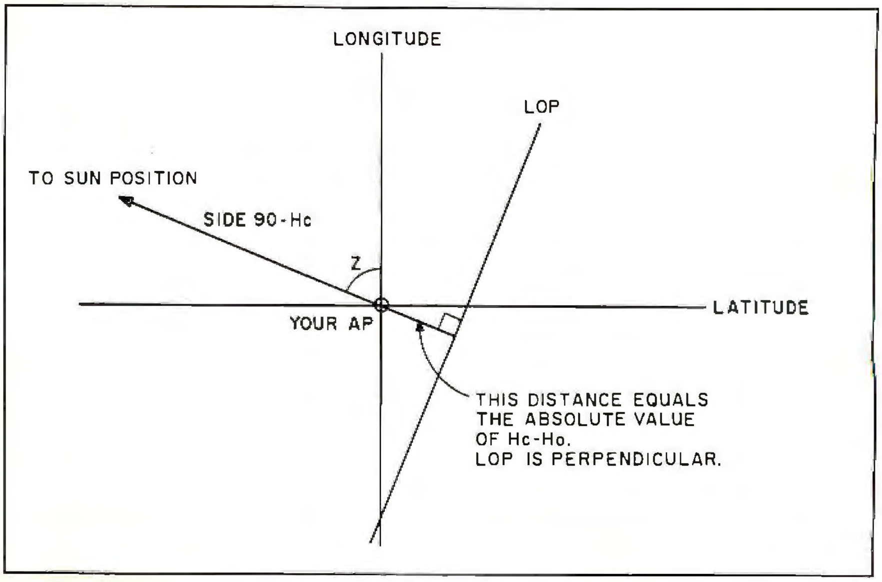

Figure D: *Your assumed longitude and latitude form a coordinate system that contains the lower right corner of the triangle in figure B. The corner is formed by 90−Hc and your longitude. The LOP is a line drawn perpendicular to the radius of length 90−Ho. This drawing is hypothetical in that it assumes 90−Ho is greater than 90−Hc.*

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:

$$Hc = \sin^{-1}(\sin(\text{your latitude}) \times \sin(\text{declination}) + \cos(\text{your latitude}) \times \cos(\text{declination}) \times \cos(LHA))$$

$$Z = \sin^{-1}(\cos(\text{declination}) \times \sin(LHA)/\cos(Hc))$$

where Hc 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, Hc and Ho. If Ho is less than Hc, then your true position lies somewhere to the right of the AP; if Hc is greater than Ho, then it is to the left.

For example, let's suppose Ho is less than Hc (as in figure C). Since Ho does not equal Hc, 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−Hc. The LOP is shown as a line drawn perpendicular to the radius of length 90−Ho.

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.

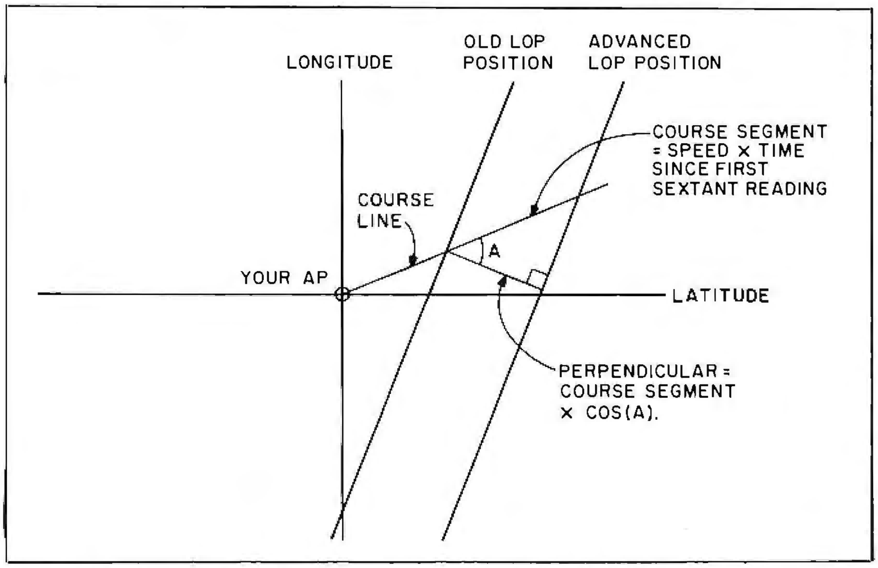

Figure E: *Advancing or retiring the LOP is done by moving the line along a perpendicular to itself, a distance equal to the course segment X Cos(a). The course segment equals your speed multiplied by the time elapsed since the last sextant reading.*

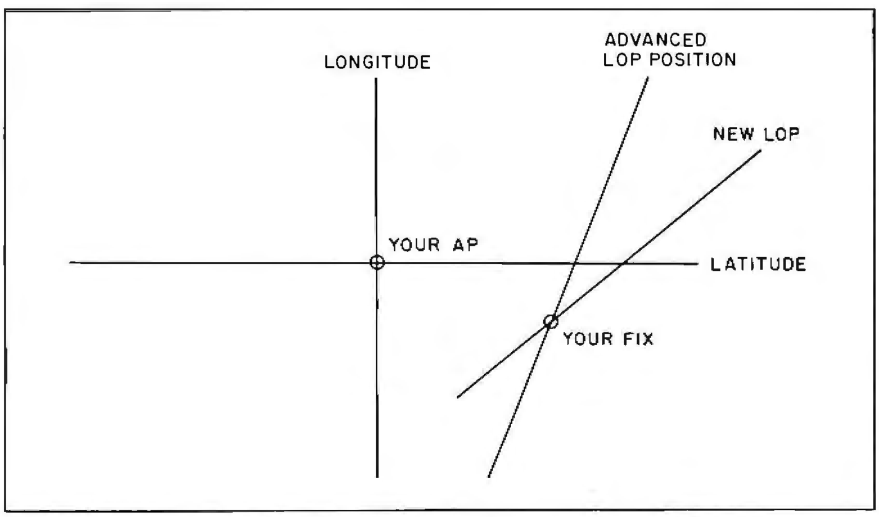

Figure F: *The point at which the advanced, or retired, LOP intersects with the new LOP is your new fix. The point of intersection can be solved using analytic geometry and by solving a set of two simultaneous equations in two unknowns.*

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* BYTE*net 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)

Glossary

Assumed position (AP): Your estimate of where you are, based on course, speed, and previous known positions—your last dead reckoning position at the time of your sextant reading. The AP is given in degrees longitude and latitude. It is only a temporary means for determining an accurate fix.

Azimuth angle (Z): The angle between your longitude line and the line between you and the celestial body's image imposed on the surface of the earth.

Dead reckoning (DR): The act of determining an estimated position based on previous positions, course, and speed.

Declination: The angular distance of a celestial object measured north and south of the equator.

DR plot: Maintaining a drawing on a nautical chart of your successive positions determined during DR.

Fix: Your calculated position.

Greenwich hour angle (GHA): The angular distance of a celestial body measured in degrees west (0 to 360) of Greenwich, England. If GHA is less than or equal to 180 degrees, then GHA and west longitude are equivalent. If GHA is greater than 180 degrees, then east longitude equals 360–GHA.

Greenwich mean sidereal time (GMST): The time measured on a 24-hour clock located at the first point of Aries (the sun's location on the first day of spring).

Greenwich mean time (GMT): The time measured on a 24-hour clock located at Greenwich, England.

Greenwich meridian: The longitude line that passes through Greenwich, England (0 degrees longitude).

Hc: Computed altitude. This is the measurement that a sextant would read if you really were at the AP.

Ho: Observed altitude. This is the actual sextant reading with all corrections made.

Knot: A measure of speed. One knot equals 6000 feet per hour, or 1 nautical mile per hour.

Line of position (LOP): The line on which you are positioned. It is determined by constructing a circle of radius 90–Ho with the center equal to the position of the celestial body.

Local hour angle (LHA): The angular distance between your meridian (longitude line) and the sun's meridian. It is measured in degrees west of your meridian.

Navigational triangle: Side A equals 90 minus the sun's declination, B equals 90 minus your latitude. Two sides and an included angle (LHA) are sufficient for solving the third side and the other angles.

Right ascension: An astronomical measure used as a longitudinal coordinate of a celestial body. It is measured in degrees east of the first point of Aries.

Sextant: A device for measuring altitudes of celestial bodies. The altitude is measured from the horizon to the body.

Zenith distance: The angular distance between you and the celestial body's image. It equals 90–Ho.

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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 1, 4713 B.C.; hence, the day counts are very large. This is the datekeeping 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 siderial time (GMST). Siderial 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. ■

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5. Van Flandern, T. C., and K. F. Pulkkinen. "Low-Precision Formulae For Planetary Positions," *The Astrophysical Journal Supplement Series*, November 1979, pages 391–411.

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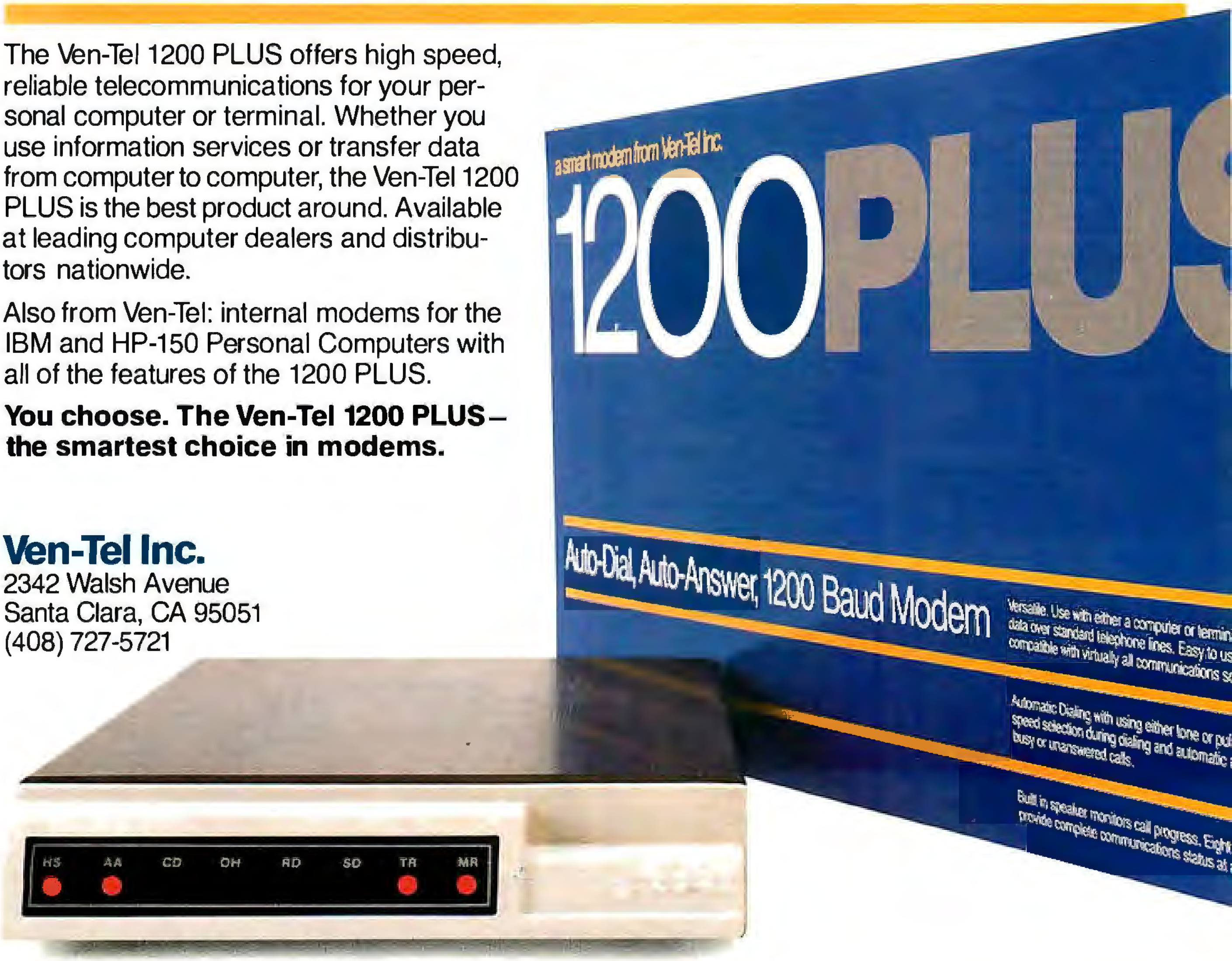

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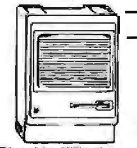

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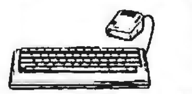

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USE ANIMALS

Selects the database.

MODIFY STRUCTURE

Move the cursor to the place where you want to insert the new field.

Ctrl N Adds the new field.

The new field will be inserted above the cursor position.

SEX ↵ ↵ 1 ↵

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

Ctrl W ends your input.

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

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BY DAVID L. KAHN

A UNIT-CONVERSION ALGORITHM

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 fit the structure of the problem. It had to be both simple to use and implement. It had to be easy to stretch to fit supersets 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* BYTE*net 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 *X*s to trade with others for a quantity of *Y*s, and it became important to know how many *X*s were equal to how many *Y*s.

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)

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NUMBER-BASE CONVERSION

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.

F: $ar^3 + br^2 + cr + d$
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 identically, in turn, from left to right. This sequential processing is illustrated with an example in figure A.

```
((ar +   b) r +  c)r +  d
    4
  x 8
   32 + 6
         =    38   (correct quantity for 46₈)
            x 8
            304 + 1
                     =  305   (correct quantity for 461₈)
                      x  8
                      2440  + 3 = 2443  (answer)
```

Figure A: *Given the number* 4613_8*, determine the quantity it represents in base 10. Note that the result after each addition would be the correct answer if the number ended after that numeral. The process could continue for as many numerals as are present.*

```
((ar + b)r + c)r + d = 2443
          2443 MOD 8 = 3
       (ar + b)r + c = (2443 - 3) / 8
                     = 305
           305 MOD 8 = 1
              ar + b = (305 - 1) / 8
                     = 38
            38 MOD 8 = 6
                   a = (38 - 6) / 8
                     = 4
             4 MOD 8 = 4
                     = (4 - 4) / 8
                     = 0
              Answer = 4613
```

Figure B: *Given the quantity 2443, determine the number that represents it in base 8. The example shows a hypothetical formula being reduced one level after each numeral is extracted, but in practice one would not know how many levels in the formula to start with. Processing should continue until the result after a subtraction is zero.*

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 ni ier-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$,C))
 70 IF V>47 AND V<58 THEN V2=V-48
 80 IF V>64 AND V<91 THEN V2=V-55
 90 IF V>96 AND V<123 THEN V2=V-85
100 IF V2 >= R1 THEN PRINT "NUMERAL TOO HIGH IN NUMBER":GOTO 10
110 T#=T#*R1+V2
120 NEXT C
130 B$=""
140 WHILE T# <> 0
150 V2=T# - INT(T#/R2)*R2:REM V2 = T# MOD R2
160 T#=(T#-V2)/R2
170 IF V2 < ·ꟼ THEN V=
180 IF V2 > ꝰ ı ʜɛ  V=V2+55
190 B$=CHR$(V)+ ʖ
200 WEND
210 PRINT "THE ANSWEF IS: ";B$:PRINT
220 GOTO 10
```

Listing B: A *sample session demonstrating the progra .*

```
CONVERT NUMBEΓ  14?5
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 ?
```

generating numerals from right to left. This process is illustrated in figure B.

The Program

The program shown in listing A will perform conversions between numbers in bases from 2 to 36. A sample script is shown in listing B.

Lines 10 to 3(·equest the ııputs and do initial error checking. Lines 40 to 120 translate the number in A$ to a quantity in T#. Lines 130 to 200 translate the quantity in T# into a number B$ in the desired base. Line 210 prints the result.

The formula used in line 150 is equivalent to the MOD operator in the comment at the end of the line. The MOD function in my initial implementation limited the use to absolute numbers ss than 32,768.

The program was written in Microsoft BASIC under MS-DOS and sh ould run or most computers. The only problem you are likely to have is with the WHILE/WEND in lines 140 and 200, which I used for clarity. If you do not have these statements, use

```
14 ) IF T# = 0 THEN GOTO 210
   ) GOTO 140
```

ıe heart of the algorithm in lines and 160, which are invers of each other. Each is executed onc ır each numeral, line 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 refer ıce (absolute meaning) where differi ɐ 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.

Listing 1: *The Convert program written in Microsoft* BASIC.

```
  10 PRINT CHR$(12);
  15 READ ND, NP, NU
  20 DIM PR$(20), PR(20), PR%(20), UN$(100), UN(100), UN%(100,10)
  30 DIM DE$(10), DI%(10)
 100 FOR X=0 TO NP:READ PR$(X), PR(X), PR%(X)
 105 NEXT X
 110 FOR X=0 TO ND:READ DE$(X):NEXT X
 120 FOR X=0 TO NU:READ UN$(X), UN(X)
 125 FOR Y=0 TO ND:READ UN%(X,Y):NEXT Y,X
 130 PRINT CHR$(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:DI%(X)=0:NEXT X
 215 PRINT:I$="":INPUT "INPUT";I$:IF I$="HELP" THEN 4000
 220 IF LEFT$(I$,1)="?" THEN I$=MID$(I$,2) ELSE 300
 230 IO=1:GOSUB 1000
 240 FL=0:FOR X=0 TO ND:IF DI%(X)>1 THEN PRINT
     DE$(X)"^"MID$(STR$(DI%(X)),2)" "; ELSE IF DI%(X)=1 THEN PRINT
     DE$(X)" ";ELSE IF DI%(X)<0 THEN FL=1
 245 NEXT X
 250 IF FL=0 THEN PRINT:GOTO 210 ELSE PRINT "PER ";:FOR X=0 TO ND:IF
     DI%(X)<-1 THEN PRINT DE$(X)"^"MID$(STR$(-DI%(X)),2)" "; ELSE IF
     DI%(X)=-1 THEN PRINT DE$(X)" ";
 255 NEXT X:PRINT:GOTO 210
 300 N=VAL(I$):IF N=0 THEN PRINT "YOU MUST GIVE AN INPUT
     NUMBER":GOTO 210 ELSE X=1
 310 IF MID$(I$,X,1)=" " OR X+LEN(I$) THEN 320 ELSE X=X+1:GOTO 310
 320 X=X+1:I$=MID$(I$,X):IO=1:GOSUB 1000
 330 I$="":INPUT "CONVERT TO";I$:IO=-1:GOSUB 1000
 340 FL=0:FOR X=0 TO ND:IF DI%(X)<>0 THEN PRINT DE$(X)" DIMENSION
     INCOMPATIBILITY":FL=1
 350 NEXT X:IF FL=1 THEN 210
 360 PRINT "ANSWER = ";:LO=INT(LOG(N)/LOG(10))+1
 370 IF LO<=5 AND LO>=0 THEN PRINT USING "#"+STRING$(LO,"#")+
     "."+STRING$(5-LO,"#");N:GOTO 210
 375 IF LO=-1 THEN PRINT USING "#.######";N:GOTO 210
 380 IF LO=-2 THEN PRINT USING "#.#######";N:GOTO 210
 390 PRINT USING "##.####^^^^";N:GOTO 210
1000 DN=1
1010 IF LEFT$(I$,1)=" " THEN I$=MID$(I$,2):GOTO 1010
1020 IF I$="" THEN RETURN
1030 FOR X=1 TO LEN(I$):IF MID$(I$,X,1)=" " THEN 1040 ELSE NEXT X
1040 T$=LEFT$(I$,X-1):I$=MID$(I$,X):T=1:P=1
1045 IF T$="PER" THEN DN=-1:GOTO 1010
1050 FOR X=1 TO LEN(T$):IF MID$(T$,X,1)="^" THEN 1060 ELSE NEXT X
1060 IF X>LEN(T$) THEN 1100
1070 P=VAL(MID$(T$,X+1))
1080 IF P=0 THEN PRINT "POWER ERROR IN TERM '"T$"' ":GOTO 210
1090 T$=LEFT$(T$,X-1)
1100 IF RIGHT$(T$,4)="CHES" THEN T$=LEFT$(T$,LEN(T$)-2)
1102 IF RIGHT$(T$,3)="IES" THEN T$=LEFT$(T$,LEN(T$)-3)+"Y"
1104 IF RIGHT$(T$,1)="S" AND RIGHT$(T$,2)<>"SS" THEN T$=LEFT$
     (T$,LEN(T$)-1)
1110 FOR X=0 TO NU:IF T$=UN$(X) THEN 1120 ELSE NEXT X:GOTO 1140
1120 N=N/((UN(X)/T)^(P*DN*IO))
1130 FOR Y=0 TO ND:DI%(Y)=DI%(Y)+P*DN*IO*UN%(X,Y):NEXT Y:GOTO
     1010
1140 FOR X=0 TO NP:IF LEFT$(T$,PR%(X))=PR$(X) THEN 1150 ELSE NEXT
     X:GOTO 1170
```

```
1150 T$=MID$(T$,PR%(X)+1):T=T*PR(X):GOTO 1110
1170 PRINT "UNDEFINED UNIT OR PREFIX IN ' "T$" ' ":GOTO 210
4000 PRINT CHR$(12);"THIS PROGRAM CONVERTS NUMBERS BETWEEN UNIT
     SYSTEMS SUCH AS"
4010 PRINT "METRIC AND ENGLISH. IT WILL ALSO EXPLAIN THE
     DIMENSIONALITY"
4015 PRINT "OF A UNIT OR COMBINATION IF DESIRED. THIS PROGRAM
     UNDERSTANDS"
4020 PRINT "A LARGE NUMBER OF UNITS AND PREFIXES THAT ARE LISTED
     ON THE"
4025 PRINT "SECOND PAGE OF THIS HELP DOCUMENTATION. THE THIRD
     PAGE INCLUDES"
4030 PRINT "SEVERAL EXAMPLES."
4035 PRINT "IF THE INPUT GIVEN IS '? <UNITS>', THE DIMENSIONALITY OF"
4040 PRINT "<UNITS> WILL BE PRINTED. IF '<NUMBER> <UNITS>' IS
     GIVEN,"
4045 PRINT "YOU WILL BE ASKED 'CONVERT TO?' AND THE RESULT OF THE
     CONVERSION"
4050 PRINT "WILL BE PRINTED."
4055 PRINT "THE <UNITS> INPUTS CONSIST OF AN OPTIONAL SEQUENCE
     OF UNIT"
4060 PRINT "SPECIFIERS, FOLLOWED BY AN OPTIONAL 'PER', FOLLOWED BY
     MORE"
4065 PRINT "OPTIONAL UNIT SPECIFIERS. SPACES MUST SEPARATE UNIT
     SPECS BUT"
4070 PRINT "MAY NOT APPEAR INSIDE THEM. A UNIT SPEC IS AN OPTIONAL
     SET OF"
4075 PRINT "PREFIXES, A UNIT, AND AN OPTIONAL POWER TERM."
4099 INPUT "PRESS ENTER TO CONTINUE";I$
4100 PRINT "VALID UNITS ARE:"
4110 FOR X=0 TO NU:O$=UN$(X):GOSUB 4900:NEXT X
4120 PRINT:PRINT "VALID PREFIXES ARE:"
4130 FOR X=0 TO NP:O$=PR$(X):GOSUB 4900:NEXT X
4199 PRINT:INPUT "PRESS ENTER TO CONTINUE";I$
4200 PRINT "A TYPICAL UNIT SPEC IS 'CENTIMETER^2'. NOTE THAT MORE
     THAN"
4205 PRINT "ONE PREFIX IS PERMITTED IN A UNIT SPEC. TYPICAL
     <UNITS>"
4210 PRINT "SEQUENCES ARE 'MILES PER HOUR' AND 'KILOGRAMS PER
     FOOT^2'."
4215 PRINT "EXAMPLES: (INPUTS AT LEFT, RESPONSE INDENTED)"
4220 PRINT "?MILES PER HOUR"
4225 PRINT "DISTANCE PER TIME"
4230 PRINT "?WATTS"
4235 PRINT "DISTANCE^2 MASS PER TIME^3"
4240 PRINT "8000 BTU PER HOUR"
4245 PRINT "CONVERT TO: WATTS"
4250 PRINT "ANSWER =2343.9"
4255 PRINT "1 ATMOSPHERE"
4260 PRINT "CONVERT TO: POUNDFORCE PER FOOT^2"
4265 PRINT "ANSWER =2116.2"
4300 GOTO 210
4900 IF POS(0)+LEN(O$) > 63 THEN PRINT:PRINT O$; ELSE PRINT O$;
4910 IF POS(0)>0 THEN PRINT "  ";
4920 RETURN
5000 DATA 5, 13, 84
5010 DATA TERA,1E12,4
5020 DATA GIGA,1E9,4
5030 DATA MEGA,1E6,4
5040 DATA KILO,1E3,4
5050 DATA HECTO,1E2,5
5060 DATA DECA,10,4
```

(continued)

```
5070 DATA DECI,.1,4
5080 DATA CENTI,1E-2,5
5090 DATA MILLI,1E-3,5
5100 DATA MICRO,1E-6,5
5110 DATA NANO,1E-9,4
5120 DATA PICO,1E-12,4
5130 DATA FEMTO,1E-15,5
5140 DATA ATTO,1E-18,4
6010 DATA DISTANCE,MASS,TIME,ANGLE,SOLIDANGLE,QUANTITY
7100 DATA METER,1.0000,1,0,0,0,0,0
7110 DATA INCH,39.370078,1,0,0,0,0,0
7120 DATA FOOT,3.2808398,1,0,0,0,0,0
7130 DATA FEET,3.2808398,1,0,0,0,0,0
7140 DATA YARD,1.0936132,1,0,0,0,0,0
7150 DATA MILE,6.2137119E-4,1,0,0,0,0,0
7160 DATA MICRON,1E6,1,0,0,0,0,0
7170 DATA ANGSTROM,1E10,1,0,0,0,0,0
7180 DATA MIL,3.9370078E4,1,0,0,0,0,0
7190 DATA LIGHTYEAR,1.0562667E-16,1,0,0,0,0,0
7200 DATA PARSEC,3.2454E-17,1,0,0,0,0,0
7210 DATA FURLONG,4.9709695E-3,1,0,0,0,0,0
7220 DATA FATHOM,.54680664,1,0,0,0,0,0
7230 DATA ROD,.19883878,1,0,0,0,0,0
7240 DATA LEAGUE,1.775E-4,1,0,0,0,0,0
7250 DATA ACRE,2.4710536,2,0,0,0,0,0
7260 DATA BARN,1E28,2,0,0,0,0,0
7270 DATA CIRCULARMILL,1.974E9,2,0,0,0,0,0
7280 DATA LITER,1000,3,0,0,0,0,0
7290 DATA GALLON,264.17205,3,0,0,0,0,0
7300 DATA QUART,1056.6882,3,0,0,0,0,0
7310 DATA PINT,2113.3764,3,0,0,0,0,0
7320 DATA CUP,4226.7528,3,0,0,0,0,0
7330 DATA FLUIDOUNCE,3.3814022E4,3,0,0,0,0,0
7340 DATA TABLESPOON,6.7628045E4,3,0,0,0,0,0
7350 DATA TEASPOON,2.0288413E5,3,0,0,0,0,0
7360 DATA BARREL,6.2898107,3,0,0,0,0,0
7370 DATA HOGSHEAD,4.1932071,3,0,0,0,0,0
7380 DATA GRAM,1000,0,1,0,0,0,0
7390 DATA SLUG,6.852E-2,0,1,0,0,0,0
7400 DATA AMU,6.024E26,0,1,0,0,0,0
7410 DATA TON,1.1023113E-3,0,1,0,0,0,0
7420 DATA POUND,2.2046226,0,1,0,0,0,0
7430 DATA OUNCE,35.273961,0,1,0,0,0,0
7435 DATA GRAIN,15432.357,0,1,0,0,0,0
7440 DATA TROYOUNCE,32.150745,0,1,0,0,0,0
7450 DATA SECOND,1,0,0,1,0,0,0
7460 DATA MINUTE,1.6666667E-2,0,0,1,0,0,0
7470 DATA HOUR,2.7777778E-4,0,0,1,0,0,0
7480 DATA DAY,1.1574074E-5,0,0,1,0,0,0
7490 DATA WEEK,1.6534391E-6,0,0,1,0,0,0
7500 DATA MONTH,3.8580246E-7,0,0,1,0,0,0
7510 DATA FORTNIGHT,8.2671957E-7,0,0,1,0,0,0
7520 DATA DECADE,3.1688E-9,0,0,1,0,0,0
7530 DATA CENTURY,3.1688E-10,0,0,1,0,0,0
7540 DATA MILLENIUM,3.1688E-11,0,0,1,0,0,0
7550 DATA YEAR,3.1688E-8,0,0,1,0,0,0
7560 DATA EON,3.1688E-17,0,0,1,0,0,0
7570 DATA RADIAN,1,0,0,0,1,0,0
7580 DATA DEGREE,57.295779,0,0,0,1,0,0
7590 DATA ARCMINUTE,3437.7467,0,0,0,1,0,0
7600 DATA ARCSECOND,206264.8,0,0,0,1,0,0
7610 DATA GRAD,63.661977,0,0,0,1,0,0
7620 DATA REVOLUTION,.1591549,0,0,0,1,0,0
7630 DATA STERADIAN,1,0,0,0,0,1,0
```

(continued)

```
7640 DATA SPHERE,7.95774E-2,0,0,0,0,1,0
7650 DATA COULOMB,1,0,0,0,0,0,1
7660 DATA MOLE,1.0364E-5,0,0,0,0,0,1
7670 DATA UNIT,6.24E18,0,0,0,0,0,1
7680 DATA FARADAY,1.0364E-5,0,0,0,0,0,1
7690 DATA KNOT,1.944,1,0,-1,0,0,0
7700 DATA NEWTON,1,1,1,-2,0,0,0
7710 DATA DYNE,1E5,1,1,-2,0,0,0
7720 DATA POUNDFORCE,.2248,1,1,-2,0,0,0
7730 DATA POUNDAL,7.233,1,1,-2,0,0,0
7740 DATA GRAMFORCE,102,1,1,-2,0,0,0
7750 DATA ATMOSPHERE,9.869E-6,-1,1,-2,0,0,0
7760 DATA BAR,1E-5,-1,1,-2,0,0,0
7770 DATA BTU,9.481E-4,2,1,-2,0,0,0
7780 DATA ERG,1E7,2,1,-2,0,0,0
7790 DATA JOULE,1,2,1,-2,0,0,0
7800 DATA CALORIE,.2389,2,1,-2,0,0,0
7810 DATA ELECTRONVOLT,6.242E18,2,1,-2,0,0,0
7820 DATA WATT,1,2,1,-3,0,0,0
7830 DATA HORSEPOWER,1.341E-3,2,1,-3,0,0,0
7840 DATA AMPERE,1,0,0,-1,0,0,1
7850 DATA VOLT,1,2,1,-2,0,0,-1
7860 DATA OHM,1,2,1,-1,0,0,-2
7870 DATA GAUSS,1E4,0,1,-1,0,0,-1
7880 DATA GAMMA,1E9,0,1,-1,0,0,-1
7890 DATA TESLA,1,0,1,-1,0,0,-1
7900 DATA FARAD,1,-2,-1,2,0,0,2
7910 DATA HENRY,1,2,1,0,0,0,-2
7920 DATA WEBER,1,2,1,-1,0,0,-1
7930 DATA HERTZ,.1591549,0,0,-1,1,0,0
```

across national boundaries. Within an individual system of weights and measures there are different ways of expressing the same things. Trying to make sense out of the differences, similarities, and equivalences can be frustrating. Is a 1½-pound jar larger or smaller than a 23-ounce jar? How manys Btus (British thermal units) of air-conditioning are needed to compensate for 600 watts of light bulbs?

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-

(continued)

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.

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.*

Multiply	By	To get
feet	12	inches
yards	3	feet
miles	5280	feet
square miles	640	acres
inches	2.54	centimeters
gallons	4	quarts
hours	60	minutes
days,	24	hours

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.*

	Inch	Foot	Yard	Meter	Mile
Inch	1	0.0833	0.0277	.0254	1.58×10^{-5}
Foot	12	1	0.3333	.3048	1.89×10^{-4}
Yard	36	3	1	.9144	5.68×10^{-4}
Meter	39.37	3.28	1.094	1	6.21×10^{-4}
Mile	63,360	5280	1760	1609	1

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

inch	39.37
foot	3.28
yard	1.094
meter	1
mile	6.21×10^{-4}

Table 4: *The inch standard conversion table.*

inch	1
foot	0.0833
yard	0.0277
meter	0.0254
mile	1.58×10^{-5}

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

(continued)

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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, steradian, 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^3, 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

(continued)

Table 5: *Common prefixes and their values. These prefixes are all metric-based, but they may be used with any unit in the Convert program. While not commonplace, the term "microgallon" is not ambiguous.*

Prefix	Value
tera	10^{12}
giga	10^{9}
mega	10^{6}
kilo	10^{3}
hecto	10^{2}
deca	10
deci	10^{-1}
centi	10^{-2}
milli	10^{-3}
micro	10^{-6}
nano	10^{-9}
pico	10^{-12}
femto	10^{-15}
atto	10^{-18}

Table 6: *A portion of the SMF conversion table that enables conversion between both simple and compound units. The dimensions columns refer to distance, mass, time, angle, solid angle, and quantity, respectively. The complete table is included in the DATA statements of the program listing.*

SMF Conversion Table

		Dimensions					
Unit	Factor	D	M	T	A	S	Q
meter	1.0000	1					
foot	3.2808398	1					
acre	2.4710536×10^{-4}	2					
gallon	264.17205	3					
gram	1000		1				
ton	1.1023113×10^{-3}		1				
second	1.0000			1			
minute	1.6666667×10^{-2}			1			
radian	1.0000				1		
degree	57.295779				1		
steradian	1.0000					1	
coulomb	1.0000						1
knot	1.944	1		−1			
newton	1.0000	1	1	−2			
calorie	0.2389	2	1	−2			

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Both the Convert and

a common subroutine

for input string parsing

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

(continued)

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 ($\log_{10}N + 1$)
DN	flag, +1 to left of PER, −1 to right in intput/output processing
T$	next word being processed
T	prefix conversion factor
P	power term of current unit

Glossary

Conversion: 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.

Power: A power is used with a simple unit or dimension to indicate multiplication by a factor. In the term meter^2, the 2 means that the dimensionality is distance^2 instead of distance.

Prefix: A prefix is used in front of a simple unit to indicate a change in magnitude. An example is the prefix *micro-*, which refers to one millionth of the unit.

Unit: A unit of measure, such as meter or quart, gives meaning to a number (quantity) such as 5. For example, 5 quarts of milk has a specific meaning, while 5 milks does not. A unit has two parts, dimensionality and magnitude. A simple unit is a single word, such as gallon or watt. A compound unit consists of several words (e.g., miles per hour).

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 lookup 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 DI% 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 DI% 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 BYTEnet, 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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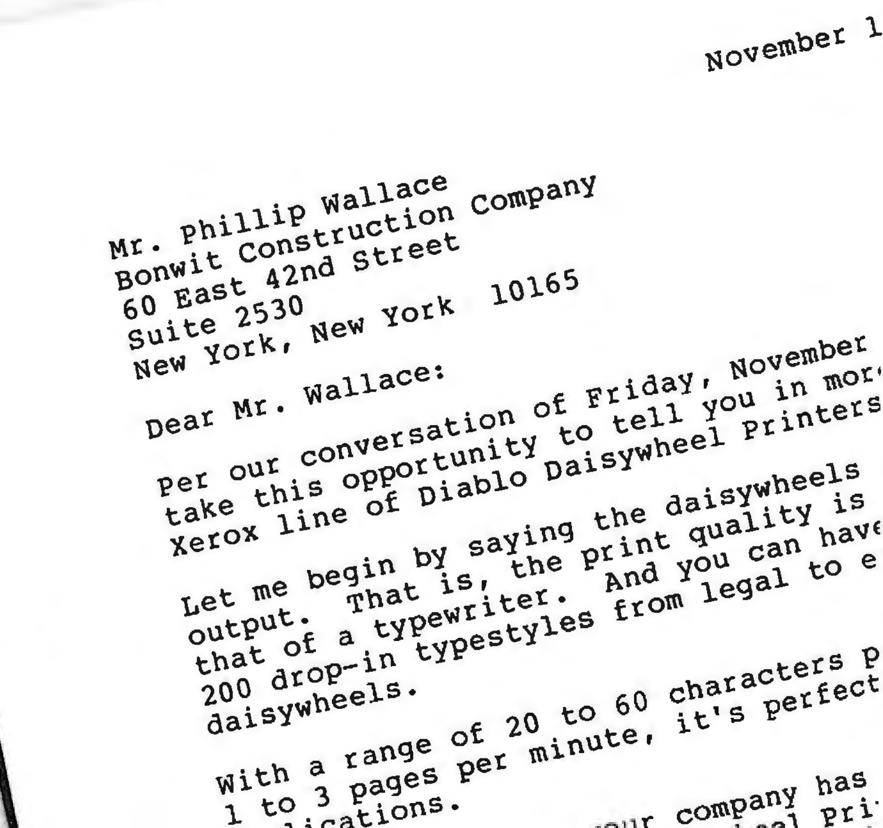

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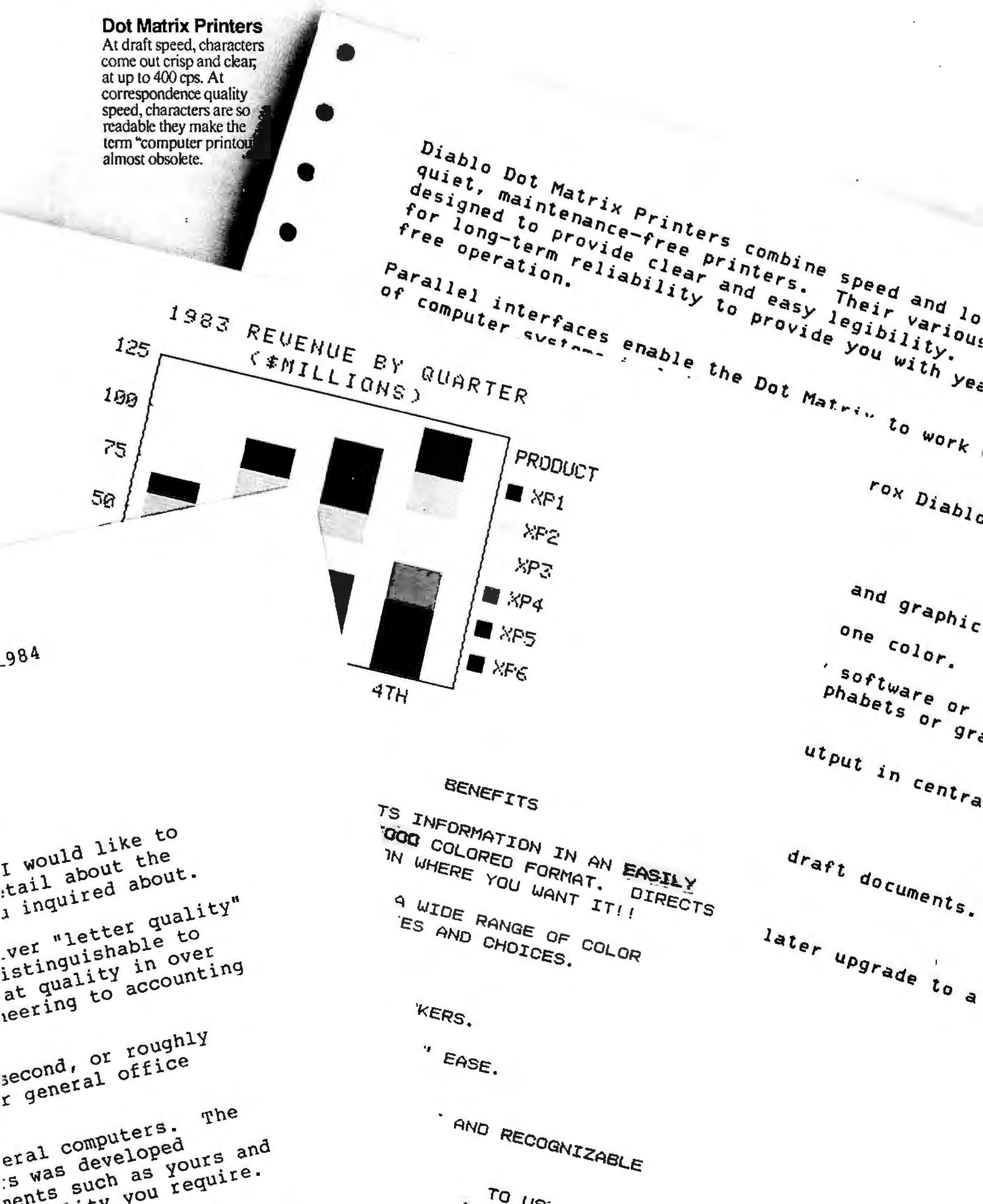

Bargain Computing

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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.

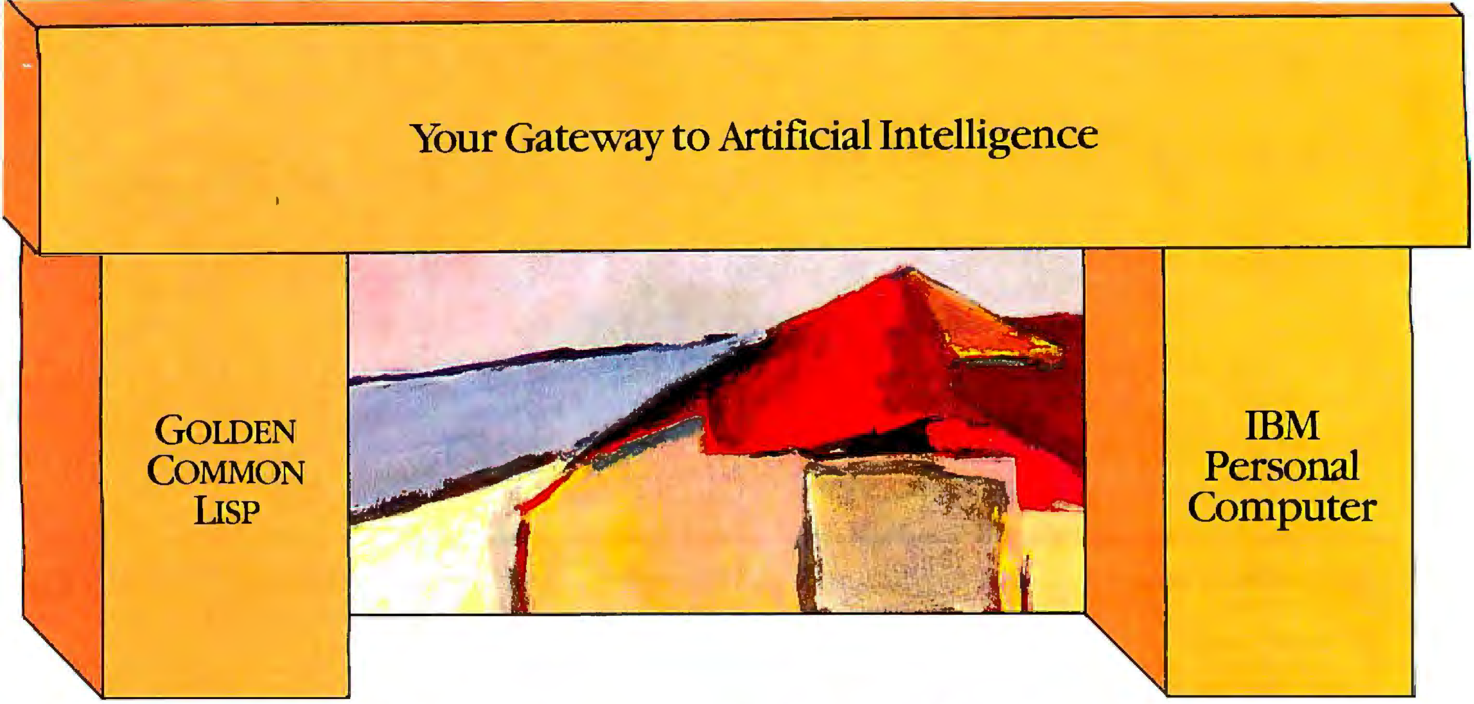
Purists tend to sneer at the so-called "home" computers, but even the lowly Commodore 64 is a powerful machine with great potential if you let your imagination soar. John C. Field, Greg Richards, and Eric Beenfeldt of the University of Maine used the C64 as the nucleus of an 80-column terminal. Their 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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Inquiry 160

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 search and replace strings).

Steve McMahon (POB 3262, Berkeley, CA 94703) is an independent software developer and freelance writer. His company, SunType Publishing Systems, produces and markets software for small newspapers. He is a graduate student of sociology at the University of California at Berkeley.

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)

IN BRIEF

Name
VEDIT Customizable Full Screen Editor 1.16d

Company
CompuView Products Inc.
1955 Pauline Blvd., Suite 200
POB 1349
Ann Arbor, MI 48106
(313) 996-1299

Computer System
Systems running CP/M-80, CP/M-86, MP/M, MP/M-86, Z-DOS, TurboDOS, or MS-DOS; versions with memory-mapped video are available for several computers, including the IBM PC

Documentation
215-page bound manual with index

Price
$150

Options
VEDIT PLUS enhanced version of VEDIT: $225
Z80 to 8086 Translator Macros for use with VEDIT PLUS: $50
VPRINT print formatter: $120
VSPELL spelling corrector: $125
VEDIT PLUS, VPRINT, and VSPELL package: $395
VEDIT PLUS and VPRINT package: $295

Name
PMATE 3.3

Company
Phoenix Computer Products Corporation
1416 Providence Highway
Suite 220
Norwood, MA 02062
(800) 344-7200
in Massachusetts, (617) 769-7020

Computer System
MS-DOS, CP/M-86, and CP/M-80 (Z80 only) systems; custom versions are available for the IBM PC, TI Professional, and Wang Professional

Documentation
235-page manual in a three-ring binder

Price
$225
CP/M-86 version: $195

Name
P-Edit 2.3

Company
Satellite Software International
288 West Center
Orem, UT 84057
(801) 224-4000

Computer System
IBM PC and compatibles running MS-DOS or PC-DOS version 1.1 or later

Documentation
97-page spiral-bound manual with index; keyboard overlay included

Price
$95

Name
BRIEF: The Programmer's Editor (prerelease version 0.99i)

Company
Solution Systems
335 Washington St.
Norwell, MA 02061
(617) 659-1571

Computer System
IBM PC and compatibles, Tandy 2000 running PC-DOS or MS-DOS 2.0 or later versions, 192K bytes of RAM required

Documentation
130-page manual in a three-ring binder, reference card, several BRIEF macro source-code programs and examples included on disk (release version includes help files on disk and a tutorial in the manual)

Price
$195

---

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 1 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.*

	VEDIT	PMATE	BRIEF	P-Edit	CSE	TED	SPF/edit	WS-NonDoc
Memory Required (kb)	64	64	192	48	64	128	256	64
Program Size (kb) Req/optional*	17/6	25	73/+	27/3	29	32/18	160	91
Memory-Mapped Video	yes	yes	yes	yes	no	yes	yes	yes
Files Larger than Memory	yes(1)	yes	yes	yes	yes	no	no	yes
Largest File in Memory (kb) (11)	47	57	63(2)	63	54	362	210	23
Edit Multiple Files	no	no(3)	many(4)	2	no	no	2	no
Windows	no	no	many(4)	no	no	no	2	no
Scratch Buffers	10	10(5)	1	1(6)	no	no	no	no
Keystroke Macros	no	yes	yes	yes	no	yes	no	no
Macro Language	yes	yes	yes	no	yes	no	no	no
Macro Variables	10	10	many(4)	n/a	no	n/a	n/a	no
Reconfigure Keyboard	yes	yes(7)	yes(7)	no	yes(8)	no	no	no
Auto-Indent	yes	yes	yes	no	no	no	no	no
Wrap Mode Available	yes	yes(9)	yes	no	no	no	no	yes
DOS 2+ Paths Supported	no	yes	yes	yes	no	yes	yes	no
Max. Line Length	258	251	144	64k	80	75	255	no limit
Directory Available in Ed.	yes	yes	yes(10)	yes	no	yes	no	yes
Deletion Undo	no	yes	yes	no	no	no	no	no
On-Line Help	yes	no	yes	yes	no	yes	no	yes
Position Markers	10	no	no	no	no	1	no	10

* 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 Innova-

Listing 1: A PMATE *macro program to change the indentation of a block of code. You must mark the block by setting a tag at the top line of the block and the cursor at the bottom line. When the macro program is invoked, it may be passed an argument, which is substituted into the place of* "@A" *when the program is run. Note that the program could be set up as a permanent* PMATE *macro.*

```
@LV1                    ;get the current line number, store in variable 1
Q#                      ;exchange cursor and tag
@1-@L                   ;now, subtract new line number from old to get
                        ;the number of iterations necessary
[                       ;begin iteration
YF-L                    ;detab line, move back up to it
@A>0[@A[I $]][-@AD]     ;if argument is greater than 0, add that many
                        ;spaces—else, delete that many
L]                      ;move to next line, end iteration
```

Listing 2a: A VEDIT *macro program to create a* 4000-*word benchmark text. Note that* VEDIT *does not actually allow comments—the ones above are added to elucidate the program. These comments would have to be deleted before the program would actually run. Also, please note that dollar signs appear in places where the escape key would be pressed.*

```
YI              ;for all following type commands, typed text
                ;should go to text buffer.
1XS1$           ;set variable one to value 1 (escape marks end of command)
40[             ;iterate the following 40 times
:XT             ;type the value of variable one.
I.
$               ;insert a period and a return.
10[I One two three four five six seven eight nine ten.
$]              ;insert the test line 10 times
I
$               ;insert an end of paragraph extra line.
1XA1            ;add 1 to variable one.
]               ;end 40-times iteration
Iend
$               ;insert the word "end" and a return.
```

Listing 2b: A PMATE *macro to create the benchmark text. Here also, the dollar sign should be taken as indicating where the escape key would be pressed.* PMATE, *unlike* VEDIT, *does allow comments, so this program will run "as is."*

```
1V1$            ;set variable one equal to 1
40[             ;iterate 40 times
@1\I.
$                   ;insert the value of variable one, followed by a period, cr
                    ;insert the following line 10 times
10[I One two three four five six seven eight nine ten.
$]
I
$                   ;insert a return
VA1                 ;increment variable one
]                   ;end the 40-times iteration
Iend
$                   ;insert "end" and a return
```

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
      (
                                          ;put the paragraph count
                                          ;value into a string also
                                          ;containing a period & new line
        (sprintf output_string "%d. \ n" paragraph_count)

        (insert output_string)            ;insert that string into text
        (= line_count 1)                  ;initialize line count
        (while (<= line_count 10)         ;while line count <= 10 do
          (
                                          ;insert the test line
            (insert " One two three four five six seven eight nine ten. \ n")

            (= 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")
  )
)
```

tions, Wizard, and Lattice) and BRIEF's macro compiler.

