BYTE

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Desktop Publishing

NEW

Eureka: The Solver™

Anyone and everyone who routinely works with equations needs Eureka: The Solver

It solves the most complex equations in seconds. Whether you're a scientist, engineer, financial analyst, student, teacher, or some other professional, you need Eureka: The Solver!

Any problem that can be expressed as a linear or non-linear equation can be solved with Eureka. Algebra, Trigonometry and Calculus problems are a snap.

Eureka: The Solver also handles maximization and minimization problems, does plot functions, generates reports, and saves you an incredible amount of time.

$X+\exp(X) = 10$ solved instantly instead of eventually!

Imagine you have to "solve for X," where $X + \exp(X) = 10$, and you don't have Eureka: The Solver. What you do have is a problem, because it's going to take a lot of time guessing at "X." Maybe your guesses get closer and closer to the right answer, but it's also getting closer and closer to midnight and you're doing it the hard way.

With Eureka: The Solver, there's no guessing, no dancing in the dark—you get the right answer, right now. (PS: $X = 2.0705799$, and Eureka solved that one in .4 of a second!)

How to use Eureka: The Solver

It's easy.

1. Enter your equation into the full-screen editor
2. Select the "Solve" command
3. Look at the answer
4. You're done

You can then tell Eureka to

- Evaluate your solution
- Plot a graph
- Generate a report, then send the output to your printer, disk file or screen
- Or all of the above

Eureka: The Solver includes

☑ A full-screen editor
☑ Pull-down menus
☑ Context-sensitive Help
☑ On-screen calculator
☑ Automatic 8087 math co-processor chip support
☑ Powerful financial functions
☑ Built-in and user-defined math and financial functions
☑ Ability to generate reports complete with plots and lists
☑ Polynomial finder
☑ Inequality solutions

*Introductory price—good through July 1, 1987

Some of Eureka's key features

You can key in:

☑ A formula or formulas
☑ A series of equations—and solve for all variables
☑ Constraints (like X has to be < or = 2)
☑ A function to plot
☑ Unit conversions
☑ Maximization and minimization problems
☑ Interest Rate/Present Value calculations
☑ Variables we call "What happens?," like "What happens if I change this variable to 21 and that variable to 27?"

All this power for only $99.95!

Equation-solving used to be a mainframe problem, but we've solved that problem.

Eureka: The Solver is all you need—and it's yours for only $99.95!

That kind of savings you can calculate with your fingers!

System requirements

IBM PC, AT, XT, Portable, 3270 or true compatibles. PC-DOS (MS-DOS) 2.0 and later. 384K.

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NEW

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Introducing Turbo Basic, the high-speed BASIC you'd expect from Borland!

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Turbo Basic is a complete development environment; it includes a lightning-fast compiler, an interactive editor, and a trace debugging system.

Because Turbo Basic is compatible with BASICA, chances are that you already know how to use Turbo Basic.

With Turbo Basic your only speed is "Full Speed Ahead"!

You probably already know us for both Turbo Pascal® and Turbo Prolog.™ Well, we've done it again!

We created Turbo Basic, because BASIC doesn't have to be slow.

In fact, building fast compilers is a Borland specialty; both our Turbo Pascal and our Turbo Prolog outperform all their rivals by factors, and with Turbo Basic, we're proud to introduce the first high-speed BASIC compiler for the IBM® PC. If BASIC taught you how to walk, Turbo Basic will teach you how to run!

The Critics' Choice

"Borland has succeeded in stretching the language without weighing us down with unnecessary details . . . Turbo Basic is the answer to my wish for a simple yet blindingly fast recreational utility language . . . The one language you can't forget how to use, Turbo Basic is a computer language for the missus, the masters, the masses, and me.

Steve Gibson, InfoWorld

Borland's Turbo Basic has advantages over the Microsoft product, including support of the high-speed 8087 math chip.

John C. Dvorak "

Turbo Basic ends the basic confusion

There's now one standard: Turbo Basic.

It's fast, BASICA-compatible, and because Turbo Basic is a Borland product, the price is right, the quality is there, and the power is at your fingertips. You see, Turbo Basic's part of the fast-growing Borland family of programming languages—we call it the "Turbo Family." Hundreds of thousands of users are already using Borland's languages, so you can't go wrong. So join a whole new generation of smart IBM PC users—get your copy of Turbo Basic today. You get an easy-to-read 300+ page manual, two disks, and a free MicroCalc spreadsheet—and an instant start in the fast new world of Turbo Basic. All of this for only $99.95—Order your copy of Turbo Basic today!

Free spreadsheet included, complete with source code!

Yes, we've included MicroCalc, our sample spreadsheet, complete with source code, so that you can get started right away with a "real program." You can compile and run it "as is," or modify it.