When BRIEF is ordered to execute the macro compile_it, the file on screen is automatically saved and one of four macros is selected on the basis of the filename extension. For example, the extension .M will cause the BRIEF macro compiler to be selected. The DOS function is then called to execute a command line invoking the appropriate compiler and redirecting DOS standard error output into a file. When compilation ends and control returns to BRIEF, an error macro parses the contents of the newly created error file, putting the cursor on the source-code error location and flashing the compiler's error message on the screen.

Similar schemes could presumably be implemented for other languages. Other development aids possible with BRIEF include simple syntax checks and "smart" automatic indentation or interactive pretty-printing of structured code—a C curly brace checker and smart-indentation macro package is already included.

MACROS WITHOUT A LANGUAGE

If spontaneity and ease of use are paramount, then the macro facility provided in Satellite Software International's P-Edit rates high. P-Edit provides not a macro language but a keystroke macro facility with conditional execution. A keystroke macro facility is a system for recording keystrokes as

(continued)

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.

SOURCE CODE INCLUDED

A DIFFERENT ROAD TO CUSTOMIZATION

IN BRIEF

Name
C Screen Editor (CSE)

Company
Solution Systems
335 Washington St.
Norwell, MA 02061
(617) 659-1571

Computer System
Systems running CP/M-80 2.2 or later, CP/M-86, MP/M-86, MS-DOS, or PC-DOS operating system (CP/M-80 version requires at least 56K bytes of RAM, 16-bit versions require at least 64K)

Documentation
75-page bound manual; portable C source code for editor is included on disk—Computer Innovations C86 and Software Toolworks C/80 will immediately compile the 16- and 8-bit versions, respectively

Price
$75

The C Screen Editor provides tremendous opportunities for customization for programmers with at least a little expertise. Included on disk with CSE is the C-language source code for both the editor and its installation program.

CSE is not the most full-featured editor on the market; it has no word wrap, auto-indent, or memory-mapped video. But it does offer command and screen-editing modes and includes a limited macro facility with provisions for iterating commands. This language can handle simple macros like

```
B#(F'dogs'5d)
```

which orders the editor to start at the top of the text buffer, find the next occurrence of "dogs" and delete the five following characters, continuing until the text buffer is exhausted.

The inclusion of source code, though, gives CSE the power to be something completely different—it could even be embedded into other programs. Also, reading CSE's source while attempting modifications would provide a good advanced introduction to the C language.

The authors of CSE have taken some pains to make the program reasonably portable. Despite this, the versions for different operating systems necessarily vary somewhat and the source code also would have to be modified to compile with different C compilers than those used to develop it. The problem is not too great, though, thanks to the portability of C and the efforts of the authors to isolate system-dependent modules. Computer Innovations' C86 and Software Toolworks' C/80 should compile without modification the 16-bit and 8-bit versions, respectively.

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 start the auto-indent macro whenever the extension is .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),

(continued)

Two SPF Look-Alikes

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

IN BRIEF

Name
TED: A Programmer's Text Editor 2.0

Company
Morgan Computing Co. Inc.
10400 North Central Expressway
Suite 210
Dallas, TX 75231
(214) 739-5895

Computer System
IBM PC, XT, or AT and 100%-compatibles running PC-DOS 2.0 or later, 128K bytes of RAM

Documentation
85-page, 8½- by 7-inch three-ring binder; index and reference card included

Price
$95

Name
SPF/editor 1.0

Company
Phaser Systems Inc.
353 Sacramento St.
San Francisco, CA 94111
(415) 434-3990

Computer System
IBM PC, XT, or AT and compatibles running PC-DOS 2.0 or later; 256K bytes of memory required, 320K recommended

Documentation
194-page manual in a three-ring binder with index

Price
$100
(a mainframe/micro file-transfer facility is now included with SPF/editor at no additional charge)

Options
micro/SPF, version 3.0 (runs on Wang Professional and TI Professional as well as the above systems), includes SPF/editor with additional browse mode, function-key redefinition, utilities, library facility, mainframe/micro file-transfer facility, true split-screen, and on-line tutorial: $450

Photo A: *With the SPF/editor's show/exclude feature, you can compress text display to show just vital function and procedure declarations (top), then expand it as need be to allow work on a particular module (bottom).*

previously marked line is on while a control key is depressed). TED also provides automatic version numbering and date and time stamping for specially labeled lines within the text. Availability of DOS directory information from inside the editor complements the file-merging and segmentation capabilities of the editor.

The primary audience for both these editors obviously comprises programmers already accustomed to the SPF environment. Persons with most of their programming experience on character-oriented microcomputer editors are likely to find the line orientation of both editors a bit of a straitjacket. One use to which both seem well adapted is the management of large data sets for statistical work. Here the line orientation, ability to handle large files in memory, and merge/segment facilities could be invaluable.

searches for zero, one, or more characters "¦M" between "(*" and "*)" and replaces the string (including the "(*" and "*)") with nothing, "\ \", continuing until the buffer is exhausted. The escape key has been pressed (indicated 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 uppercase letter, any numeric digit, any control character, anything other than a certain character, and any combination of these specifications.

BRIEF's pattern-recognition capability is even greater because it is more general. BRIEF can search for patterns defined by regular expressions of the sort recognized by UNIX's grep (globally find regular expressions and print) and other such utilities. The greater power of the regular-expression design can be shown in a comparison of the way VEDIT and BRIEF can be told to look for a numeric digit. VEDIT's notation is more concise: ¦D matches any numeric digit. However, BRIEF's notation is more general: [0–9] matches any numeric digit, while [a–z] matches anything in the alphabet; [aeiou] will match any vowel and [~aeiou] will match any character that's not a vowel.

Not only does BRIEF make use of this marvelously general regular-expression notation in its search facility, but its pattern-recognition capability extends to its replacement (or translation) facility. Requesting the replacement of if{*}then by if (\0)—where \0 stands for the first group delimited by curly brackets in the search string—will cause the translation of a Pascal-type if . . . then construction to a C-type if (. . .) construction.

The usefulness of this facility for programmers, who deal constantly with the regular expressions of formal languages, is obvious, but such a facility is likewise of use to anyone who works within the formal straitjackets of multiple, varying style books. Regular expression-translation power within a fast microcomputer editor could take much of the work out of translating bibliographical information, for example, from one format to another—while allowing detailed attention to those parts of the translation that just can't be narrowed down to translations of regular expressions.

Regular-expression searches are also a valuable part of the BRIEF macro language. I was able to use a command to search backward for the most recent pattern of white space followed by characters as part of a macro turning BRIEF's tab key into an automatic-alignment command.

Flexible Keyboards

VEDIT, PMATE, and BRIEF each allow complete reconfiguration of the relation between the keyboard and the particular editor's command set. This means that the user can map nearly any editor command to almost any key (including function, numeric keypad, alternate, and control keys). So, if the user wants the home key to do the same thing in one of these editors that it does in another application program or just doesn't like the default choice, the key's function may be changed.

Reconfigurations of VEDIT and PMATE are accomplished through installation programs that allow simple customization of key assignments and a variety of other features. Starting modes (insert, overstrike, or command), cursor-movement pattern (should the cursor be allowed to move into dead areas of the screen), and even, in the case of VEDIT, cursor shape and blink rate, may be adjusted. BRIEF's far more extensive, but more difficult to use, reconfiguration capabilities are available through its macro language.

One use for such customization capacities might escape immediate notice: These editors may be customized to be simpler and have fewer commands than most text and word processors. Both PMATE and VEDIT easily could be stripped down to bare

(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 text 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.*

	PMATE	VEDIT	BRIEF	P-Edit	CSE	TED	SPF/editor	WS-NonDoc	BASIC
Save File	8.4	11.1	18.4	12.8	12.0	10.8	12.3	22.5	—
Load File	5.2	10.7	2.8	2.2	18.3	10.2	12.9	8.6	—
Search	1.8	1.9	4.0	5.2	3.3	1.7	1.3	11.9	—
Run Macro	2.4	2.3	51.1	—	—	—	—	—	20.6

essentials for use as fast, no-nonsense writing engines.

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 recover 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 that 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." With 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.

Photo 1: A BRIEF *screen shot showing windowing.*

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 programs (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 Z80-to-8086 assembly-language source-code translation package for use with VEDIT PLUS. ■

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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)

Greg Richards is a student at the University of Maine–Orono, where he is studying for his master's degree in electrical engineering. Eric Beenfeldt is both a student and a lecturer at UMO. He enjoys home remodeling, electronics, and computers. John C. Field, an associate professor at UMO, holds a Ph.D. in electronics engineering and is a consultant in the area of microprocessor applications.

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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 ($\overline{\text{RAM}}$) 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/$\overline{\text{W}}$ signal from the 6510 and applies it to the R/$\overline{\text{W}}$ 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/$\overline{\text{W}}$. 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

The character clock synchronizes the CRTC with the rest of the system.

D flip-flop, and inverters to produce the system timing signals S/$\overline{\text{L}}$, CC, and $\overline{\text{CC}}$. When S/$\overline{\text{L}}$ is high, the shift register clocks out data to the video mixer; when S/$\overline{\text{L}}$ 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 $\overline{\text{CC}}$ 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, MA0–MA10, become valid. However, before the data at the output of the screen memory can change, the rising edge of the S/$\overline{\text{L}}$ 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/$\overline{\text{L}}$, HSYNC, and VSYNC are mixed together to produce the composite-video signal. The mixed signal is matched to the 75-ohm

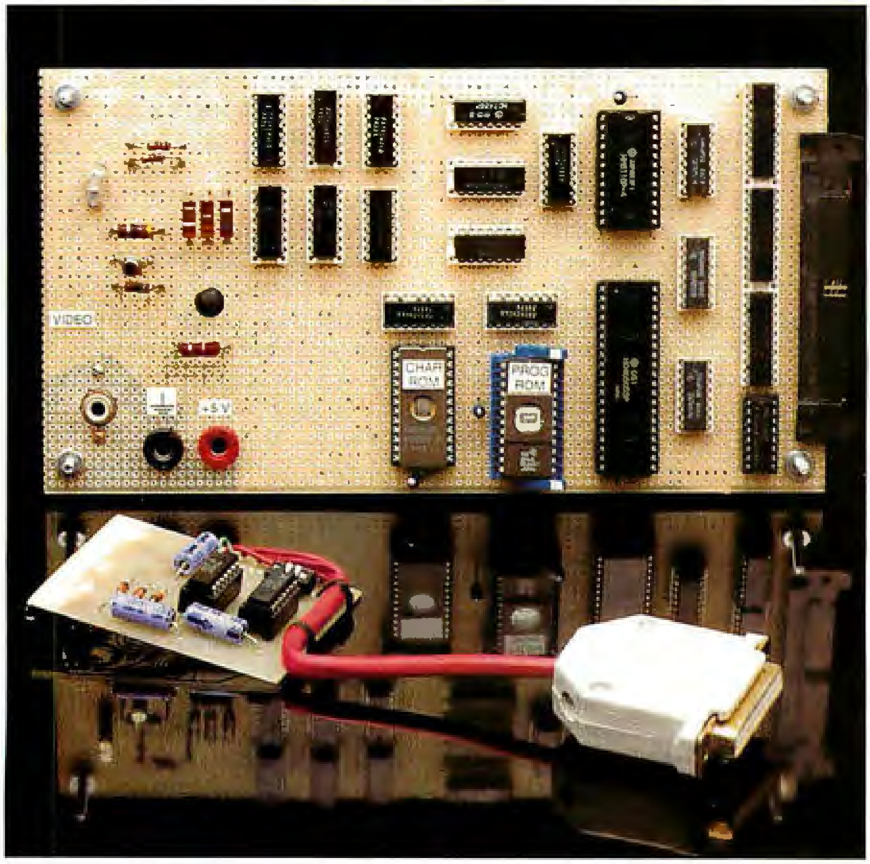

Photo 1: *The 80-column board and the RS-232C interface board.*

(continued)

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/$\overline{\text{L}}$, 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 circuitry, 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 74LS138 1-of-8 Line Decoder to generate the signal $\overline{\text{RAM}}$. 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 $\overline{\text{RAM}}$ 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.

$\overline{\text{RAM}}$ is also applied to the 74LS245 bus transceiver so that when the machine is accessing screen memory,

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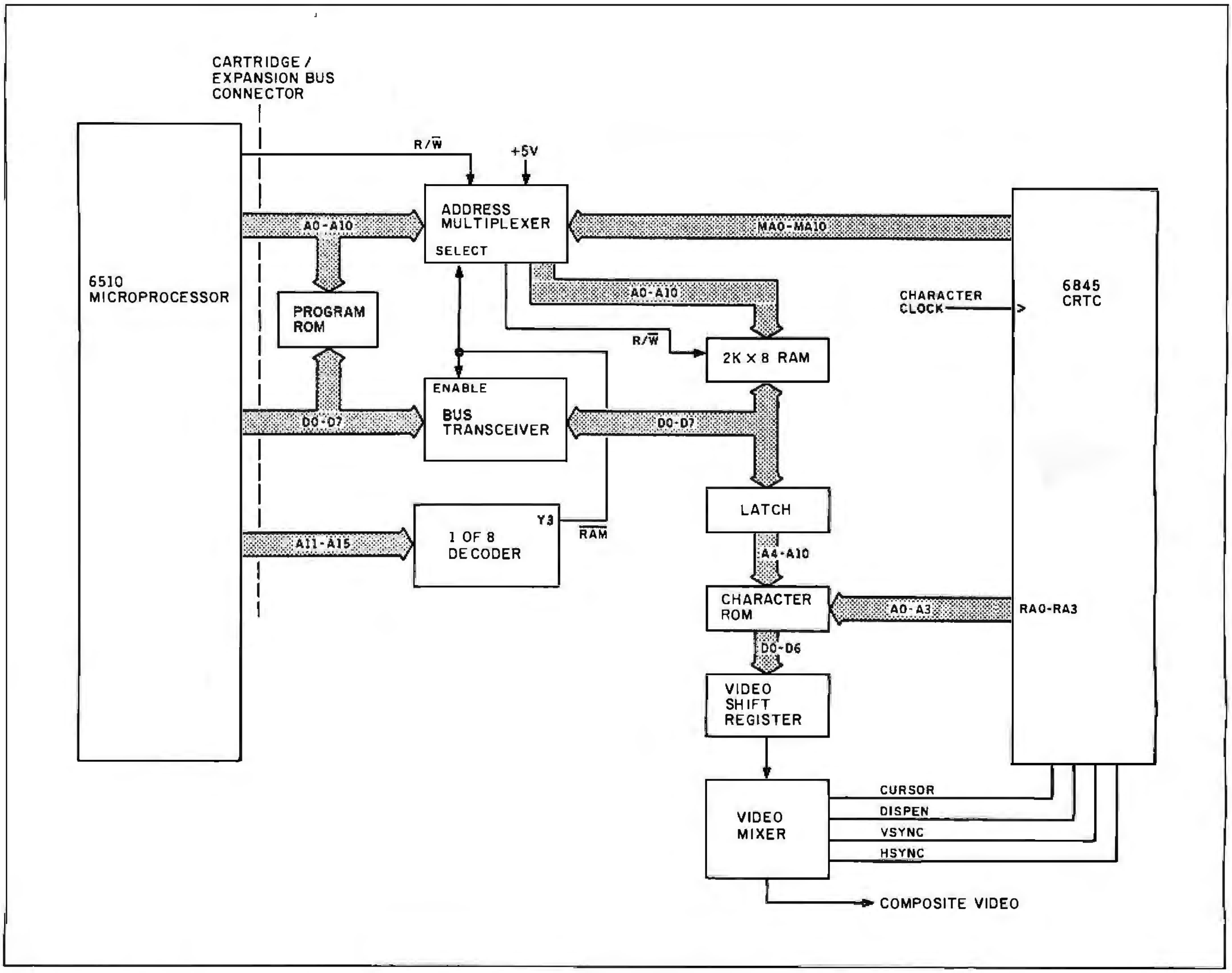

Figure 1: *A block diagram of the 80-column video board.*

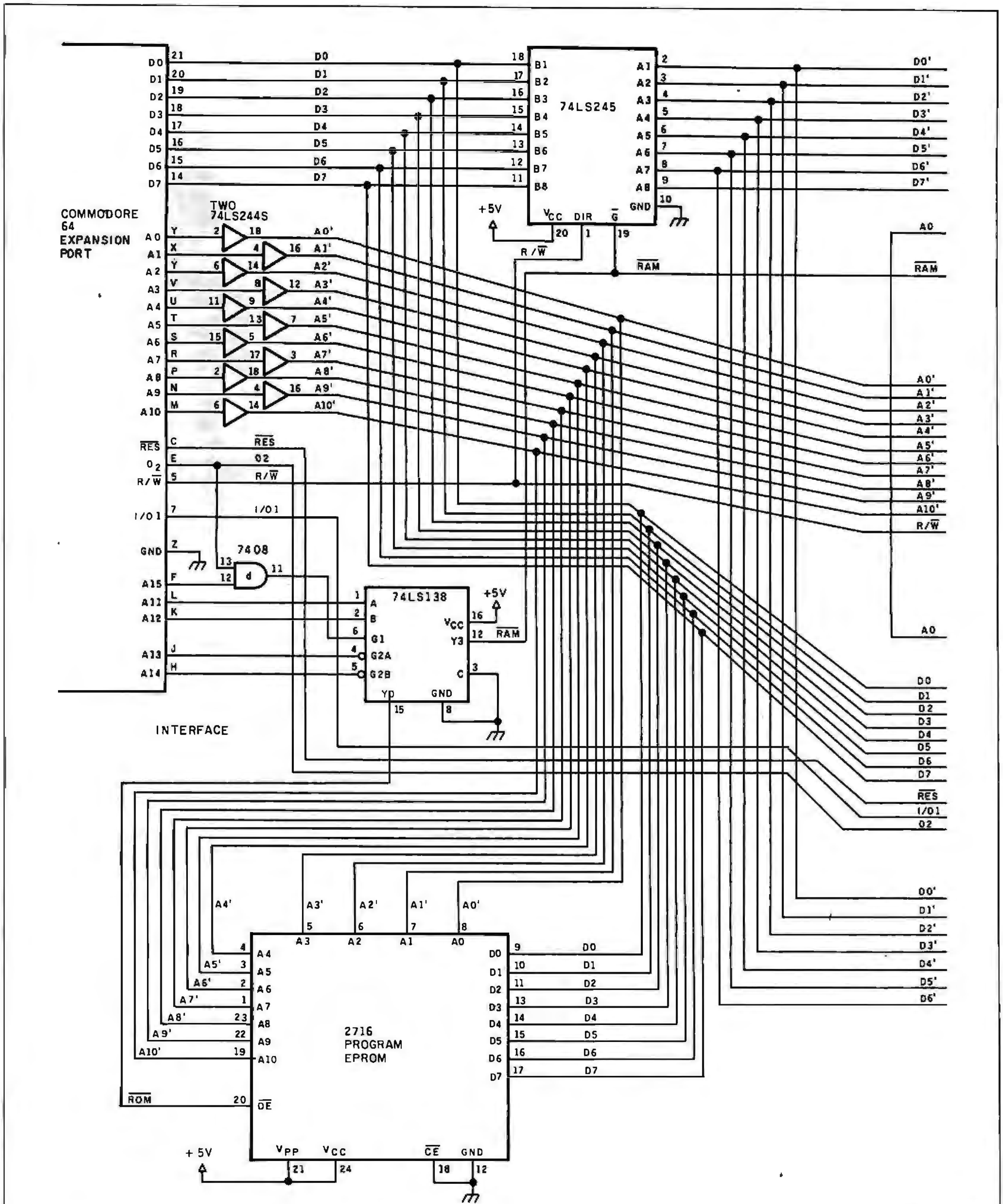

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Figure 2: A *schematic of the 80-column video board.*

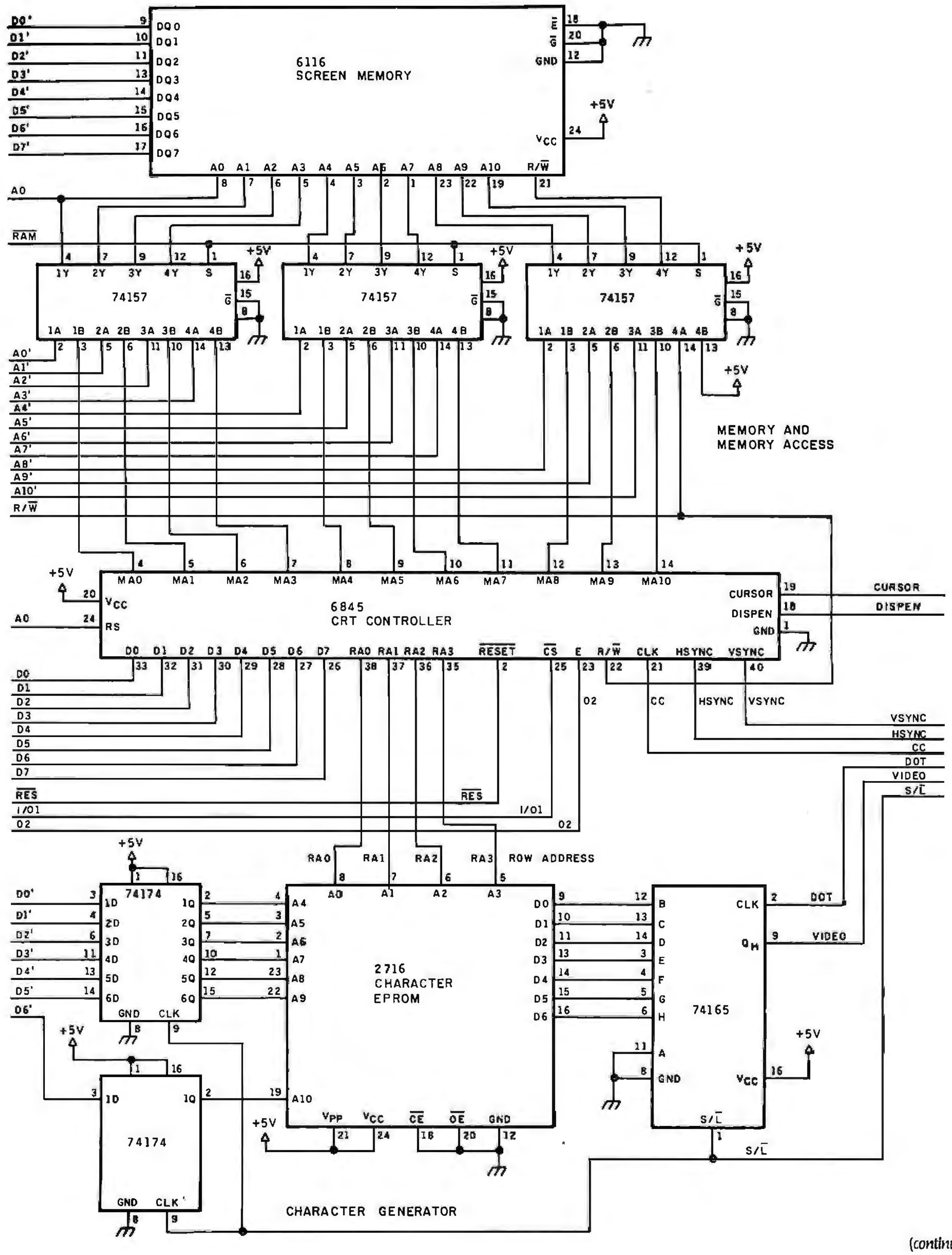

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Figure 2 continued.

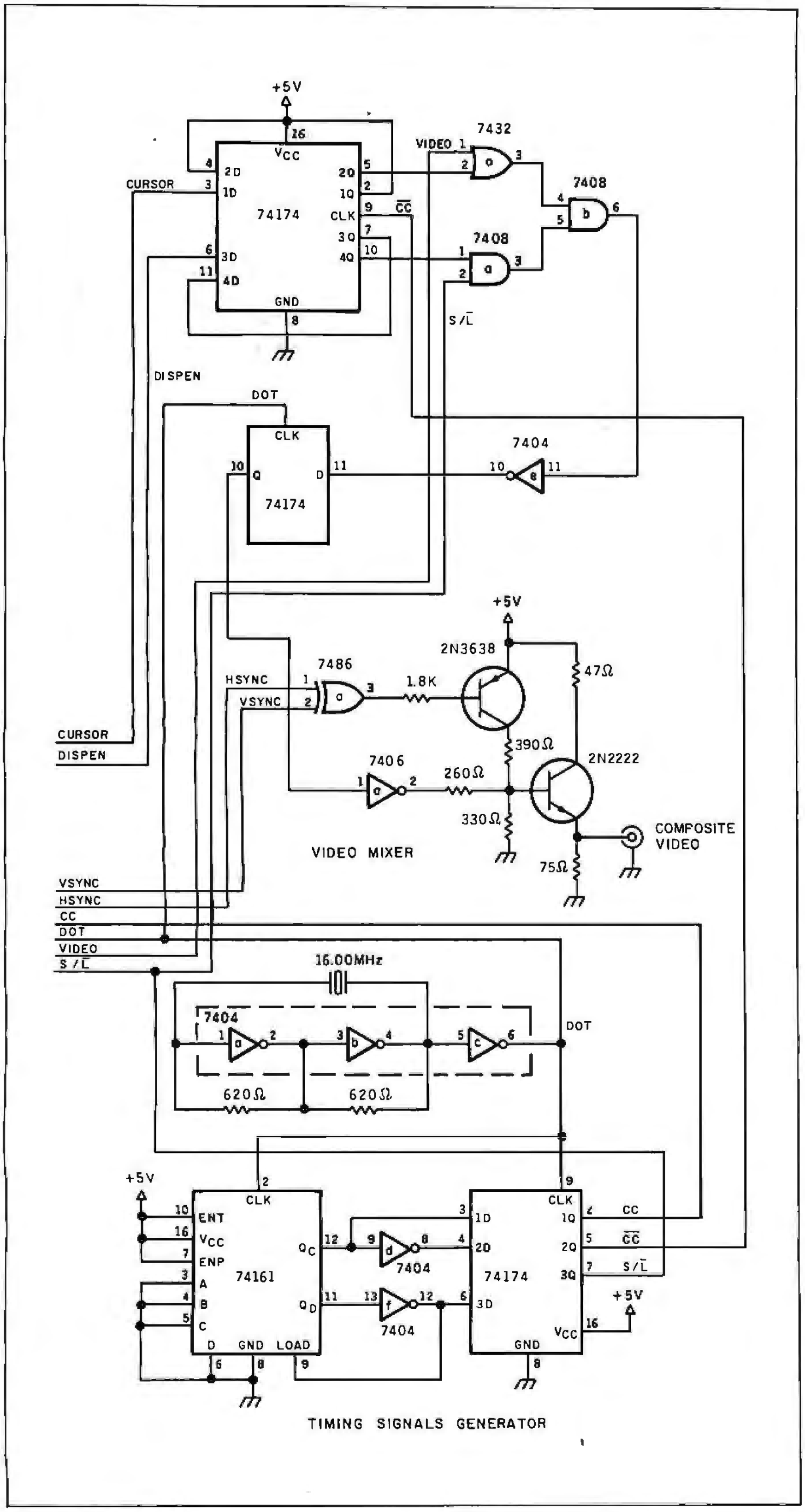

Figure 2 continued.

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 BYTEnet Listings at (603) 924-9820. (See the February 1985 "Ciarcia'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,

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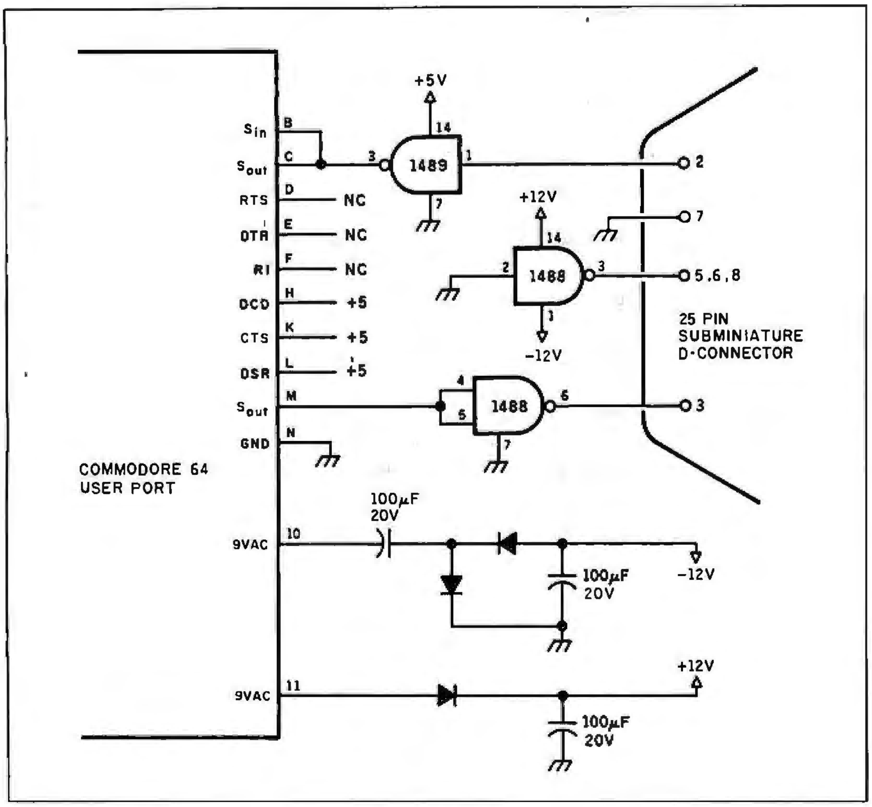

Figure 3: A *schematic of the* RS-232C *interface.*

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.

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respectively. The last initialization block sets the look-up revector 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 flowchart, 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.

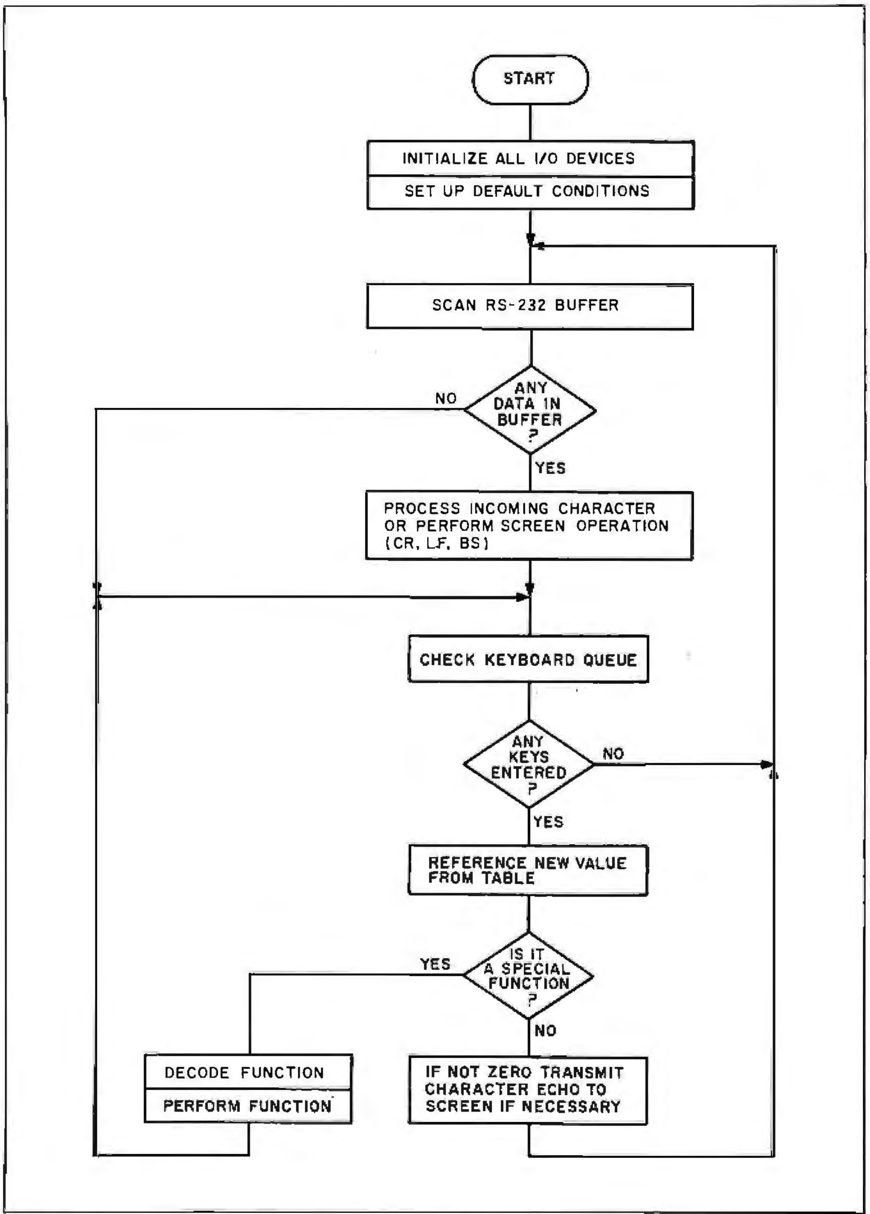

Figure 4: A *flowchart of the program in the* EPROM.

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. ■

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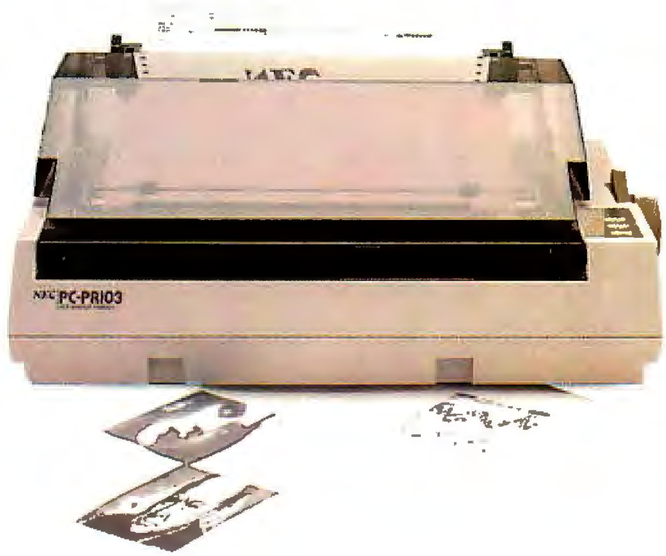

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BY LAINE STUMP

The 8-MHz 16-bit Slicer

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).

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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

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(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, 5¼-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.

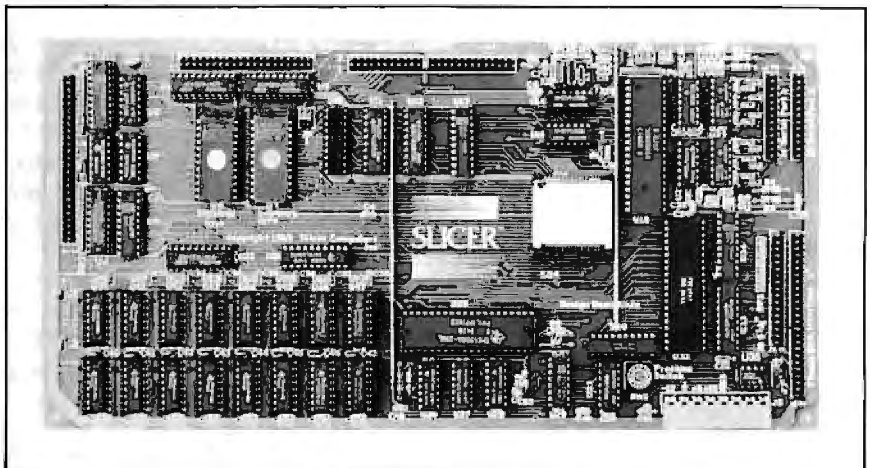

Photo 1: *The Slicer board has an 80186 microprocessor, two serial ports, a floppy-disk controller for up to four drives, 256K bytes of dynamic RAM, and an SASI interface. Note that the RAM chips (lower left) are piggybacked.*

The Slicer

The Slicer (see photo 1) seems to have been designed to be fast and com-

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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; 1797 controller and an FDC 9229B data separator permit use of 8-inch and 5¼-inch disks, double-density and double-sided; SASI interface allows connection of Winchester controller; 90-line expansion interface provides buffered data, address and control buses

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 (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:	$125
with power supply:	$245
with two 5¼-inch 96-tpi (tracks per inch) drives:	$795

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 compatibles 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 FDC9229 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, so things like 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-

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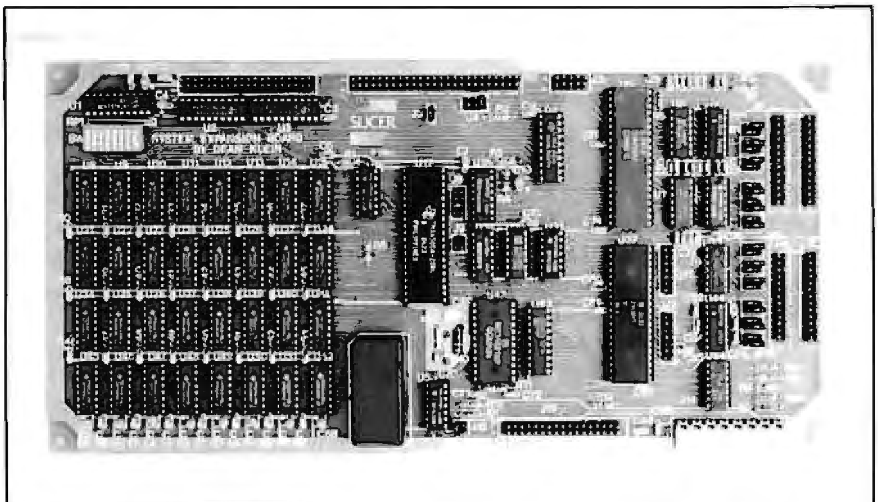

Photo 2: *The Slicer expansion board has an additional 256K dynamic RAM, a real-time clock/calender with battery backup, a parallel port, and four serial ports.*

matically 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 benchmarks (see table 1).

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-

(continued)

Table 1: *The Benchmark programs were written and compiled with Turbo Pascal version 2.0. The listings for these programs are available for downloading on* BYTEnet Listings, (603) 924-9820, *as* STUMP1 *through* 4. *The times for disk access show how long it takes to write and read a 64K-byte sequential text file to a blank floppy disk. The Sieve times record how long it takes to run one iteration of the Sieve of Eratosthenes prime-number benchmark. The Calculations times show how long it takes to do* 10,000 *multiplication and division operations using single-precision numbers. The tests were run on a Big Board* (Z80A *at* 4 MHz, 64K *bytes of* RAM, *two 8-inch single-sided single-density drives, and* CP/M-80) *and the Slicer* (80186 *at* 8 MHz, 256K, *two 8-inch single-sided single- or double-density drives, and* CP/M-86). *All times are in seconds.*

	Big Board	Slicer Single-density	Slicer Double-density
Disk write	29.2	19.9	15.4
Disk read	25.4	17.8	13.6
Calculations	49.8	33.1	—
Sieve	2.5	0.6	—


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tended input/output system) keeps an exact copy of the contents of the screen for each job. A lot of overhead is involved in screen-buffered mode, since the XIOS must interpret all cursor-control and clearing commands sent to the screen. Line-buffered mode will not work properly with windowing, however, so both modes are necessary.

In line-buffered mode, application programs can use the special escape commands of the terminal hooked to the Slicer; in screen-buffered mode, they must use standard IBM PC escape commands. Any of the commands not implemented on your terminal are simulated in software. In order for this to work, you must use the SU program described below to tell CCP/M your terminal's commands for positioning the cursor and clearing the screen.

The third choice of modes is, of course, between using windowing and simply having the currently active job fill the entire screen. You may think that you will always want to use windows, but many times you will want to see the full screen of a job, and it's nice to be able to just type a key and have it that way. Also, since the nonwindowing method can use line-buffered mode, output to the screen can be more efficient.

Besides the operating system itself, the CCP/M disk contains all the standard CCP/M utilities (PIP, SUBMIT, GENCCPM, etc.). It also includes W, a program that can save the current window parameters and restore them at a later time, and SU, a setup program that virtually eliminates the need for GENCCPM.

SU lets you define the location, data rate, terminal type, and windowing parameters of up to 10 physical consoles, as well as the location, type, and capacity of on-line disk drives (which disk is the system disk, what I/O ports the printers are on, etc). This can all be done interactively or from a file that contains all the information in a readable form. Just as you will probably never have to reassemble the CP/M-86 BIOS, you probably will never have to reassemble the 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 you have to go back to normal CP/M to format a new disk.

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

(continued)

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

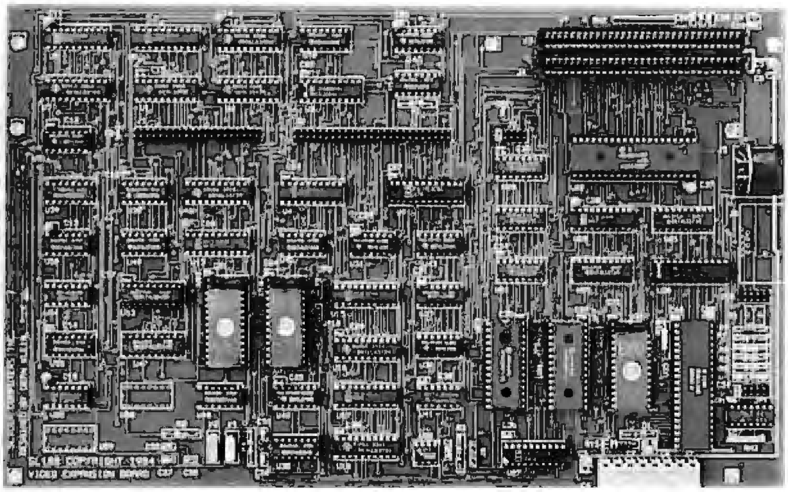

Photo 3: *The video expansion board supports an IBM-compatible 80 by 24 monochrome display, 640 by 200 bit-mapped graphics, and has two IBM PC slots and a connector for an IBM replacement keyboard.*

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 Slicer is a solid machine; it is the most reliable piece of hardware I have ever owned.

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. ■

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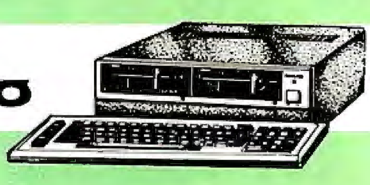

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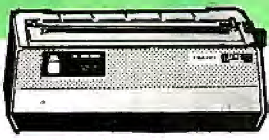

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PUBLIC-DOMAIN GEMS

BY JOHN MARKOFF AND EZRA SHAPIRO

A selection of free and nearly free software for the IBM PC *and the* Macintosh

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, and 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" (user-supported software) have played an equally vital role.

Ezra Shapiro is the West Coast bureau chief. You can reach him at BYTE, 425 Battery St., San Francisco, CA 94111. *John Markoff is a senior technical editor for* BYTE. *Write to him at* McGraw-Hill, 1000 Elwell Court, Palo Alto, CA 94303.

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-Talk, 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)

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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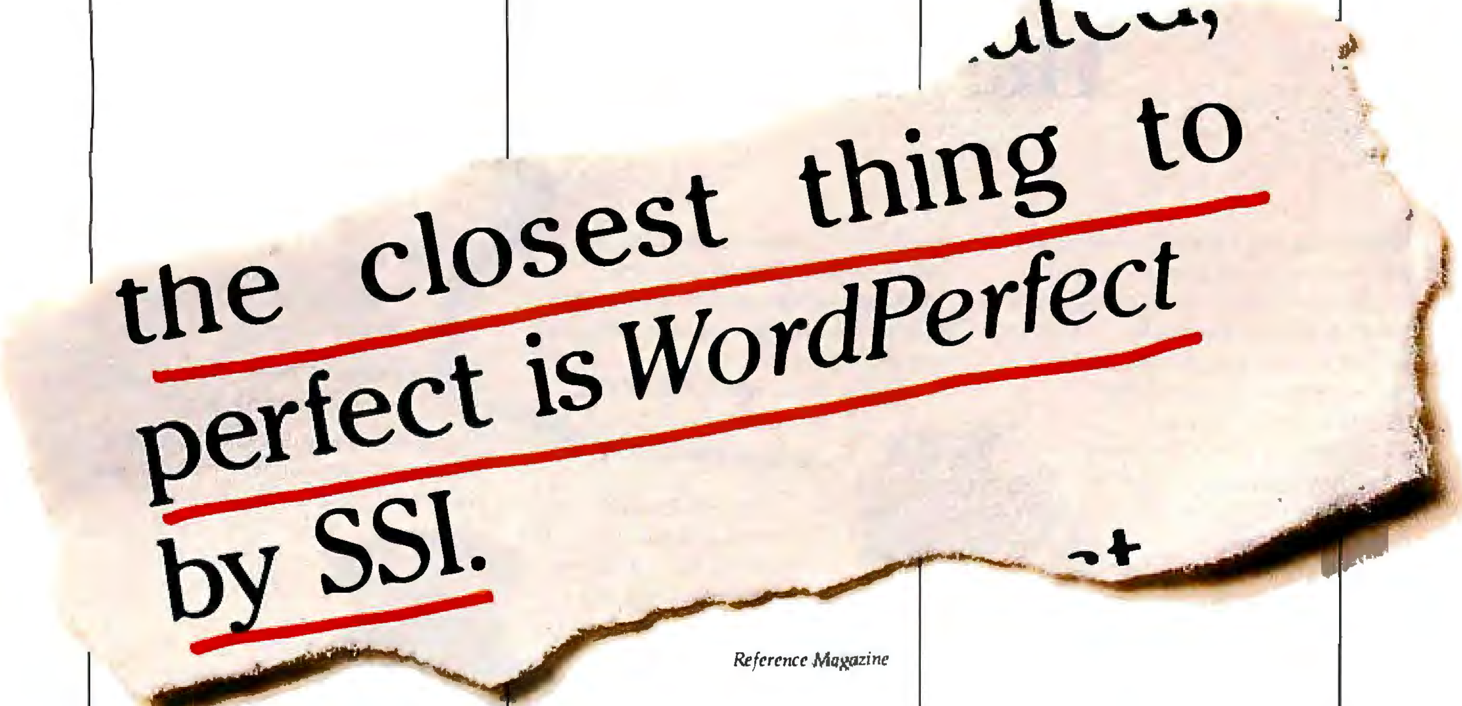

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When it comes to software, nobody's perfect. But according to many of the experts, one word processing program is as close as you can get. No wonder it's called WordPerfect.

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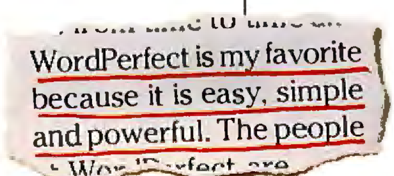
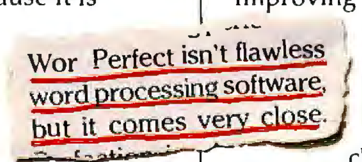


List Magazine



Digital Review

Features. From writers to doctors, accountants to lawyers, WordPerfect has built-in special functions to meet a wide variety of specific needs. And at SSI, every day is spent upgrading and improving WordPerfect — reaching for perfection.

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Microsoft are direct descendants of CP/M 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 CP/M-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 CP/M ancestors. There are modem 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 CP/M versions.

Some of the best of these clones are programs developed as adjuncts to the tedious business of file transfer. The modem 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 LU (Library Utility). Originally written by Gary Novosileski for CP/M, an MS-DOS version by Tom Jennings is now making the rounds. LU 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 KEYSTAT, 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 (1RD): Written by Jim Button, author of PC-File and other user-supported programs, 1RD 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 pro-

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Inquiry 254

Fido takes the concept of the BBS *a step further.*

tocol 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 is a rather powerful and complex terminal program that can be found in the databases of a number of the CompuServe SIGs. It, too, can be configured for most popular systems. Finally, the ubiquitous descendants of Ward Christensen's original MODEM program (MODEM795 seems to be the latest revision making the rounds) shouldn't be overlooked. The user interface may be a bit clunky, but the programs are time-tested, functional, and you certainly can't beat the price.

Bulletin-Board Systems

RBBS-PC: The most widely available BBS program for the IBM PC is similar in design to CP/M's RBBS and CBBS systems. It permits sending messages, downloading files via XMODEM, and posting bulletins. It is designed to run on the IBM PC or XT and requires 128K bytes and at least two floppy-disk drives. The current incarnation, RBBS-PC version CPC12.1, includes a provision for recording and storing information on users. A recent beta-test version we've seen claims to support full conferencing, and it should be widely available within the next few months.

FIDO: Written by programmer Tom Jennings, Fido takes the concept of the BBS a step further (see the October 1984 BYTE West Coast, page 357). In addition to supporting messaging, Fido provides XMODEM and a series of other communications protocols that permit batch file transfers. Fido also contains FidoNet, a simple electronic-mail system that permits individual unattended Fido systems to transfer messages to each other automatically.

Word Processors and Text Editors

PC-WRITE: Written by former Microsoft programmer Bob Wallace, PC-Write 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 split-screen 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 assembly-language 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 BBSs 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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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 straight 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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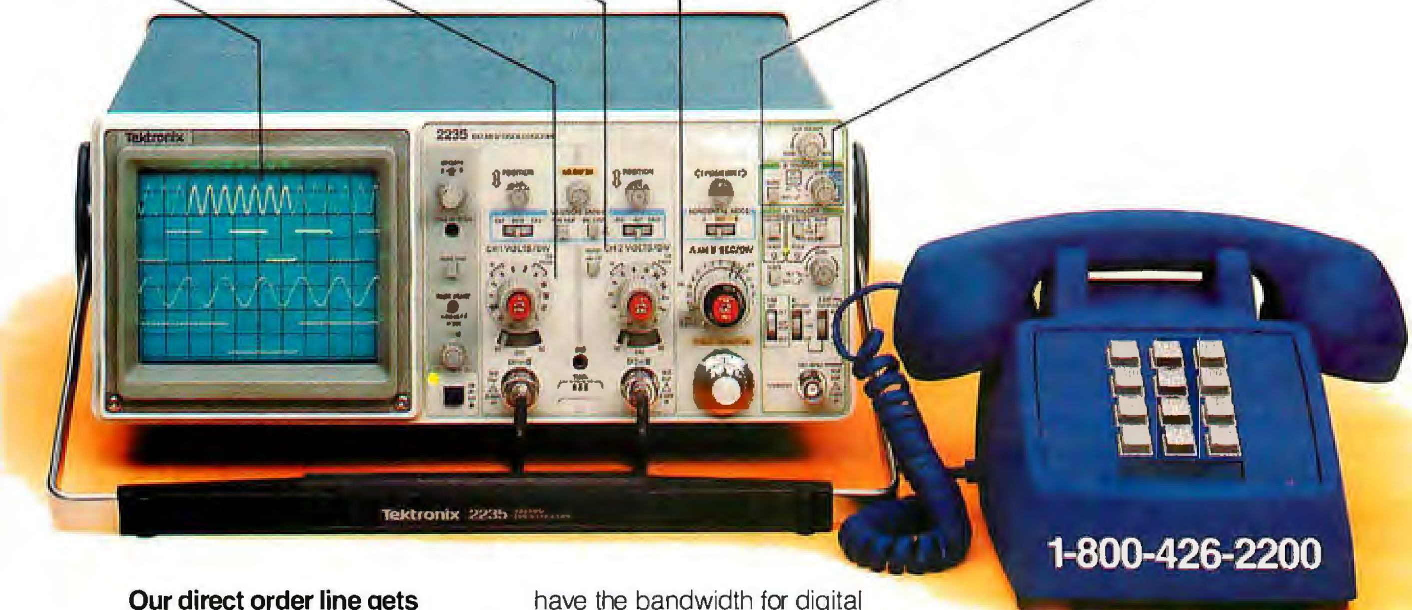
B trigger slope and level. Use B trigger level to select B-triggered or run-after-delay modes; use B TRIGGER SLOPE to select transitions.



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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 Acces-

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GOULD Electronics

sory Mover allows users to add and delete desk accessories from the Macintosh desktop. A number of desk 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.

REVERSI: 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 22901. 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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Inquiry 325

AN XLISP TUTORIAL

BY DAVID BETZ

This public-domain language lets you experiment with artificial intelligence

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* BYTE*net 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 in-

(continued)

David Betz (114 Davenport Ave., Manchester, NH 03103) is the inventor of XLISP *and various applications based on the principle of artificial intelligence. He is a senior software engineer for* Hastech *Inc., developing text-composition software for the newspaper industry.*

telligence, 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 PDT-11/150 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-11, 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 PDT 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-11 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-11 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.
2. XLISP computes the value of the expression.
3. 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 really 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)
14
```

In the following example, notice that there is a single-quote character immediately preceding the argument to be evaluated. Here and elsewhere, this quote tells XLISP to treat the expression following it as a constant rather than an expression whose value is to be computed. This constant expression is passed to eval, which responds by returning the value of the expression:

```
>(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.

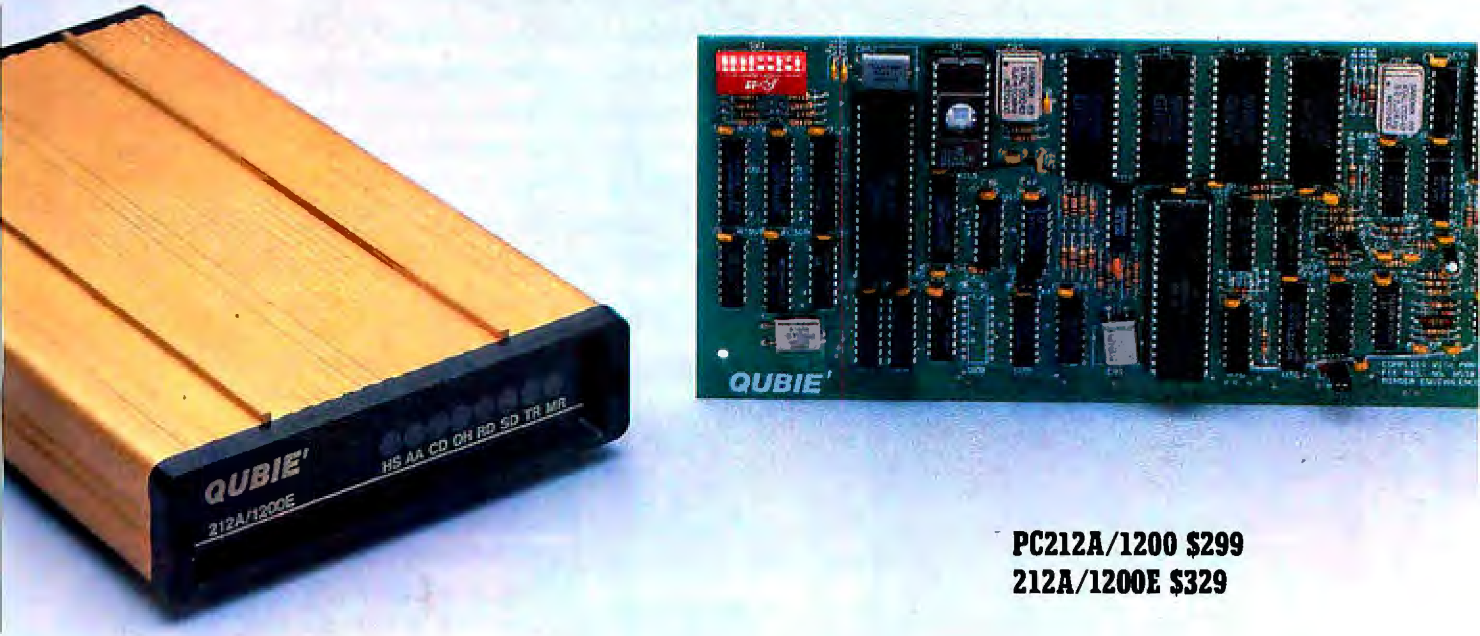
```
>(defun second (x) (car (cdr x)))
second
```

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)
```

(continued)

Inside Outside



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XLISP TUTORIAL

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

```
(cond
  (condition-1 action-1-1 action-1-2 . . . action-1-n)
  (condition-2 action-2-1 action-2-2 . . . action-2-n)
  .
  .
  .
  (condition-m action-m-1 action-m-2 . . . action-m-n))
```

(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:

```
>(setq a 0)
0
>(cond ((eq a 0) (setq a 1))
1 >      (t (setq a 0)))
1
```

First, 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:

```
>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 two-dimensional 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 refer 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

```
(object selector arg1 arg2 . . . argn)
```

For example, to create a new class, you enter the expression

```
>(Class 'new)
<Object: #159B>
```

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.

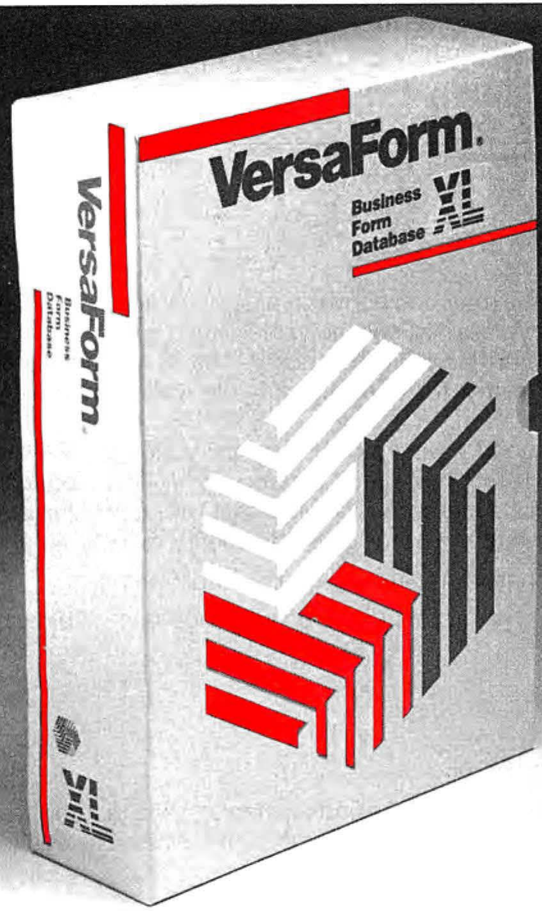
For the purpose of illustration, we will define a class of objects that represent simple dictionaries. Each instance of this class will be a dictionary capable of storing entries that consist of a name and a value. You will be able to create new dictionaries, add entries to an existing dictionary, and find previously stored entries. To create the dictionary class, type

```
>(setq Dictionary (Class 'new))
<Object: #194F>
```

This expression creates a new class and assigns the result to the symbol Dictionary.

To store information in a dictionary, you must provide each instance of the Dictionary class with an instance variable to refer to this information:

(continued)



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```
>(Dictionary 'ivars '(entries))
<Object: #194F>
```

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 you 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:

```
>(Dictionary 'answer 'isnew '()
1>            '((setq entries nil)
2>              self))
<Object: #194F>
```

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:

```
>(Dictionary 'answer 'add '(name value)
1>            '((setq entries
3>                (cons (cons name value) entries))
2>             value))
<Object: #194F>
```

Now it's time to create a dictionary and add some entries:

```
>(setq d (Dictionary 'new))
<Object: #166D>
>(d 'add 'mozart 'composer)
composer
>(d 'add 'winston 'computer-scientist)
computer-scientist
```

The first expression above creates a new instance of the Dictionary class. The second expression adds an entry for mozart with the value composer. The third expression adds an entry for winston with the value computer-scientist.

It's no 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.

```
>(Dictionary 'answer 'find '(name &aux entry)
1>            '((cond ((setq entry (assoc name entries))
4>                     (cdr entry))
3>                    (t
4>                      nil))))
<Object: #194F>
```

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:

```
>(d 'find 'mozart)
composer
>(d 'find 'winston)
computer-scientist
>(d 'find 'bozo)
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)

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 <fcn> <list1>. . .<listn>) APPLY FUNCTION TO SUCCESSIVE CARS
(maplist <fcn> <list1>. . .<listn>) APPLY FUNCTION TO SUCCESSIVE CDRS
(subst <to> <from> <expr>) SUBSTITUTE ONE EXPRESSION FOR ANOTHER
(sublis <alist> <expr>) SUBSTITUTE USING AN ASSOCIATION LIST

Destructive List Functions

(rplaca <list> <expr>) REPLACE THE CAR OF A LIST NODE
(rplacd <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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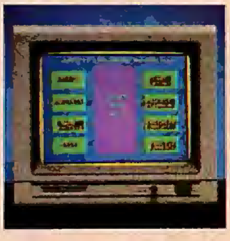

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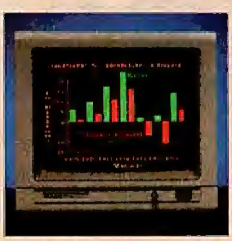

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XLISP TUTORIAL

(numberp <expr>) IS THIS A NUMBER?
(null <expr>) IS THIS AN EMPTY LIST?
(not <expr>) IS THIS FALSE?
(listp <expr>) IS THIS A LIST?
(consp <expr>) IS THIS A NON-EMPTY LIST?
(boundp <sym>) IS THIS A BOUND SYMBOL?
(eq <expr1> <expr2>) ARE THE EXPRESSIONS IDENTICAL?
(equal <expr1> <expr2>) ARE THE EXPRESSIONS EQUAL?

Control Functions

(cond <pair>...) EVALUATE CONDITIONALLY
(let (<binding>...) <expr>...) BIND SYMBOLS AND EVALUATE EXPRESSIONS
(and <expr>...) THE LOGICAL AND OF A LIST OF EXPRESSIONS
(or <expr>...) THE LOGICAL OR OF A LIST OF EXPRESSIONS
(if <texpr> <expr1> [<expr2>]) EXECUTE EXPRESSIONS CONDITIONALLY
(progn <expr>...) EXECUTE EXPRESSIONS SEQUENTIALLY
(while <texpr> <expr>...) ITERATE WHILE AN EXPRESSION IS TRUE
(repeat <iexpr> <expr>...) ITERATE USING A REPEAT COUNT

Arithmetic Functions

(+ <expr>...) ADD A LIST OF NUMBERS
(- <expr>...) SUBTRACT A LIST OF NUMBERS
(* <expr>...) MULTIPLY A LIST OF NUMBERS
(/ <expr>...) DIVIDE A LIST OF NUMBERS
(1+ <expr>) ADD ONE TO A NUMBER
(1- <expr>) SUBTRACT ONE FROM A NUMBER
(rem <expr>...) REMAINDER OF A LIST OF NUMBERS
(minus <expr>) NEGATE A NUMBER
(min <expr>...) THE SMALLEST OF A LIST OF NUMBERS
(max <expr>...) THE LARGEST OF A LIST OF NUMBERS
(abs <expr>) THE ABSOLUTE VALUE OF A NUMBER

Bitwise Logical Functions

(bit-and <expr>...) THE BITWISE AND OF A LIST OF NUMBERS
(bit-ior <expr>...) THE BITWISE INCLUSIVE OR OF A LIST OF NUMBERS
(bit-xor <expr>...) THE BITWISE EXCLUSIVE OR OF A LIST OF NUMBERS
(bit-not <expr>) THE BITWISE NOT OF A NUMBER

Relational Functions

(< <e1> <e2>) TEST FOR LESS THAN
(<= <e1> <e2>) TEST FOR LESS THAN OR EQUAL TO
(= <e1> <e2>) TEST FOR EQUAL TO
(/= <e1> <e2>) TEST FOR NOT EQUAL TO
(>= <e1> <e2>) TEST FOR GREATER THAN OR EQUAL TO
(> <e1> <e2>) TEST FOR GREATER THAN

String Functions

(strcat <expr>...) CONCATENATE STRINGS
(strlen <expr>) COMPUTE THE LENGTH OF A STRING
(substr <expr> <sexpr> [<lexpr>]) EXTRACT A SUBSTRING
(ascii <expr>) NUMERIC VALUE OF CHARACTER
(chr <expr>) CHARACTER EQUIVALENT OF ASCII VALUE
(atoi <expr>) CONVERT AN ASCII STRING TO AN INTEGER
(itoa <expr>) CONVERT AN INTEGER TO AN ASCII STRING

Input/Output Functions

(read [<source>[<eof>]]) READ AN XLISP EXPRESSION
(print <expr> [<sink>]) PRINT A LIST OF VALUES ON A NEW LINE
(prin1 <expr> [<sink>]) PRINT A LIST OF VALUES
(princ <expr> [<sink>]) PRINT A LIST OF VALUES WITHOUT QUOTING

(continued)

(terpri [<sink>]) TERMINATE THE CURRENT PRINT LINE
(flatsize <expr>) LENGTH OF PRINTED REPRESENTATION USING PRIN1
(flatc <expr>) LENGTH OF PRINTED REPRESENTATION USING PRINC
(explode <expr>) CHARACTERS IN PRINTED REPRESENTATION USING PRIN1
(explodec <expr>) CHARACTERS IN PRINTED REPRESENTATION USING PRINC
(maknam <list>) BUILD AN UNINTERNED SYMBOL FROM A LIST OF CHARACTERS
(implode <list>) BUILD AN INTERNED SYMBOL FROM A LIST OF CHARACTERS

File I/O Functions

(openi <fname>) OPEN AN INPUT FILE
(openo <fname>) OPEN AN OUTPUT FILE
(close <fp>) CLOSE A FILE
(read-char [<source>]) READ A CHARACTER FROM A FILE OR STREAM
(peek-char [<flag> [<source>]]) PEEK AT THE NEXT CHARACTER
(write-char <ch> [<sink>]) WRITE A CHARACTER TO A FILE OR STREAM
(readline [<source>]) READ A LINE FROM A FILE OR STREAM

System Functions

(load <fname>) LOAD AN XLISP SOURCE FILE
(gc) FORCE GARBAGE COLLECTION
(expand <num>) EXPAND MEMORY BY ADDING SEGMENTS
(alloc <num>) CHANGE NUMBER OF NODES TO ALLOCATE IN EACH SEGMENT
(mem) SHOW MEMORY ALLOCATION STATISTICS
(type <expr>) RETURNS THE TYPE OF THE EXPRESSION
(exit) EXIT XLISP

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 1 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 implemented. 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. ■

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6. Xerox Learning Research Group. "The Smalltalk-80 System," BYTE, August 1981, page 36.

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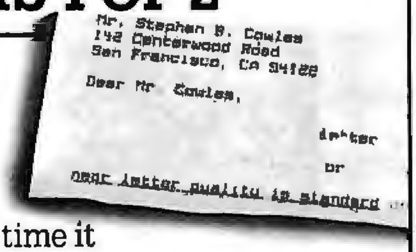

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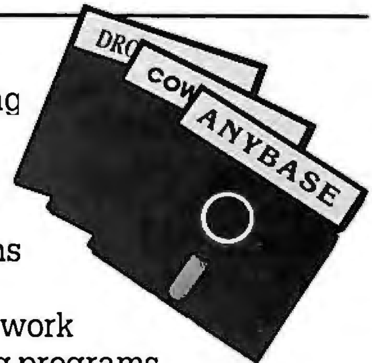

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To use SURF, you just enter the equation of the surface that you want to plot. If there are any singularities in the plot, you also enter them. In most cases, you can then let the package automatically set the parameters necessary to draw the plot 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 1: *The* SURF *main menu. In this photo, the "f" option (enter function) has been selected and the formula used in photo 2 entered.*

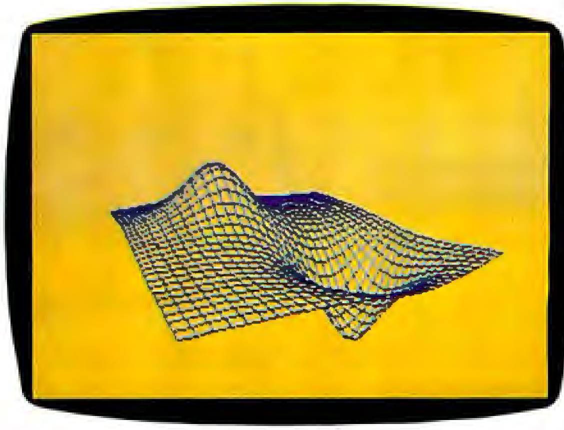


Photo 4: Z = 1 / ((x + 1) * (x + 1) + (y + 1) * (y + 1) + 1) − (1.5) / ((x − 1) * (x − 1) + (y − 1) * z)y − 1) + 1). *The viewpoint has been changed from the default* 10000,0,0 *to* 800,0,0 *and the figure was rotated* 30 *degrees around the z-axis and* −30 *degrees around the y-axis.*

Photo 7: Z = cos(x + y) * cos(3 * x − y) + cos(x − y) * sin (x + 3 * y) + 5 * exp((−x * x − y * y) / 8). *The clipped peak in the back of the plot illustrates the kind of problem that can arise from auto-graphing complex functions. You can eliminate this by adjusting the scaling factors after viewing the plot.*

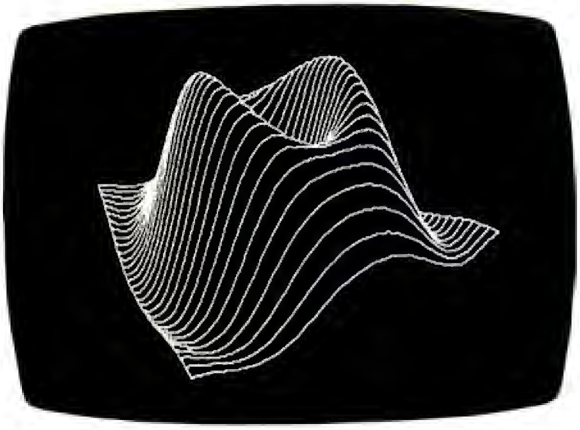


Photo 2: *The plot generated by* sin (x * x + 2 * y * y) * exp(−x * x − y * y) *after rotating −5 degrees around the y-axis and changing the x and y scales. The colors are the default high-resolution colors.*

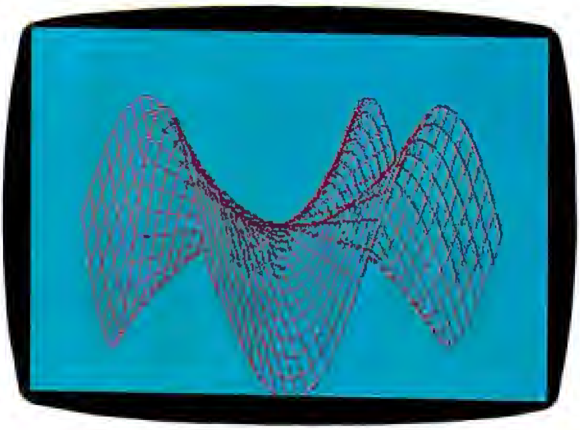


Photo 3: *The plot of* z = x * y * (x * x − y * y) / (x * x + y * y). *The border has been eliminated and cross-hatching added in this plot. Using red on blue instead of the default colors requires only the use of the estimate-scales selection instead of the auto-graph routine.*

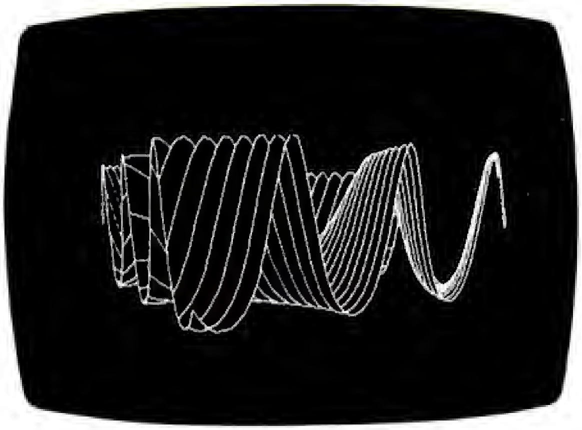


Photo 5: Z = exp (sin(x * y)). *plotted with the default settings.*

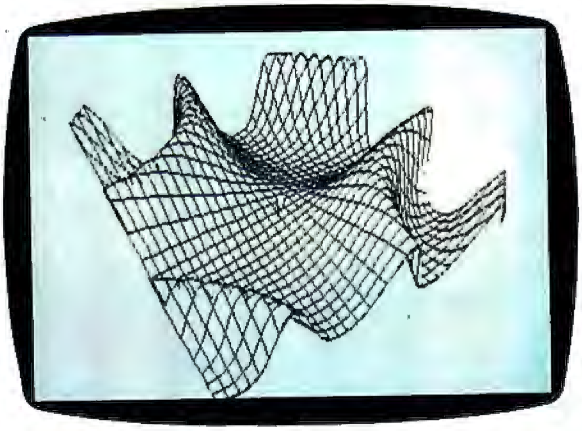


Photo 6: *A plot of the same figure as photo 5 after a 45-degree rotation around the y-axis.*

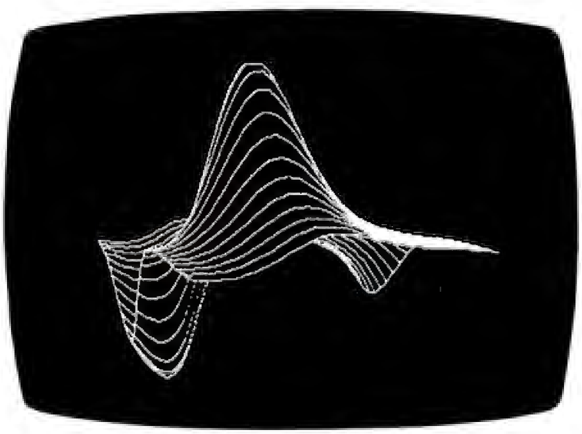


Photo 8: Z = (sin(x) + cos(y)) / (exp(sin(y) − cos(x))).

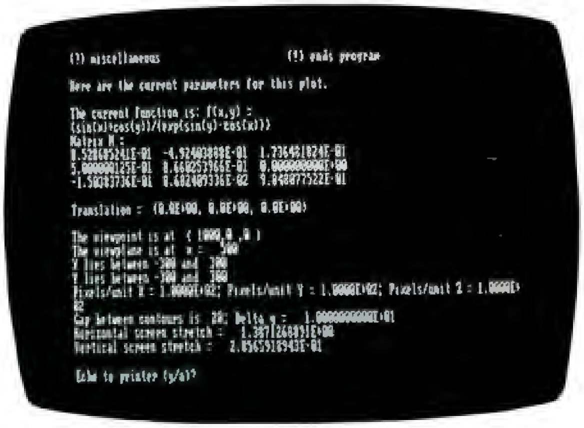
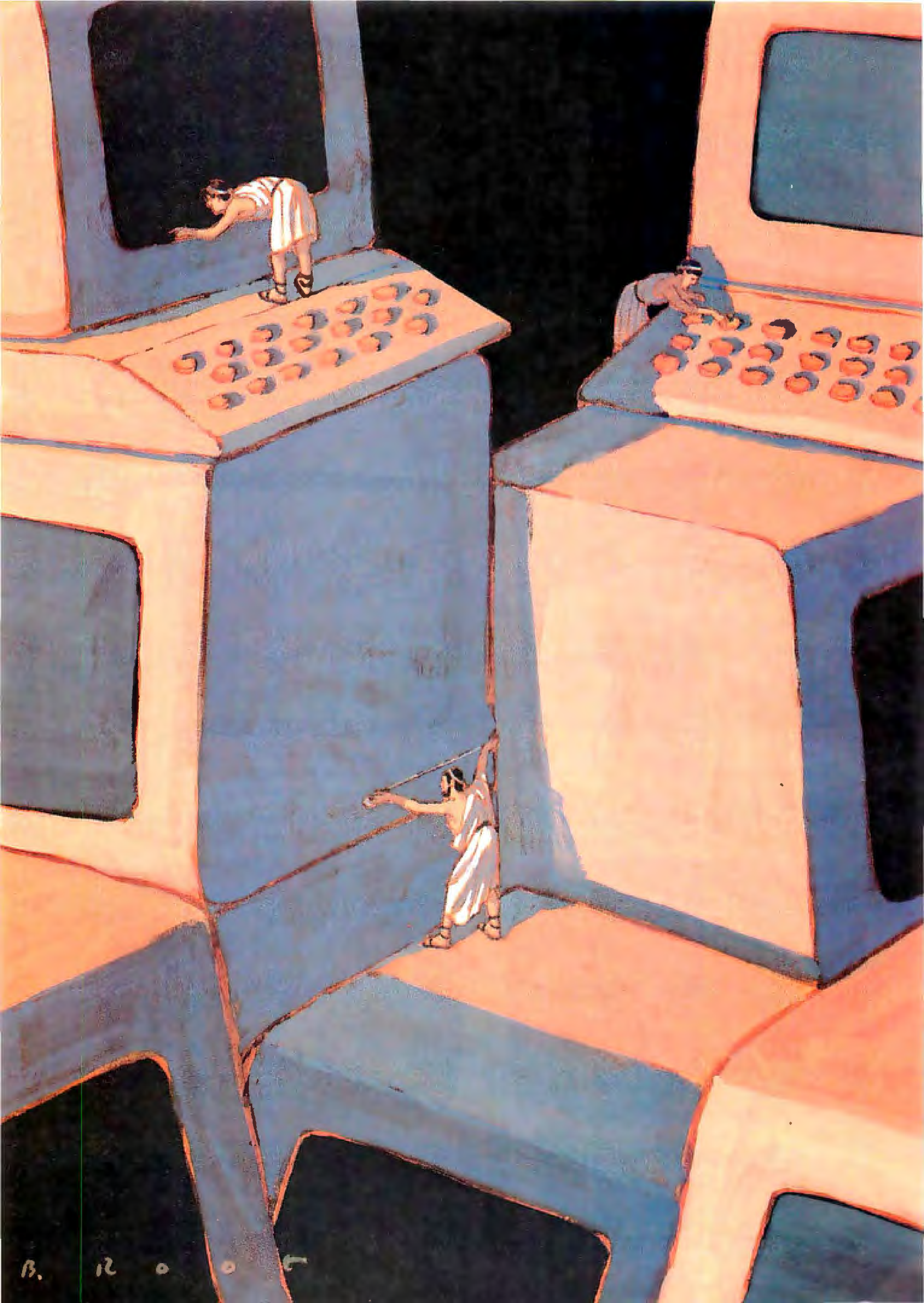


Photo 9: *The print parameters screen for photo 8. All values were generated by the program. This information is useful in fine-tuning a plot.*


B. ROOT

Reviews

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 nonkeyboard 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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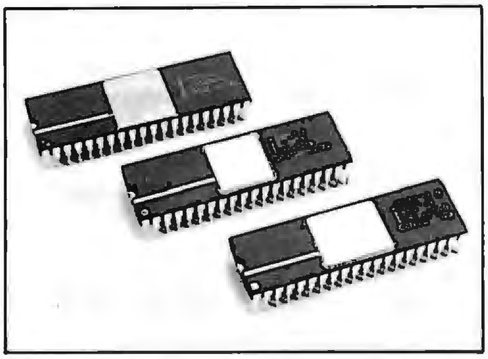

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R·E·V·I·E·W·E·R'S N·O·T·E·B·O·O·K

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.

TT&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.

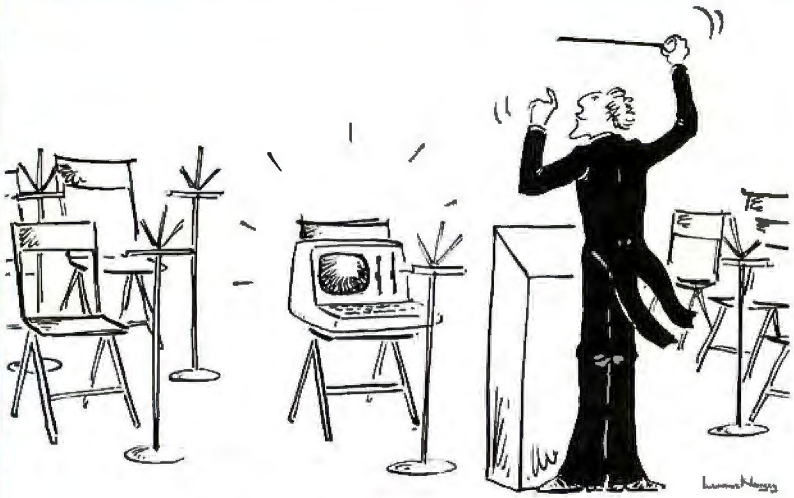
As for documentation, TT&T includes a copy of *Ada for Programmers* by Eric W. Olsen and Stephen B. Whitehill (Reston, VA: Reston Publishing Co., 1983) with the compiler. Unfortunately, nowhere is there a list of which Ada features NH-Ada does not include. For something that costs over $200, we expected its utility to be higher.

True, this is a first effort. TT&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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The Altos 586 with the XENIX Development System

Despite some bugs, it's a good product

BY GREG CORSON

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)

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.

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 disk 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 multiuser 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)

AT A GLANCE

Name
Altos 586

Manufacturer
Altos Computer Systems
2641 Orchard Park Way
San Jose, CA 95134
(408) 946-6700

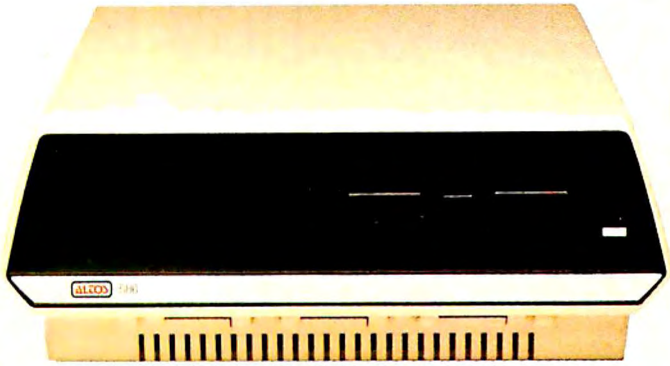
Components
Size: 17 by 18 by 6 inches
Processors: 10-MHz 8086 main processor, 8089 intelligent disk controller, Z80 serial-port controller
Memory: 512K bytes (1 megabyte on 986)
Mass storage: 737K 5¼-inch floppy-disk drive (formatted), 20- or 40-megabyte hard-disk drive (unformatted) (see text)
I/O interfaces: 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

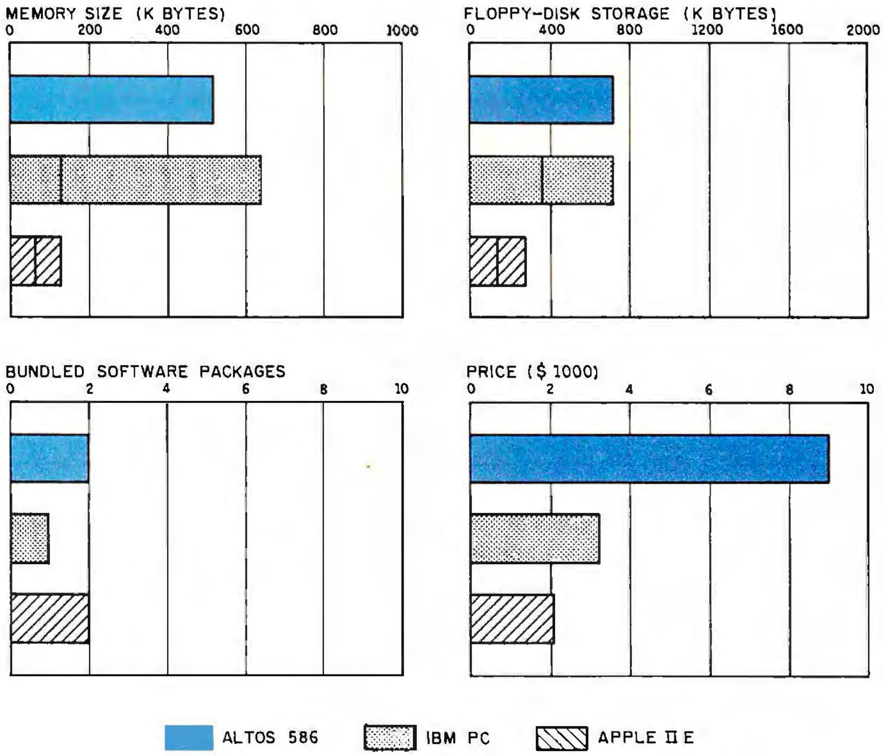
Software
Microsoft XENIX run-time system, Altos Diagnostic Executive; XENIX Development System ($1000) optional

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

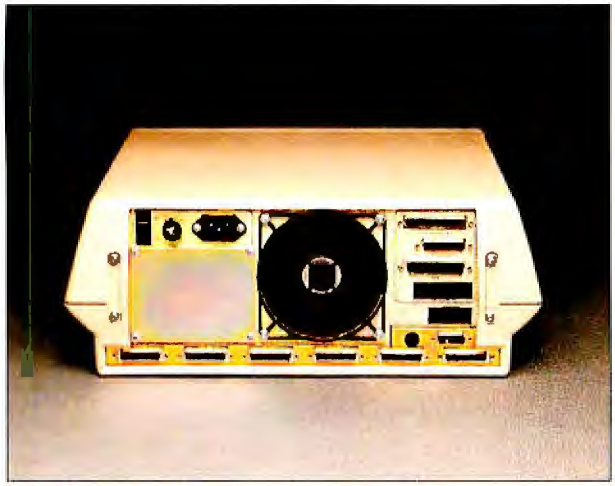


The Altos 586 system unit, showing a single floppy-disk drive.

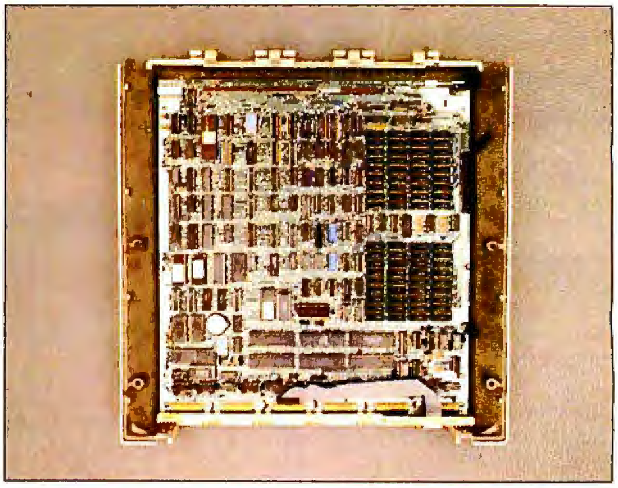


The Memory Size graph shows the standard and optional memory that is available for the computers under comparison. The graph of Disk Storage shows the highest capacity of each system's floppy disks. The Bundled Software Packages graph shows the number of software packages included with each system.

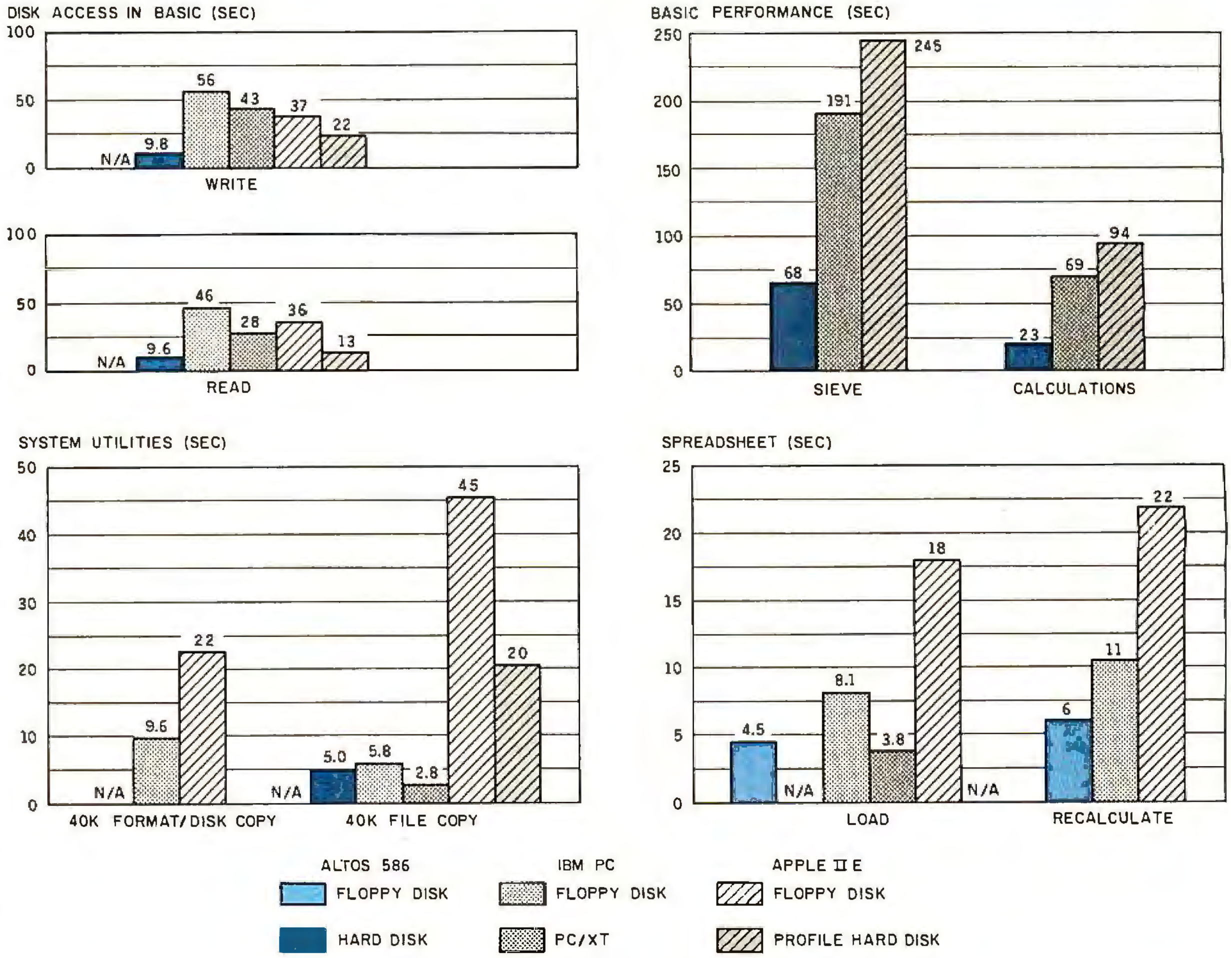
The Price graph shows the list price of a system with a monochrome monitor, a printer port and a serial port, and the standard operating system for each system; the Altos 586 has one hard-disk drive and one floppy-disk drive, while the IBM and Apple offerings have two floppy-disk drives.



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 detects 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 appendixes 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 question 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. ■

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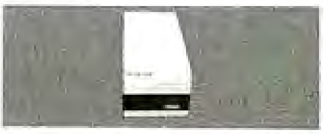

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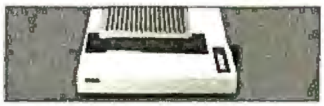

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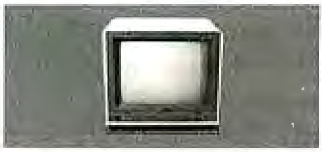

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The computer press is hailing Modula-2 as "the next standard in programming languages." Modula-2 combines the strengths of Pascal with the features that made C so popular, like independent compilation and direct hardware control.

But until today, no company offered a Modula-2 system that made the development of software fast, easy and efficient. Now, though, there's a new tool at your disposal.

The fast, powerful tool for programmers

The breakthrough is here: Interface Technologies' new Modula-2 Software Development System for the IBM® PC, XT, AT and compatible computers to give programmers the same quantum leap in productivity spreadsheets and word processors gave to end-users. It can reduce monotonous wait time, will dramatically increase speed, help stop thoughtless mistakes, and free you to become more creative in virtually all of your programming efforts.

How to speed input and eliminate 30% of errors

Thirty percent of programming mistakes are syntax errors and simple typos in the program structure. Our "syntax-directed" Modula-2 editor does away with these time-consuming headaches once and for all.

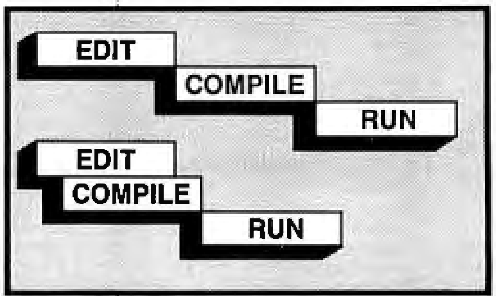
Enter complete statements with one keystroke.

It speeds input by cutting manual typing as much as 90%, letting you enter statements with a single keystroke. For example, if you type a capital "I" to begin a line, the editor completes the logical "IF THEN" statement automatically, so you can concentrate on what you want to program, rather than concentrate on what you're typing.

The editor locks out errors, finishing statements and procedures in perfect accord with the standardized rules of Modula-2. It also indents and formats your text automatically, making programs easy to read and maintain, an important feature on big projects.

And if you leave an undefined variable or data type, the editor detects the mistake and gives you the option of on-line "help" to correct it. No other programming text editor offers you so much innovation at any price.

How to turn "wait time" into "work time"



It not only has a faster compiler, it also saves time by compiling while you edit.

The vast majority of programming time is spent waiting, and the biggest slowdown is most often with compilers.

THE ANATOMY OF A

Our compiler turns wait time to work time with a new innovation that lets you compile in the "background."

With background compilation, your program is automatically compiled into object code line by line as you work, every minute you spend writing or editing a Modula-2 program!

When you're finished editing, all that's left for the compiler is a quick mopping up job that generates optimized native code in a single pass.

How quick is "quick"?

Thanks to background compilation and the fact that the compiler itself is so fast, Interface Technologies' compiler turns 100 lines of typical Modula-2 text into optimized machine code in *under five seconds*.

Plus the Interface compiler produces compact code with execution speed superior to that produced by any other Modula-2 compiler on the market.

How to do two things at once

Along with the background compiler and syntax-directed editor, which can save you hours every day and make you more productive, Interface Technologies' Software Development System gives your monitor

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 5¼-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.

Dominating the front panel are two Teac double-sided double-density half-height disk drives. The optional 10-megabyte half-height hard-disk drive would take the place of one of the floppy-disk drives. In the bottom-left corner, tucked away to prevent accidental pokes and prods, is the button used to reboot the system.

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

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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)

Photo 1: *The* NEC APC III *microcomputer.*

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 [2J, 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).

Photo 2: *Screen display in the 80 by 25 text mode.*

Photo 3: *Screen display in the 640 by 400 color-graphics mode.*

Integral Peripherals

The two floppy-disk drives have a nominal storage capacity of 360K bytes each. Disks formatted by MS-DOS 2.11 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 com-

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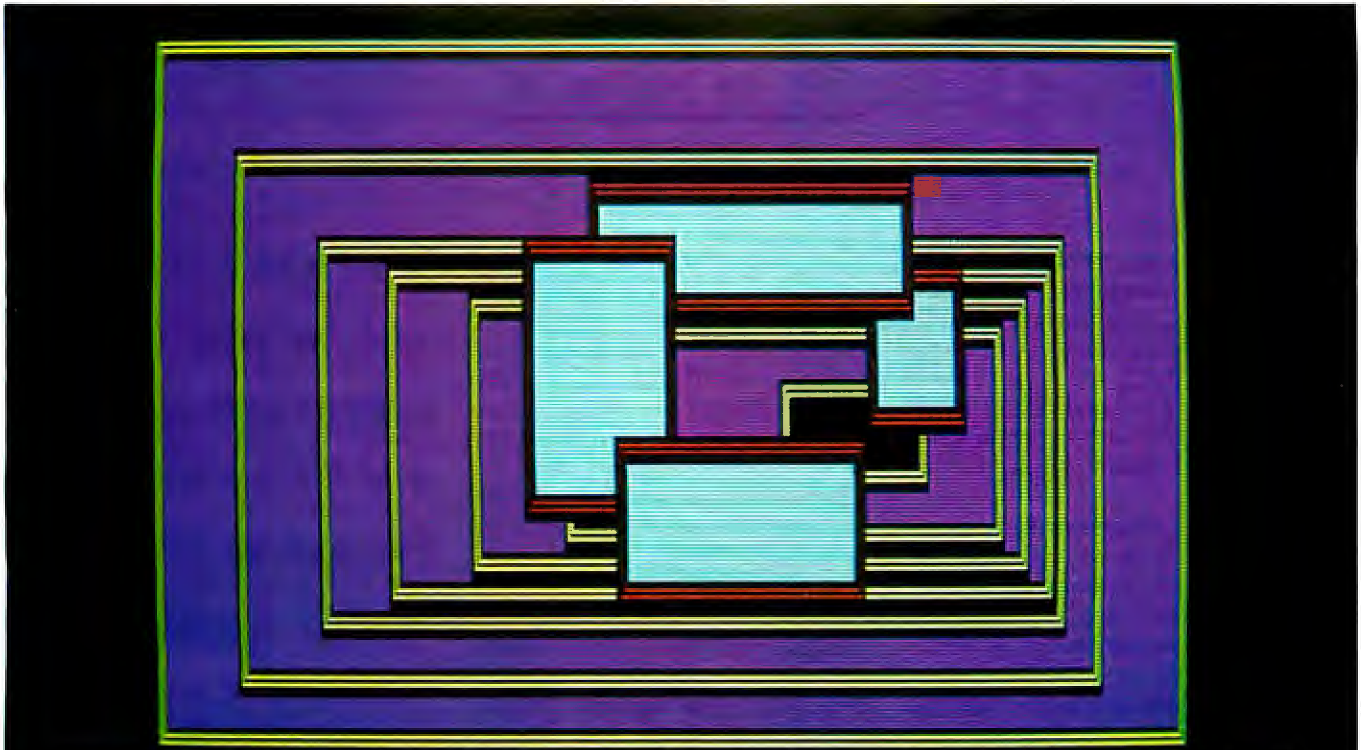


WHEN YOU BUILD A HOUSE . . . YOU DON'T NEED TO MAKE THE WINDOWS YOURSELF. NOW . . . THE SAME IS TRUE WHEN YOU'RE WRITING CODE.

puter 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.

PORTS

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 coprocessor 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.

Photo 4: *The* APC III *keyboard. Note the* 12 *unlabeled programmable function keys and the template for recording the functions.*

MS-DOS 2.11 *supplied with the* APC III *appears well integrated with the* 8-MHz 8086; *I've seen no evidence of the* OS *degrading the hardware performance.*

SOFTWARE

MS-DOS 2.11 supplied with the APC III appears to be 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 RAMDISK 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

(continued)

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 1). The speed of the processor and disk I/O is 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.

Table 1: *Word-processing benchmarks with WordStar (times in seconds). Tests for the* NEC APC III *used two* 360K*-byte disk drives and* 384K *bytes of memory. The* IBM PC *had two* 360K*-byte disk drives and* 512K *bytes of memory. The* Apple II *used the* Microsoft Z80 Softcard*. All three systems had a monochrome display. The loading and saving tests measure the time required to load and save the standard* 4000*-word document. Search measures the time required to find the last word in the standard document. Scroll measures the time required to scroll manually through the document.*

Test	APC III	IBM PC	Apple II
Document load	10.3	9.9	10.3
Document save	23.0	24.2	32.3
Search	9.1	10.5	6.6
Scroll	29.0	41.2	46.4

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

(continued)

AT A GLANCE

Name
NEC APC III

Manufacturer
NEC Information Systems Inc.
1414 Massachusetts Ave.
Boxborough, MA 01719
(617) 264-8000

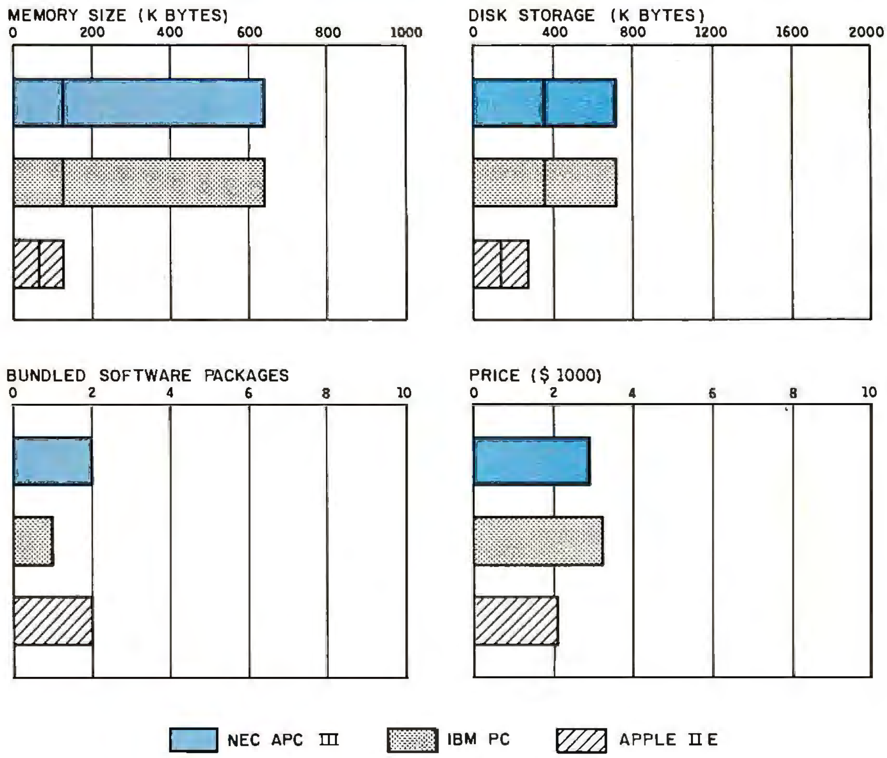
Components
Processor: 16-bit 8-MHz 8086-Z
Memory: 128K dynamic RAM (standard) expandable in 128K increments to 640K; 32K ROM (bootstrap and self-test); 1K CMOS RAM with battery backup (for system use); 8K text video RAM; 64K graphics video RAM (standard); 192K with color graphics (optional)
Mass storage: one (standard) or two 360K double-sided double-density 5¼-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 GW-BASIC

Expansion Capability
Four card slots (NEC bus) accessible from outside; one internal slot for optional color-graphics card

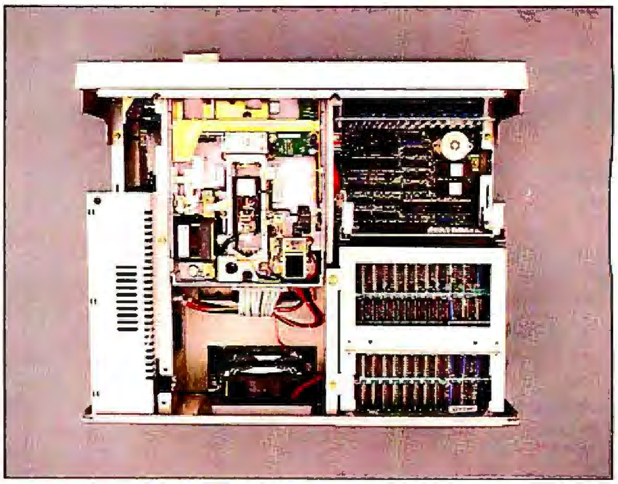
Documentation
MS-DOS user's guide, MS-DOS programmer's reference manual, MS-DOS macro assembler manual, GW-BASIC manual

Price
APC-H101M (single 360K drive, monochrome monitor) $1995
APC-H101C (single drive, color monitor) $2495

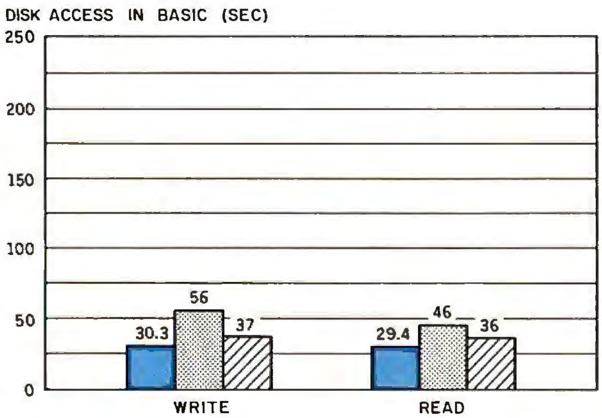


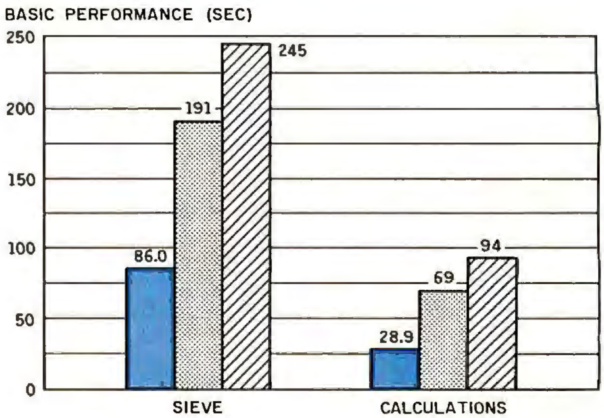
The Memory Size graph shows the standard and optional memory available for the computers under comparison. The Disk Storage graph shows the highest capacity of a single floppy-disk drive for each system. The Bundled Software Packages graph shows the number of software packages included with each system. 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.

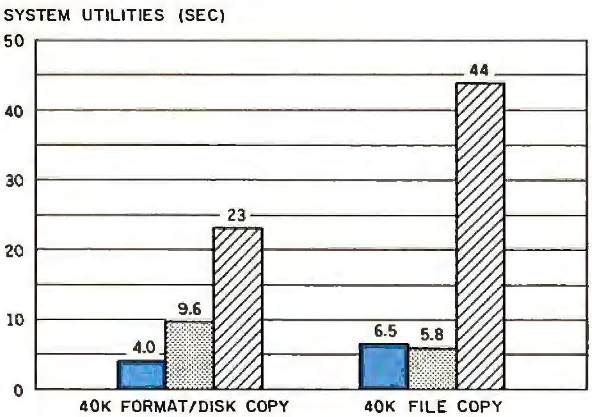
The rear panel of the APC III. Note that the four card slots are accessible from the outside.

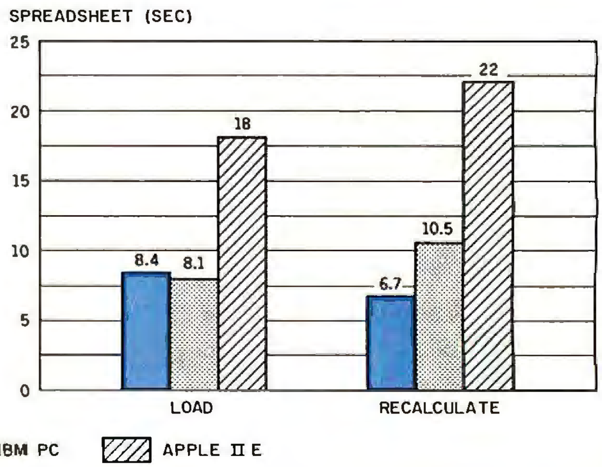


The top view of the main system unit.









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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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 reshuffles 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 manager, 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 Boxborough, Massachusetts, has provided good support by answering all my questions about the computer, but it appears the company prefers that users 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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S·Y·S·T·E·M R·E·V·I·E·W

Atari 800XL

A new look for an old friend

BY JON EDWARDS

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 8½ 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 pseudoreset 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)

Jon Edwards is a technical editor for BYTE. He can be contacted at POB 372, Hancock, NH 03449.

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.

Table 1: *Summary of text and graphics modes directly available in* Atari BASIC *(reproduced from* Atari BASIC Reference Guide, *page* 9).

Screen Format

Graphics Mode	Mode Type	Columns	Rows— Split Screen	Rows— Full Screen	Number of Colors	RAM Required (bytes) Split	Full
0	Text	40	—	24	1.5		992
1	Text	20	20	24	5	674	672
2	Text	20	10	12	5	424	420
3	Graphics	40	20	24	4	434	432
4	Graphics	80	40	48	2	694	696
5	Graphics	80	40	48	4	1174	1176
6	Graphics	160	80	96	2	2174	2184
7	Graphics	160	80	96	4	4190	4200
8	Graphics	320	160	192	5	8112	8138
9	Graphics	80	—	192	1.5		8138
10	Graphics	80	—	192	9		8138
11	Graphics	80	—	192	16		8138
12	Graphics	40	20	24	5	1154	1152
13	Graphics	40	10	12	5	664	660
14	Graphics	160	160	192	2	4270	4296
15	Graphics	160	160	192	4	8112	8138

Photo 1: *Screen display from* Electronic Arts' Murder on the Zinderneuf. *The Atari* 800XL *allows customized graphics displays and character sets.*

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

(continued)

AT A GLANCE

Name
Atari 800XL

Manufacturer
Atari Corp.
1312 Crossman Ave.
POB 61657
Sunnyvale, CA 94086
(408) 745-2109

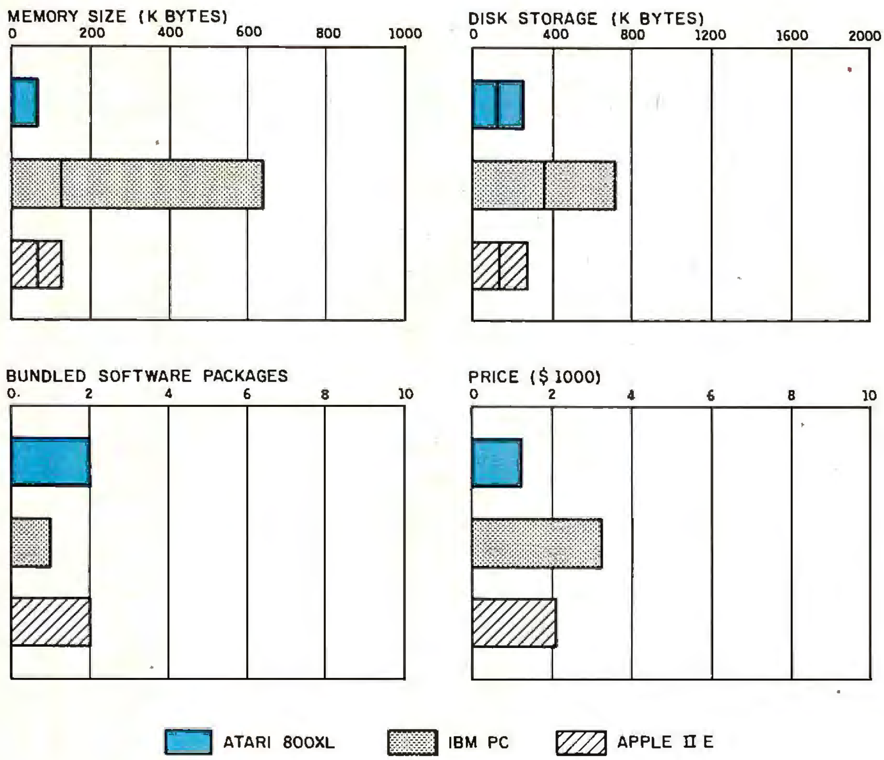
Components
Memory:
64K bytes bank-selected
Processor:
Modified 6502C, 1.79 MHz
Special integrated circuits:
GTIA (graphics display), POKEY (sound generator and controller ports), and Antic (screen control)
Keyboard:
Full-stroke design; 62 keys, including Start, Option, Select, and Help keys; international 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, 3½-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

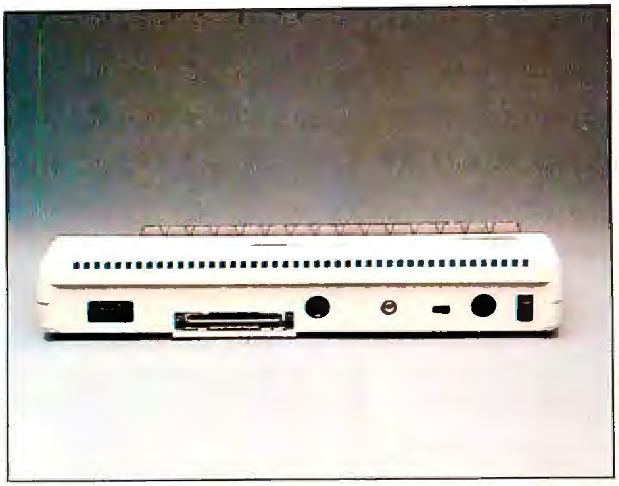
Options
Wide variety of peripherals, including disk drives, interfaces with parallel and serial ports, printers, graphics pads, light pens, joysticks. CP/M and MS-DOS capability with the ATR8000.

Documentation
Short BASIC and owners guides

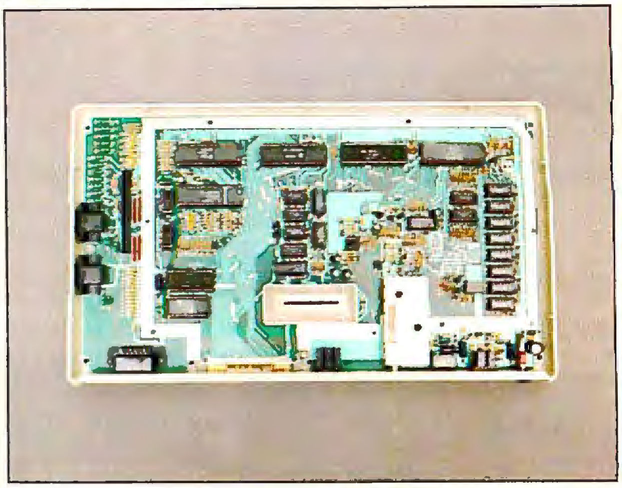
Price
64K bytes, two disk drives, monitor, parallel and serial ports $1240



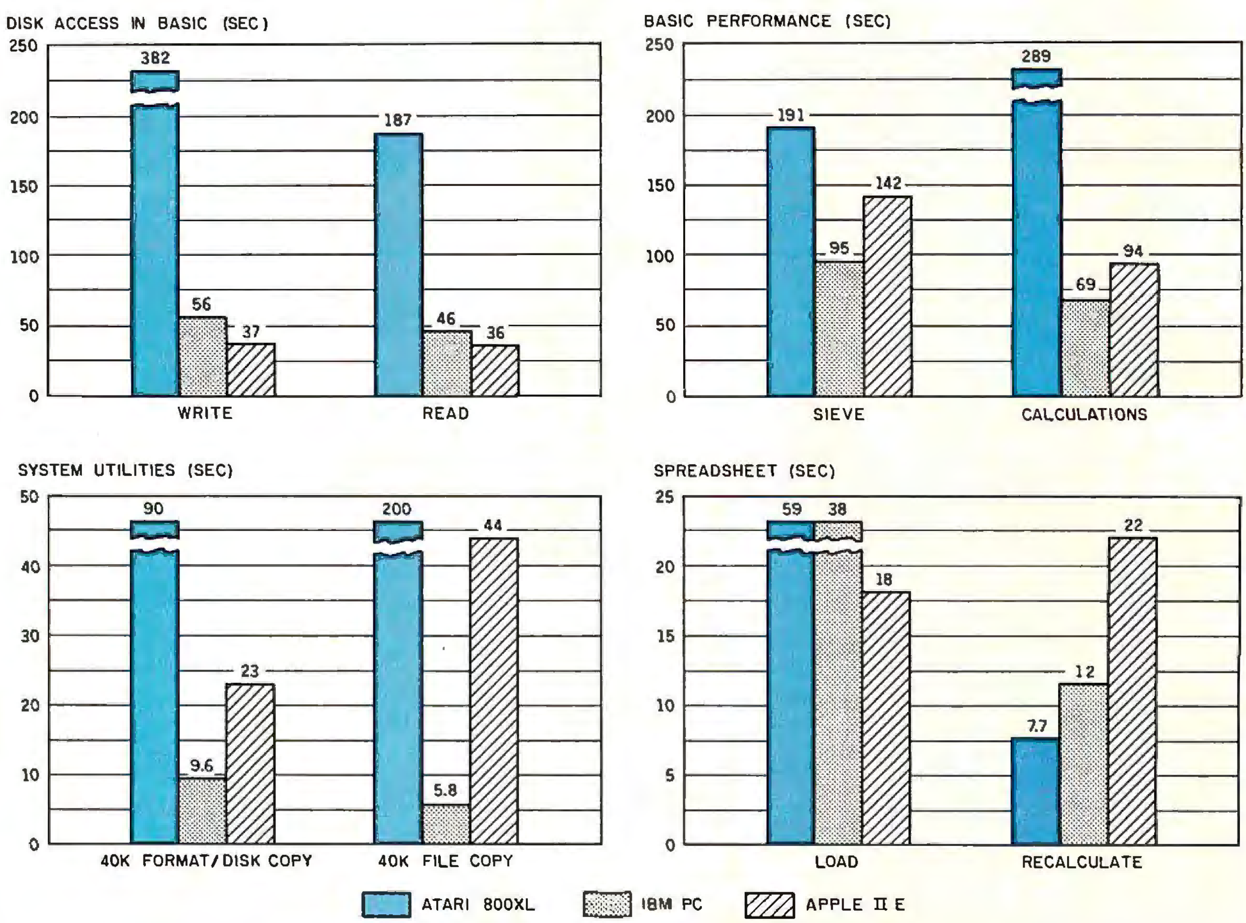
The Memory Size graph shows the standard and optional memory for the computers under comparison. The Disk Storage graph shows the capacity of one and two floppy-disk drives for each system. The Bundled Software Packages graph shows the software packages included with each system. The Price graph shows 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 booted, 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 LEFT$, MID$, and RIGHT$, 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 Using 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 . . . ENDWHILE; 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. LVAR 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, one contains 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+, BASIC XL, 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 AT-D2, the Rana 1000, the Indus GT, Astra Systems' drives, or an

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, two more than 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 lacked 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 C's. You can define both constants and expressions. Data types include bytes (characters) and signed and unsigned integers. You can use these in single-dimensioned 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.

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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.

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. ■

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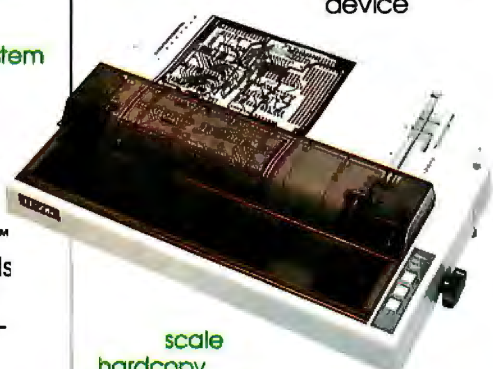
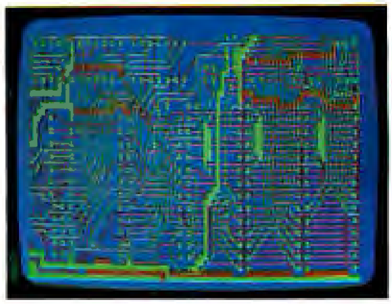


scale
hardcopy
artwork is produced using the Epson dot-matrix printers or the Houston Instrument DMP-41 pen-and-ink plotter. Quick 1X check plot is also available from Epson printers.



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- ☐ IBM Color/Graphics Adapter with RGB color or b&w monitor
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- ☐ Houston Instrument DMP-41 pen-and-ink plotter (optional)
- ☐ Microsoft Mouse (optional)

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Dazzle Draw

Paint with 16 colors on an Apple IIc or 128K IIe

BY GREGG WILLIAMS

Brøderbund 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 unexcelled 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 JX-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.

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

you to draw in simultaneous "mirrors" (horizontal, vertical, or both axes) and to insert text into your drawings. You can save patterns, whole or partial drawings, and create "slide shows" of multiple drawings.

I could find only a couple of faults with Dazzle Draw. The first fault is an-

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.*

noying: the program forces you to use drive 1 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 onscreen 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.

saving of pictures to disk.

Dazzle Draw is limited to two fonts (each font can be either italicized or bold and comes in two sizes). More fonts could have been accommodated if Snider had loaded fonts in as needed from the disk. Part of the reason for the small number of fonts, however, may be related to the odd pixel size of double hi-res graphics. A color pixel is brick-shaped and divided horizontally into four tall, narrow monochrome pixels. Given the pixel shape, it is difficult to make characters smaller than Dazzle Draw's smallest font (18 point) that still look presentable.

CONCLUSION

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. ■

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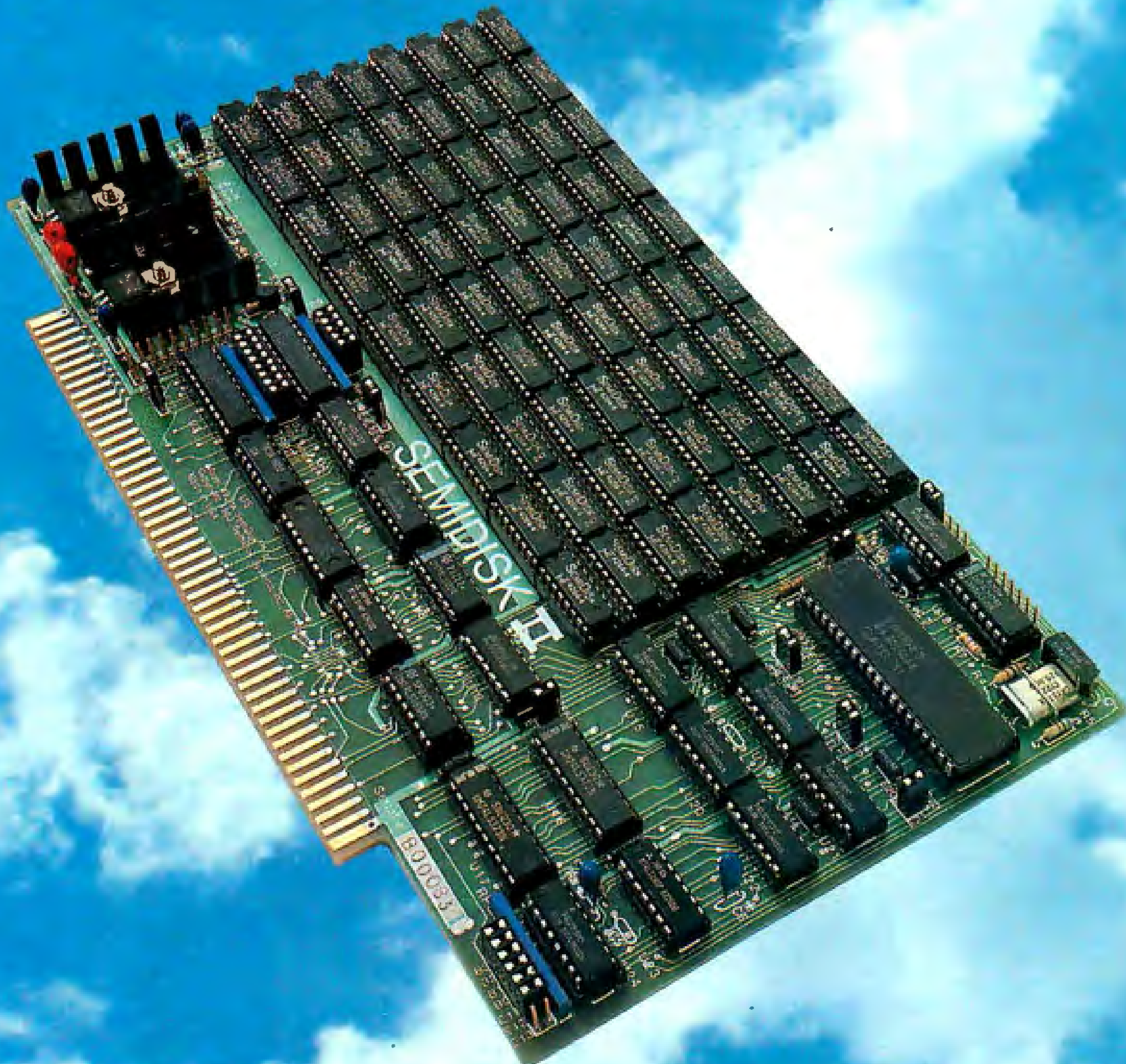

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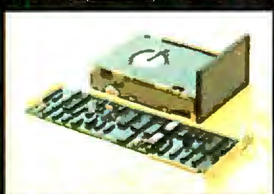
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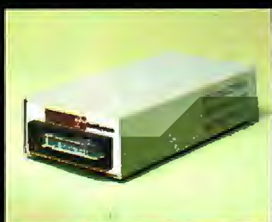
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H·A·R·D·W·A·R·E R·E·V·I·E·W

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 IIe 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)

Donald R. Osgood (2404 Peach Ln., Pasadena, TX 77502) is a retired data-systems engineer who formerly worked for the National Aeronautics and Space Administration. He now works in the Biomedical Engineering Department of the Bayshore Medical Center in Pasadena, Texas. He uses an Apple II, an Apple III, and an IBM Personal Computer.

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.*

stallation 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)

Photo 2: *The Micro Illustrator software is provided with the KoalaPad to permit easy preparation of drawings and figures.*

Photo 3: *Using Fill, you can color in shapes drawn with the Lines mode. Box, Circle, and Disc also are available modes.*

Table 1: *The KoalaPad's operating modes and options.*

MODE	DESCRIPTION
Point	A cursor or brush marks a single location each time the button is pressed.
Line	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.
Lines	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.
Rays	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.
Frame	In the Frame mode the locations of two opposite corners are specified and the program draws a rectangle through those points.
Box	A frame filled with a specified color is produced.
Circle	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.
Disc	Provides a color-filled circle.
Fill	The closed area on the screen in which the cursor is positioned is filled with the active color.
Erase	A color specification is requested then used to fill the entire screen.
Magnify	Enlarges the area around the cursor by a factor of seven. This function permits work on the fine details of a shape.
Normal	Returns to normal from the Magnify mode.
Help	Calls up a set of detailed instructions about the other modes.
Storage	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.

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. ■

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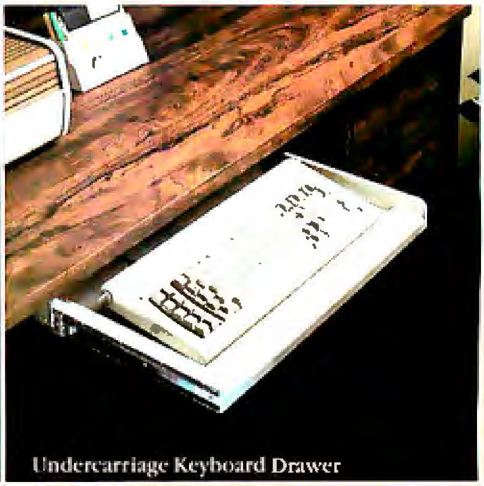

Undercarriage Keyboard Drawer

SOFTWARE REVIEW

FriendlyWriter and FriendlySpeller

A useful but limited word processor

BY STEVEN D. RYALS

If high-powered, expensive word-processing programs are more than you need, FriendlyWriter for the IBM PC 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 users 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, with the text to be moved or deleted flashing on the screen. 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)

Steven D. Ryals is president of Ryals and Associates Inc. (629 Oakland Ave., Oakland, CA 94611), a microcomputer consulting firm for small businesses.

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

(continued)

Photo 1: *Main menu for FriendlyWriter.*

Photo 2: *Write-new-letter screen. You enter the major commands with the special function keys listed in the top two lines. The cursor position and the amount of memory available for a document appear in the third line.*

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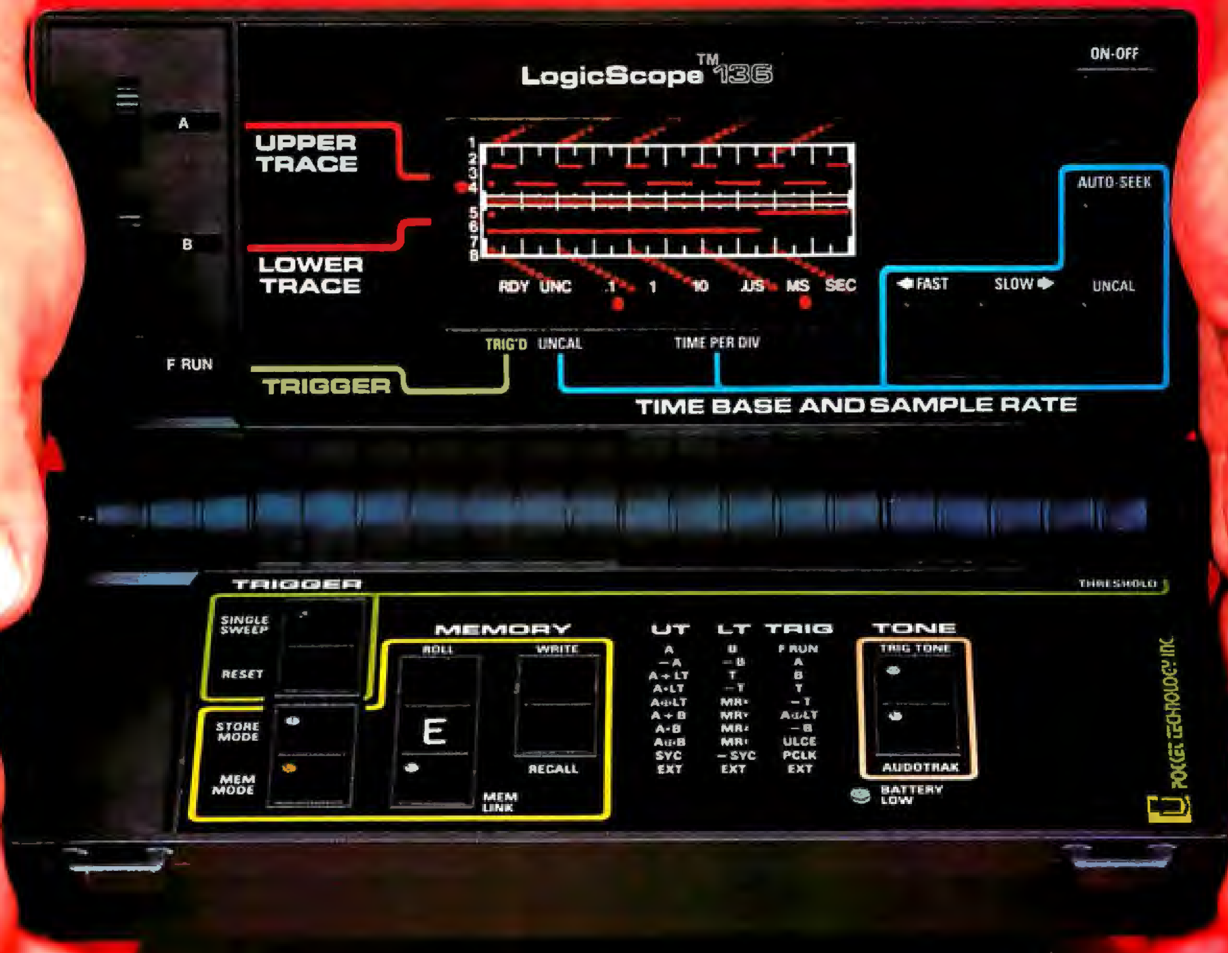

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AT A GLANCE

Name
FriendlyWriter with FriendlySpeller

Type
In-memory word processor/spelling checker

Manufacturer
FriendlySoft Inc.
3638 West Pioneer Parkway
Arlington, TX 76013
(817) 277-9378

Computer
IBM PC, XT, and compatibles

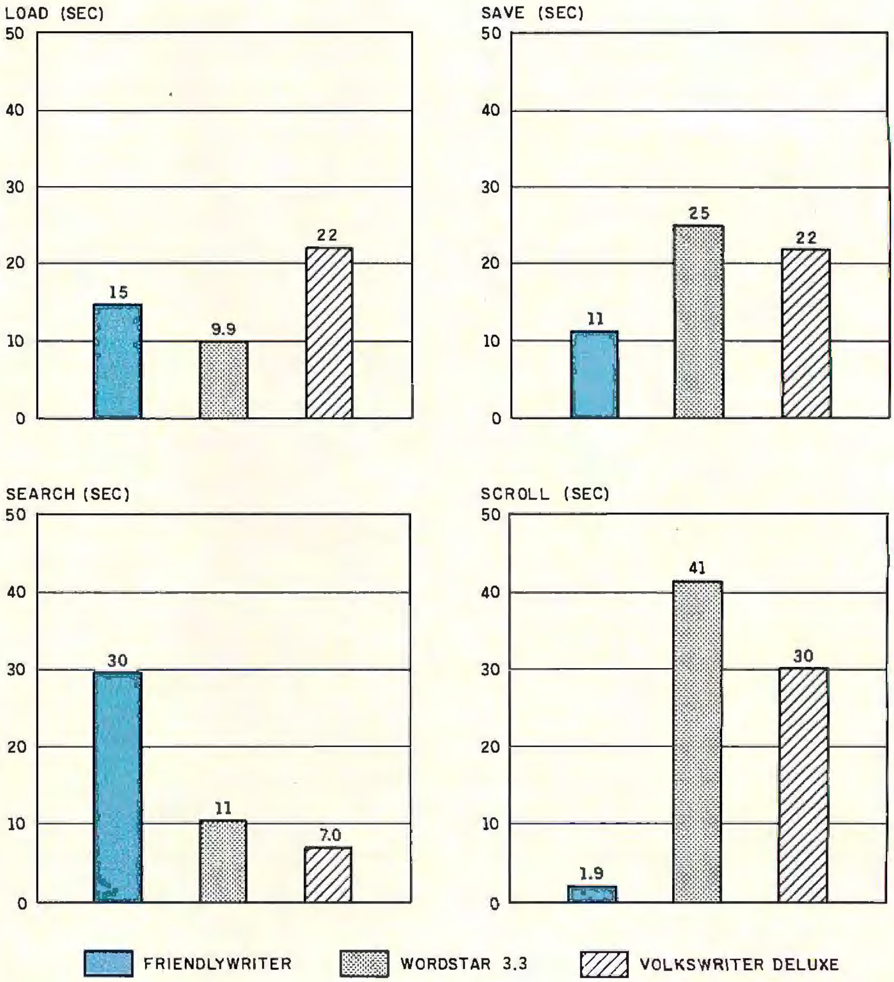
Disk Format
Two 5¼-inch single-sided floppy disks

Language
Assembly language

Documentation
IBM PC-style, 100-page, indexed manual

Price
\$89.95

Audience
Anyone needing an inexpensive, RAM-based word processor



A comparison of FriendlyWriter with WordStar 3.3 and Volkswriter Deluxe. The graphs show the results of performing various standard word-processing functions using a 4000-word text file. The Load graph shows the time required to load the file from disk to memory. The Save graph shows the time required to save the file on disk. The Search graph shows the timing results for a search starting at the beginning of a file and looking for its last word. The Scroll graph illustrates the time required to scroll manually from the file's first line to its last line.

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-

(continued)

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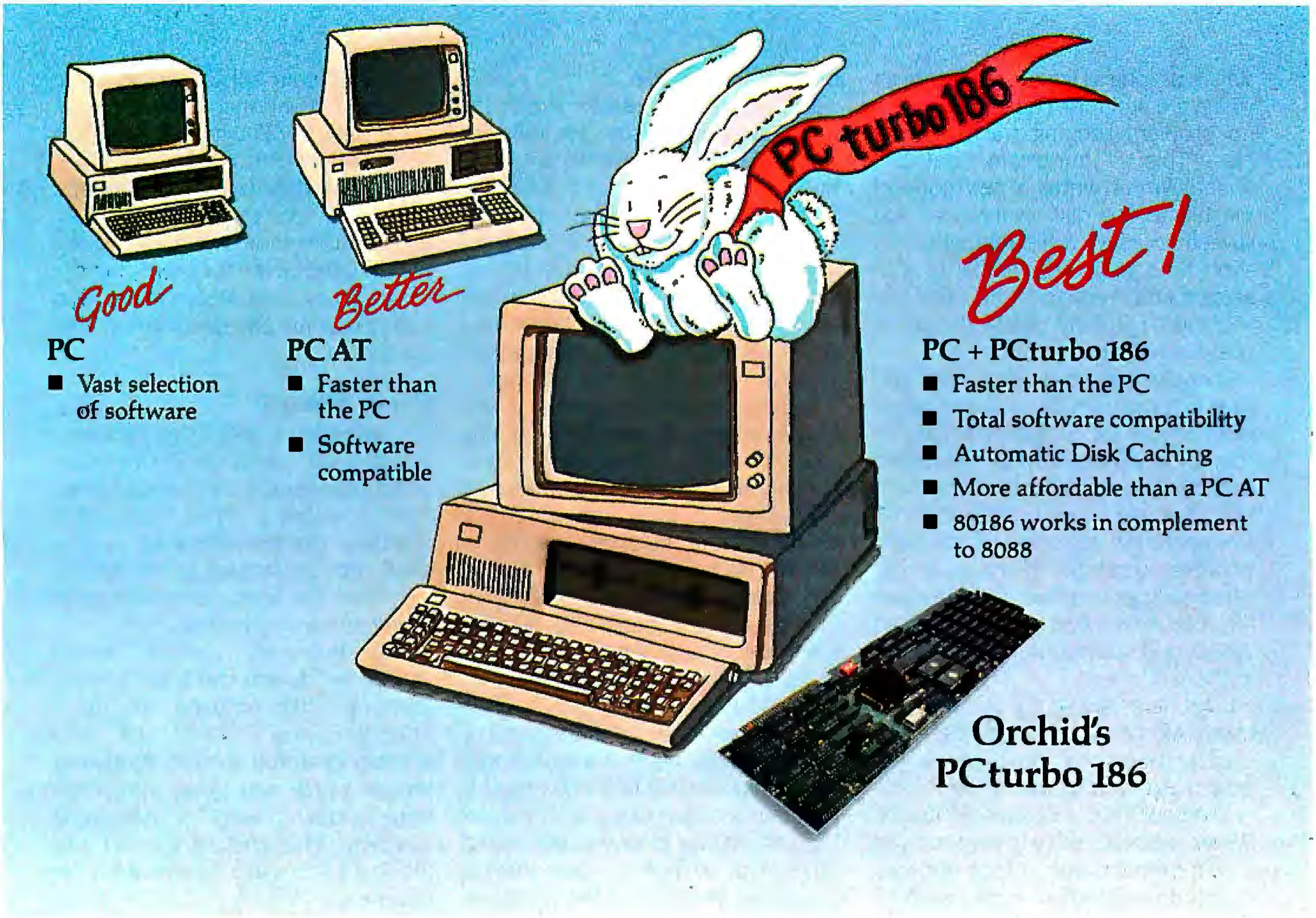

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Inquiry 265

stance, 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.

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.*

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. ■

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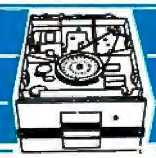

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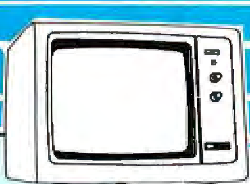

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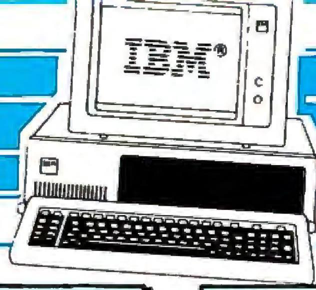

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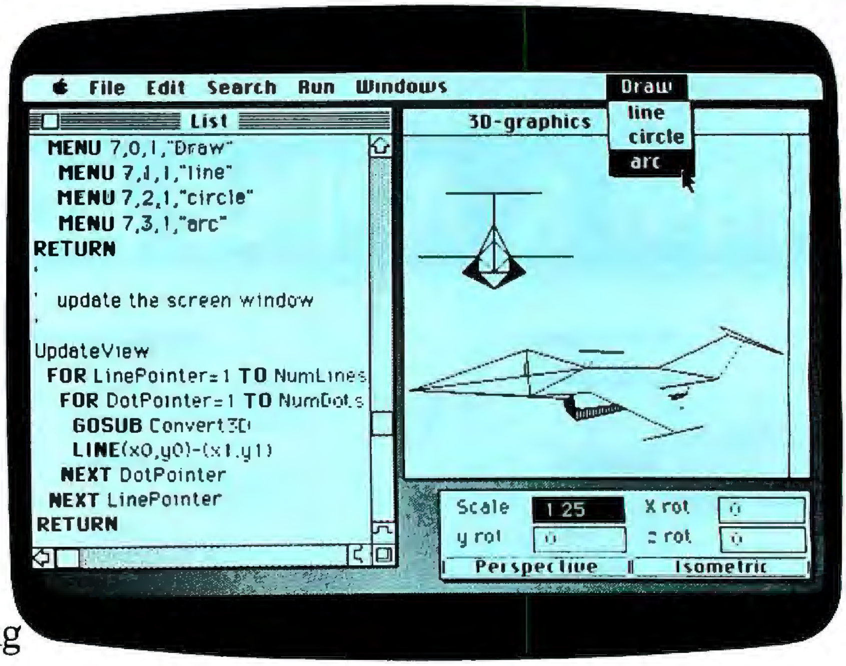

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Tecmar's jrCaptain

Expand the memory on your IBM PCjr

BY GLENN HARTWIG

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-

(continued)

Glenn Hartwig is a technical editor at BYTE. *Contact him at* POB 372, *Hancock,* NH 03449.

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

ly expanded your PCjr's memory.

You need to configure the jrCaptain right away. The manual gives you step-by-step instructions, and the whole procedure is easy to accomplish. The jrCaptain also comes with a feature called Memdisk. With Memdisk you can configure part of the RAM as a second disk and eliminate the PCjr's annoyingly slow and noisy disk drive.

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:–BUFnum 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 jrCaptain 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 jrCaptain. By all accounts, Tecmar's products are sound. The early PCjr is not an easy system to love and, once you get past the jrCaptain'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, jrCaptain 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, but 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 PC/FORTH" 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 1, 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 PC/FORTH+ 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 PC/FORTH 2.0. Therefore, the first two Sieve times in table 1 must be wrong, although I do not have that version to give the correct times.

Because of long publishing lead times, the PC/FORTH 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 PC/FORTH 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 PC/FORTH and the native code compiler are available for generic MS-DOS, CP/M-86, and CP/M-80 (Zilog Z80 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 in *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's and Goldberg's must be unaware that Logo gives you much more to work with than older languages such as BASIC. In fact, the conventions and con-

(continued)

straints 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.

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 Millis 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)

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Photography by Barbara Kasten

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 TI's 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 TI and other fine, non-clone microcomputers omitted in software reviews. Each time I read "for IBM PCs, ATs, and jrs" 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 microcompuer 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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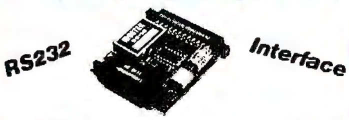

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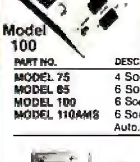

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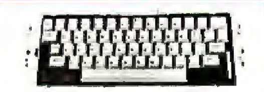

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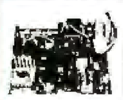

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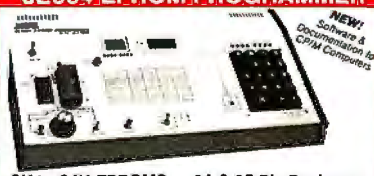

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JM32B	2732	25V	AMD, Fujitsu, NEC, Hitachi, Intel, Mitsubishi, National	$14.95
JM32C	2732A	21V	Fujitsu, Intel	$14.95
JM64A	MCM68764, MCM68L764	21V	Motorola	$14.95
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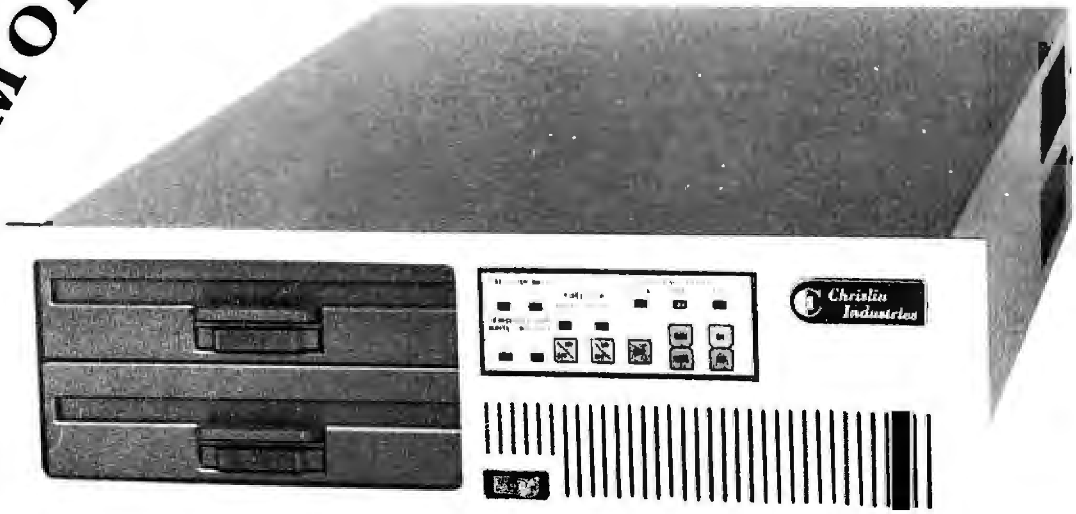

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Kernel

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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BY JERRY POURNELLE

Jerry Pournelle holds a doctorate in psychology and is a science-fiction writer who also earns a comfortable living writing about computers present and future.

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.

(continued)

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 superlative 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 Carlston of Brøderbund. 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 polyFORTH."

"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 craftsman'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 Atari 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 Wizardry (written in collaboration with Andrew Greenberg) out as a MacAdventure that I could probably play for weeks. When my Dungeons and Dragons fanatic sons get it, they'll probably vanish into the Macintosh forever.

Not so much marvels as just fun were copies of Reversi and John Conway's game, Life. The former is fun only for a while; you'll soon learn that you can't beat the machine when it's properly instructed. The nice part about the Reversi game is that as the machine thinks about different moves, it puts a dot on the screen while it considers whether or not to go there. It's instructive to watch it zero in on the proper move.

I've no business complaining since the game is in the public domain and free, but I wish I had some way to change the scale of the little cells in the version of Life. If the cells could be points it would be better, because while the round cells make for dramatic patterns, the edges of the screen are hit all too soon. I'm sure someone else has a version of Life that has the scale change.

(continued)

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 if they have a program that will scan a MacPaint file and turn any text it finds into a MacWrite (or ASCII [American Standard Code 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," said they. "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 COMDEX (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 expansible 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 hassles. 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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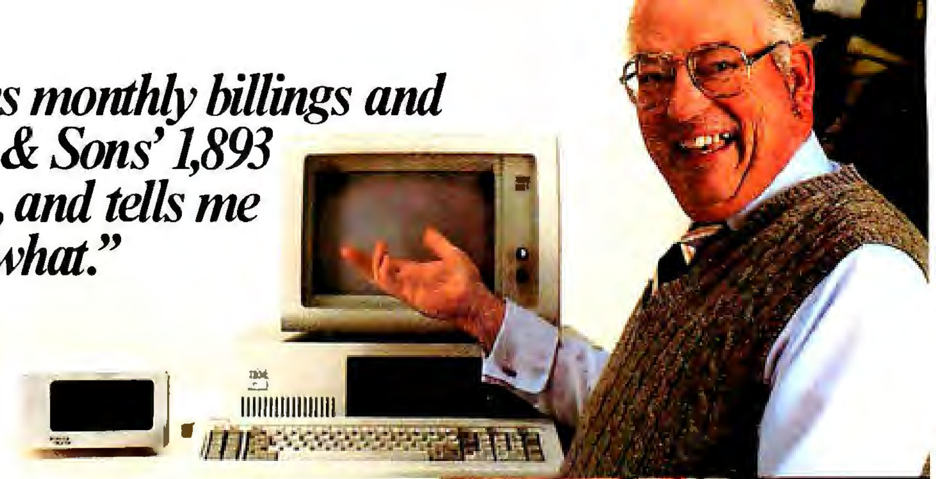

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"But," protest the true MacTribesmen, "if we do not reward Apple for insight, foresight, and courage, then there will be no one out there to fight the battle against Big Blue. The Macintosh was the first machine designed with users in mind. It was 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; and now the rumors are flying about "SuperMac," "Bloated 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-

(continued)

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 IIx—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 a matter of both ethics and right for all Apple employees.

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 ex-

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hibits; 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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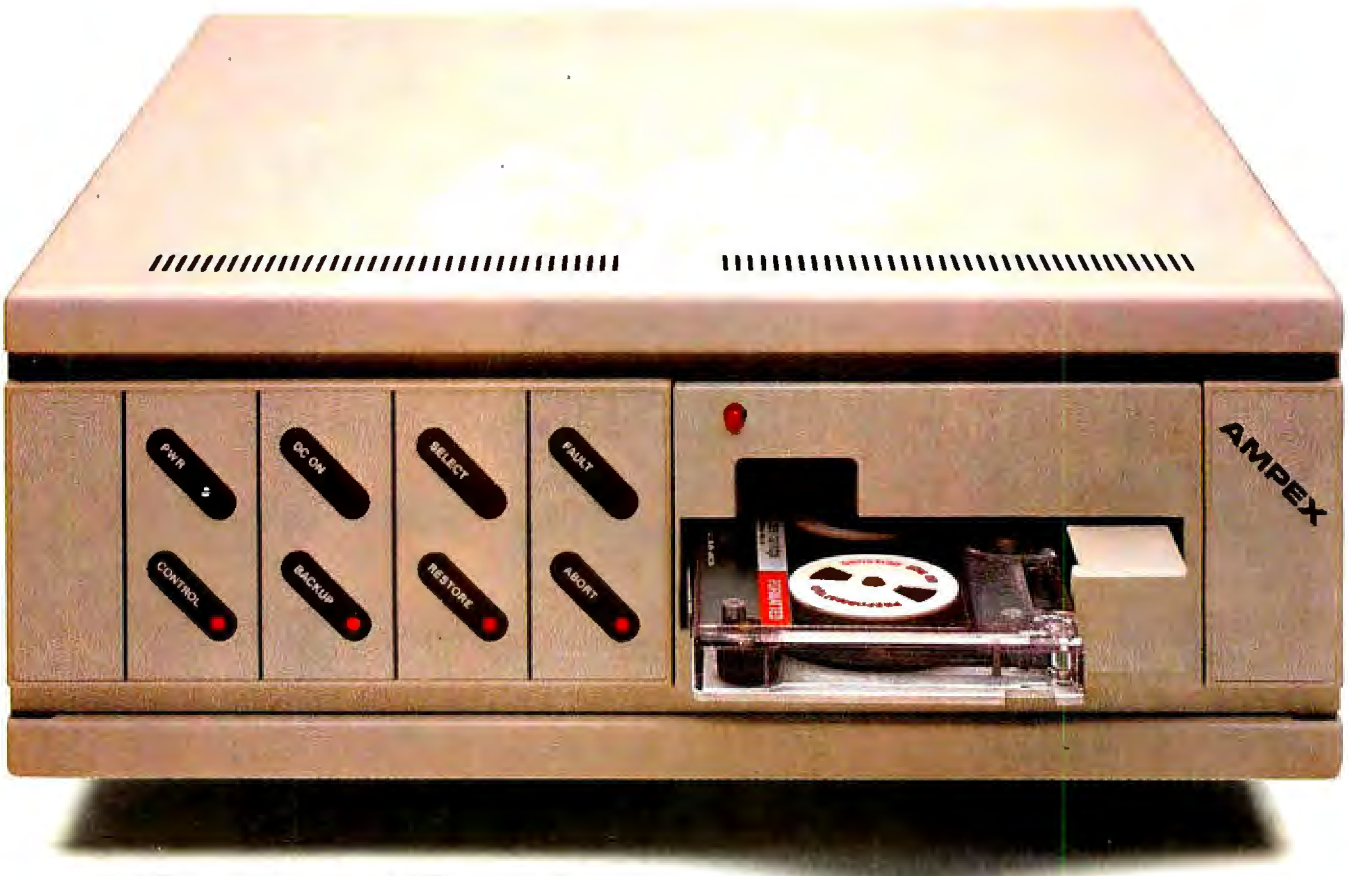

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drive, it will not copy onto that. True to Apple's motto, the Macintosh wants me to do everything precisely its way. Eventually, with patience and grim determination, you can make a copy of the DB Master disk. Do *not* name it "DB Master"; the master 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 PCompatible 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

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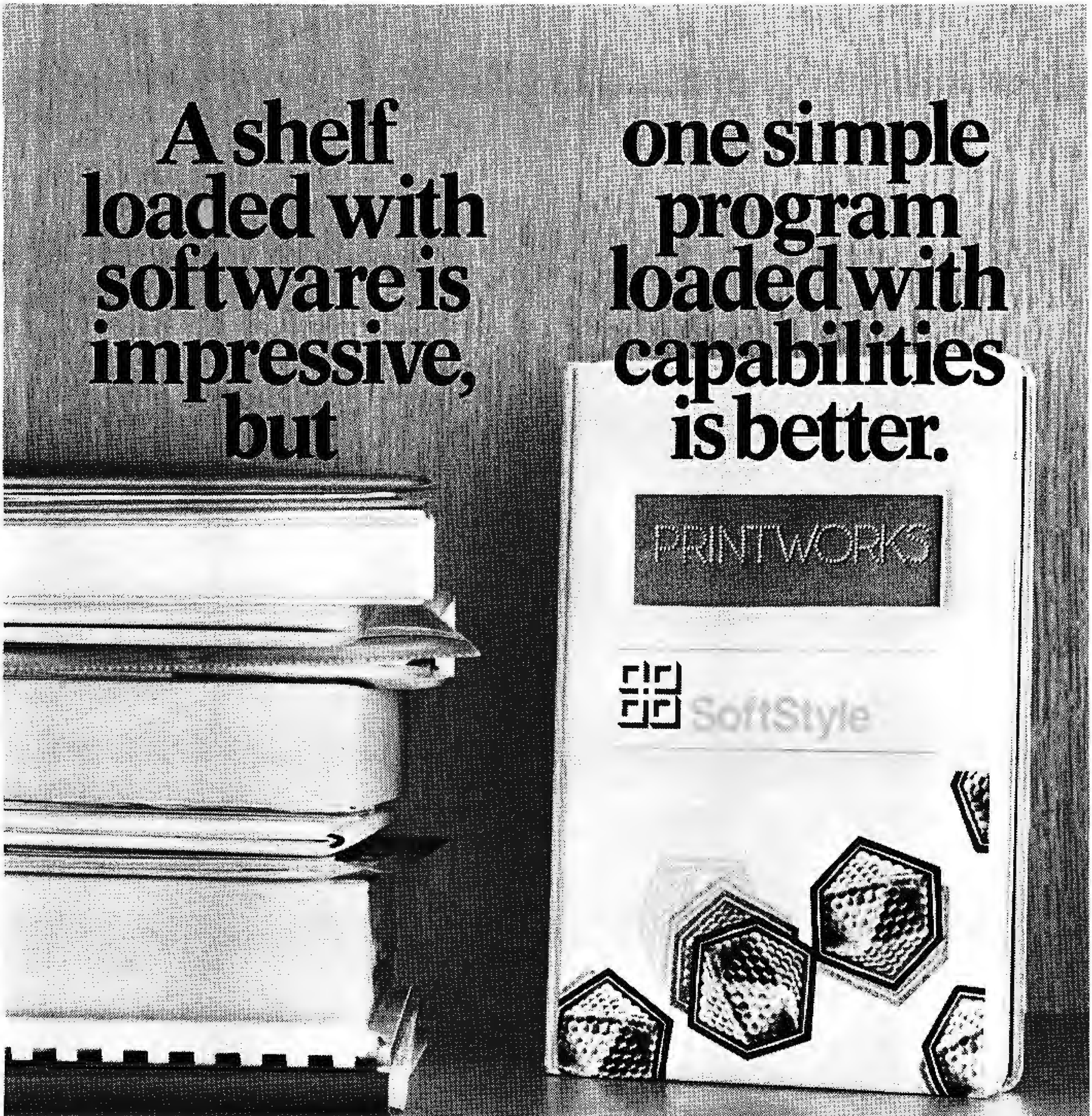

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most of the work for the Mac. I hate it. Indeed, I don't know anyone who actually likes it. Atkinson and Capps didn't even seem too happy with it. Anyway, Mike Lehman has written a new one called Fast Finder (not to be confused with Factfinder, a database 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 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 bring 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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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 set that up.

ANIMATION, ANYONE?

Another program I brought home but haven't had a chance to use is Animation Toolkit 1—The Players from Ann Arbor Softworks. 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 with the Mac, or if you're interested in doing animation with it, you probably ought to look into this one. Incidentally, Scott Wiener, the program's author, says Ann Arbor Softworks 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—and 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)

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 *got* 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.

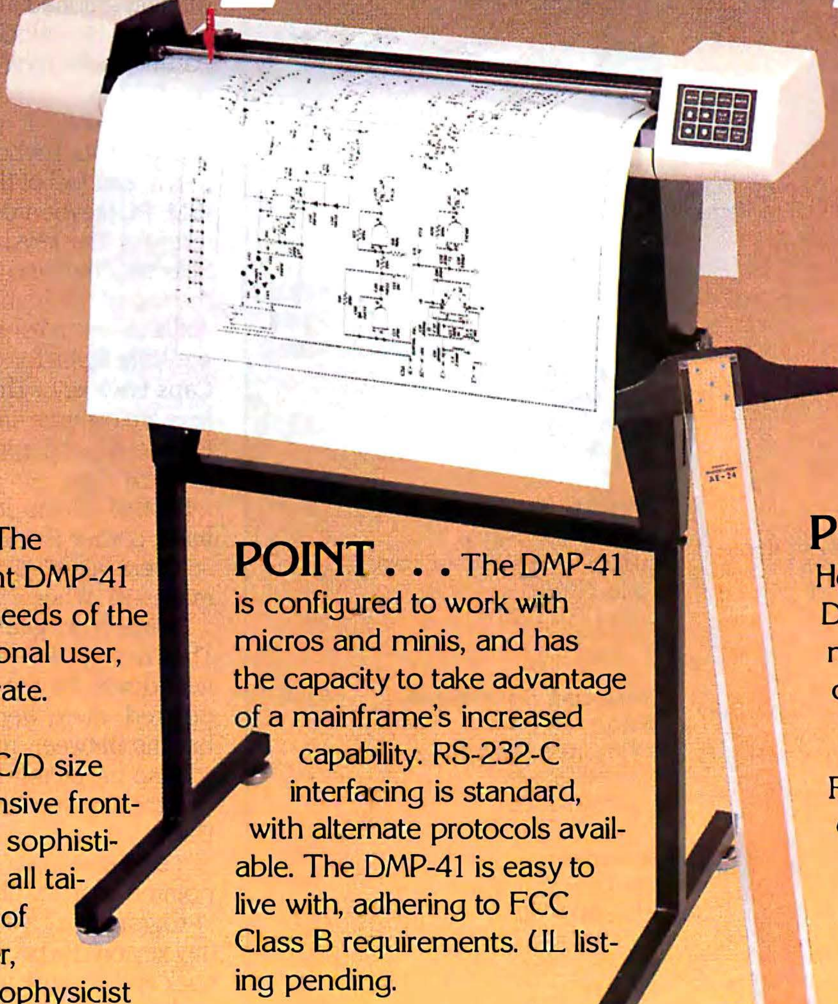
KEYBOARD! A REAL KEYBOARD!

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.

POINT . . . C/D size format, comprehensive front-panel controls and sophisticated firmware are all tailored to the needs of the surveyor, drafter, oceanographer, geophysicist and land developer . . . to name but a few. You can generate superior architectural elevations, contour maps, circuit-board layouts and assembly drawings quickly and accurately on bond, vellum or synthetic media.

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POINT . . . The Houston Instrument DMP-41 is one of your most cost effective considerations.*

For the name, address and phone number of your nearest representative, write Houston Instrument, P.O. Box 15720, Austin, TX 78761. Phone 512-835-0900, or 800-531-5205 if outside Texas. In Europe contact Houston Instrument Belgium NV., Rochesterlaan 6, 8240 Gistel, Belgium. Tel 059-27-74-45, tlx 846-81399.

houston instrument

houston instrument 25th Anniversary 1959-1984

*suggested US retail $2,995

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 MicroPro 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 Ghu!" 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 at all. Sure, 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?"

(continued)

ITEMS DISCUSSED

ANIMATION TOOLKIT $49.95
Ann Arbor Softworks
308½ South State St.
Ann Arbor, MI 48104
(313) 996-3838

CD ROM . . . . OEM items
Sony Corporation of America
Sony Drive
Park Ridge, NJ 07656
(201) 930-6432

Hitachi America Ltd.
Industrial Components Sales & Service Division
50 Prospect Ave.
Tarrytown, NY 10591-4698
(914) 332-5800

CINEMAC UPGRADE KIT $249 installed
MicroGraphic Images Corp.
9612 Kingsbury St.
Chatsworth, CA 91311
(818) 368-3482

DB MASTER $195
Stoneware Inc.
50 Belvedere St.
San Rafael, CA 94901-4870
(415) 454-6500

FAST FINDER $100
Tardis Software Inc.
2817 Sloat Rd.
Pebble Beach, CA 93953
(408) 372-1722

HYPERDRIVE $2795
General Computer Company
215 First St.
Cambridge, MA 02142
(617) 492-5500

MACINTOSH $2195
Apple Computer Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(408) 996-1010

MACVISION $399
Koala Technologies
3100 Patrick Henry Dr.
Santa Clara, CA 95052-8100
(800) 562-2327

MITE
8-bit version $150
16-bit version $195
Mycroft Labs Inc.
POB 6045
Tallahassee, FL 32314
(904) 385-1141

PASCAL MT+
8-bit version $350
CP/M-86 version $400
other 16-bit versions $600
Digital Research Inc.
POB 579
Pacific Grove, CA 93950
(800) 382-1800

PROFESSIONAL BASIC $99
Morgan Computing
10400 North Central Expwy.
Suite 210
Dallas, TX 75231
(214) 739-5895

SMARTLINE SMARTBOARD $399
Wico
6400 Gross Point Rd.
Niles, IL 60648
(312) 647-7500

WIZARDRY $59.95
Sirtech Software Inc.
6 Main St.
Ogdensburg, NY 13669
(315) 393-6633

WORDSTAR 2000 . . . . $495
MicroPro International Corp.
33 San Pablo Ave.
San Rafael, CA 94903
(415) 499-1200

WRITE ONCE . . . . OEM item
Information Storage Inc.
2768 Janitell Rd.
Colorado Springs, CO 80906
(303) 579-0460

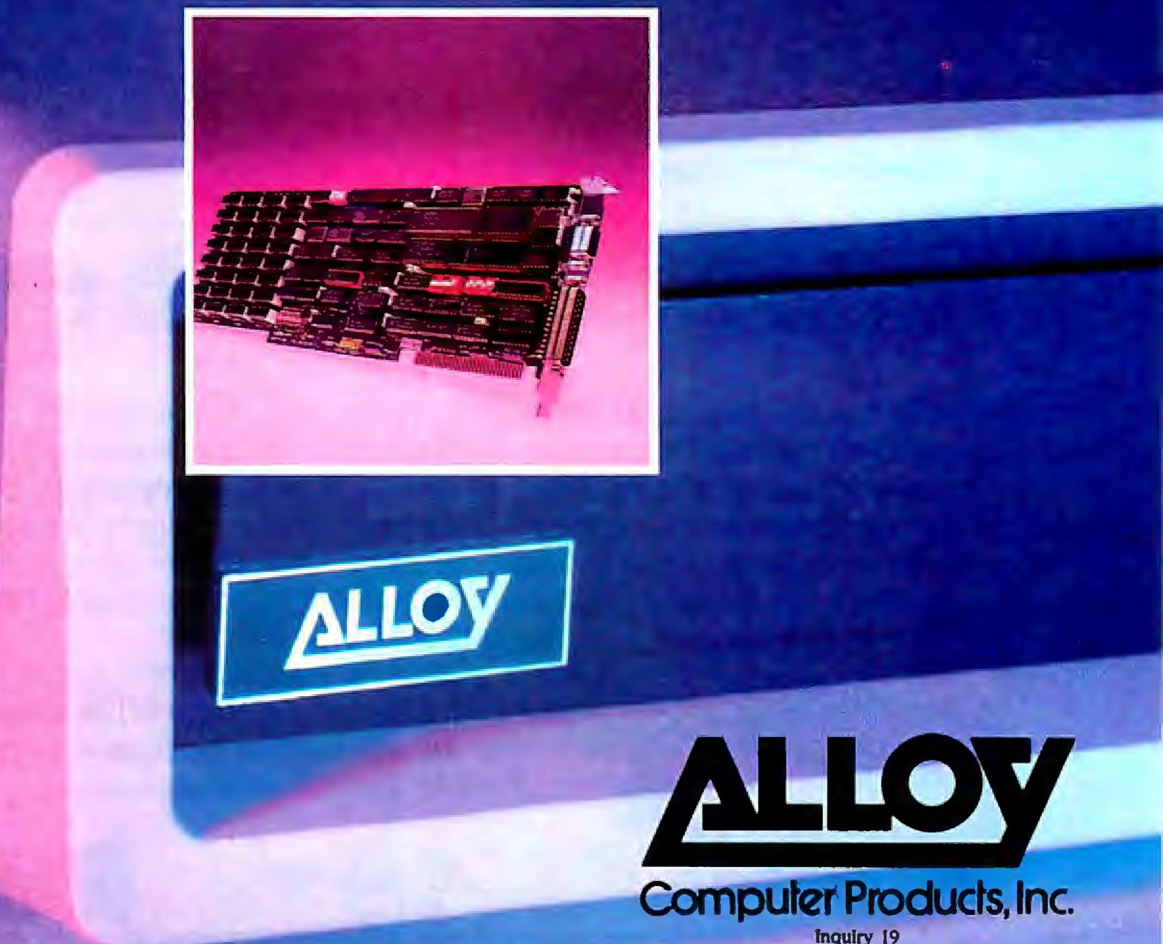
Alloy makes your PC multi-user.

Introducing Alloy's PC-SLAVE/16. The multi-user PC strategy that doesn't require additional PCs.

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.

And with Alloy's PC-X BUS, you can add up to 31 users. So whether you're adding your secretary or 31 colleagues, Alloy's PC-SLAVE/16 can do it at a much lower cost and with higher performance.

For any system requiring more than one PC, PC-SLAVE/16 is more powerful and less expensive. Each board comes complete with its own 8 MHz, 8088 micro processor and dedicated memory. PC-SLAVE/16 eliminates the need to add costly PCs. And it is ten times faster than LANs (Local Area Networks) at half the cost. Best of all, it's available right now. See PC-SLAVE/16 in action at your local dealer. Or call Alloy today at (617) 875-6100.



ALLOY
Computer Products, Inc.

Inquiry 19

Alloy Computer Products, Inc., 100 Pennsylvania Avenue, Framingham, Massachusetts 01701. (617) 875-6100, TWX: 710-346-0394
In Europe: Alloy Computer Products (Europe) Ltd., Cirencester, Gloucestershire, England. Tel: 0285-68709, Tlx: 43340

Now you can get personal with a Datasouth.

Say hello to the Datasouth Personal Printer—an office-quality dot matrix printer that makes itself right at home next to your personal computer.

Technically speaking, the Personal Printer is "Epson compatible." But it's better than the competing Epson because it also does near-letter-quality printing.

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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.

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Inquiry 114

"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.

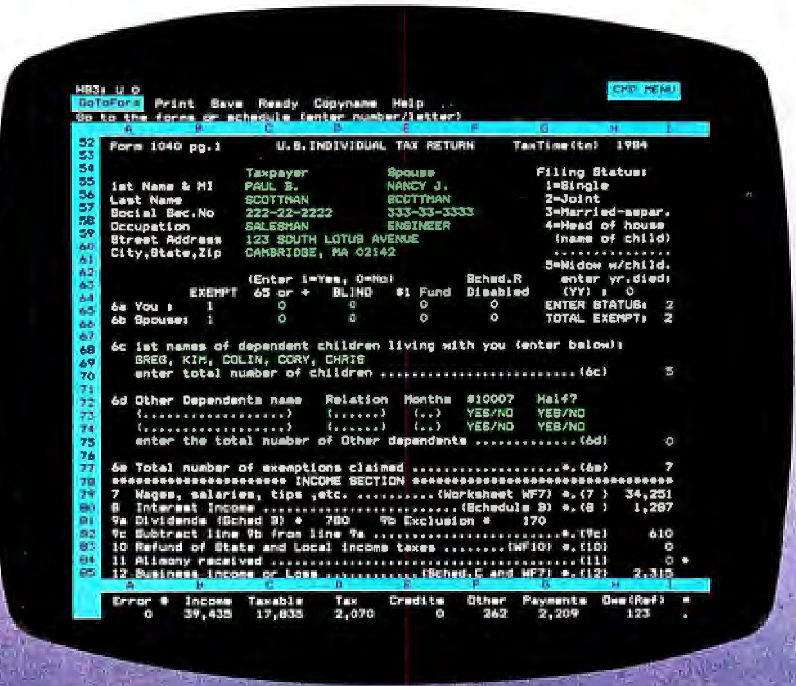
Write Once

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 123 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 preparation or 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, & 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, proper 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 under-payment penalty by actual date, and correct "income as adjusted" loss for Sched.D, line 25c. Two keystrokes allow you to printout just the forms you need or specify individual forms by letter/number and page.

TaxTime 1040 PRO (requires 320K) is $95.00, and annual updates are only $45. Also available are the 1040 Regular for $35.00, New York, California, Corporate, and Partnership forms. All programs require Lotus 123 version 1A and 256Kb or 320Kb memory. To order programs or free detailed catalog phone 800-227-2634 extension 998, or in California 800-772-2666 extension 998.

FEDERAL 1040 (REGULAR 256K)

1040	G
A	SE
B	SE(S)
D	W
	6251

Plus worksheets for wages, IRAs, Soc Sec. & EIC

TaxTime™
FOR 1·2·3

FEDERAL 1040 (PRO 320K)

1040	G	C	2106	[illegible]
A	SE	E	2210	[illegible]
B	SE(S)	F	2441	[illegible]
D	W	R	3468	[illegible]
	6251			[illegible]

C,F,& 4562 are standalone for multiples. Automatic supporting statements for Sched.A.

A product of Austin Scientific, Inc. 1259 El Camino, Suite 260, Menlo Park, CA 94025.

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, and if you access without specifying a number you 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. "We'll invite the hackers and the writers. Especially 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 would get 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

Combine Write Once and the CD ROM and we have the information revolution.

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)

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?

Anything I have a business interest in has my name on the cover.

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)

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, consultantships, 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

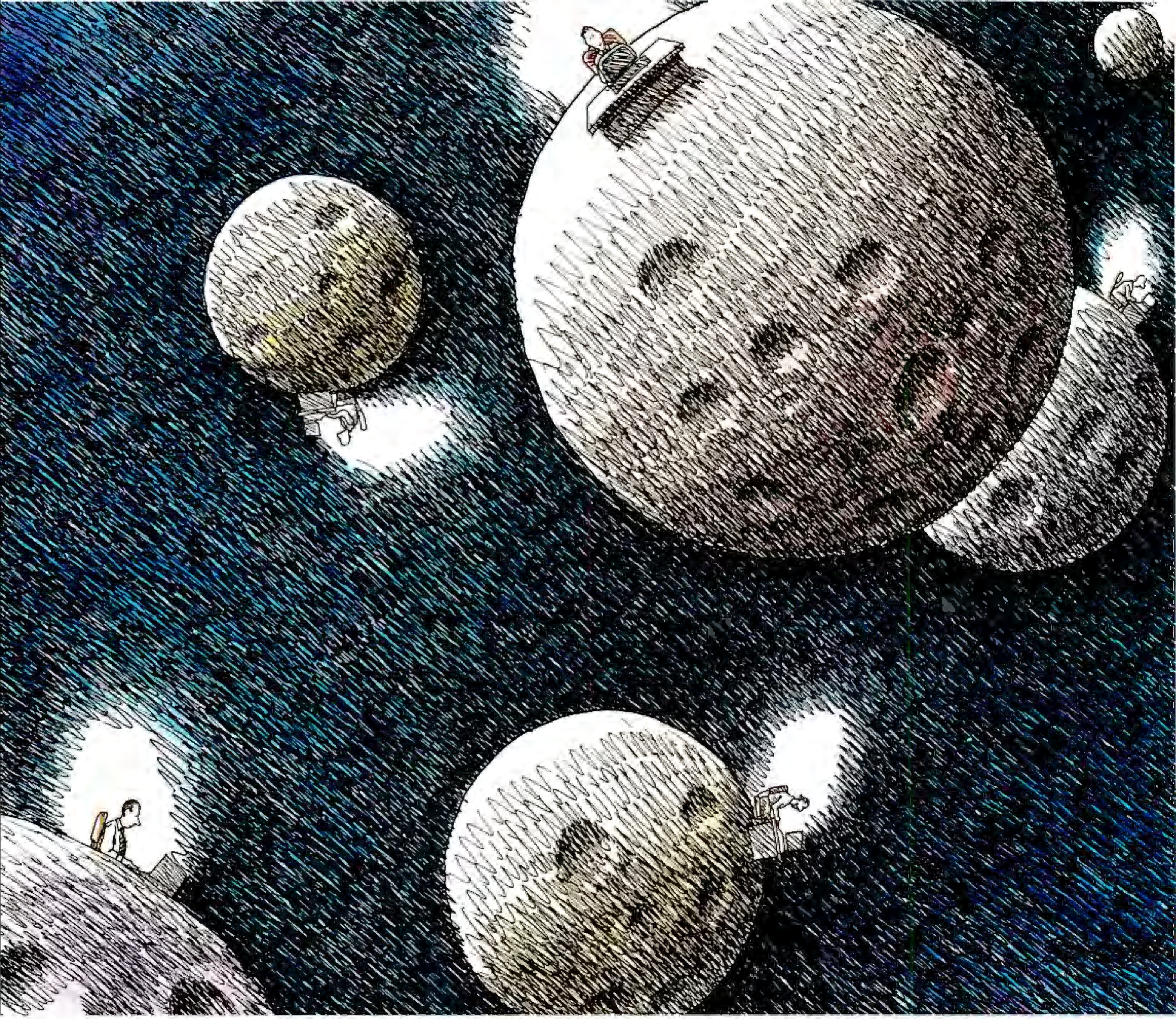
I'm out of time and space and I still haven't covered all of COMDEX. More on that next month.

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.

Inquiry 171



Inquiry 99

C·H·A·O·S M·A·N·O·R M·A·I·L

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 6⅞ 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 shambleized and my 6⅞ 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 one is bound to that commitment. Period. If you want the role of leadership in this ethically 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. Ostensibly, 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 hereby 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

(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
JM 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 MOB$Character
•page 282, after line 09270, insert
LXI H,Disk$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 MIT-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 cafard* (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, bogy; a scarecrow." For example, the OED quotes Thomas More's *Comfort Against Tribulation* (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
Avuec ton Dieu Mahom et Cahu.

(O then from hell you went, O Bugaboo,
With your God Mahomet and Cahu.)

The OED gives related entries under "bog," "bogy," "buggard," "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) slewe, being bogged by hym."

W. JAY DOWLING
Richardson, TX

I have got a lot of letters on this. Yours is certainly the earliest reference.
Thanks.—Jerry

INDEXING

Dear Jerry,

This is in response to your section ("The Index Dilemma," October 1984, page 332) about indexing a book. I have acquired, essentially for free, a fairly decent indexing program. It is in the public domain on SIG/M volume 94, which is a reissue of the Pascal/Z User Group's volume 20. The program is called Indexer, and it comes in executable form and with Pascal source code. It does not read a text file and index it. A human being must read the printed text, preferably the galley proofs of the book, and decide what terms to include in the index. The Indexer program then substitutes for a stack of index cards; you type your entries into the computer, and it alphabetizes them and keeps track of page numbers. It also does an intelligent job of indexing subterms (subheadings under major topics). Since the source code comes with it, a Pascal programmer could customize it without too much trouble. In general, I find little difficulty in translating Pascal/Z code to Turbo Pascal.

Here's a tip your Kaypro users will be interested in—a processor upgrade for the older 2.5-MHz Kaypro 2s and 4s for $49.95 ($39.95 for the 4). It consists of four or five chips, one of which is a 5-MHz Z80B, plus thorough, step-by-step instructions. A bargain—my Kaypro is now a hot rod! Available from Highland Microkit, POB 21, Highland, MD 20777.

Thanks for the work you do.

WILLIAM MEACHAM
Austin, TX

I've not tried to turn Pascal/Z code into Turbo, but I have got a lot of Pascal/Z sources from public domain; thanks for the suggestion.

Me, I'm about to solve the index problem generically by writing a combination index, log processor, and general text masher in Modula-2 and using that as one of the example programs in my Modula-2 book.

Thanks again.—Jerry

LANGUAGE ISSUES

Dear Jerry,

I can't help but notice that you favor Modula-2.

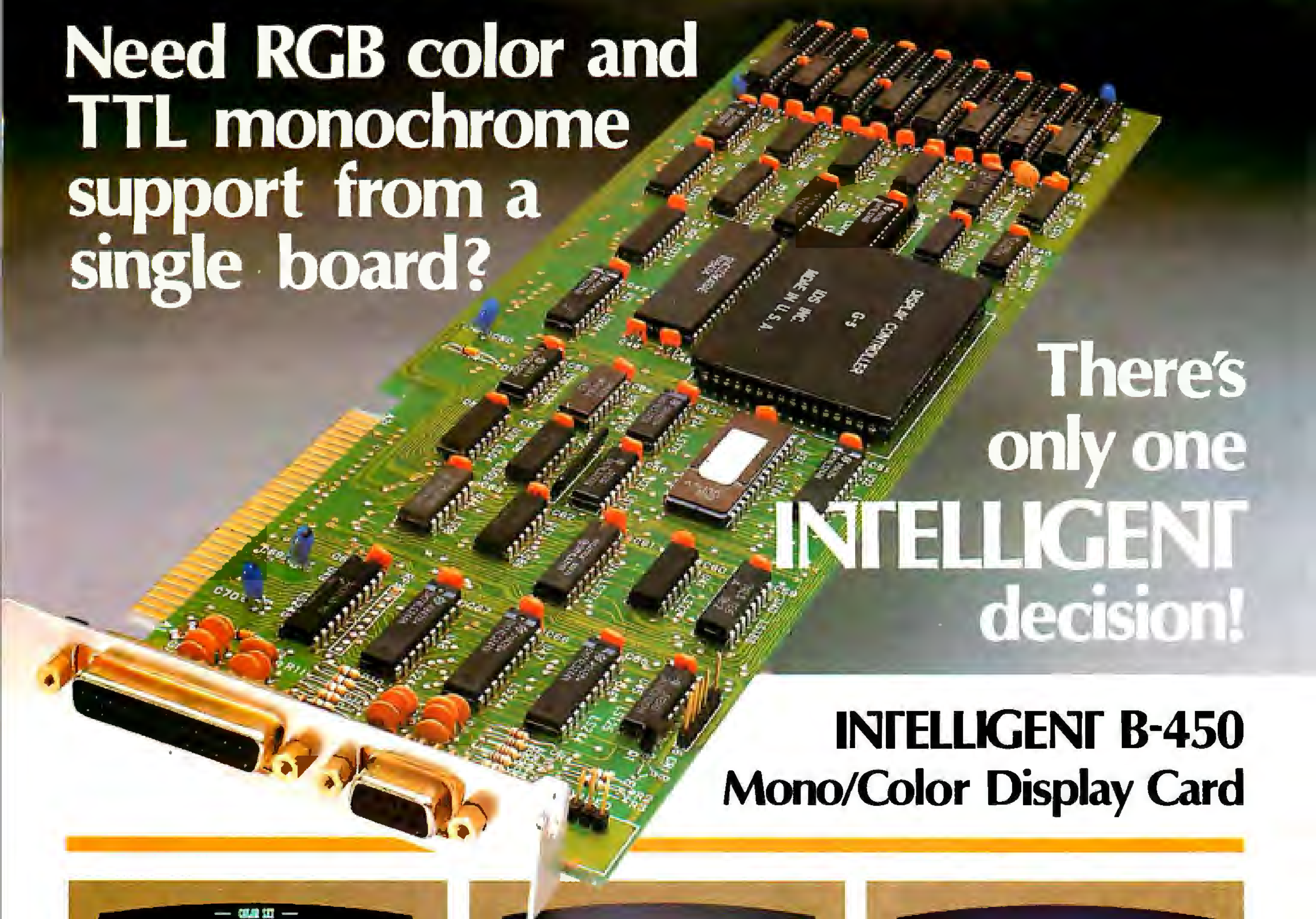
There is a fundamental difference in architecture between Modula-2 and our current microcomputers and languages. Modula-2 was designed and optimized in parallel with the stack-oriented Lilith computer and operating system. If the processor instruction set and compiler language statements are not closely matched, the compiled code becomes bulky and slow. The Intel chips (8080, 80286) are register oriented and don't organize memory in a way for fast stack utilization.

Are you suggesting that in the long term we should be moving away from register-oriented computers (just as we are moving away from assembly language) and use stack-oriented computers that may be better suited to high-level languages? At the moment we may be trying to push a square peg in a round hole. Alas, we might get compilers that look like Modula-2 on the surface, while the basement is full of a bunch of crazy plumbing and supports that try to adapt to two different architects. How real and practical is Modula-2 as adapted to the microcomputer?

When you promote Modula-2, are you jumping on the bandwagon because you think it is outstanding or because it has some improvements in structure over what you have now? Are you really saying that you are comfortable with CB-80 but want more data structures and types and other features?

I am probably typical of the millions of people buying microcomputers to use as a tool. I make my money from my profession, and even though I enjoy programming and get fascinated with all the high-

(continued)



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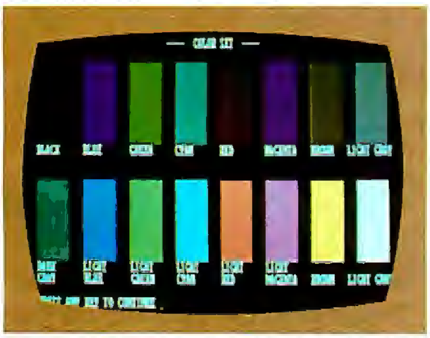

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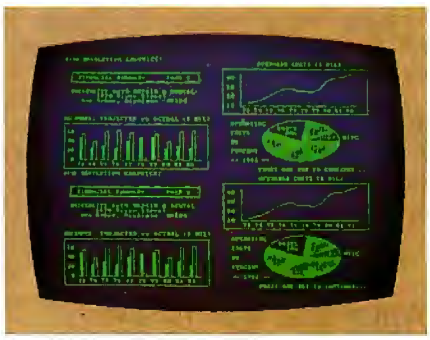

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tech toys, I must allocate my time. I don't have the urge to "feel the bits and registers between my toes" or even play with a building-block set like C or FORTH. If software doesn't exist for an application, I want a complete and friendly compiler, 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 to 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 innards 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 50545, 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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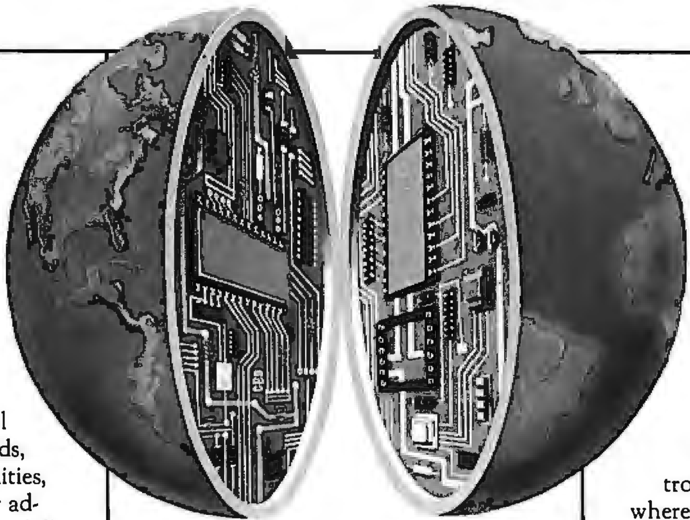

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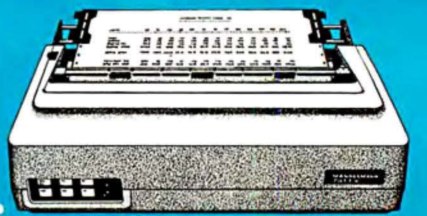

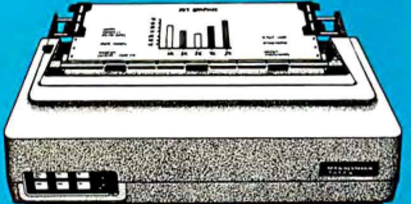

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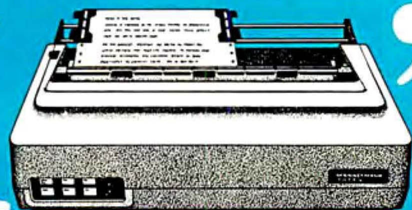

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Up to Date

Hackers gather together and a new product from Digital Research

BY JOHN MARKOFF, PHILLIP ROBINSON, AND EZRA SHAPIRO

The ev[illegible]n 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," *(Doubleday, 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

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BYTE West Coast is prepared monthly by BYTE's editors and staff in San Francisco and Palo Alto. Correspondence should be addressed to BYTE West Coast, BYTE Magazine, 425 Battery St., San Francisco, CA 94111.

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 attempts to give software away and make a living at the same time. (The idea of "user-supported" software frees programs for copying but asks users who find the programs of value to them to send a contribution to the author.) Wallace called his Shareware idea a "marketing hack" and said that his company, Quicksoft, has made $250,000 during the past year by giving software away and requesting a donation. Fluegelman added that he believes only about one in ten people who made copies of his communications program, PC-Talk, actually sent him a donation.

These conflicts seemed to be the result of the sudden wealth that many of the hackers have found—and most started with purely intellectual motivation. A reporter from the *Washington Post* said that he was leaving to write a story about the mixed feelings among the hacker community regarding wealth. Gene Wallis, an engineer who was an early Homebrew Computer Club member said, "I went to that original meeting [of the Homebrew Computer Club] in Gordon French's garage, and I think the two of us are the only ones who aren't millionaires today."

Some were still captivated by the vision of a community of hackers. Lee Felsenstein, Homebrew Computer Club member and designer of the Sol and Osborne 1 computers, proposed a public project to create a "Hacker's Macintosh." Felsenstein said that his Hacker's Mac was a new name for projects he has previously described 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 Hackers' Conference, see "Computing at Chaos Manor" by Jerry Pournelle, page 313.)

Ted Kaehler, a designer of the Small-

(continued)

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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 to 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, which 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 reclaims 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.

It's a novel approach to distribution, and time will tell if it's a good one, but it is certainly well planned to serve the needs of all parties involved—developers, manufacturers, DR, and even end users. ■

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Multitasking FORTH

Two British versions and a FORTH-basec computer

BY DICK POUNTAIN

Dick Pountain is a technical author and software consultant living in London, England. Address correspondence to him c/o BYTE, *POB 372, Hancock,* NH 03449.

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 /ith 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 multiuser multiprogramming on minicomputers and more recently on the IBM Personal Computer (PC). In a multiuser 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

I've been using a British implementation of FORTH called xFORTH for several years. It's now the programming tool I reach for most often for

(continued)

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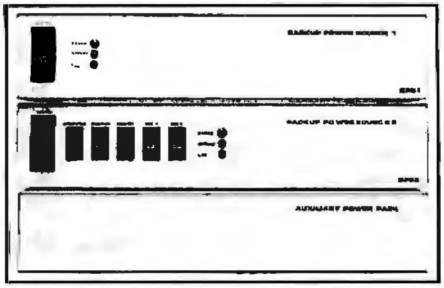

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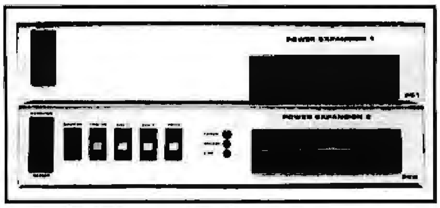

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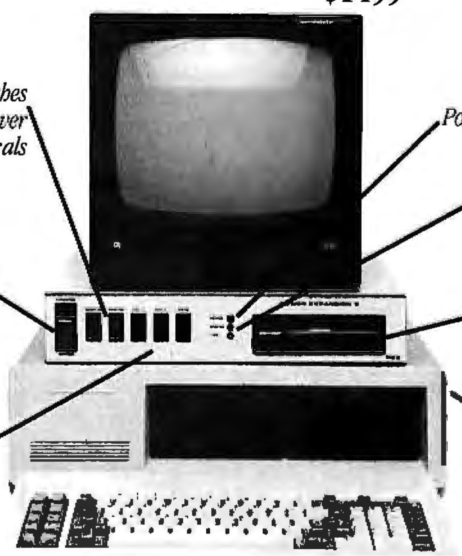

CP/M jobs, in preference to my C compiler, Pascal, or BASIC. xFORTH was written and distributed by Cambridge mathematician Alistair Mees (at a price that ranks it with BDS C and Turbo Pascal as one of the great software bargains of our time). Mees has recently departed for Australia to take up the Chair 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.

(continued)

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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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64th runs the Sieve almost seven times faster than Commodore BASIC.

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 setrate 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 prevents flicker in a graphics task.

While it is not the fastest 6502 FORTH in the world, 64th runs the Sieve in 620 seconds, almost seven times faster than Commodore BASIC, 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 turnkey (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 HMOS (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 Z80 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. ■

[*Editor's note: At the time of this writing,* NOVIX *Corporation of Los Gatos, California, and Charles Moore, the inventor of* FORTH, *were developing a* FORTH *microprocessor on a single chip. There will be more information available on this in a future issue of* BYTE.]

[*Author's note: In the January* BYTE U.K. *I erroneously stated that Amstrad is a subsidiary of* GEC. *In fact, Amstrad is a privately owned company.*]

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BY WILLIAM M. RAIKE

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-11BS. 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

(continued)

William M. Raike, who holds a Ph.D. in applied mathematics from Northwestern University, has taught operations research and computer science in Austin, Texas, and Monterey, California. He holds a patent on a voice scrambler and was formerly an officer of Cryptext Corporation in the U.S. In 1980, he went to Japan looking for 64K-bit RAMs. He has been there ever since as a technical translator and a software developer.

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 256K 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-

Photo 1: *The* IBM *Japan Ltd.'s* JX.

(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. Without the English-mode cartridge, the JX operates under something called Nihongo DOS (Japanese-language DOS), which looks like PC-DOS but has full kanji capability.

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 MS-DOS 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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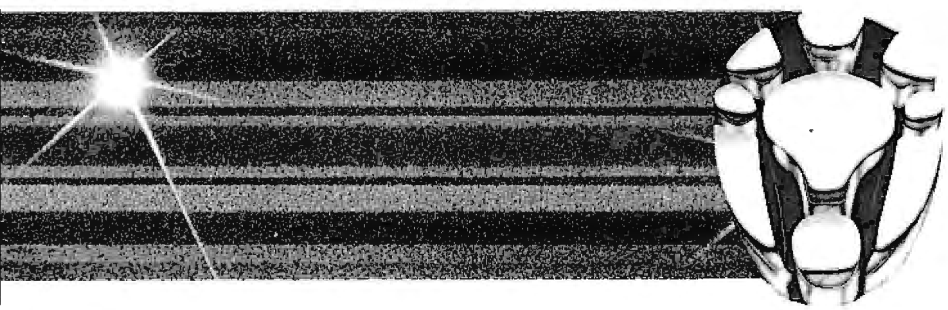

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Magic Squares

Generating a classic array by computer

BY ROBERT T. KUROSAKA

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 $16! = 1\times2\times3\times \ldots \times14\times15\times16 > 2\times10^{13}$. 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)

Robert T. Kurosaka teaches mathematics in the Massachusetts State College system. He invites your correspondence, c/o BYTE, POB 372, Hancock, NH 03449.

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 "1" 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, using a wraparound effect as if the array were printed on a cylinder. In the program, the edge-wrapping statements see to this task.

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 "1" in the next diagonal cell. Using the break-move, we enter the "6" directly below the "5" (the last cell filled, not below the "1"). 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 BYTEnet 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

(continued)

1	15	14	4
12	6	7	9
8	10	11	5
13	3	2	16

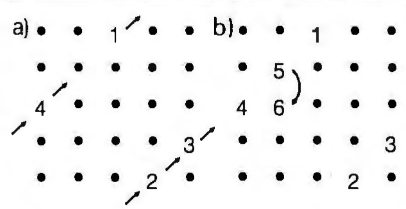
Figure 1: *A 4-by-4 magic square. Each row, column, and main diagonal adds up to 34.*

a)	a	b	c	b)	1	b	c
	d	5	f		d	5	f
	g	h	i		g	h	9
c)	a	1	c	d)	a	1	c
	7	5	3		d	5	f
	g	9	i		g	9	i
e)	6	1	8				
	7	5	3				
	2	9	4				

Figure 2: *Steps in the construction of a 3-by-3 magic square by trial and error.*

1	•	•	4
•	6	7	•
•	10	11	•
13	•	•	16

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.*



c)

17	24	1	8	15
23	5	7	14	16
4	6	13	20	22
10	12	19	21	3
11	18	25	2	9

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.*

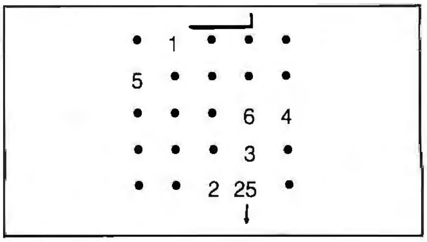


Figure 5: *The shortest path for an off-center starting position.*

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Listing 1: *The Magic Square program.*

```
10 '*****************************************************************************************************
20 '*                                                                                                   *
30 '*                                     MAGIC SQUARE PROGRAM                                          *
40 '*                                                                                                   *
50 '*                                       by Bob Kurosaka                                             *
60 '*                                                                                                   *
70 '*****************************************************************************************************
80 REM
90 REM
100 DEFINT A-Z:CLS
110 INPUT "Enter the size of the square's side (odd number, 3 or larger)";SIDE
120 IF SIDE/2=INT(SIDE/2) THEN PRINT "SIDE MUST BE AN ODD NUMBER":GOTO 110
130 IF SIDE<3 THEN PRINT "NUMBER MUST BE 3 OR LARGER":GOTO 110
140 DIM ARRAY(SIDE,SIDE)
150 CLS
160 ROW=1: COLUMN=(SIDE+1)/2              'LOCATE STARTING CELL
170 ARRAY(ROW,COLUMN)=1                   'INITIALIZE FIRST VALUE
180 REM ARRAY-FILLING ROUTINE
190 FOR I=2 TO SIDE^2
200     ROW=ROW-1:COLUMN=COLUMN+1         'NORTHEAST MOVE
210     IF ROW<1 THEN ROW=ROW+SIDE        'WRAP AROUND THE EDGES OF THE ARRAY
220     IF COLUMN>SIDE THEN COLUMN=COLUMN-SIDE
230     IF ARRAY(ROW,COLUMN)=0 THEN 280   'IF CELL IS EMPTY, FILL IT
240     ROW=ROW+1:COLUMN=COLUMN-1         'OTHERWISE, RETREAT
250     ROW=ROW+1                         'AND MAKE THE BREAK-MOVE
260     IF ROW>SIDE THEN ROW=ROW-SIDE     'CHECK FOR EDGE-WRAPPING CONDITIONS
270     IF COLUMN<1 THEN COLUMN=COLUMN+SIDE
280     ARRAY(ROW,COLUMN)=I               'FILL THE CELL
290 NEXT I
300 REM PRINT THE SQUARE
310 PRINT "MAGIC SQUARE, ORDER";SIDE
320 PRINT "EACH ROW, COLUMN, AND DIAGONAL ADD UP TO";SIDE*(SIDE^2+1)/2
330 PRINT
340 FOR ROW=1 TO SIDE
350     FOR COLUMN=1 TO SIDE
360         PRINT USING "####";ARRAY(ROW,COLUMN);
370     NEXT COLUMN
380     PRINT
390 NEXT ROW
400 END
```

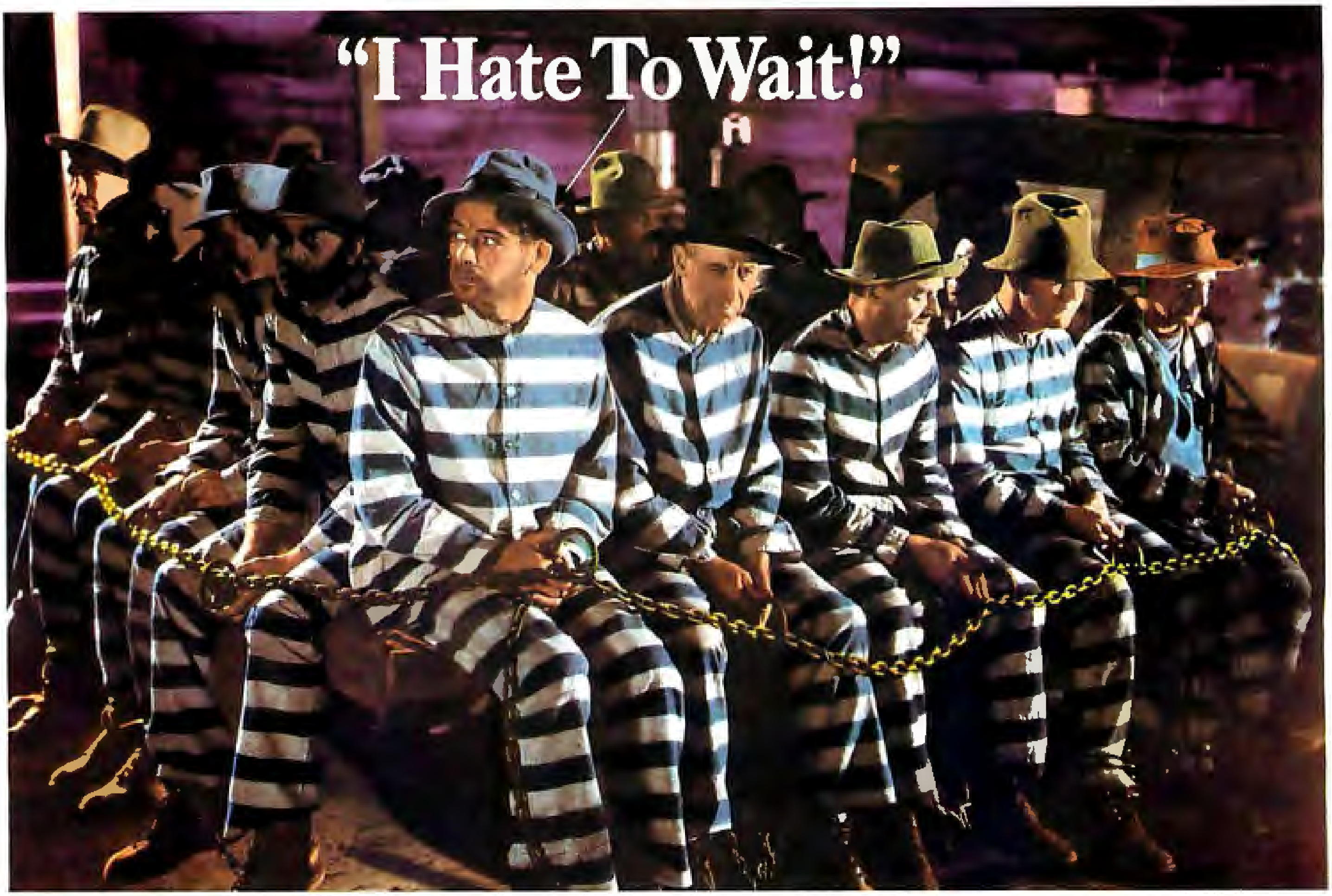
Listing 2: *Changes to the program to use a northwest move.*

```
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 north*west* 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 4c, one path from the "25" back to the "1" may be called up-four, but using the wraparound effect, the shortest path is down-one (250 ROW =ROW+1). 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, I 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 V_{cc} 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) 343-6133. 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 C 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 Z8001 at 5.5 MHz, and I would have expected better results from a clock-stretched, fast-memory, 10-MHz Z8001 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 benchmark runs in 4.8 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

```
/*      printf("±n%d",prime);/*
```

The program line in the June 1984 BYTE is written

```
/*      printf("±n%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 linear (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 Rodnay 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,*

(continued)

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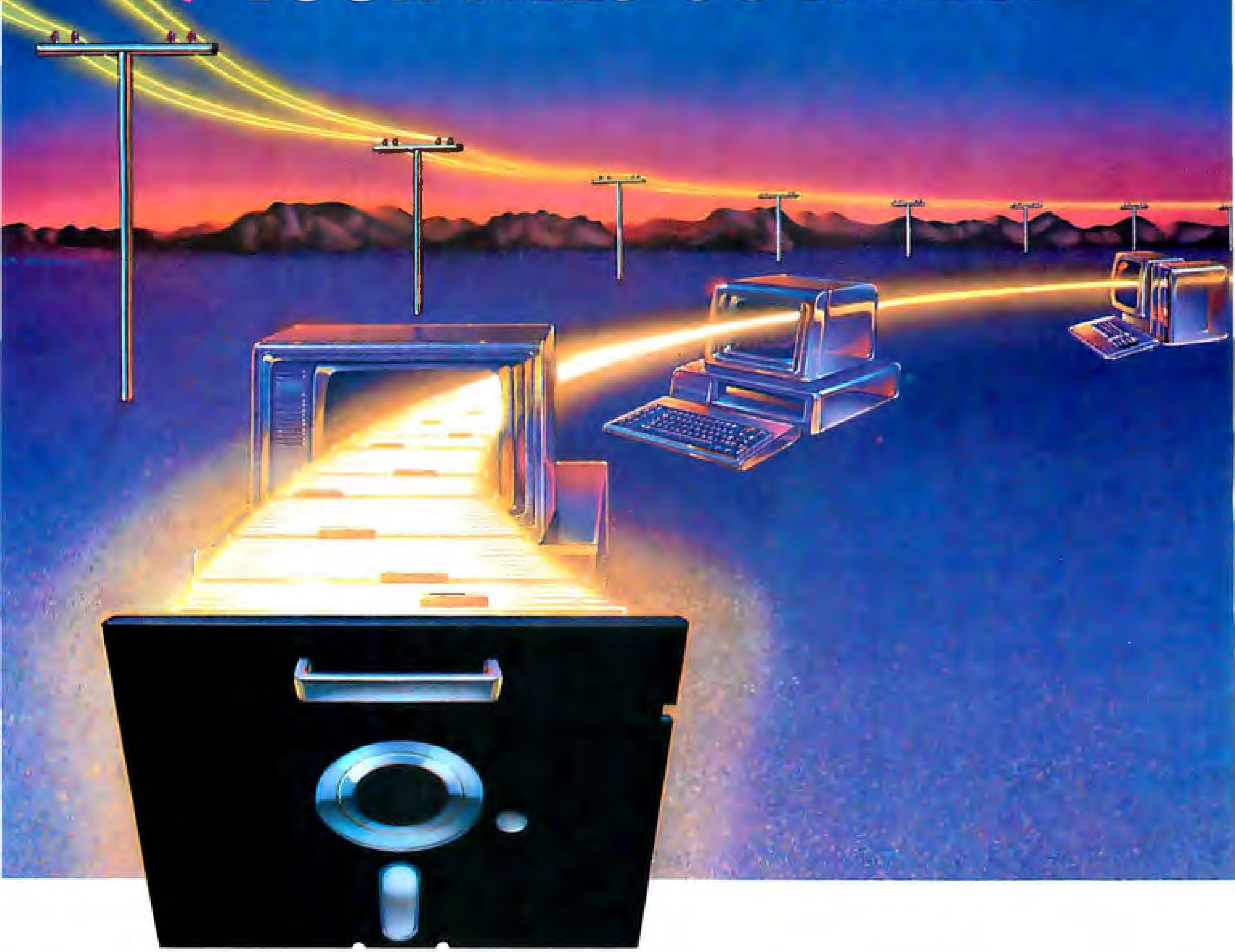

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—Steve

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 DJ/DMA board will do that but only in CP/M. I would want to continue to use North Star BASIC programs where applicable.

MALCOLM H. AUKERMAN
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-sectored disks, but articles have been written that describe how to run North Star BASIC in a CP/M environment. One article that reviewed three 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, PIP, etc.) do a warm boot on starting (DDT is an exception, but it loads below the TPA).

PETER G. INGRAM
Genolier, Switzerland

Listing 1: CP/M *hexadecimal dump at location* 0A00 *before the autoload modification.*

```
0A00 C3 5C 03 C3 58 03 7F 00 20 20 20 20 20 20 20 20
0A10 20 20 20 20 20 20 20 20 43 4F 50 59 52 49 47 48
```

Listing 2: *Listing 1 modified to autoload* MBASIC *and a program called* MYPROG.

```
0A00 C3 5C 03 C3 58 03 7F 00 4D 42 41 53 49 43 20 4D
0A10 59 50 52 4F 47 20 20 20 43 4F 50 59 52 49 47 48
```

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 into a copy of CP/M. The technique was described in the January/February 1984 issue of Microsystems Journal *in the article "Using CP/M's Undocumented Autoload Feature." I will summarize the technique for your use.*

First, set up a scratch disk with a full copy of CP/M, including the system tracks, and warm-boot it in drive A. Then use the following recipe:

```
A>ddt movcpm.com
DDT VERS 2.2
NEXT PC
2800 0100
```

Perform a dump starting at location 0A00 hexadecimal. The first two lines should read as shown in listing 1.

The string of 20s in line 0A10 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 0A00 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 0A07, 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 0A07. You can place an input string all the way to location 0A7F 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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FACTORING WITH HYPER

BY RICHARD B. LEINING

A factoring demon

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 ϕ 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

(continued)

Richard B. Leining (1631 Harrison Ave., Salt Lake City, UT 84105) is a senior engineer and principal investigator on research-and-development contracts for Hercules Aerospace Co. He is a member of the American Cryptogram Association. His hobbies include amateur radio (call W7DML), modern languages, old-time music, and hiking.

Listing 1: *Microsoft* BASIC *version of Hyper.*

```
10 '*************************************************************
20 '*                                                           *
30 '*                         HYPER                             *
40 '*                  by Richard B. Leining                    *
50 '*                                                           *
60 '*************************************************************
70 PRINT "HYPER FACTORS OR TESTS PRIME BY INTERSECTING "
80 PRINT "TWIN HYPERBOLAS X*Y = N AND (X-1)*(Y-1) = FE"
90 BEEP: INPUT "ENTER ODD INTEGER N =";N#
100 N#=INT(N#)
110 IF N#<15 THEN 90
120 REM MAY INSERT UPPER LIMIT ON N HERE
130 REM TOLERANCE SERVES AS ZERO IN TESTS
140 TOL=0.0001
150 REM REJECT N IF PERFECT SQUARE
160 ROOT#=SQR(N#)
170 IF (ROOT#-INT(ROOT#))>TOL THEN 230
180 PRINT "N WAS THE PERFECT SQUARE OF";ROOT#
190 GOTO 90
200 REM REJECT N IF EVEN. MAY REPLACE 200-220 WITH A PREPROCESSOR
      FOR THE FIRST 12 OR SO PRIMES TO USE HYPER AS A GENERAL
      FACTORING PROGRAM.
210 HALF#=N#/2
220 IF (HALF#-INT(HALF#))<=TOL THEN 90
230 REM CALCULATE CONSTANTS. A AND B ARE SCALED DOWN TO DEFER
      OVERFLOW
240 C1%=1: C2%=2: C4%=4
250 A#=(N#+C1%)/C2%
260 B#=(N#-C1%)/C2%: B#=B#*B#
270 PRINT "CONSTANTS: A=";A#;"B=";B#
280 REM FIND CRITICAL VALUE OF FE/4 FOR TWO REAL INTERSECTIONS
290 FECR4#=(A#-ROOT#)/C2%
300 FECR4#=INT(FECR4#)
310 PRINT "UPPER BOUND OF FE =";FECR4#*C4%
320 REM ESTIMATE LOWER BOUND OF FE
330 BEEP: INPUT "ENTER SMALLEST CREDIBLE PRIME FACTOR =";MIN%
340 FEMN4#=A#/C2%-(MIN%+N#/MIN%)/C4%
350 FEMN4#=INT(FEMN4#)
360 PRINT "ESTIMATED LOWER BOUND OF FE =";FEMN4#*C4%
370 REM PREDICT MAX REASONABLE TRIALS FOR FE
380 MAX#=1+FECR4#-FEMN4#
390 PRINT "MAX REASONABLE TRIALS =";INT(MAX#)
400 BEEP: INPUT "ENTER ALLOWABLE TRIALS <= MAX. ALLOW=";ALLOW#
410 IF ALLOW#>MAX# THEN 400
420 REM UPPER BOUND IS SOMETIMES A SOLUTION FOR FE. TRY IT FIRST
430 FE4#=FECR4#
440 TRIAL#=C1%
450     REM CALCULATE POLYNOMIAL Z (R^2) WHICH IS SCALED BY 1/4
460     Z#=B#-FE4#*(A#-FE4#)*C4%
470     REM SELECT PERFECT SQUARE. THAT MAKES X,Y INTEGERS
480     ROOT#=SQR(Z#)
490     RDEC#=ROOT#-INT(ROOT#)
500     IF RDEC#<=TOL THEN 590
510     REM AFTER FAILURE, REVISE FE/4 FOR NEXT ROUND
520     FE4#=FE4#-C1%
530 TRIAL#=TRIAL#+C1%:IF TRIAL#<=ALLOW# THEN 450 ELSE
      TRIAL#=TRIAL#-C1%
540 PRINT "SEARCH CONCLUDED AFTER ";TRIAL#:" TRIALS. IF NO
      SOLUTION BY NOW, THEN:"
550 PRINT "DIDN'T ALLOW MAX TRIALS, OR MIN WASN'T SMALL ENOUGH,
      OR N WAS PRIME"
```


(continued)

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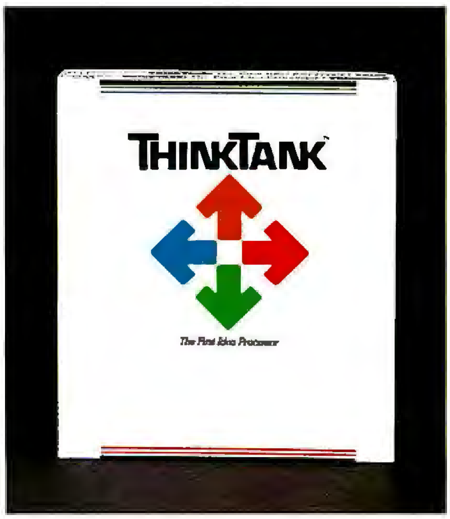

The First Idea Processor.

```
560 INPUT "TO GUESS A SMALLER MIN, ENTER 1, OTHERWISE JUST RETURN";J%
570 IF J%=1 THEN 320
580 END
590 REM FOR PERFECT SQUARE, COMPLETE CALCULATION OF X, Y
600 W#=A#-FE4#*C2%
610 X#=W#-ROOT#
620 Y#=W#+ROOT#
630 REM CALCULATE FACTORING ERROR
640 ER#=INT(X#)*INT(Y#)-N#
650 PRINT "ERROR = ";ER#
660 PRINT "HYPERBOLAS INTERSECT AT (X,Y) = (";X#;",";Y#;") AND (";Y#;",
     ";X#;")"
670 PRINT "WHEN SECOND HYPERBOLA HAS FE =";FE4#*C4%
680 PRINT "FACTORS";X#;Y#;"FOUND WITHIN";TRIAL#;"TRIALS"
690 PRINT "PRIMES? IF IN DOUBT, RERUN PROGRAM. ENTER A FACTOR AS N"
700 INPUT "IF TRIALS < ALLOW, MAY ENTER 1 TO SEARCH FURTHER. ELSE
     RETURN";J%
710 REM A SECOND DISTINCT SOLUTION IS UNLIKELY
720 IF J%=1 THEN 510
```

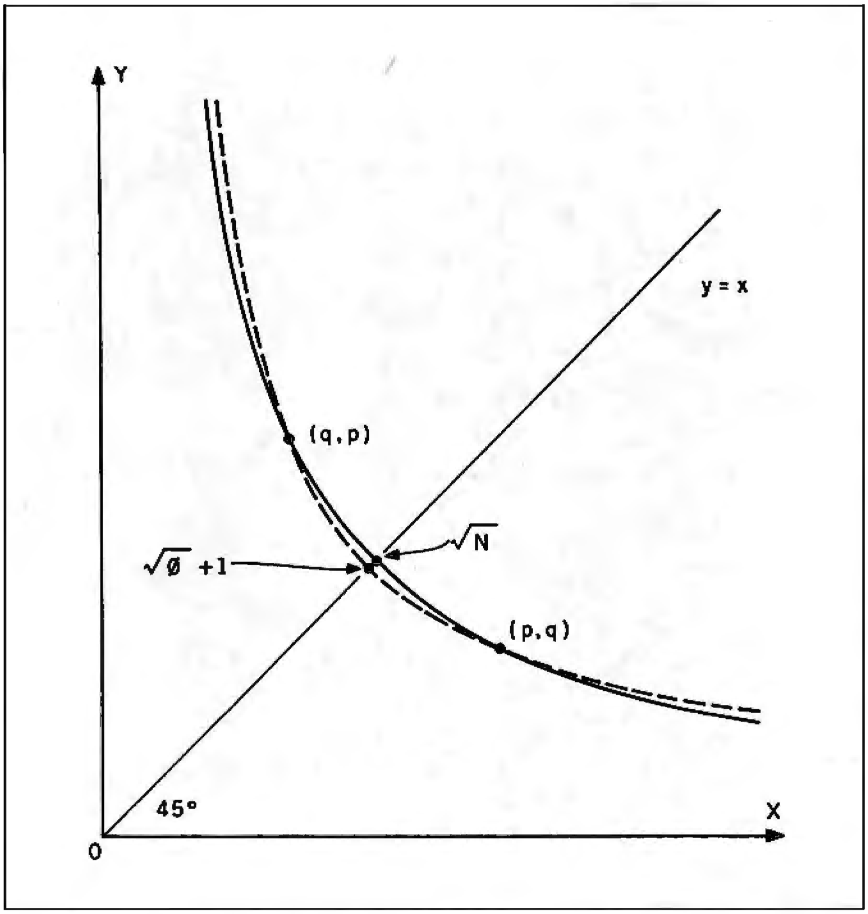

Figure 1: *Graphic representation of equations (1) and (2). The solid curve is $pq=N$, and the dashed curve is $(p-1)(q-1)=\phi$. Because values of N worth factoring are not perfect squares, the hyperbolas will not intersect at the 45-degree line. Because of symmetry, it doesn't matter which factor we call p and which we call q.*

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 ϕ 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) $pq-p-q+1=\phi$

Subtracting (3) from (1) gives

(4) $p+q-1=N-\phi$

Rearranging (4) gives

(5) $p+q=N+1-\phi$

Because $p+q$ is even, the average of p and q is a whole number. That is:

(6) $(p+q)/2=(N+1-\phi)/2$

which is an integer. Let $w=(p+q)/2$. Since p, q, and w are all integers (unless N is not factorable) and w is the average of p and q, there must be some integer r (the absolute value of the deviation of factors p and q from their average) such that (7) $w+r=p$ and (8) $w-r=q$.

Let us rewrite equation (1) using w and r:

(9) $(w+r)(w-r)=N$

Expanding (9) gives

(10) $w\hat{}2-r\hat{}2=N$

Rearranging (10) gives

(11) $r\hat{}2=w\hat{}2-N$

Since $w=(p+q)/2=(N+1-\phi)/2$, we can substitute $(N+1-\phi)/2$ for w in (11), giving

(12) $r\hat{}2=[(N+1-\phi)/2]\hat{}2-N$

Expanding and simplifying (12) gives

(13)
$r\hat{}2=[(N-1)/2]\hat{}2-\phi[(N+1)/2-\phi/4]$

$[(N-1)/2]\hat{}2$ and $(N+1)/2$ 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 ϕ that makes the right side of equation (13) a perfect square in order to find p and q.

(continued)

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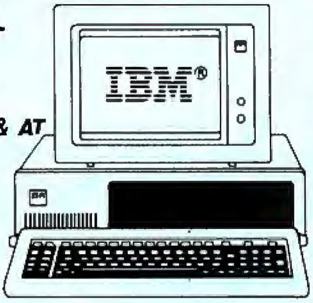

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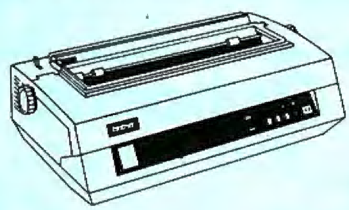

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Inquiry 83

The last question we need to address is what the largest possible value of ϕ could be so we know where to start our search. Equation (13) offers an indication of what values for ϕ are possible. In order for r to be a real number, $r\hat{}2$ must not be a negative number. Therefore, from (13):

(14) $[(N-1)/2]\hat{}2 \geq \phi[(N+1)/2-\phi/4]$

If we expand (14), rearrange the terms, and multiply through by 4 to get rid of the fraction, we get

(15) $\phi\hat{}2-2(N+1)\phi+(N-1)\hat{}2\geq 0$

Using the quadratic equation to solve for ϕ, we see that

(16) $\phi \leq N+1\pm 2\sqrt{N}$

Going back to equation (2), we see that ϕ must be smaller than N. Therefore, the sign in (16) must be negative, and we obtain

(17) $\phi \leq N+1-2\sqrt{N}$

We can refine our starting value of ϕ by recalling that it must be divisible by 4. We decrement the value calculated from (17) until our first guess for ϕ is divisible by 4, plug that value into equation (13), and see if the result is a perfect square. If not, we decrement our guess of ϕ by 4 and try again.

To determine the lower bound of ϕ, take the smallest possible factor of N (call it Min) and calculate ϕ_{min} from equation (2) by (Min − 1) (N/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) $(p+1)(q+1)=\psi$

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.

CODE	NAME	DESCRIPTION
1*nn*	READ	read a value into the accumulator (*nn* not used)
2*nn*	WRITE	print the number in the accumulator (*nn* not used)
3*nn*	LOAD	move the contents of *nn* into the accumulator
4*nn*	STORE	move the contents of the accumulator into *nn*
5*nn*	JUMP	jump to the instruction in memory cell *nn*
6*nn*	JPN	jump only if the accumulator is negative
7*nn*	JPZ	jump only if the accumulator is zero
8*nn*	ADD	add the contents of *nn* to the accumulator
9*nn*	SUB	subtract the contents of *nn* from the accumulator
0*nn*	STOP	stop execution (*nn* not used)

Table 1: *The* MAC10 *language commands and operations.*

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 [operating] codes). Each instruction consists of three digits: a single-digit op code followed by a two-digit address. Although the machine understands only numbers, names have been given to the commands for programmer convenience. A list of the commands is given in table 1 along with a description of their operation (*nn* represents the address of one of the memory cells).

The registers are loaded and the RUN command and input data are entered through BASIC's standard DATA statement. An optional trace output is available that gives the instruction just executed, the current contents of the accumulator, and the

(continued)

John R. Robbins (816 Esslinger Rd. SE, Huntsville, AL 35802) is a senior engineer with CAS *Inc.*

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Listing 1: *The* MAC10 *program listing.*

```
5 REM *** "MAC10/BAS" *** 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 C$=LEFT$(A$,3)
90 IF C$="RUN" THEN 170
100 IF C$<>"LOA" THEN 150 :REM  INITIAL STATEMENTS MUST BE LOADED THEN RUN
110 XX=VAL(MID$(A$,6,2))    :REM  GET MEMORY LOCATION
120 A=VAL(MID$(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$)>4 THEN PC=VAL(MID$(A$,5,2))
190 PRINT "EXECUTION STARTED AT ";PC
200 IF T=0 THEN 260
210 LPRINT "INITIAL STATE OF MEMORY" : LPRINT
220 GOSUB 770
230 LPRINT " EXECUTION STARTED AT ";PC : LPRINT
240 LPRINT "PC CMD VAL ACC"
250 REM *** LOOP FOR RUNNING PROGRAM STARTS HERE ***
260 V=M(PC)                 :REM  GET VALUE OF NEXT PROGRAM INSTRUCTION
270 C=INT(V/100)            :REM  GET OP CODE NUMBER
280 XX=V-C*100              :REM  GET MEMORY CELL NUMBER
290 IF C=0 THEN 700
300 ON C GOSUB 350,390,430,470,510,540,580,620,660
310 IF T=0 THEN 260
320 LPRINT USING T$;PC,C,XX,A,C$
330 GOTO 260
340 REM ASSIGNMENT OF C$ TELLS PURPOSE OF SUBROUTINE
350 C$="READ A VALUE INTO THE ACCUMULATOR"
360 READ A
370 PC=PC+1
380 RETURN
390 C$="OUTPUT THE VALUE IN THE ACCUMULATOR"
400 LPRINT : LPRINT "*** OUTPUT VALUE= ";A : LPRINT
410 PC=PC+1
420 RETURN
430 C$="LOAD CONTENTS OF"+STR$(XX)+" INTO A"
440 A=M(XX)
450 PC=PC+1
460 RETURN
470 C$="STORE CONTENTS OF A IN"+STR$(XX)
480 M(XX)=A
490 PC=PC+1
500 RETURN
510 C$="JUMP TO"+STR$(XX)
520 PC=XX
530 RETURN
540 C$="IF A < 0 THEN JUMP TO"+STR$(XX)
550 PC=PC+1
560 IF A<0 THEN PC=XX
570 RETURN
580 C$="IF A = 0 THEN JUMP TO"+STR$(XX)
590 PC=PC+1
600 IF A=0 THEN PC=XX
610 RETURN
620 C$="ADD CONTENTS OF"+STR$(XX)+" TO A"
630 A=A+M(XX)
640 PC=PC+1
650 RETURN
660 C$="SUBTRACT CONTENTS OF"+STR$(XX)+" FROM A"
670 A=A-M(XX)
680 PC=PC+1
```

(continued)

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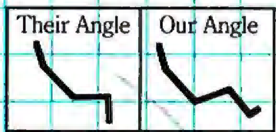

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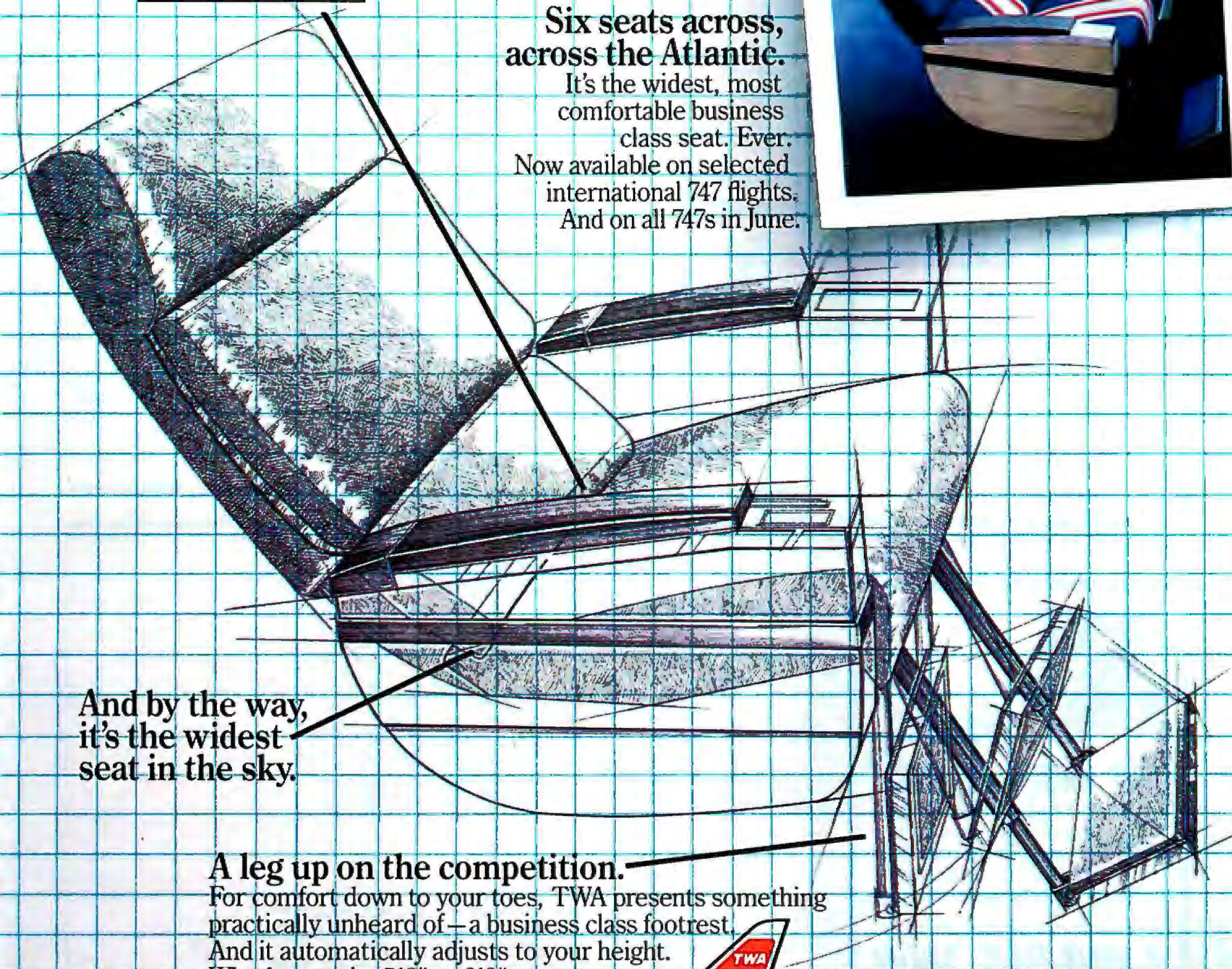

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```
690 RETURN
700 PRINT "HALT AT ";PC
710 IF T=0 THEN END
720 LPRINT"HALT AT ";PC
730 LPRINT CHR$(12)
740 LPRINT : LPRINT"FINAL STATE OF MEMORY" : LPRINT
750 GOSUB 770
760 END
770 FOR I=0 TO 90 STEP 10
780 FOR J=0 TO 9
790 LPRINT USING "#####";M(I+J);
800 NEXT J
810 LPRINT
820 NEXT I
830 LPRINT
840 RETURN
850 REM PROGRAM DATA FOLLOWS
860 DATA LOAD 00 100            :REM READ A NUMBER, N
870 DATA LOAD 01 715            :REM IF N=0 THEN JUMP TO 15 TO STOP
880 DATA LOAD 02 499            :REM STORE N IN 99
890 DATA LOAD 03 100            :REM READ IN THE FIRST VALUE, A
900 DATA LOAD 04 497            :REM STORE A IN 97
910 DATA LOAD 05 100            :REM READ IN NEXT VALUE, B
920 DATA LOAD 06 496            :REM STORE B IN 96
930 DATA LOAD 07 100            :REM READ IN FINAL NUMBER, C
940 DATA LOAD 08 897            :REM ADD A TO C
950 DATA LOAD 09 996            :REM SUBTRACT B
960 DATA LOAD 10 996            :REM SUBTRACT B AGAIN GIVING A-2*B+C
970 DATA LOAD 11 200            :REM PRINT THE RESULTS
980 DATA LOAD 12 399            :REM LOAD N INTO THE ACCUMULATOR
990 DATA LOAD 13 998            :REM SUBTRACT 1 (DECREMENT)
1000 DATA LOAD 14 501           :REM JUMP TO 01
1010 DATA LOAD 15 000           :REM HALT PROGRAM
1020 DATA LOAD 98 001           :REM LOAD IN THE VALUE 1 FOR USE IN
                                DECREMENTING
1030 DATA RUN
1040 DATA 2
1050 DATA 3
1060 DATA 2
1070 DATA 4
1080 DATA 23
1090 DATA 51
1100 DATA 36
```

Listing 2: A MAC10 *sample run with trace.*

```
INITIAL STATE OF MEMORY

  100  715  499  100  497  100  496  100  897  996
  996  200  399  998  501    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    1    0

EXECUTION STARTED AT 0

 PC CMD  VAL  ACC
  1   1    0    2   READ A VALUE INTO THE ACCUMULATOR
  2   7   15    2   IF A = 0 THEN JUMP TO 15
  3   4   99    2   STORE CONTENTS OF A IN 99
  4   1    0    3   READ A VALUE INTO THE ACCUMULATOR
  5   4   97    3   STORE CONTENTS OF A IN 97
  6   1    0    2   READ A VALUE INTO THE ACCUMULATOR
  7   4   96    2   STORE CONTENTS OF A IN 96
```

(continued)

```
  8   1   0   4   READ A VALUE INTO THE ACCUMULATOR
  9   8  97   7   ADD CONTENTS OF 97 TO A
 10   9  96   5   SUBTRACT CONTENTS OF 96 FROM A
 11   9  96   3   SUBTRACT CONTENTS OF 96 FROM A

*** OUTPUT VALUE= 3

 12   2   0   3   OUTPUT THE VALUE IN THE ACCUMULATOR
 13   3  99   2   LOAD CONTENTS OF 99 INTO A
 14   9  98   1   SUBTRACT CONTENTS OF 98 FROM A
  1   5   1   1   JUMP TO 1
  2   7  15   1   IF A = 0 THEN JUMP TO 15
  3   4  99   1   STORE CONTENTS OF A IN 99
  4   1   0  23   READ A VALUE INTO THE ACCUMULATOR
  5   4  97  23   STORE CONTENTS OF A IN 97
  6   1   0  51   READ A VALUE INTO THE ACCUMULATOR
  7   4  96  51   STORE CONTENTS OF A IN 96
  8   1   0  36   READ A VALUE INTO THE ACCUMULATOR
  9   8  97  59   ADD CONTENTS OF 97 TO A
 10   9  96   8   SUBTRACT CONTENTS OF 96 FROM A
 11   9  96 -43   SUBTRACT CONTENTS OF 96 FROM A

*** OUTPUT VALUE= -43

 12   2   0 -43   OUTPUT THE VALUE IN THE ACCUMULATOR
 13   3  99   1   LOAD CONTENTS OF 99 INTO A
 14   9  98   0   SUBTRACT CONTENTS OF 98 FROM A
  1   5   1   0   JUMP TO 1
 15   7  15   0   IF A = 0 THEN JUMP TO 15
HALT AT 15

FINAL STATE OF MEMORY

 100  715  499  100  497  100  496  100  897  996
 996  200  399  998  501    0    0    0    0    0
   0    0    0    0    0    0    0    0    0    0
   0    0    0    0    0    0    0    0    0    0
   0    0    0    0    0    0    0    0    0    0
   0    0    0    0    0    0    0    0    0    0
   0    0    0    0    0    0    0    0    0    0
   0    0    0    0    0    0    0    0    0    0
   0    0    0    0    0    0    0    0    0    0
   0    0    0    0    0    0   51   23    1    1
```

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 *nn* 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 $A-2\times B+C$, 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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TAMING THE SUBMIT UTILITY

BY MARK ANACKER

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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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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     0000H       ; 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                  MVI     C,19        ; "DELETE FILE" function
011D  CD0500                CALL    BDOS

0120  0E09                  MVI     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      '$$$     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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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   C,9        ; "PRINT STRING" function
0102  115401                LXI   D,MSG1
0105  CD0500                CALL  BDOS

0108  0E01                  MVI   C,1        ; "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   C,9        ; 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   C,19       ; "DELETE FILE" function
0122  CD0500                CALL  BDOS

0125  0E09                  MVI   C,9
0127  11AC01                LXI   D,MSG3     ; say that we did it
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
013C                        DB    24               ; the rest of the FCB

0154  0D0A07         MSG1   DB    CR,LF,BELL
0157  5072657373            DB    'Press A to abort batch,'
016E  20616E7920            DB    '  any other key to resume $'

0188  0D0A0A07       MSG2   DB    CR,LF,LF,BELL
018C  4261746368            DB    'Batch processing continuing. . ',CR,LF,'$'

01AC  0D0A0A07       MSG3   DB    CR,LF,LF,BELL
01B0  4261746368            DB    'Batch processing ABORTED!',CR,LF,'$'

01CC                        END   START
```

Pause puts breakpoints in the batch stream so I can abort if the compiler finds errors in my code.

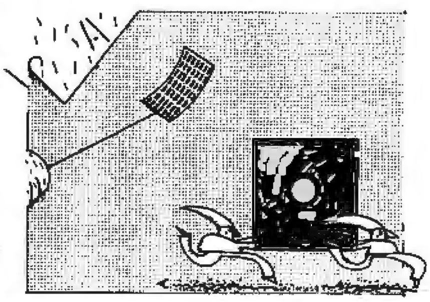
linker programs, so I can gracefully abort if the compiler finds errors in my code. Although it is possible to abort a batch job by pressing Control-C, this requires some tricky timing.

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. ■



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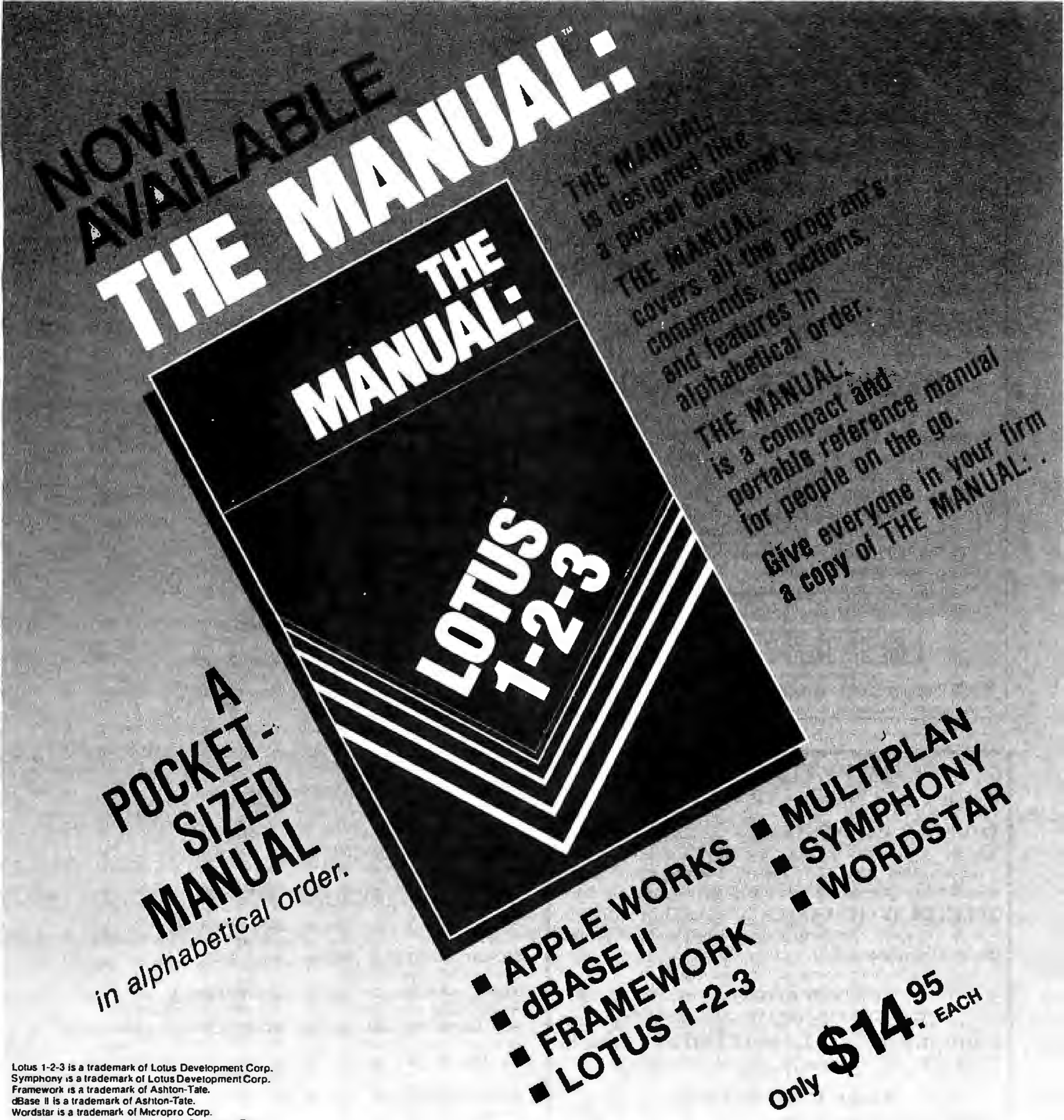

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HOW TO PROTECT COMPUTER PROGRAMS, Pal Asija. Allahabad, India: Law Publishers and Westport, CT: Computer Law Group, 1983; 208 pages, 16.5 by 25 cm, hardcover, ISBN—none, $45.

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and John Dvorak. Berkeley, CA: Idthekkethan Publishing, 1984; 212 pages, 16 by 24 cm, hardcover, 0-918347-00-9, $19.95.

An IBM Guide to Choosing Business Software, Susan Losey Tiller, John D. Parker, and Edwin M. Halkyard. Wayne, PA: Banbury Books and International Business Machines, 1984; 296 pages, 21.5 by 23 cm, softcover, ISBN 0-88693-162-2, $19.95.

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Joys of Computer Networking: The Personal Connection Handbook, Judy Barrett. New York: McGraw-Hill, 1984; 230 pages, 15.3 by 22.8 cm, softcover, ISBN 0-07-003768-X, $9.95.

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MATHEMATICAL APPLICATIONS OF ELECTRONIC SPREADSHEETS, Deane E. Arganbright. New York: McGraw-Hill, 1985; 176 pages, 15 by 22.8 cm, softcover, ISBN 0-07-002429-4, $16.95.

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METHODS AND APPLICATIONS OF ERROR-FREE COMPUTATION, R. T. Gregory and E. V. Krishnamurthy. New York: Springer-Verlag, 1984; 206 pages, 16 by 24 cm, hardcover, ISBN 0-387-90967-2, $29.80.

MICROCOMPUTER SOFTWARE BUYER'S GUIDE, Tony Webster and Richard Champion. New York: McGraw-Hill, 1984; 432 pages, 21 by 27.8 cm, softcover, ISBN 0-07-068967-9, $19.95.

MICROPROCESSOR PROGRAMMING AND APPLICATIONS FOR SCIENTISTS AND ENGINEERS, Richard R. Smardzewski. New York: Elsevier Science Publishers, 1984; 368 pages, 16.8 by 25 cm, hardcover, ISBN 0-444-42407-5, $37.75.

MICROREF: LOTUS 1-2-3, Wilmette, IL: Educational Systems, 1984; 82 pages, 11 by 21.5 cm, spiral-bound, ISBN 0-8359-4418-2, $16.95.

MINUTE MANUAL FOR APPLE WRITER IIE, Jim Pirisino. Columbia, MD: MinuteWare, 1983; 140 pages, 13.5 by 21.5 cm, softcover, ISBN 0-913131-01-6, $7.95.

THE MOTOROLA MC68000 MICROPROCESSOR FAMILY, Thomas L. Harman and Barbara Lawson. Englewood Cliffs, NJ: Prentice-Hall, 1985; 592 pages, 18 by 24.3 cm, hardcover, ISBN 0-13-603960-X, $29.95.

MULTI-DIMENSIONAL SEARCHING AND COMPUTATIONAL DATA STRUCTURES AND ALGORITHMS 3: GEOMETRY, Kurt Mehlhorn. New York: Springer-Verlag, 1984; 304 pages, 17 by 24.8 cm, hardcover, ISBN 0-387-13642-8, $17.50.

MULTIPLAN MADE EASY, Walter A. Ettlin. Berkeley, CA: Osborne/McGraw-Hill, 1984; 286 pages, 18.5 by 23.5 cm, softcover, ISBN 0-88134-135-5, $14.95.

MUNCHERS: THE ULTIMATE TIMEX/SINCLAIR GAMES BOOK, Yin Chiu and Henry Mullish. New York: McGraw-Hill, 1984; 240 pages, 14 by 20.5 cm, spiral-bound, ISBN 0-07-010839-0, $9.95.

1985 COMPUTER USER'S DESK DIARY, Gil Roeder and Jason A. Shulman. New York: Workman Publishing, 1984; 128 pages, 14.5 by 23 cm, spiral-bound, ISBN 0-89480-692-0, $8.95.

OMNI COMPLETE CATALOG OF COMPUTER SOFTWARE, Owen Davies, ed. New York: Macmillan Publishing Co., 1984; 482 pages, 21.3 by 27.5 cm, softcover, 0-02-008310-6, $13.95.

1-2-3 RUN! 41 READY-TO-USE LOTUS 1-2-3 MODELS, Robert Flast and Lauren Flast. Berkeley, CA: Osborne/McGraw-Hill, 1985; 304 pages, 20.5 by 27.5 cm, softcover, ISBN 0-88134-142-8, $16.95.

1-2-3 TIPS, TRICKS, AND TRAPS, Dick Andersen and Douglas Ford Cobb. Indianapolis, IN: Que Corp., 1984; 282 pages, 18.5 by 23.5 cm, softcover, ISBN 0-88022-110-0, $14.94.

PERSONAL COMPUTERS: A COMPLETE HANDBOOK FOR BEGINNERS, William M. Brown. Chicago, IL: Chicago Review Press, 1984; 224 pages, 15 by 22.8 cm, softcover, ISBN 0-914091-49-2, $9.95.

P-FUNCTIONS AND BOOLEAN MATRIX FACTORIZATION, Andre Thayse. Lecture Notes in Computer Science #175. New York: Springer-Verlag, 1984; 256 pages, 16.5 by 24 cm, softcover, ISBN 0-387-13358-5, $13.

THE POLICEMAN'S BEARD IS HALF CONSTRUCTED, Racter. New York: Warner Books, 1984; 130 pages, 20.5 by 23 cm, softcover, ISBN 0-446-38051-2, $9.95.

THE PORTABLE COMPUTER BOOK, 1985 EDITION, James E. Balmer and Matthijs Moes. Los Angeles, CA: Arrays, 1984; 360 pages, 18.5 by 25 cm, softcover, ISBN 0-912003-36-7, $19.95.

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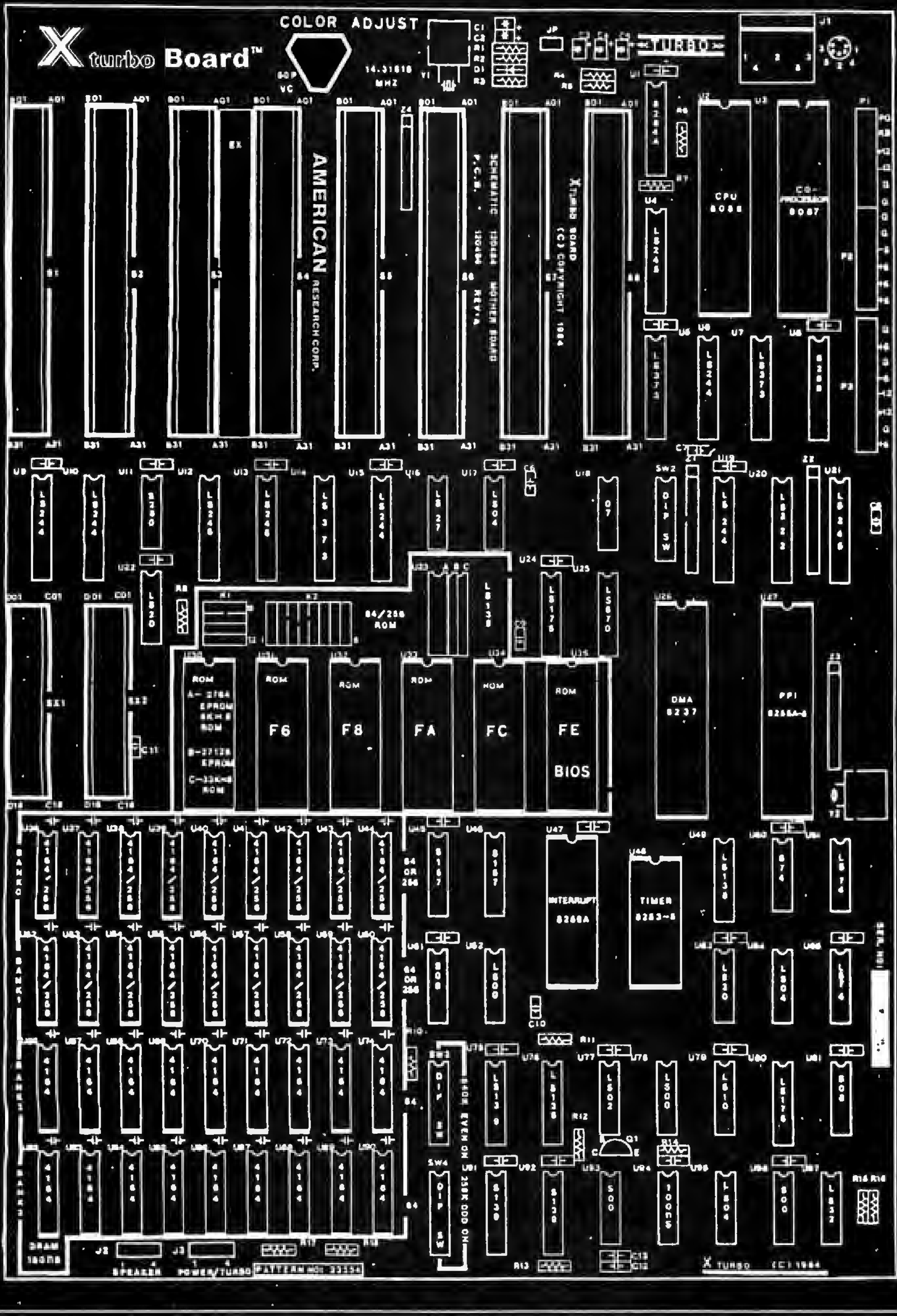

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BOOKS RECEIVED

PROBLEM ORIENTED PROGRAMMING LANGUAGES, Hans Jürgen Schneider. New York: John Wiley & Sons, 1984; 168 pages, 15.5 by 23.5 cm, hardcover, ISBN 0-471-90111-3, $23.95.

PROGRAMMING THE ADAM COMPUTER WITH READY-TO-RUN PROGRAMS, Susan Sutphin. Englewood Cliffs, NJ: Prentice-Hall, 1985; 208 pages, 15 by 22.8 cm, softcover, ISBN 0-13-729377-1, $15.95.

THE SOFTWARE CATALOG: BUSINESS SOFTWARE, International Software Database of Imprint Software. New York: Elsevier Science Publishing Co., 1984; 752 pages, 21.5 by 27.8 cm, softcover, ISBN 0-444-00934-5, $35.

SOFTWARE MASTER FOR PFS, Ted Leonsis and LIST Magazine. New York: Warner Books, 1984; 240 pages, 20.5 by 23.5 cm, softcover, ISBN 0-446-38217-5, $14.95.

SOFTWARE PORTABILITY AND STANDARDS, Ingemar Dahlstrand. New York: John Wiley & Sons, 1984; 150 pages, 17 by 24.5 cm, hardcover, ISBN 0-470-20083-9, $24.95.

TI-99/4A GAME PROGRAMS, Frederick Holtz. Blue Ridge Summit, PA: Tab Books, 1983; 240 pages, 19.5 by 23.5 cm, softcover, 0-8306-1630-6, $11.50.

TK!SOLVER USER'S HANDBOOK, staff of Weber Systems. Cleveland, OH: Weber Systems Inc., 1984; 300 pages, 15 by 22.5 cm, softcover, ISBN 0-938862-32-4, $14.95.

THE URGENTLY NEEDED PARENT'S GUIDE TO COMPUTERS, Brian Williams and Richard Tingey. Reading, MA: Addison-Wesley, 1984; 224 pages, 15.8 by 23.5 cm, softcover, ISBN 0-201-09666-8, $9.95.

USER GUIDE AND APPLICATIONS FOR THE TRS-80 MODEL 100 PORTABLE COMPUTER, Steve A. Schwartz. Glenview, IL: Scott, Foresman and Co., 1984; 146 pages, 19 by 23 cm, softcover, 0-673-15970-1, $17.95.

THE USERS GUIDE TO SMALL COMPUTERS, Jerry Pournelle. New York: Baen Enterprises, 1984; 350 pages, 13.5 by 21 cm, softcover, ISBN 0-671-55908-7, $9.95.

USING & PROGRAMMING THE IBM PCJR, Frederick Holtz. Blue Ridge Summit, PA: Tab Books, 1984; 256 pages, 18.5 by 23.5 cm, softcover, ISBN 0-8306-1830-9, $11.50.

USING LOTUS 1-2-3 TO SOLVE YOUR BUSINESS PROBLEMS, George Gershefski. Totowa, NJ: Rowman & Allanheld, 1984; 160 pages, 18 by 25 cm, softcover, ISBN 0-8476-7346-4, $19.95.

USING MACWRITE AND MACPAINT, Tim Field. Berkeley, CA: Osborne/McGraw-Hill, 1984; 208 pages, 18.5 by 23.3 cm, softcover, ISBN 0-88134-137-1, $11.95.

USING THE WANG FOR BUSINESS: THE TECHNICIAN'S PERSPECTIVE, VOLUME I, Bert Dumpé. New York: Harper & Row, 1984; 368 pages, 21 by 27.8 cm, softcover, ISBN 0-06-041801-X, $22.95

THE VIDEODISC BOOK: A GUIDE AND DIRECTORY, 1984 EDITION, Rod Daynes and Beverly Butler, eds. New York: John Wiley & Sons, 1984; 512 pages, 22.5 by 28.5 cm, hardcover, ISBN 0-471-80342-1, $75.

WANG WORD PROCESSING COMPANION, Debra J. Tait. Bowie, MD: Brady Communications Co., 1985; 256 pages, 18.5 by 23.5 cm, spiral-bound, ISBN 0-89303-945-4, $17.95.

WHAT A LAWYER NEEDS TO KNOW TO BUY AND USE A COMPUTER, Robert P. Wilkins. Lexington, SC: R. P. W. Publishing, 1984; 122 pages, 17.5 by 22.8 cm, softcover, ISBN 0-960845O-2-X, $14.95.

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THE WORD PROCESSOR BUYER'S SURVIVAL MANUAL, Ralph Roberts. Blue Ridge Summit, PA: Tab Books, 1984; 320 pages, 13 by 21 cm, software, ISBN 0-8306-1642-X, $10.95. ■

(continued from page 32)

The IBM part number for the 130-W supply is 8529247.

If you are going to install a hard disk, do yourself a favor and buy the BIOS and DOS from IBM. Most users are not willing or able to undertake the massive amount of effort in writing their own DOS. Not to mention the risk involved in possibly destroying data with a marginal DOS driver.

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, mention was made that you should not "turn the power on and off with the heads over the outer track." To facilitate this, the IBM Diagnostic disk for the XT has a program called Shipdisk, which must be run as the last activity before you turn the system off. I can't overemphasize this. You must run Shipdisk last thing before power-off.

Once the Shipdisk program has been started, the system will lock up, unable to do anything—this is normal (if it returned you to the C: prompt, the heads would be over track 0, the directory).

IBM says that the Shipdisk program should be run even if the system is to be moved two inches across a desk! You will lose all of your data if you do not run this program prior to moving the system at all!

The disk manufacturers will often attach a label warning that the warranty will be void if the disk is subjected to shocks exceeding 25 Gs. This is roughly equivalent to a six-inch drop. A reliable, visible indication of this level of drop is given by a Shock Watch indicator available from Media Recovery Inc. These indicators are available in a variety of sensitivities and give an unambiguous indication (they turn bright red on impact) and are nonreversible. If you cannot obtain them locally, we (Microcenters) will sell a 23-G unit for $5 each plus shipping.

In the section on hard-disk care it is stated that hard disks are "heavily filtered." While this is true of large (washing-machine-size) disk drives, the disks that you will be installing are completely sealed. There is no air entrance of any kind into the disk chamber. The advice of not smoking around your equipment is valid for your floppy disks and is recommended for all computer installations.

Mark M. Lambert
Chief Engineer
Microcenters Service Corp.
Miami, FL

Roy M. Matney replies:

Mark 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 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 $200 when they don't need to. 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 im-

purities, the higher the probability of something finally getting through.

I hope that these clarifications are of use and urge everyone to consider adding a hard disk to his system.

Random-Number Computation

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

$$W = (\Sigma(O_i - E_i)^2/E_i - n)/\sqrt{2n}$$

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 BASICA 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 $I_i = (a(I_{i-1} \bmod 2^{16}) + c) \bmod 2^{24}$, for a = 214013, c = 13,523,655. Thus the cycle is 2^{16} = 65,536. The mod 2^{16} 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 affordably priced units are within reach of many of us. This

(continued)

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.

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 DOS are arguably correct, 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 routinely run three programs at once. I've never encountered an abnormal response, much less a disaster. I do, however, limit myself to programs listed in the documentation shipped with the operating system.

The only limitation I've discovered to Concurrent DOS's multitasking ability is the system's mammoth size. It takes up about 150K bytes of my 512K-byte complement. If I load the File Manager package, I lose about another 70K bytes.

Finally, on a nontechnical issue, your statement that "DR's CP/M line of products received a sound trouncing from Microsoft's MS-DOS and PC-DOS for 16-bit computers" is misleading to the point of be-

(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 DR 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

142) very interesting.

Mr. Rodina did three tests on the floppy disks he had obtained. There is a fourth test that I wish Mr. Rodina had done: Run CHKDSK on each disk to find out the number of bad sectors. I think it would be very interesting to know the average number of bad sectors (or bad bytes) per disk.

STEVEN BURICK
Hollywood, FL

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

I Like Raike

I wish to thank you for introducing the BYTE Japan column in BYTE. I wish to thank Mr. Raike for including some nice C programs within BYTE Japan. I am always interested in seeing other programmers' C techniques. When I learned C I had been using Pascal for several years, and I thought at first that I was taking a step backward. I was quite delighted to discover that as I became more familiar with C's constructs, they permitted introducing more structure into my code than Pascal permits.

I recently adapted Mr. Raike's cdir (August 1984) utility for my CPM-86 system. I also included the ability to restrict the files retrieved to: (a) just DIR or SYS files; (b) to just RO or RW files; or (c) to some combination such as SYS RW files. The only problem I encountered was due to a difference in the way returned values from bdos were handled. On my system, hex ff returned in the al register

(continued)

was not sign-extended to hex ffff in the ax register. Consequently, the test for *i* equal to −1 in lookup always failed and ther program ran until a bdos error returned to the ccp.

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$(TEMP)
180 REM Left-set the string into the
        field
190   LSET F1$ = TEMP$
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 Now convert it back to a
        number
270   T1 = CVD(F1$)
280 REM Print the number
290   PRINT T1
300 END
```

While the IBM PCs and many of the compatibles run the program without error, some of the compatibles fail in statement 270, where the CVD function attempts to convert a string representation into a number. Our experience to date has shown that nearly half (4 of 10) of the systems tested have failed while attempting this CVD conversion. However, the problem is not with the CVD function.

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 CLOSE 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:

Machine	Scope of FIELD Statement
Columbia	Global
Commuter	Local
Compaq	Global
Data General DGI	Global
Eagle	Global
ITT-Xtra	Local
IBM PCs (all)	Global
Leading Edge	Local
Panasonic Sr. Partner	Global
Tandy 1200	Local

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 reallocation 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 closed 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 ■

NEW SYSTEMS

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 voicing 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.

Yamaha's CX5M *music computer.*


The CX5M *with optional keyboard and software.*

The CX5M has 32K bytes of ROM and an equal amount of RAM. It has audio, joystick, printer, video monitor, and cassette hookups 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 BH8 9QW, 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)

NEW SYSTEMS

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, and 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 $475. 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.

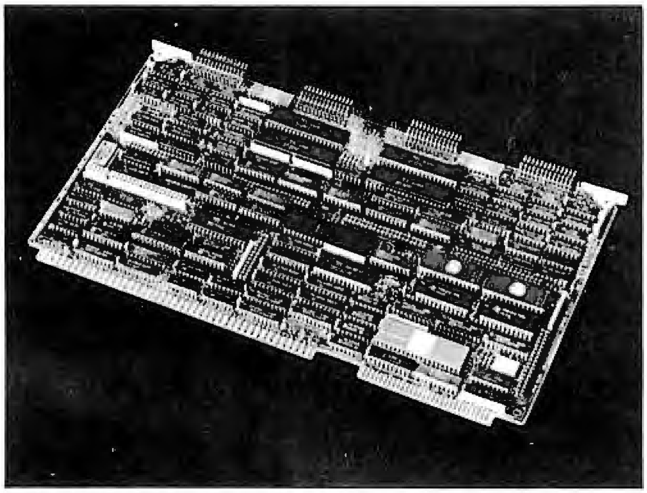
The DCS-570 is $6250. A model with a 10-megabyte hard-disk drive and one floppy-disk unit is $8000. Contact Multitech Industrial Corp., International Marketing Division, 266 Sung Chiang Rd., 9F, Taipei, Taiwan, Republic of China; tel: (02) 551-1101; Telex: "19162 MULTIIC."
Inquiry 618.

ADD-INS

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 is a single board for multiuser communications.

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.

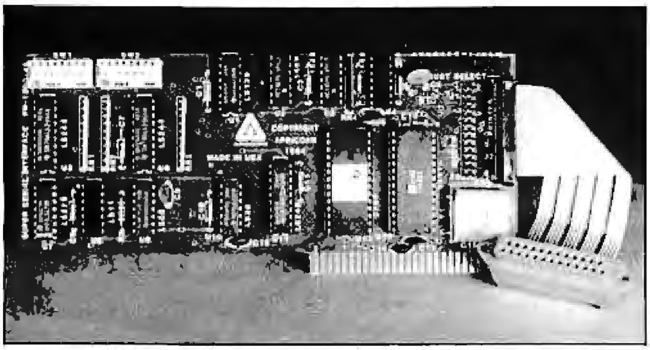
The COM16's unit price is $1890. Contact Microbar Systems Inc., 785 Lucerne Dr., Sunnyvale, CA 94086, (408) 720-9300.
Inquiry 619.

ADD-INS

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.



The Super Serial Imager transfers images from screen to printer.

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**.

Voicecraft

Logical Business Machines' Voicecraft system operates on the IBM PC XT and compatibles with 128K bytes or more of RAM. This dedicated speech-recognition system includes a full-size plug-in board, three microphone options, and user manuals. It supports 32,000 words in storable/switchable vocabularies with up to 500 words in each.

Voicecraft runs on IBM PC software without modification. Each word in a given application's vocabulary can invoke user-defined macro commands of up to 1000 keystrokes. Voicecraft's voice-transfer rate is under 200 milliseconds.

The Voicecraft system sells for $895. For further information, contact Logical Business Machines, 1294 Hammerwood Ave., Sunnyvale, CA 94089, (408) 744-1290.
Inquiry **621**.

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.

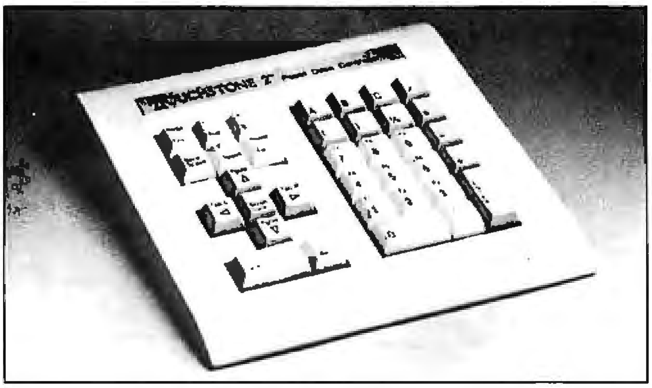
In its 16K-byte configuration, the Sprite and Stereo Board is $249. The 64K-byte version costs $299. Contact Development Devices, RD 3, Box 490, Middlebury, VT 05753, (802) 388-6698.
Inquiry **622**.

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.

The Touchstone 2 is 8 inches square and has a coiled cable that extends to 6 feet and terminates in two DIN-type connectors. One connector plugs into the keyboard port at the rear of the PC cabinet. The other attaches to the standard keyboard connector for combined operation.

The Touchstone 2 rapid data controller is sold with a one-year warranty for $199.95. Contact Touchstone Technology Inc., 955 Buffalo Rd., POB 24954, Rochester, NY 14624, (716) 235-8358.
Inquiry **623**.

(continued)

PERIPHERALS

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 *image scanner integrates with a number of host computers.*

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

Soniture'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.

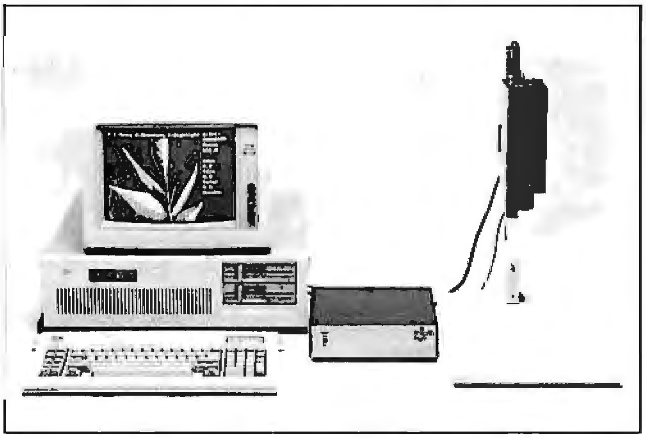
Soniture provides a software sampler with each Space Tablet. For the Apple II and IBM PCjr, the Space Tablet is $175. The IBM PC version costs $200, and the Atari and Commodore models sell for $150. The IBM PC version requires a $75 expansion card. For more information, contact Soniture Inc., 2146 Paragon Dr., San Jose, CA 95131, (408) 435-0217.
Inquiry 626.

IBM PC AT Image Analysis

Digithurst 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 image scanner and camera with 256- by 256-pixel resolution is priced at £1950; the MicroScale IIR frame store and camera with 512- by 512-pixel resolution is £4405. Contact Digithurst Ltd., Leaden Hill, Orwell, Royston, Hertfordshire, SG8 5QH, England, tel: (0223) 208926.
Inquiry 625.



The MicroScale II *package performs image processing for the* IBM PC AT.

PERIPHERALS

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 A114, 1630 Oakland Rd., San Jose, CA 95131, (408) 293-3360.
Inquiry 627.

Keyboard for the Disabled

Key Tronic has a version of its IBM PC or PC XT plug-compatible keyboard that is modified to make input easier for disabled persons. The special keyboard, Model KB5150H, has alternate action switches at accessible locations. The Shift and *Return* keys are in the familiar typewriter locations. Also the F and J home keys have a raised bar on the key tops, and the 5 key on the numeric keypad is dimpled.

The KB5150H keyboard costs $209. Contact Key Tronic, POB 14687, Spokane, WA 99214, (509) 928-8000.
Inquiry 631.

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, IIc, 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.
Inquiry 629.

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 5¼-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.

The Model F353-MFD sells for $150. Contact Everett/Charles Marketing Services Inc., 6101 Cherry Ave., Fontana, CA 92335, (800) 443-1860; in California, (800) 821-0589.
Inquiry 632.

(continued)

SOFTWARE • APPLE

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 styles, including carved stone, wood grain, and plumbing pipes. Most of the letters are available in 72 point and larger.

The program is used in conjunction with MacPaint. Because the character sets are located in MacPaint documents, you can instantly access the sets without having to give up disk space by installing them in the Mac font file.

Headline Graphics has a suggested retail price of $24.95. Contact American Softwerkz, POB 678, Brandon, FL 34299, (813) 626-0755.
Inquiry **634**.

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 buttons; the computer will sound an alarm or quietly keep time when the device is triggered.

Apple Alarm comes with a manual that contains suggestions for constructing burglar alarms, floor-mat switches, and light and heat sensors. The program, which costs $20, requires 48K bytes of RAM, one disk drive, DOS 3.3, and paddles. For complete details, contact Andent Inc., 1000 North Ave., Waukegan, IL 60085, (312) 223-5077.
Inquiry **633**.

Package Lays Out Pages for Newsletters and Flyers

ReadySetGo is an interactive page-makeup 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.

Text can either be keyed in directly or brought in from an external Mac program. Text can be subjected to full editing functions, and ReadySetGo lets you change fonts, styles, and size at any point in the copy. With any editing or text-size alteration, your display is updated.

Graphics blocks can contain rules, borders, solids, or pictures. Pictures can be brought in from such programs as MacPaint. Graphics are automatically scaled as their block is resized.

ReadySetGo supports standard Mac fonts and such typefaces as Times and Helvetica. Type sizes can range from 1 to 99 picas. Most standard page sizes are supported. Scaled views of full pages can be called up.

Pages can be stored as a full document with layout and contents. You can also store layouts for later use. An Imagewriter or Laser Printer will produce hard copy of your pages.

The suggested retail price for ReadySetGo is $125. For more information, contact Manhattan Graphics, 163 Varick St., New York, NY 10013, (212) 924-2778.
Inquiry **635**.

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 subfiles. 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.

Softeam will distribute 1st Base, which is published by the DeskTop Software Corporation of Princeton, New Jersey. The suggested list price is $195. Contact Softeam Inc., 900 West Walnut St., POB 9022, Compton, CA 90220, (213) 604-7400.
Inquiry **636**.

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 establishes communications through a modem with NAPLPS videotex databases. This software features a double-high-resolution graphics mode, and it will display text and graphics in up to 16 colors. You can save any displayed page to disk and recall pages stored locally. SOFDEC supports hard-copy printouts through dot-matrix printers.

Designed for the Apple IIc, SOFDEC "C" costs $160.

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.
Inquiry **637**.

SOFTWARE • IBM PC

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 double-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**.

Gryphon Microproducts' library of add-in products.

dBASE Report Generator

You can connect up to six databases in one report and define reports up to 255 columns wide with Quickreport, 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. Quickreport 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.

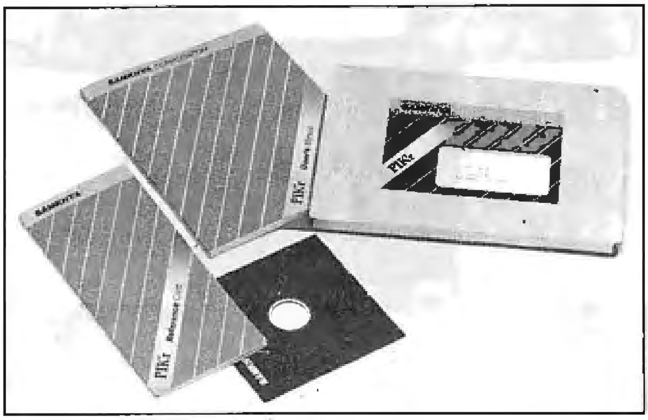
Quickreport runs on the IBM PC, PC XT, or systems that are totally compatible. Requirements include 256K bytes of memory, IBM PC-DOS 2.0 or later, two double-sided disk drives on the PC or a double-sided drive on the XT, dBASE II or III, and any printer. Quickreport costs $295. Contact Fox & Geller Inc., 604 Market St., Elmwood Park, NJ 07407, (800) 221-0156; in New Jersey, (201) 794-8883.
Inquiry **640**.

(continued)

SOFTWARE • IBM PC

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.



Samkhya Software's PIK'r.

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 enables 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 Samkhya 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 **642**.

Network Operating System

QNX 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 jobs across the whole network. As a result, any program or application can access any serial port, printer, or disk on the network.

QNX 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. QNX is available in a form suitable for porting to other 8088/8086/80186/80286 computers.

QNX 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 $18.

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 you 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**.

SOFTWARE • CP/M/MS-DOS

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, in-line 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 microcomputer. 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 MODEM7 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 $49. 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 1 card with GO86 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, DeSmet, Introl, and McCosh/Microware 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-80 runs on any 8080, 8085, or Z80 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)

SOFTWARE • OTHER COMPUTERS

BASIC Compiler for Models III and 4

VIVACE! is a BASIC compiler for Radio Shack's TRS-80 Models 4 and 4P with TRSDOS 6.x and the Model III running TRSDOS 1.3.

This compiler does not require program rewriting because it directly supports such BASIC commands as CALL, CHAIN, DEF FN, DEFSTR, ERASE, SYSTEM CMD, FRE, NEW, RUN, TRON, VARPTR, WHILE/WEND, and any FOR/NEXT convention that operates under the interpreter. Programs to be compiled do not have to be saved in ASCII format.

VIVACE! accepts a plain /BAS file for input and generates a /CMD file as output. Compiled programs are said to run from 1.1 to 10 times faster than original code. String reorganizations are reported to be hundreds of times faster than with the BASIC interpreter alone.

With a manual, VIVACE! is $49.95. Contact The Alternate Source, 704 North Pennsylvania Ave., Lansing, MI 48906, (517) 482-8270.
Inquiry **650**.

C-64 and VIC Database Program

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 Burstein, 510 Little Creek Rd., Lynchburg, VA 24502.
Inquiry **651**.

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, POB 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' interests? and (b) is it new or is it simply a reintroduction of an old item? Because of the volume of submissions we must sort through every month, the items we publish are based on vendors' statements and are not individually verified. If you want your product to 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, POB 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 III 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 update, review, delete, full line editing in a field, memory-full and I/O 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, POB 9602, Marina Del Rey, CA 90295.
Inquiry **653**.

PRIORITY ONE ELECTRONICS

VIASYN/CompuPro S-100 BOARD SPECIALS!!

M-DRIVE H™ High-Speed RAM Disk Emulator

512K Board	2MByte Board
$695 Ea.	**$2450** Ea.
2 for $1295	2 for $4500
SAVE $1655!	SAVE $3490!
BOGBTA072	BOGBTA348

CPU 286
Ultra High Performance 16 Bit S-100 CPU Board

NEWEST C VERSION!
Fixes B Level Bugs!

List Price: $1595.00 **SALE PRICE:**

$895

BOGBT51028

S-100/PC Video Board

- PC compatible monochrome & RGB video in text and graphics!
- Fast bit mapped graphics! • RUNS LOTUS!
- Also compatible with Digital Research's GSX graphics software!
- Works with CompuPro 8088/286/& 8086 CPU boards!

Supplied with the IBM PC™ compatibility module and requires Concurrent DOS 8-16™ and 256K of RAM for operation.

BOGBTA356 LIST PRICE: $495.00

SALE PRICE: $475

BOGBTCDOS816 Concurrent DOS 8-16™ operating system ***$400***

BOGBT51081 SPU Z Slave Processor, List: $395.00 ***SALE PRICE: $379.00***

For More Information on These VIASYN/CompuPro Boards See Their Ad In This Magazine

IBM PC™ COMPATIBLE ADD-ONs

Franklin Hard Disks with Controllers

Description	Part no.	Price
10MB Internal 10 lbs.	BOFTCHOI10	$ 699
10MB External 18 lbs	BOFTCHDX10	$ 895
10MB Int rnal ½-Height 8 lbs	BOFTCI10HH	$ 699
20MB Internal ½-Height 8 lbs	BOFTCI20HH	$1195
15MB Internal 10 lbs	BOFTCHOI15	$ 995
15MB External 18 lbs	BOFTCHOX15	$1095
33MB Internal 12 lbs	BOFTCHDI33	$1895
33MB External 20 lbs	BOFTCHDX33	$2095

Memory Expansion

Description	Part no.	Price
64K RAM expansion for IBM PC™ contains 9-4164's 1 lb 150ns	BOPDBIBMMEM9	$ 25
256K Dynamic RAM chips 150ns	BOHM50256P15	$ 30

8 or more $19.95 each

IBM AT™ Compatible Hard Disk Drive

Description	Part no.	Price
1.2Mbyte ½height w/hrdware 5lbs	BOIIATFDO	$ 395
20Mbyte hrd dsk formattd SEAGATE 5lbs	BDSEAST225F	$ 895
33Mbyte IBM color video card 2lbs.	BDIBM1504910	$ 250
IBM Monochrome Card 2lbs.	BDIBM1504900	$ 250

IBM-PC™ COMPATIBLE MONITORS

Description	Part no.	Price
IBM 12" greenscreen 18lbs.	BOIBM5151001	$ 275
TAXAN 12" green screen for IBM 18lbs.	BOTAX121	$ 169
TAXAN 12" amber screen for IBM 18lbs.	BOTAX122	$ 179
IBM 13" color RGB 28lbs	BOIBM5153001	$ 680
TAXAN 12" color RGB w/cable 28lbs.	BOTAXRGB420	$ 495

STD CARDS (2 lbs. each)

Description	Part no.	Price
Super RIO (64K)	BOSTBSRIO	$ 319
Super I/O II	BOSTSIO	$ 199
RIO PLUS II (64K)	BOSTBRIOPLS	$ 289
Graphic PLUS II	BOSTBGRPLS2	$ 395

TECMAR BOARDS

Description	Part no.	Price
The CAPTAIN™ Multi board 64K	BOTECCAPTAIN	$ 259
GRAPHICS MASTER™	BOTECGRMSTR	$ 499
EXPANSION CHASSIS for IBM PC™ 8slot	BOTECEXPCHS	$ 749

HERCULES GRAPHIC CARDS

Description	Part no.	Price
High res monochrome card	BOHECGC	$ 339
Color card with printer port	BOHECCOLOR	$ 179

QUADRAM CARDS (2 lbs. each)

Description	Part no.	Price
EXPANDED QUADBOARD (0 K)	BOOORQOBROXPO	$ 239
QUADBOARD II	BOOORODBROIIO	$ 229
QUADCOLOR I™	BOOOROOCLRI	$ 219
QUADCOLOR II™	BOOORODCLRII	$ 449
QUAD 512 (64K installed)	BOOOROD512+	$ 259
QUADLINK	BOOOROOLINK	$ 539
Serial int card 1-RS232	BOQDRRS232	$ 89
Serial expansion for above	BOOORRS232EXP	$ 40
Parallel card	BOOORIPIC	$ 89

VIDEO MONITORS

Description	Part no.	Price
SANYO 12MHz 12" Amber 18 lbs.	BOSYOOM2212	$ 79
SANYO 18MHz 12" Green 24 lbs.	BOSYOOM8112CX	$ 129
SANYO 18MHz 12" Amber 24 lbs.	BOSYOOM8212CX	$ 129
TAXAN 18MHz 12" Green 18 lbs.	BOTAX115	$ 139
TAXAN 18MHz 12" Amber 18 lbs.	BOTAX116	$ 139
SANYO 13" RGB color 7MHz 30 lbs.	BOSYDOM7500	$ 379
TAXAN 12" RGB color 6MHz 50 lbs	BOTAX210	$ 319

MICRO COMPUTER ACCESSORIES

See Page 287 For Details

Description	Part no.	Price
Keyboard Storage Drawer 10 lbs	BOMCA610	$ 89
Tilt N Turn Monitor Base 3 lbs	BOMCA900	$30
Rolltop Disk File w/o lock 3 lbs	BOMCA100	$30

KEYTRONICS

Description	Part no.	Price
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IBM PCjr™ replacement keybrd	BOKEYKB5151JR	$199
PCjr™ Numeric Data Entry Pad 3 lbs.	BOKEYKB5149JR	$ 89

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Description	Part No.	Price
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1200 Baud for IBM-PC™ w/software	BOOCH1200B	$ 429
300 Baud Smartmodem	BOOCH0200P	$ 249
Micromodem II for Apple	BOOCH701400	$ 249

PROMETHEUS

Description	Part No.	Price
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ProModem IBM-PC™ card w/software	BOPRMPM1200B	$289
ProModem Apple II card w/software	BOPRMPM1200A	$349
ProModem for Macintosh w/cable & software	BOPRMPM1200M	$399
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Options processor for ProModem	BOPRMOPTPRO	$ 79
64K Memory exp for options processor	BOFOBPRMEXP64	$ 59

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2 to 5 Drives $110 each / 6 or more Drives $99 each		
WORLD DISK DRIVES Double side dbl/density 18 lbs.	BOWD02008P	$ 219
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MITSUBISHI dbl side, dbl dens 18lbs.	BOMITM2894638	$ 375
TANDON ½ height sgl side, dbl dens 9lbs.	BOTNOTM8481E	$ 319
TANDON ½ height dbl side, dbl dens 9lbs.	BOTNDTM8482E	$ 389

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Description	Part No.	Price
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TEAC 48tpi ½ height, dbl side 3lbs.	BOTEA55B	$ 155
TEAC 96tpi ½ height, dbl side 3lbs	BOTEA55F	$ 169
TANDON 100-2 40trk full height, dbl side 4lbs.	BOTNOTM1002	$ 199

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Description	Part No.	Price
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TANDON 19.2Mbyte Hrd Disk	BOTND503	$ 895
Seagate ST225 ½ high 25Mbyte 5lbs	BOSEAST225	$ 795
MAXTOR 85Mbyte 30ms access 12lbs	BOMX1XT1085	$2995
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FX80 20lbs	BOEPNFX80+	$ 399
FX100 26lbs	BOEPNFX100+	$ 599
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LQ1500 Par int. 30cps	BOPOBEPNLQ1500P	$1199

OKIDATA

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84A - serial 35 lbs.	BOOKIOAT84AS	$ 979
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CompuPro 8085/88 dual processor	BOGBTA041	$ 399
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ADVANCED DIGITAL SuperSix w/floppy controller, 128K RAM	BOADCSUP6128	$ 699
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46505	14.75	5037	21.95	8002	19.95
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1013A	3.95	8250	10.50	TMS5501	14.95
1015A	6.75	IM6402	7.75	2651	8.95

EPROMS

1702 (1mS)	$3.90	2732A-4 (450nS)	$6.50
2708 (450nS)	3.65	2732A (250nS)	8.95
2758 (5V)	5.50	2732A-2 (200nS)	12.50
2716 (450nS)	3.75	2764 (450nS)	6.50
2716 (350nS)	5.50	2764 (250nS)	7.50
2516 (5V)	5.50	2764 (200nS)	17.50
TMS2716	7.50	TMS2564 (450nS)	12.95
TMS2532	5.60	MCM68764 (450nS)	34.95
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CMOS EPROMS		27C32	$14.95
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STATIC RAMS

2101 (450nS)	$2.29	MK4118	$4.95
21L02 (450nS)	.99	TMM2016-2 (200nS)	4.10
2102-1 (450nS)	.79	TMM2016-15 (150n)	4.95
21L02-2 (250nS)	1.39	TMM2016-1 (100nS)	6.10
2111 (450nS)	2.75	HM6116P-4 (200nS)	4.75
2112 (450nS)	2.75	HM6116P-3 (150nS)	4.95
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2114L-4 (450n)	1.69 8/12.50	HM6116LP-4 (LP)	5.90
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2147 (55nS)	4.50	Z6132 (300nS)	32.95
4044-4 (450nS)	3.25	HM6264P-15 (150nS)	32.95
4044-3 (300nS)	3.75	HM6264LP-15 (LP)	36.95
4044-2 (200nS)	4.35	74S189 (35nS)	1.85
UPD410 (100nS)	3.75	93415 (50nS)	3.95
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4116N-4 (250nS)	1.45 8/10.50	TMS4060 (300nS)	1.85
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LM310CN	1.65	LM723H	.75	RC4151	3.75
LM311CN	.62	LM733	.98	CA3023	2.75
LM312H	1.75	LM739	1.85	CA3039	1.25
LM318CN	1.45	LM741CN	.33	CA3046	1.25
LM318H	1.55	LM741H	.40	CA3059	2.85
LM319N	1.19	LM741N	.29	CA3060	2.85
LM320 (see VRs)		LM747	.65	CA3065	1.69
LM324N	.55	LM748	.55	CA3080	1.10
LM339N	.95	LM1014	1.15	CA3081	1.60
LM340 (see VRs)		LM1303	1.90	CA3082	1.60
LM348N	.95	LM1310	1.45	CA3083	1.55
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LM392N	.69	ULN2003	1.49	TL071CP	.79
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7403	.19	7450	.19	74128	.49	74180	.75
7404	.19	7451	.19	74132	.45	74181	1.75
7405	.23	7453	.19	74136	.75	74182	1.15
7406	.49	7454	.19	74141	.85	74184	2.25
7407	.49	7459	.25	74142	2.95	74185	2.25
7408	.24	7460	.37	74143	3.70	74190	.67
7409	.19	7470	.29	74144	2.95	74191	.67
7410	.19	7472	.29	74145	.59	74192	.67
7411	.24	7473	.33	74147	1.49	74193	.67
7412	.38	7474	.34	74148	1.19	74194	.67
7413	.34	7475	.38	74150	1.09	74195	.67
7414	.49	7476	.34	74151	.55	74196	.75
7416	.49	7479	4.60	74152	.67	74197	.86
7417	.49	7480	.69	74153	.53	74198	1.15
7420	.19	7482	.95	74154	1.19	74199	1.15
7421	.35	7483	.45	74155	.69	74221	1.19
7422	.45	7485	.55	74156	.59	74251	.75
7423	.58	7486	.35	74157	.59	74273	1.65
7425	.29	7489	1.95	74158	1.65	74276	1.89
7426	.29	7490	.35	74159	1.58	74279	.75
7427	.25	7491	.65	74160	.79	74283	1.40
7428	.55	7492	.45	74161	.69	74284	2.90
7430	.18	7493	.35	74162	.69	74285	2.90
7432	.29	7494	.85	74163	.69	74290	1.49
7437	.25	7495	.50	74164	.69	74298	1.49
7438	.29	7496	.69	74165	.69	74365	.55
7439	.58	7497	2.70	74166	.85	74366	.55
7440	.19	74100	1.50	74167	2.75	74367	.55
7441	.79	74107	.24	74170	1.25	74368	.55
7442	.45	74109	.37	74172	4.75	74390	1.45
7443	1.15	74116	1.45	74173	.69	74393	1.33
7444	1.15	74121	.29	74174	.89	74490	2.25
7445	.68	74122	.44	74175	.69		

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74LS03	.25	74LS123	.95	74LS251	.59
74LS04	.33	74LS124	2.75	74LS253	.59
74LS05	.25	74LS125	.49	74LS257	.59
74LS08	.27	74LS126	.49	74LS258	.59
74LS09	.28	74LS132	.59	74LS259	2.95
74LS10	.25	74LS136	.39	74LS260	.59
74LS11	.33	74LS138	.59	74LS261	2.49
74LS12	.33	74LS139	.59	74LS266	.55
74LS13	.39	74LS145	1.19	74LS273	1.45
74LS14	.59	74LS148	1.38	74LS275	3.29
74LS15	.33	74LS151	.55	74LS279	.59
74LS20	.26	74LS153	.55	74LS283	.68
74LS21	.29	74LS154	1.49	74LS290	.88
74LS22	.29	74LS155	.69	74LS293	.78
74LS26	.29	74LS156	.69	74LS295	.98
74LS27	.29	74LS157	.69	74LS298	.88
74LS28	.29	74LS158	.69	74LS324	1.75
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74LS32	.33	74LS161	.69	74LS348	1.95
74LS33	.53	74LS162	.69	74LS352	1.25
74LS37	.35	74LS163	.69	74LS353	1.25
74LS38	.39	74LS164	.69	74LS363	1.29
74LS40	.25	74LS165	.90	74LS365	.48
74LS42	.44	74LS166	1.90	74LS366	.48
74LS47	.74	74LS168	1.15	74LS367	.45
74LS48	.74	74LS169	1.15	74LS368	.45
74LS51	.25	74LS170	1.40	74LS373	1.39
74LS54	.29	74LS173	.67	74LS374	1.33
74LS55	.29	74LS174	.67	74LS375	.69
74LS73	.39	74LS175	.67	74LS377	1.38
74LS74	.34	74LS181	1.95	74LS385	1.95
74LS75	.39	74LS190	.85	74LS386	.45
74LS76	.39	74LS191	.85	74LS390	1.15
74LS78	.39	74LS192	.78	74LS393	1.15
74LS83	.59	74LS193	.78	74LS395	1.15
74LS85	.69	74LS194	.69	74LS399	1.47
74LS86	.39	74LS195	.69	74LS424	2.95
74LS90	.54	74LS196	.79	74LS668	1.75
74LS92	.54	74LS197	.79	74LS670	2.29
74LS93	.54	74LS221	.89	81LS95	1.45
74LS95	.75	74LS240	.95	81LS96	1.45
74LS96	.89	74LS242	.95	81LS97	1.45
74LS107	.39	74LS243	.95	81LS98	1.45
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4007	.25	4032	2.15	4070	.35	4510	.79
4008	.95	4034	1.91	4071	.28	4511	.79
4009	.39	4035	.79	4072	.28	4512	.79
4010	.39	4037	1.95	4073	.28	4514	1.18
4011	.24	4040	.75	4075	.28	4515	1.79
4012	.24	4041	.75	4076	.75	4516	1.19
4013	.35	4042	.65	4077	.35	4518	.85
4014	.75	4043	.85	4078	.35	4520	.75
4015	.39	4044	.69	4081	.29	4555	.95
4016	.35	4046	.80	4082	.29	4556	.95
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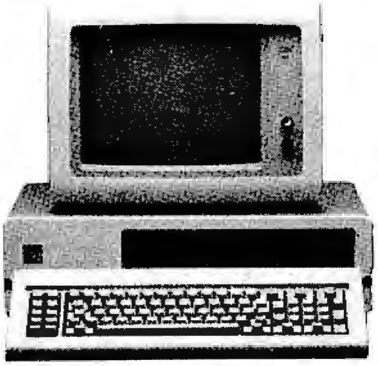

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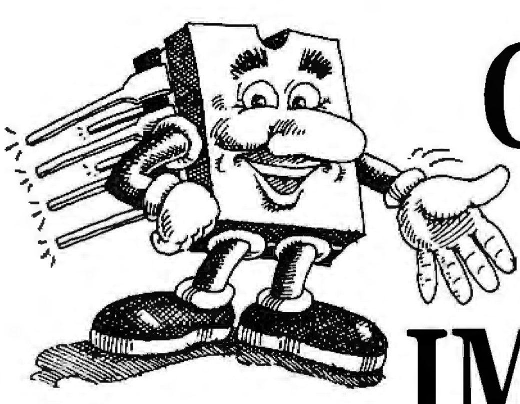

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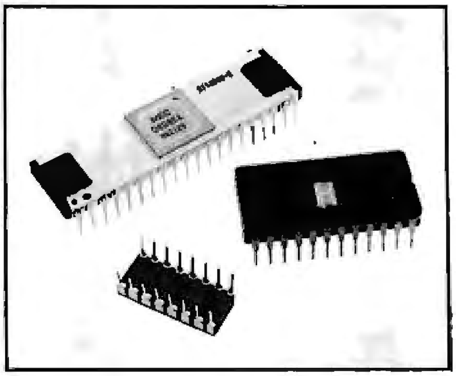

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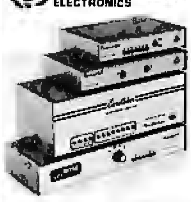

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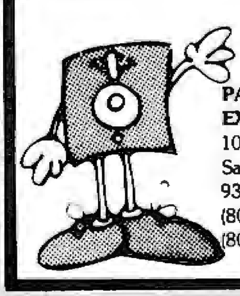

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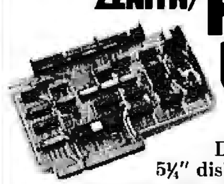

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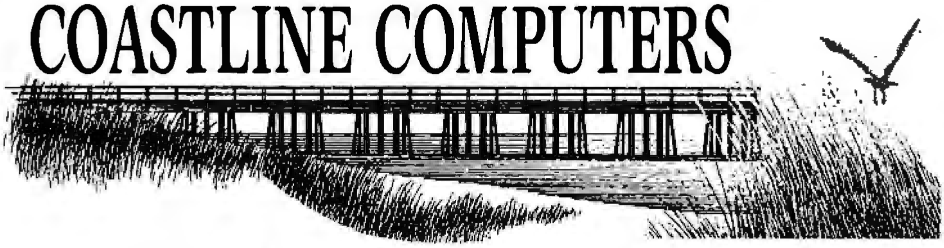

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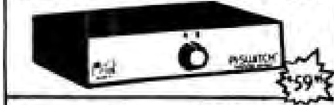

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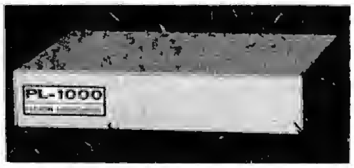

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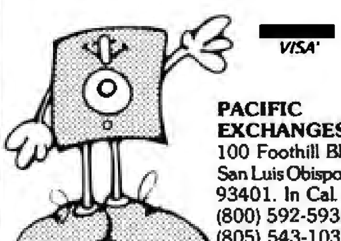

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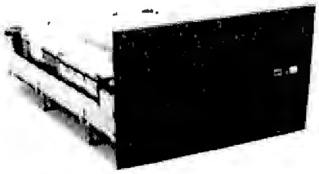

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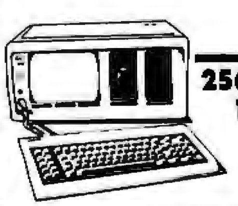

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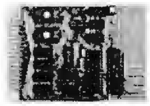

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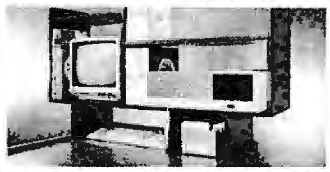

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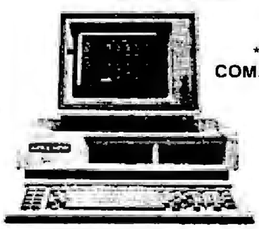

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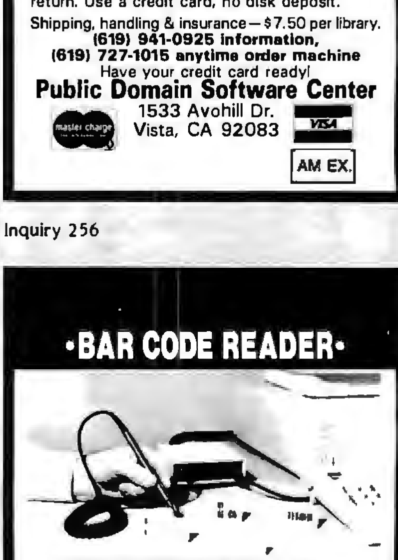

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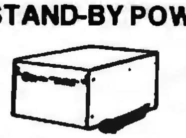

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74LS15	.34	74LS154	1.85	74LS324	1.70
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74LS22	.24	74LS157	.64	74LS363	1.30
74LS26	.28	74LS158	.58	74LS364	1.90
74LS27	.28	74LS160	.68	74LS366	.48
74LS28	.34	74LS161	.64	74LS366	.48
74LS30	.24	74LS162	.68	74LS367	.44
74LS32	.28	74LS163	.64	74LS368	.44
74LS33	.54	74LS164	.68	74LS373	1.35
74LS37	.34	74LS165	.94	74LS374	1.35
74LS38	.34	74LS166	1.90	74LS377	1.35
74LS40	.24	74LS168	1.70	74LS378	1.13
74LS42	.48	74LS169	1.70	74LS378	1.30
74LS47	.74	74LS170	1.46	74LS385	1.85
74LS48	.74	74LS173	.68	74LS386	.44
74LS49	.74	74LS174	.54	74LS390	1.15
74LS51	.24	74LS175	.54	74LS393	1.15
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74LS86	.38	74LS221	.88	74LS670	1.45
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74LS91	.88	74LS241	.98	74LS682	3.15
74LS92	.54	74LS242	.98	74LS683	3.15
74LS93	.54	74LS243	.98	74LS684	3.15
74LS95	.74	74LS244	1.26	74LS685	3.15
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74LS113	.38	74LS251	.58	81LS96	1.45
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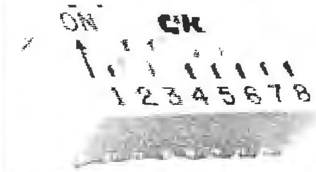

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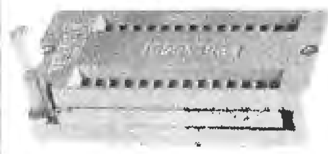

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14 pin ST.	.14	14 pin WW.	.68
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18 pin ST.	.19	18 pin WW.	.98
20 pin ST.	.28	20 pin WW.	1.04
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32.000	32.0000 MHz	6.99

CRYSTALS

1.0000 MHz	3.89	8.0000 MHz	2.69
1.8432 MHz	3.69	10.0000 MHz	2.69
2.0000 MHz	2.89	10.7388 MHz	2.69
2.0972 MHz	2.89	12.0000 MHz	2.69
2.4576 MHz	2.69	14.3182 MHz	2.69
3.2768 MHz	2.69	15.0000 MHz	2.69
3.5795 MHz	2.89	16.0000 MHz	2.69
4.0000 MHz	2.69	17.4300 MHz	2.69
4.1943 MHz	2.89	18.0000 MHz	2.69
4.9160 MHz	2.89	18.4320 MHz	2.69
5.0000 MHz	2.69	19.6608 MHz	2.69
5.0688 MHz	2.69	20.0000 MHz	2.69
5.1860 MHz	2.69	22.1184 MHz	2.69
5.2429 MHz	2.69	32.0000 MHz	2.69
5.7143 MHz	2.69	36.0000 MHz	2.69
6.0000 MHz	2.89	48.0000 MHz	2.69
6.1440 MHz	2.69	49.4350 MHz	2.69
6.4000 MHz	2.69	49.8900 MHz	2.69
6.5536 MHz	2.89		

32.768 KHz...... 1.69

VOLTAGE REGULATORS

7805T	.74	7905T	.84
78M05C	.34	7908T	.84
7808T	.74	7912T	.84
7812T	.74	7915T	.84
7815T	.74	7924T	.84
7824T	.74	7905K	1.44
7805K	1.34	7912K	1.44
7812K	1.34	7915K	1.44
7815K	1.34	7924K	1.44
7824K	1.34	79L05	.78
76L05	.68	79L12	.78
78L12	.68	79L15	.78
78L15	.68	LM323K	4.90
78H05K	9.90	UA78S40	1.90
78H12K	9.90		

C,T = TO-220 K = TO-3
L = TO-92

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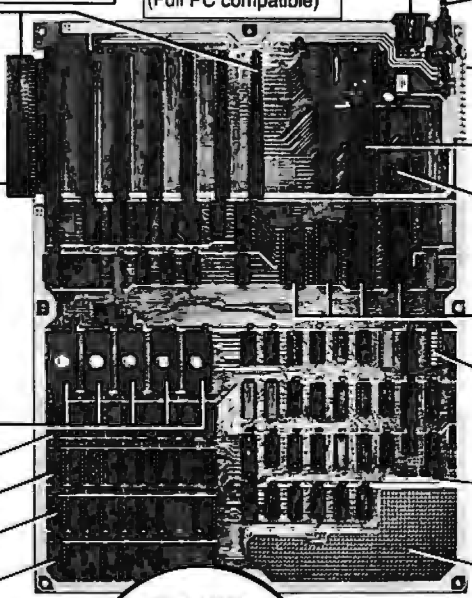

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☐ USERS MANUAL WITH THEORY OF OPERATION, SCHEMATICS, BLOCK DIAGRAM, APPLICATION NOTES . . . . $ 19.95

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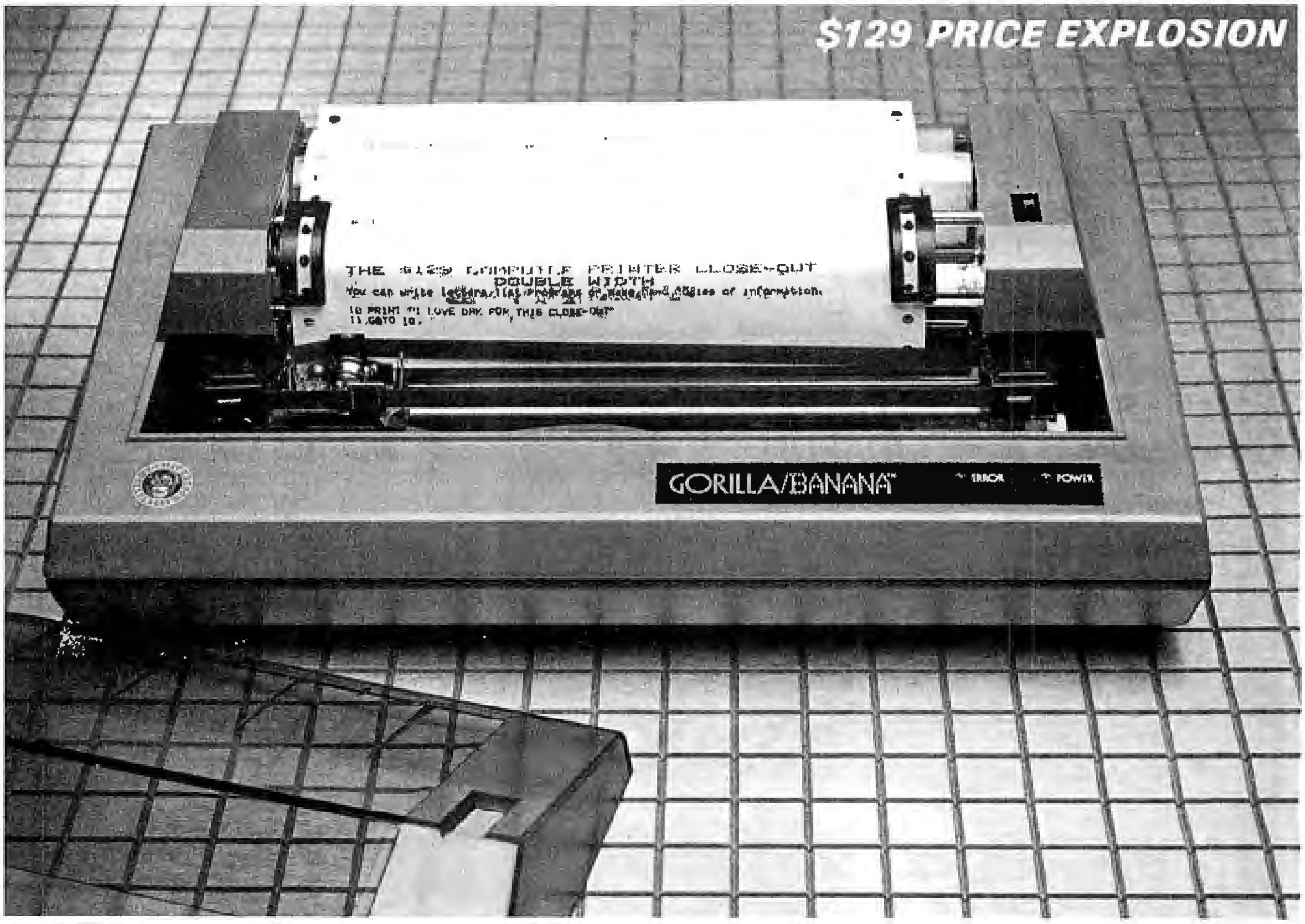

The Complete Computer

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 data base will let you find or organize and print out any information you want, however you want, whenever you want. There's no more complicated programming required. And, inexpensive data base programs are availible 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 Com puServe 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 hooked to your computer, you'll never have to retype anything 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 nation wide.

It takes standard long life inked ribbon cassettes that are readily available nation-wide. This is a printer that will give you many years of continuous reliable service and enjoyment.

AND NOW THE BAD NEWS

If you're 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.

But, 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, j, p, q, and y are level with the other letters. Each letter is completely and perfectly 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, programming and 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, TRS80, Osborn, Atari, Commodore VIC 20, Commodore 64, Kaypro, and 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.

So, rather than sell you something you don't need, you don't buy an interface untill you add onto your computer.

There are two types of printer interfaces. The first allows you to do text word 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 told where to go. This interface, or '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 a printer, the same Centronics parallel interface and cable (about 85% of all printers are compatible) should work with this printer.

With this printer you can alter your graphics as you desire. You can print normal or reversed (both shown above, reduced to fit in this catalog) and you can even print double size.

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 limited 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, your 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 the TRS80 Color Computer, order the identical printer with a built-in Serial Interface for the same price. Use Order No. 4102.

The Printer comes packaged with a long life ribbon. Extra ribbons are available at computer stores. DAK has them for **$4** each ($1 P&H) Order No. 4103.

Standard Centronics Interfaces 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 favorites 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 capable 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 usually 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. 9879. 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 on up to 200 subjects at a time. 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. 4122 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's plug.

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.

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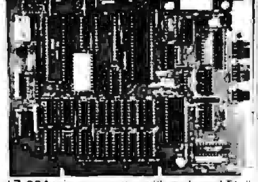
NEC RGB COLOR MONITOR $259

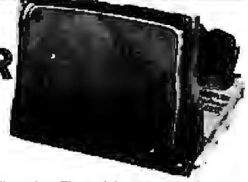
The NEC JC-1401D is a 13" medium/high resolution RGB monitor suitable for use with the Sanyo MBC-550/555 or the IBM/PC. The monitor features a resolution of 400 dots by 240 lines. Colors available are Red, Green, Blue, Yellow, Cyan, Magenta, Black and White. These monitors are currently being used in applications far more critical than microcomputers.
The NEC monitor carries the Litton-Monroe label and was originally scheduled for use in their "Office of the Future" equipment. A change in Monroe's marketing strategy has made these units excess inventory which were sold to California Digital. We are offering these prime "new" RGB monitors at a fraction of their original cost. Sanyo compatible NEC-1401/S; IBM/P/C Computer compatible NEC-1401/PC

Ampro Little Board $339



The Ampro Little Board is a single board Z-80A microcomputer with on board 5¼" disk controller, 64K/btyes of memory two serial ports along with a Centronics parallel printer port. This computer is supplied with enhanced CP/M 2.2 with well documented user manual. APO-LB1A

CONRAC 9" MONITOR $59

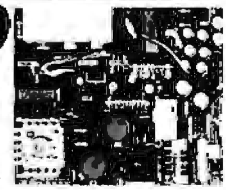


A crisp display is assured with the conrac 9" monitor. This unit features 12 volt only operation, open frame construction, separate high resolution video and most of all incomparable Conrac quality. Documentation includes schematic and theory of operation. CON-9BW

ASCII KEYBOARD $49

California Digital has purchased over 3000 of these Microswitch keyboards from the General Dynamics Corporation. 93 ASCII encoded Hall effect switches includes 8 function keys and 14 key numeric cluster make this keyboard an excellect value at only $49. MIC-93GD We also have available a matching General Dynamics steel trim panel. $10

Switching Supply $49



Power your single board system with one supply! This Kepro switcher power supply outputs +5 volts at 5 amps, +12 volts at 1.8 amps, 2.8 amps surge, −12 volts at 0.5 amps, and a second +12 volts at 2.0 amp output. It is jumper selectable for both 120 volt and 220 volt operation. Units measures approximately 6" by 8". This board is capable of supplying power for two 5¼" Winchesters, a single board computer along with a hard disk controller. Also suitable for use with all IBM look-a-likes. Priced at only $49.95 this power supply offers excellent value along with high reliability. KPT-512

MONITORS

BMC 12A green phosphor 15 MHz composit video	BMC-12A	78.95
BMC 12" high resolution, 20MHz	BMC-12EN	119.00
Amdek 300G 12" green phospher	AMK-300G	128.95
Amdek300A 12" amberphos., hi-resolution	AMK-300A	138.95
Amdek 310A designed for IBM/PC, amber	AMK-310A	158.95
Zenith ZVM122 Amber Phosphor 12 40/80 column switch	ZTH-122	89.95
Zenith ZVM123 green phosphor 12 40/80 column switch	ZTH-Z123	89.95
NEC JB1201 green phosphor 18 MHz composit video.	NEC-JB1201	159.00
NEC JB1260 commercial grade composit	NEC-JB1260	119.00
Conrac 9" openframe requires horz sync & 12v supply	CON-BW9	59.00

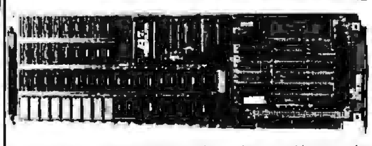
COLOR

NEC JC1401D Medium/High 13" RGB	NEC-1401/X	259.00
BMC AU9191U Color composit video with sound	BMC-9191	238.95
BMC 9191M RGB designed for use with the IBM computer	BMC-9191M	379.00
NEC JC1203DM, RGB color monitor	NEC-1203	699.00
NEC JC1215 color composit.	NEC-JC1215	339.00
Zenith ZVM 135 RGB & composite suitable for IBM PC	ZTH-Z135	475.00
Amdek Color I, 13 composit video	AMK-100	299.00
Amdek Color II+, 13 RGB hi/resolution	AMK-200	419.95
Amdek Color III+, 13" RGB, medium resolution	AMK-300	359.95
Princeton HX-12 RGB IBM/PC compatible	PRN-HX12	478.95

EAGLE $895

The Eagle IIE/2 Computer features a 12" non-glare green phosphor CRT, typewriter style keyboard with separate numeric cluster. This unit provides two 5 1/4" drives for a combined storage capacity of 780 K/Byte. The computer contains a 4Mhz Z-80A. DMA disk interface, two RS-232C serial ports, Centronics printer interface, along with an auxillary parallel port.
Software included consists of ULTRACALC electronic spread sheet, SPELLBINDER word processor, CBASIC2, CP/M 2.2, and an exclusive Eagle menu driven utility package.
These units are all "factory new" and are being offered far below their suggested price of $2495. This is your opportunity to purchase a complete CP/M system for only $895

DigiGraphics Multifunction Card $179



The Digigraphic 384M multifunction card is a work-a-like to the over priced AST Sixpack Plus but at a much more attractive price.
Memory is expandible to 384K/byte, battery backed up clock/calendar, fully programmable RS-232 communication port, centronics parallel port, and game port as standard equipment making this card an outstanding value.
Software is also provided for clock/calendar functions, RAM-Disk up to 360K, print spooler for up to 3 printers, as well as diagnostic memory tests.
$179.00 no memory DGC-384/0; $219.00 64K/byte memory DGC-384/64.

PRINTERS

MATRIX PRINTERS

Star Gemini-10X 120 char/sec	STR-G10X	259.00
Star Gemini-15X, 100 char./sec 15" paper	STR-G15X	365.00
Star Gemini Delta 10, 160 Char/sec	STR-D10	399.00
Star Coex 80FT friction & tractor	VST-C80FT	179.00
Toshiba P1351, 192 char/sec. letter quality	TOS-1351	1495.00
Okidata 82A serial & parallel 9½" paper	OKI-82A	329.00
Okidata 92A parallel interface, 160 char/sec.	OKI-92A	399.00
Okidata 83A & parallel 15" paper	OKI-83A	559.00
Okidata 84A & parallel 15" paper	OKI-84A	929.00
Epson RX-80 10" 120 Char/sec	EPS-RX80	259.00
Epson FX80, 10" 160 char./sec. with graphtrax	EPS-FX80	439.00
Epson FX 100 15" 160 char./sec with graphtrax	EPS-FX100	629.00
Epson LQ1500, 15" corespondence quality	EPS-LQ1500	1179.00
Epson JX80 Color printer	EPS-JX80	579.00
Anadex 9501B high speed with graphics	ADX-9501B	1029.00
Anadex 9620B 200 char/sec. par'l & serial	ADX-9620B	1129.00
Prowriter 8510 parallel 9½" paper	PRO-8510P	359.00
Prowriter II, parallel 15" paper, graphics	PRO-2P	689.00
Dataproducts B-600-3, band printer 600 LPM.	DPS-B600	6985.00
Printronix P300 high speed printer 300 lines per minute	PTX-P300	3995.00
Printronix P600 ultra high speed 600 lines per minute.	PTX-P600	5795.00

WORD PROCESSING PRINTERS

NEC7710 55 char/second, serial interface	NEC-7710	1795.00
NEC7730 55 char/sec. par'l interface	NEC-7730	1795.00
NEC3550 popular printer designed for the IBM/PC	NEC-3550	1599.00
NEC2050 designed for IBM/PC 20 char/sec. par'l.	NEC-2050	995.00
Silver Reed EXP500, 14 char/sec. par'l interface	SRD-EXP500	459.00
Silver Reed EXP550 17 Char/sec par'l interface.	SRD-EXP550	659.00
Diablo 630 40 char/sec, serial	DBL-630	1765.00
Diablo 620, proportional spacing, horz.& vert. tab 20 cps.	DBL-620	775.00
Juki 6100 18 char./sec. SPECIAL	JUK-6100	429.00
Brother HR1A serial interface	BTH-HR1S	695.00
Starwriter F10 serial, 40 char/sec	PRO-F10S	1125.00
Starwriter F10 parallel, 40 char/sec	PRO-F10P	1125.00
Comrex CR2, 5k buffer, proportional spacing, par'l.	CRX-CR2P	495.00

PROMETHEUS ProModem 1200 $339

The Prometheus Promodem 1200 is best value that we have seen in a 300/1200 baud modem. This Hayes compatible modem features completely unattended operation, auto answer/auto dial and even includes "redial number when busy". Internal diagnostics makes the Promodem 1200 an easy modem to install. Help commands, real time clock and internal speaker add to the ease of use of this unit.

An optional processor accessory allows battery back up, extra memory space for storing additional phone numbers, messages received, and can act as a transfer buffer when exchanging programs.

The Alphanumeric display option allows messages saved to be displayed when they were received, diagnostic test results, numbers in the directory, as well as modem status.

Return of a Smash Hit Sellout DRAGON $139

Compatible with most Radio Shack Color Computer software. The world famous Dragon computer is now available in the United States. Manufactured by the Tano Corp. under license of the British Broadcasting Company. The Dragon comes complete with 64K Byte of memory, serial modem port along with a Centronics printer interface. This unique microcomputer features Motorola's advanced 6809E microprocessor and comes standard with Microsoft Color Basic, data base manager, and a complete word processing package. The computer outputs color composite video along with R.F. video that allows the unit to be used in conjunction with any color television. This is the ideal low cost computer to be used with any dial up information system such as the Source, Western Union's EasyLink or any other time share service

TERMINALS

Freedom 100, split screen, detatchable keyboard	LIB-F100	495.00
Qume 102 green phosphor terminal	QUM-102	539.00
Ampex Dialogue 125 green screen,	APX-D125G	675.00
Ampex Dialouge 175 amber screen, two page, func. keys	APX-D175A	719.00
Wyse 50, 14" green phosphor	WYS-50	595.00
Wyse 300, Eight color display, split screen.	WYS-300	1159.00
Zenith 29 terminal, VT52 compatible, detatch ble keyboard.	ZTH-Z29	765.00
Televideo 910 Plus, block mode	TVI-910P	575.00
Televideo 925, detatchable keyboard, 22 function keys	TVI-925	759.00
Televideo 950, graphicchar.,split screen, 22 func	TVI-950	950.00
Televideo 970, 14" green, 132 column, European	TVI-970	1095.00

MODEMS

CTS 212AH 1200 baud, auto dial	CTS-212AH	319.00
Signalman Mark 12, 1200 baud, Hayes compatible	SGL-MK12	259.00
Signalman Mark 1, direct connect with terminal cable	SGL-MK1	75.00
Hayes Smart Modem 1200 baud, auto answer, auto dial	HYS-212AD	479.00
Hayes 1200B for use with the IBM/PC, 1200 baud	HYS-1200B	429.00
Hayes Smartmodem, 300 baud only, auto answer, auto dial	HYS-103AD	229.00
Hayes Micromodem II, 103 Apple direct connect	HYS-MM2	279.00
Hayes Chronograph, time & date	HYS-CHR232	199.00
Prometheus 1200 super features	PRM-P1200	339.00
Prometheus 1200B internal PC	PRM-P1200B	279.00
Team 1200 Hayes Compatible	TEM-SM1200	229.00
U.S. Robotics 212A 300/1200 baud, auto dial/answer	USR-212A	439.00
U.S. Robotics Password 300/1200 baud	USR-PW212	389.00
Penril 300/1200 industrial quality	PEN-12AD	595.00
Universal Data 103LP line power, answer & originate	UDS-103LP	169.00
Universal Data 202, 1200 baud, half duplex only	UDS-202LP	219.00
Universal Data 212LP, full 1200 baud duplex, line power	UDS-212LP	359.00
Novation J Cat direct connect, auto answer	NOV-JCAT	115.00

Shugart 604 WINCHESTER $159

These 6.7 Megabyte drives are new units recently released by the Shugart division of Xerox.
The Shugart 604 is fully 506 industry compatible. Each drive is tested before shipment and is supplied with a 90 day warranty. SHU-604

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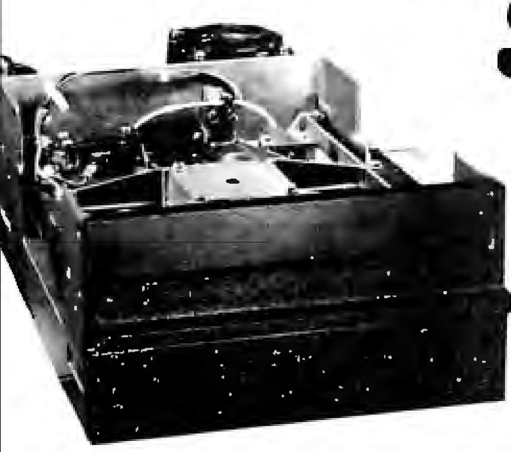
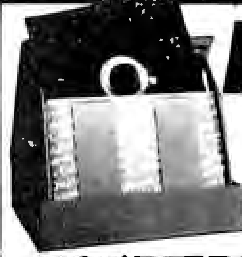


Shugart

$159

The Shugart 801R has long been the standard by which all other eight inch disk drives have been judged. The 801R has historically been used by thousands of quality conscious equipment manufacturers because of their extremely high degree of reliability.
These units are current production, rackmountable LSI tech- The drives are identical to drives currently sold by distributors at $600.
California Digital has aquired these NEW units as a result of a change of marketing strategy of the A.M. Jaquard Corporation. This is the best value that has ever been offered on any Shugart eight inch disk drive. SHU-801R



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VERBATIM	VRB-525/01 / VRB-525/10 / VRB-525/16	22.95	21.7	20.75
MEMOREX	MRX-3481 / MRX-3483 / MRX-3485	19.95	18.7	17.85
MAXELL	MXL-MD1 / MXL-MH1/10 / MXL-MH1/16	22.95	21.7	20.75
DYSAN	DYS-104/1D / DYS-107/1D / DYS-105/1D	32.25	31.0	29.75

OUBLE SIDED DOUBLE DENSITY

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SCOTCH	MMM.745/0 / MMM.745/10 / MMM-745/16	29.95	27.95	24.75
	VRB-550/01 / VRB.550/10 / VRB-550/16	29.95	27.95	23.75
	MRX-3491 / MRX-3493 / MRX-3495	27.95	26.75	24.25
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MAXELL / HD	MXL-MD2/96 / N/A / N/A		CALL	
DYSAN	DYS-104/2D / DYS-107/2D / DYS-105/2D	42.50	40.50	35.50
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VERBATIM	VRB-34/9000	31.50	29.50	25.60
DYSAN	DYS-3740/1	35.75	32.75	29.75

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MEMOREX	MRX-3090	31.95	27.75	26.15
VERBATIM	VRB-34/8000	35.25	33.25	28.75
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MAXELL	MXL-FD1	45.50	39.75	35.15

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MEMOREX	MRX-3102	37.95	36.75	31.50
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RODINE RO-208 53 Meg.	1589	1493
MAXTOR XT1065 65 Meg.	1995	1965
SHUGART 712 13 Meg. ½ Ht	795	765
SHUGART 604 6.7 Meg.	159	149
TANDON 502 10 Meg.	419	395
TANDON 503 19 Meg.	795	775

Upon request, all drives are supplied with power connectors and manual

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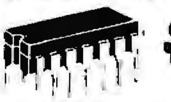
4164 DYNAMIC MEMORY 150ns $3.95



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		1-31	32 +	100 +
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4116 200ns.16K	ICM-4116200	1.75	1.65	1.45
4164 150ns. 64K 128 refresh	ICM-4164150	3.95	3.40	3.25
41256150ns. 256K	ICM-41256150	18.95	17.50	14.75
4228for IBM/AT	ICM-4128150	18.95	17.50	14.75
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CONTROL DATA 9428 ½ ht.	119	115	109
SHUGART SA455 Half Height	139	135	129
PANASONIC JA551/2N (455)	139	135	129
SHUGART SA465 ½ Ht. 96TPI	239	229	219
TANDON 100-2 full height	169	165	169
TANDON 101-4 96TPI full ht.	329	319	305
MITSUBISHI 4851 half height	159	149	145
MITSUBISHI 4853 96/TPI½ Ht.	169	159	155
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REMEX

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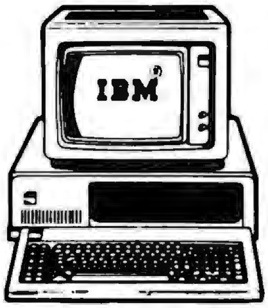

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7426	.29	74123	.49	74198	1.35
7427	.29	74125	.45	74199	1.35
7428	.45	74126	.45	74221	1.35
7430	.19	74128	.55	74246	1.35
7432	.29	74132	.45	74247	1.25
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7472	.29	74161	.69	74367	.65
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74HCT27	.69	74HCT243	2.19
74HCT30	.69	74HCT244	2.19
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LM310	1.75	LM711	.79
LM311	.64	LM723	.49
LM311H	.89	LM723H	.55
LM312H	1.75	LM733	.98
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LM317T	1.19	LM741N-14	.35
LM318	1.49	LM741H	.40
LM318H	1.59	LM747	.69
LM319H	1.90	LM748	.59
LM319	1.25	LM1014	1.19
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LM322	1.65	LM1310	1.49
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LM324	.59	MC1349	1.89
LM329	.65	MC1350	1.19
LM331	3.95	MC1358	1.69
LM334	1.19	MC1372	6.95
LM335	1.40	LM1414	1.59
LM336	1.75	LM1458	.59
LM337T	1.95	LM1488	.69
LM337K	3.95	LM1489	.69
LM338K	3.95	LM1496	.85
LM339	.99	LM1558H	3.10
LM340	see7800	LM1800	2.37
LM348	.99	LM1812	8.25
LM350K	4.95	LM1830	3.50
LM350T	4.60	LM1871	5.49
LM358	.69	LM1872	5.49
LM359	1.79	LM1877	3.52
LM376	3.75	LM1889	1.95
LM377	1.95	LM1896	1.75
LM378	2.50	ULN2003	1.29
LM379	4.50	XR2206	3.75
LM380	.89	LM2877	2.05
LM380N-8	1.10	LM2878	2.25
LM381	1.60	LM2900	.85
LM382	1.60	LM2901	1.00
LM383	1.95	MPQ2907	1.95
LM384	1.95	LM2917	2.95
LM386	.89	LM3900	.59
LM387	1.40	LM3905	1.25
LM389	1.35	LM3909	.98
LM390	1.95	LM3911	2.25
LM392	.69	LM3914	3.95
LM393	1.29	LM3915	3.95
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NE555	.34	RC4136	1.25
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LM565	.99	RC4558	.69
LM566	1.49	LM13600	1.49
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CA3039	1.29	CA3086	.80
CA3046	1.25	CA3089	2.98
CA3059	2.90	CA3096	3.49
CA3060	2.90	CA3130	1.30
CA3065	1.75	CA3140	1.15
CA3080	1.10	CA3146	1.85
CA3081	1.65	CA3160	1.19
CA3082	1.65	CA3183	.99

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TL496	1.65	75450	.59
TL497	3.25	75451	.39
75107	1.49	75452	.39
75108	1.49	75453	.39
75110	1.95	75454	.39
75150	1.95	75491	.79
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75188	1.25	75493	.89
75189	1.25	75494	.89

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TL071	.79	LF351	.60
TL072	1.19	LF353	1.00
TL074	2.19	LF355	1.10
TL081	.79	LF356	1.10
TL082	1.19	LF357	1.40
TL083	1.19	LF411	1.29
TL084	2.19	LF412	1.99

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MPS918	.25	2N3903	.25
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2N2218	.50	2N3906	.10
2N2218A	.50	2N4122	.25
2N2219	.50	2N4123	.25
2N2219A	.50	2N4249	.25
2N2222	.25	2N4304	.75
PN2222	.10	2N4401	.25
MPS2369	.25	2N4402	.25
2N2484	.25	2N4403	.25
2N2905	.50	2N4857	1.00
2N2907	.25	PN4916	.25
PN2907	.13	2N5086	.25
2N3055	.79	PN5129	.25
3055T	.69	PN5139	.25
2N3393	.30	2N5209	.25
2N3414	.25	2N6028	.35
2N3563	.40	2N6043	1.75
2N3565	.40	2N6045	1.75
PN3565	.25	MPS-A05	.25
MPS3638	.25	MPS-A06	.25
MPS3640	.25	MPS-A13	.40
PN3643	.25	MPS-A55	.25
PN3644	.25	MPU-131	.99
MPS3704	.15	TIP29	.65
MPS3706	.15	TIP31	.75
		TIP32	.79

IC SOCKETS

	1-99	100
8 PIN ST	.13	.11
14 PIN ST	.15	.12
16 PIN ST	.17	.13
18 PIN ST	.20	.18
20 PIN ST	.29	.27
22 PIN ST	.30	.27
24 PIN ST	.30	.27
28 PIN ST	.40	.32
40 PIN ST	.49	.39
64 PIN ST	4.25	CALL

ST=SOLDERTAIL

8 PIN WW	.59	.49
14 PIN WW	.69	.52
16 PIN WW	.69	.58
18 PIN WW	.99	.90
20 PIN WW	1.09	.98
22 PIN WW	1.39	1.28
24 PIN WW	1.49	1.35
28 PIN WW	1.69	1.49
40 PIN WW	1.99	1.80

WW=WIREWRAP

INTERFACE

8T26	1.59
8T28	1.98
8T95	.89
8T96	.89
8T97	.89
8T98	.89
DM8131	2.95
DP8304	2.29
DS8833	2.25
DS8835	1.99
DS8836	.99
DS8837	1.65
DS8838	1.30

INTERSIL

ICL7106	9.95
ICL7107	12.95
ICL7660	2.95
ICL8038	3.95
ICM7207A	5.59
ICM7208	15.95

DATA AQC

ADC0800	15.55
ADC0804	3.49
ADC0809	4.49
ADC0816	14.95
ADC0817	9.95
ADC0831	8.95
DAC0800	4.49
DAC0806	1.95
DAC0808	2.95
DAC1020	8.25
DAC1021	7.95
DAC1022	5.95
MC1408L6	1.95
MC1408L8	2.95

EXAR

XR2206	3.75
XR2207	3.75
XR2208	3.75
XR2211	5.25
XR2240	3.25

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9304	.95
9316	1.00
9328	1.49
9334	2.50
9368	3.95
9401	9.95
9601	.75
9602	1.50
9637	2.95
96S02	1.95

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76477	3.95
76488	5.95
76489	8.95
SSI-263	39.95
AY3-8910	12.95
AY3-8912	12.95
MC3340	1.49
SP1000	39.00

OPTO-ISOLATORS

4N26	1.00	MCA-7	4.25
4N27	1.10	MCA-255	1.75
4N28	.69	IL-1	1.25
4N33	1.75	ILA-30	1.25
4N35	1.25	ILQ-74	2.75
4N37	1.25	H11C5	1.25
MCT-2	1.00	TIL-111	1.00
MCT-6	1.50	TIL-113	1.75

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4164	64K	200ns	9/$24.95

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TMM2016	2Kx8	200ns		$3.25
HM6116	2Kx8	200ns	CMOS	$3.69

EPROMS

27128	16Kx8	250ns	$13.95
2764	8Kx8	450ns	$4.95
2732	4Kx8	450ns	$4.25

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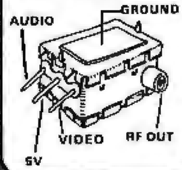

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LC-2	2 CONDUCTOR	6 ft	.39
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LC-HP	3 CONDUCTOR WITH STANDARD FEMALE SOCKET	6 ft	1.49
LC-CIR	CIGARETTE LIGHTER PLUG WITH 6 ft COILED CORD		2.95

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4.68" SQUARE	14.95
3" SQUARE	14.95

RESISTORS

¼ WATT 5% CARBON FILM
ALL STANDARD VALUES
FROM 1 OHM TO 10 MEG OHM

50 PIECES SAME VALUE	.025
100 PIECES SAME VALUE	.02
1000 PIECES SAME VALUE	.015

BYPASS CAPS

.01 µf DISC	100/$6.00
.01 µf MONOLITHIC	100/$12.00
.1 µf DISC	100/$8.00
.1 µf MONOLITHIC	100/$15.00

CAPACITORS

TANTALUM

1.0µf	15V	.40	.47µf	35V	.50
6.8	15V	.70	1.0	35V	.45
10	15V	.80	2.2	35V	.65
22	15V	1.35	4.7	35V	.85
.22	35V	.40	10	35V	1.00

DISC

10pf	50V	.05	560	50V	.05
22	50V	.05	680	50V	.05
25	50V	.05	820	50V	.05
27	50V	.05	.001µf	50V	.05
33	50V	.05	.0015	50V	.05
47	50V	.05	.0022	50V	.05
56	50V	.05	.005	50V	.05
68	50V	.05	.01	50V	.07
82	50V	.05	.02	50V	.07
100	50V	.05	.05	50V	.07
220	50V	.05	.1	12V	.10

MONOLITHIC

.01µf	50V	.14	.1µf	50V	.18
.047µf	50V	.15	.47µf	50V	.25

ELECTROLYTIC

RADIAL			AXIAL		
1µf	25V	.14	1µf	50V	.14
2.2	35V	.15	4.7	16V	.14
4.7	50V	.15	10	16V	.14
10	50V	.15	10	50V	.16
47	35V	.18	22	16V	.14
100	16V	.18	47	50V	.20
220	35V	.20	100	15V	.20
470	25V	.30	100	35V	.25
2200	16V	.60	220	25V	.30
			330	16V	.40
			550	16V	.42
			1000	16V	.60
			2200	16V	.70
			6000	16V	.85

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44,000µf 30V 3.95

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4 POSITION	.85
5 POSITION	.90
6 POSITION	.90
7 POSITION	.95
8 POSITION	.95
10 POSITION	1.29

EDGECARD CONNECTORS

S-100 ST	S-100	3.95
S-100 WW	S-100	4.95
72 PIN ST		6.95
72 PIN WW		7.95
62 PIN ST	IBM PC	4.95
50 PIN ST	APPLE	4.95
44 PIN ST		2.95
44 PIN WW		4.95

36 PIN CENTRONICS

IDCEN36	RIBBON CABLE MALE	8.95
IDCEN36/F	RIBBON CABLE FEMALE	8.95
CEN36	SOLDER CUP MALE	7.95

DIODES

1N751	5.1 VOLT ZENER	.25
1N759	12.0 VOLT ZENER	.25
1N4148	(1N914)SWITCHING	25/1.00
1N4001	50PIV 1A	12/1.00
1N4004	400PIV RECTIFIER	10/1.00
1N5402	200PIV 3A	.25
KBP02	200PIV 1 5A BRIDGE	.45
KBP04	400PIV 1.5A BRIDGE	.55
MDA801	50PIV 12A BRIDGE	1.39
MDA980-1	50PIV 12A BRIDGE	1.95
MDA980-2	100PIV 12A BRIDGE	2.25
VM48	DIP-BRIDGE	.35

LED DISPLAYS

HP5082-7760	CC	.43"	1.29
MAN-72	CA	.3"	.99
MAN-74	CC	.3"	.99
FND-357(359)	CC	.375"	1.25
FND-500(503)	CC	.5"	1.49
FND-507(510)	CA	.5"	1.49
TIL-311 4x7 HEX W/LOGIC		.270"	9.95

DIP CONNECTORS

DESCRIPTION	ORDER BY	CONTACTS								
		8	14	16	18	20	22	24	28	40
HIGH RELIABILITY TOOLED ST IC SOCKETS	AUGATxxST	.99	.99	.99	1.69	1.89	1.89	1.99	2.49	2.99
HIGH RELIABILITY TOOLED WW IC SOCKETS	AUGATxxWW	1.30	1.80	2.10	2.40	2.50	2.90	3.15	3.70	5.40
COMPONENT CARRIES (DIP HEADERS)	ICCxx	.49	.59	.69	.99	.99	.99	.99	1.09	1.49
RIBBON CABLE DIP PLUGS (IDC)	IDPxx	---	.95	.95	---	---	---	1.75	---	2.95

FOR ORDERING INSTRUCTIONS SEE IDC CONNECTORS BELOW

HEAT SINKS

TO-220	SCREW ON	.35
TO-220	CLIP ON	.35
TO-3	SCREW ON	.95
TO-220	INSULATOR	10/1.00
TO-3	INSULATOR	10/1.00

SWITCHES

SPDT	MINI-TOGGLE ON-ON	1.25
DPDT	MINI-TOGGLE ON-ON	1.50
DPDT	MINI-TOGGLE ON-OFF-ON	1.75
SPST	MINI-PUSHBUTTON N.O.	.39
SPST	MINI-PUSHBUTTON N.C.	.39
BCD OUT	10 POSITION 6 PIN DIP	1.95

DIFFUSED LEDS

		1-99	100-up
JUMBO RED	T1¾	.10	.09
JUMBO GREEN	T1¾	.18	.15
JUMBO YELLOW	T1¾	.18	.15
MOUNTING HDW	T1¾	.10	.09
MINI RED	T1	.10	.09
MINI GREEN	T1	.18	.15
MINI YELLOW	T1	.18	.15
RECT RED	2x5mm	.25	.22
RECT GREEN	2x5mm	.30	.27
RECT YELLOW	2x5mm	.30	.27

D-SUBMINIATURE

DESCRIPTION		ORDER BY	CONTACTS				
			9	15	25	37	50
SOLDER CUP	MALE	DBxxP	1.19	1.59	1.90	2.85	4.25
	FEMALE	DBxxS	1.50	1.85	2.25	3.90	5.25
RIGHT ANGLE PC SOLDER	MALE	DBxxPR	1.65	2.20	3.00	4.83	---
	FEMALE	DBxxSR	2.18	3.03	3.00	6.19	---
WIRE WRAP	MALE	DBxxPWW	1.69	2.56	3.89	5.60	---
	FEMALE	DBxxSWW	2.76	4.27	6.84	9.95	---
IDC RIBBON CABLE	MALE	IDBxxP	2.95	3.90	4.75	6.95	---
	FEMALE	IDBxxS	3.25	4.29	5.25	7.95	---
HOODS	BLACK	HOOD-B	---	---	.99	---	---
	GREY	HOOD	.89	.99	.99	1.09	1.19

IDB37S

DB37S

DB25SR

MOUNTING HARDWARE-$1.00

FOR ORDERING INSTRUCTIONS SEE IDC CONNECTORS BELOW

TEXTOOL ZERO INSERTION FORCE SOCKETS AND RECEPTACLES

SCREWDRIVER CLAMP
ECONO ZIF

LEVER CLAMP
ZIF SOCKET

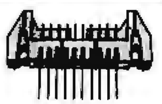
WW RECEPTACLES
ZIF RECEPTACLE

TYPE	CONTACTS				
	14	16	24	28	40
ECONO ZIF	---	4.95	6.75	7.75	9.95
ZIF SOCKET	4.95	4.95	5.95	6.95	9.95
ZIF RECEPTACLE	8.25	8.75	9.75	10.50	12.75

IDC CONNECTORS

DESCRIPTION	ORDER BY	CONTACTS					
		10	20	26	34	40	50
SOLDER HEADER	IDHxxS	.82	1.29	1.68	2.20	2.58	3.24
RIGHT ANGLE SOLDER HEADER	IDHxxSR	.85	1.35	1.76	2.31	2.72	3.39
WW HEADER	IDHxxW	1.86	2.98	3.84	4.50	5.28	6.63
RIGHT ANGLE WW HEADER	IDHxxWR	2.05	3.28	4.22	4.45	4.80	7.30
RIBBON HEADER SOCKET	IDSxx	.79	.99	1.39	1.59	1.99	2.26
RIBBON HEADER	IDMxx	---	5.50	6.25	7.00	7.50	8.50
RIBBON EDGE CARD	IDExx	1.75	2.25	2.65	2.75	3.80	3.95

ORDERING INSTUCTIONS: INSERT THE NUMBER OF CONTACTS IN THE POSITION MARKED "xx" OF THE "ORDER BY" PART NUMBER LISTED. EXAMPLE: A 10 PIN RIGHT ANGLE HOLDER STYLE WOULD BE IDH10SR



IDH20W

IDE50

RIBBON CABLE

CONTACTS	SINGLE COLOR		COLOR CODED	
	1'	10'	1'	10'
10	.18	1.60	.83	7.30
16	.28	2.50	1.00	8.80
20	.36	3.20	1.25	11.00
25	.45	4.00	1.32	11.60
26	.46	4.10	1.32	11.60
34	.61	5.40	1.65	14.50
40	.72	6.40	1.92	16.80
50	.89	7.50	2.50	22.00

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TERMS: Minimum order $10.00. For shipping and handling include $2.50 for UPS Ground and $3.50 for UPS Air. Orders over 1 lb. and foreign orders may require additional shipping charges - please contact our sales department for the amount. CA. residents must include 6% sales tax. Bay Area and LA residents include 6½%. All merchandise is warranted for 90 days unless otherwise stated. Prices are subject to change without notice. We are not responsible for typographical errors. We reserve the right to limit quantities and to substitute manufacturer. All merchandise subject to prior sale.

U·N·C·L·A·S·S·I·F·I·E·D A·D·S

WANTED: Benedictine monk seeks tax-deductible donation of IBM PC, minimum 256K to 512K RAM with graphics capabilities, two 360K disk drives or 5- or 10-megabyte hard-disk drive, color monitor, graphics tablet with pen. Brother Adam Kochlin, OSB, St. John's Abbey, Collegeville, MN 56321, (612) 363-2875.

WANTED: Nonprofit organization seeks tax-deductible donation of Apple or Apple-compatible with printer for use by nonpartisan voter registration and education campaign working in low-income and minority communities. Delaware County Project V.O.T.E., Chester YWCA, 7th and Sproul Sts., Chester, PA 19013, (215) 876-8226.

WANTED: Vocational instructor needs donation of hardware (any brand) for inmates learning computer use and repair. Richard Lamica, Adirondack Correctional Facility, POB 110, Ray Brook, NY 12977.

WANTED: Tax-deductible donations of computer and peripherals for parish church's communications and administration. Rev. Mark Grimes, Saint Maurice Church, 358 Glenbrook Rd., Stamford, CT 06906.

WANTED: Epson QX-10 users to join over 1000 members of the National Epson Users Group. Free sample newsletter. NEUG, POB 1076, Lemont, PA 16851.

AVAILABLE: Apple Computer donates microcomputer equipment to nonprofit organizations for networking. Send for guidelines. Apple Community Affairs, Apple Computer Inc., 20525 Mariani Ave. M/S 23-L, Cupertino, CA 95014.

FOR SALE: IBM PC floppy-drive controller: $95. New Maynard SandStar floppy-drive controller for IBM PC: $185 (with clock/calendar module: $215; module alone: $30). Profit Systems Multigraph monochrome/monochrome-graphics/color-graphics card for IBM PC: $385. All work perfectly. Michael Riggs, 825 7th Ave., New York, NY 10019, (212) 794-1430 or 887-8467.

FOR SALE: New Epson MX-100 printer, 100 cps: $549. Epson FX-100, 160 cps: $849. Smith-Corona TP-II letter-quality printer: $349. David Wong, POB 406, Croton Falls, NY 10519, (212) 294-8087.

FOR SALE: Apple hardware and compatible computer. Will sell parts separately. Philip Ragaway, 430 South Fuller Ave., Los Angeles, CA 90036, (213) 939-8026.

WANTED: C64 peripherals and accessories, and information exchange for our 300 members. The C64 Club, POB 2184, Manama, Bahrain.

AVAILABLE: CP/M and PC public-domain library disks on a variety of topics and in a variety of formats. Send SASE, J. Cramer, POB 28606, Columbus, OH 43228-0606.

WANTED: ROM expansion board, DD/DS, 40/80-track (Acorn-compatible), light pen, and information. M. Bourdon Bruno, 49/45 Boulevard Paul Verley, 59140 Dunkerque, France.

FOR SALE: Tandem 6530 multipage terminal, never used. Cost $2500; sell for $1800 or best offer. New Media Graphics laserdisc interface. Cost $425; sell for $300 or best offer. Xerox 5¼-inch dual disk-drive unit. Cost $850; best offer. Gordon Jennings, 2562 East Glade, Mesa, AZ 85204, (602) 892-0015.

WANTED: Commodore 64 or Apple IIe-compatible system. Indicate age, use, and condition. If you have additional accessories, include list. Greg Hamel, Route 5, Box 162, Watertown, WI 53094.

FOR SALE: Diablo 630 API, letter quality, 40-cps, parallel Centronics-compatible with bidirectional tractor feed, extra daisy wheels, and cartridges. One year old, mint condition, rarely used: $1600 firm plus UPS. Wally Parker, 443 Ridgewood Ave., Glen Ridge, NJ 07028, (201) 746-2381.

FOR SALE: BYTE, numbers 1 through 16 except 7, 9, and 10. Perfect condition: $65 or best offer. A. Helfrick, RD 1, Box 87, Boonton, NJ 07005.

WANTED: Information or correspondence with users of OSI equipment about programs, clubs, hardware, etc. I want to set up or join an OSI users group. Wesley Kaplow, 88 Bleecker St., New York, NY 10012, (212) 460-7283.

FOR SALE: Morrow MD2 computer, Ampex D175 terminal with function keys and amber screen, Mannesmann Tally 160L matrix printer. Will sell all or part for best offer. John Birck, 458 East 600 N, Orem, UT 84057, (801) 224-4809.

FOR SALE: Gimix 6809 system, 120K RAM, dual 5¼-inch DS/DD disks, dual 8-inch DD disks, four serial ports. Phil Hughes, POB 7, Northgate Station, Seattle, WA 98125-0007, (206) 367-8649.

FOR SALE: Apple Silentype thermal printer with manuals and paper, like new: $150. Mike Kirk, 1205 Washington, Friona, TX 79035.

FOR SALE: 64K dual DS/DD North Star Horizon II with 80-kilobaud terminal (Viox video board, Key Tronics keyboard, and 12-inch Sanyo green monitor): $2000. PMMI modem card $200 extra. Gary Case, (303) 599-0744.

WANTED: Unwanted or broken computers, disk drives, printers, modems, plotters. Sue Barker, Apt. E, 5690 Roche Dr., Columbus, OH 43229.

WANTED: Help designing a personal computer. Interested in parallel processing of different microprocessors for software versatility. Access to a CAD system would help. I have moderate understanding of Intel processors/coprocessors. Lon Murchison, 7 Bell Place, Yonkers, NY 10701.

FOR SALE: TI 810 printer with extra features plus IMSAI VDP-44 computer with 64K RAM, three 360K drives, full set backup boards. All first-class condition: $2500. Will sell separately. W. T. Rice, YTCO, POB 546, Wilmington, DE 19899, (302) 655-9168.

FOR SALE: New IBM PC monochrome display adapter card: $200. Morrow MD3 Micro Decision: $1200. Liberty Freedom 100 terminal: $350. DEC PDP-11/03 BA11 cabinet, H927D backplane, H780 power supply, and REV11 boot terminator card: $380. Charles B. Wall, 533 Stratford Way, Clarksville, TN 37043, (615) 552-2199.

WANTED: Apple II computer and peripherals. Can pay plus shipping costs. New Jersey Tool Show Foundation Inc., 12 Chestnut Place, Short Hills, NJ 07078.

FOR SALE: BYTE, July 1976 and October 1976 to present (missing May 1978). *Interface Age*, January 1977 to present. *Dr. Dobb's Journal*, March 1976 to August 1982. *Kilobaud Microcomputing*, January 1977 to present. *Lifelines*, June 1980 to present. Sell complete sets only to highest bidder. Dr. J. Williams, 902 Anderson Dr., Fredericksburg, VA 22405.

WANTED: Osborne 1 computers, tan case, working or not, for parts scavenging to keep my O1 working. Let me know what you have and what you want for it. Loren Martindale, 1746 West 25th Lane, Yuma, AZ 85364, (602) 344-1812.

FOR SALE: Maintenance manuals, heads, 46 printed-circuit boards, mostly new, for Memorex 630 hard-disk drive: $50 plus shipping. Seymour Schatz, 631 Normandy Rd., Madeira Beach, FL 33708, (813) 393-2040 or 321-3232.

TRADE: My Heath H-89 with two disk drives, three serial ports, printer, and manuals for your 8-inch or larger Meade or Celestron telescope. Bob Kerns, 913 Wheaton Rd., Fredericksburg, VA 22401, (202) 355-2682 days, (703) 786-4377 evenings.

FOR SALE: Columbia ROM chips version 4.33 (set of three): $50. One Tandon DS/DD: $135. Robert Sacks, POB 935, Lilburn, GA 30247.

FOR SALE: DECwriter IV (LA34) with tractor feed: $400. Allan Kenworthy, 6939 Keynote St., Long Beach, CA 90808, (213) 429-4606.

WANTED: Persons to correspond with about the TI 99/4A. Bill Axsom, 661 Northwest 75th Terrace, Plantation, FL 33317.

FOR SALE: Sharp PC-1500 pocket computer with plotter/cassette interface, RS-232C parallel interface, 4K RAM module, all cables, HC adapters, and all manuals. Excellent condition: $275 or best offer. Contact Mike Weiblen, 4809 Calvert Rd., College Park, MD 20740, (301) 864-3365.

FOR SALE: Quality copper-clad circuit board, 3- to 5-inch width, 5- to 18-inch length, 250 square inches: $11. Shipped UPS, postage paid in U.S. Larry A. Plutchak, 10506 Winrock Place, Tampa, FL 33624, (813) 969-3047.

FOR SALE: Commodore VIC-20 computer with all accessories: $300 or best offer. Chad Boroff, POB 129, Dacono, CO 80514, (303) 833-2118.

WANTED: Hewlett-Packard 16C calculator with documentation for under $50. Greg Hitchings, 2623 West Artesia Blvd., Torrance, CA 90504, (213) 327-1060.

FOR SALE: MPX-16 microcomputer, IBM-compatible, 256K memory, two Tandon DS/DD disk drives, Key Tronic keyboard, and Paradise multidisplay card. $3000 new, will accept reasonable offer. Brent Bonewits, POB 2027, Columbus, IN 47202.

FOR SALE: Tektronix 335 oscilloscope, 35 MHz, dual trace, delayed time base, recently calibrated, includes service manual: $1500 or best offer over $1000. Rich Pagnusat, 748 Berkley, Elmhurst, IL 60126, (312) 941-0739.

FOR SALE: Heath H-11A with 64K bytes of memory (WH-11-32), dual 8-inch disk-drive system (H-27), serial interface (H-11-5), video terminal (H-19), arithmetic chip (H-11-6), and all documentation: $4000 or best offer. Dennis Page, 602 Laurel Lane, Monrovia, CA 91016, (818) 354-4429 or 358-8854.

FOR SALE: 8879 computer and 128K memory expansion, three video terminals (one remote), four hyterms (one remote), one matrix printer. Will sell complete system or parts. Originally $87,000; asking $57,000. United Mortgage Service Corp., POB 23746, Oklahoma City, OK 73123, (405) 722-8046.

WANTED: p-code expansion card for TI 99/4A. Michael J. Donahue, 148 First Parish Rd., Scituate, MA 02066.

FOR SALE: Back issues of BYTE, 1977 to present; *Creative Computing*, 1979 to present. Send SASE for list. Nathan Benechat, 37 Bluecoat, Irvine, CA 92714.

WANTED: Contact with anyone interested in APL and its application to engineering projects. Dale A. Thrasher, 267 Nassau Rd., Costa Mesa, CA 92626, (714) 549-4136.

FOR SALE: Apple II+ and single disk drive in excellent condition: $1000 or best offer. Don Arcangel, 12063 Camino Valencia, Cerritos, CA 90701, (213) 865-0495 between 6 and 9 p.m.

WANTED: Fujitsu Micro 16s users to exchange hints, ideas, and information. Stefan Friedli, Neueneggstrasse 39, 3172 Niederwangen, Switzerland.

WANTED: Peripherals (especially a modem) for an HP 85 with tape drive. F. Callahan, 14826 66th Ave. W, Edmonds, WA 98020, (206) 745-5472.

FOR SALE: 16K TRS-80 Model I, with monitor, keyboard, cassette tape, power pack, and books: $350. Dale Hutchinson, 10818 Brentway Dr., Houston, TX 77070-3911, (713) 469-2584.

WANTED: Technical information about the Incoterm Data Terminal. I would also like the boot tapes for the cassette drives. Todd Wiegand, RR #1, Box #100, Thompsonville, IL 62890.

FOR SALE: Digital computer: system type CL8, serial no. 6222, operating system COS-310, and version 8.00, DEC no. 3PA15, P/L 48. Also instruction manual and document disk (word-processing manual) EY-DG121-SG-001. Any reasonable offer accepted. Michael Bodri, 418 Kalmia St., Warminster, PA 18974, (215) 674-3962.

FOR SALE: BYTE, 1980–83 complete: $30 per year; 1979 except February: $25; 1978, January, February, and August through December: $15; 1977, November and December: $5. Early volumes of *S-100 Microsystems*, *onComputing*, *BCS Update*. Send SASE for list. Louise Silver, 271 Florence Ave., Arlington, MA 02174, (617) 643-2422.

FOR SALE: Epson MX-80 printer with graphics support chips, reliable and in very good condition: $240. Hayes Smartmodem, 300-bps, excellent condition: $175. I will ship. Randy Kahle, 190 East O'Keefe #18, Menlo Park, CA 94025, (415) 326-8200.

FOR SALE: Copper Mountain College has IBM System/40 with two 8-inch drives, ADDS Regent 25 terminal, and TI Omni 800 printer. Complete to best offer. Friends of CMC, POB 1398, Joshua Tree, CA 92252.

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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 1," 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."

APPLE GUIDE RESULTS

Writer Rob Moore and BYTE senior technical editor Gregg Williams garnered the most votes for "The Apple Story, Part 1: Early History." The $100 goes to Rob Moore. Karen Cmar takes home $50 for her second-prize article, "Appleworks: An Integrated Office Product." Eric Eldred wins third prize for "Artistic Tools for the Apple II Family." Congratulations, authors.

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