A technical look at Turbo Basic

- ☑ Full recursion supported
- ☑ Standard IEEE floating-point format
- ☑ Floating-point support, with full 8087 (math co-processor) integration. Software emulation if no 8087 present
- ☑ Program size limited only by available memory (no 64K limitation)
- ☑ EGA and CGA support
- ☑ Access to local, static, and global variables
- ☑ Full integration of the compiler, editor, and executable program, with separate windows for editing, messages, tracing, and execution
- ☑ Compile, run-time, and I/O errors place you in the source code where error occurred
- ☑ New long integer (32-bit) data type
- ☑ Full 80-bit precision
- ☑ Pull-down menus
- ☑ Full window management

System requirements

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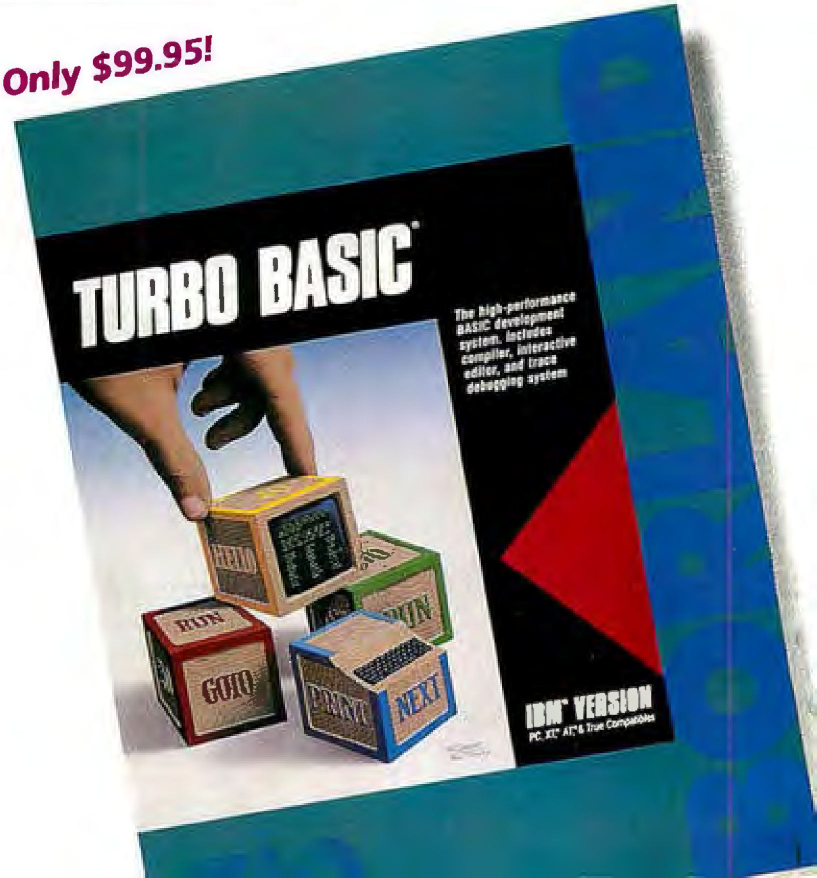
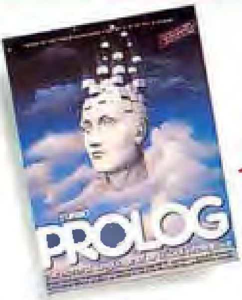


BI-1103A

Turbo Prolog™

> “ If you're at all interested in artificial intelligence, databases, expert systems, or new ways of thinking about programming, by all means plunk down your $100 and buy a copy of Turbo Prolog.
> **Bruce Webster, BYTE 9/86** ”

Only $99.95!



Turbo Prolog, the natural language of Artificial Intelligence, is the most popular AI package in the world with more than 100,000 users. It's the 5th-generation computer programming language that brings supercomputer power to your IBM PC and compatibles. You can join the AI revolution with Turbo Prolog for only $99.95. Step-by-step tutorials, demo programs and source code included.

New! Turbo Prolog Toolbox

Our new Turbo Prolog Toolbox™ enhances Turbo Prolog—with more than 80 tools and over 8,000 lines of source code that can be easily be incorporated into your programs. It includes about 40 example programs that show you how to use and incorporate your new tools.

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New Turbo Prolog Toolbox features include:

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- ☑ Sophisticated user-interface design tools

It's the complete developer's toolbox and a major addition to Turbo Prolog. You get a wide variety of menus—pull-down, pop-up, line, tree and box—so you can choose the one that suits your application best. You'll quickly and easily learn how to produce graphics; set up communications with remote devices; read information from Reflex,® dBASE III,® Lotus 1-2-3® and Symphony® files; generate parsers and design user interfaces. All of this for only $99.95.

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System requirements

Turbo Prolog: IBM PC, XT, AT or true compatibles. PC-DOS (MS-DOS) 2.0 or later. 384K. Turbo Prolog Toolbox requires Turbo Prolog 1.10 or higher. Dual-floppy disk drive or hard disk. 512K.

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5. 5-term Polynomial

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System requirements

IBM PC, XT, AT or true compatibles. PC-DOS (MS-DOS) 2.0 or later. Turbo Pascal 2.0 or later. Graphics module requires graphics monitor with IBM CGA, IBM EGA, or Hercules compatible adapter card, and requires Turbo Graphix Toolbox. 8087 or 80287 numeric co-processor not required, but recommended for optimal performance. 256K.

Turbo Pascal 3.0.
Includes 8087 & BCD features for 16-bit MS-DOS and CP/M-86 systems. CP/M-80 version minimum memory: 48K; 8087 and BCD features not available. 128K.

NEW

Turbo C®

Turbo C: The fastest, most efficient and easy-to-use C compiler at any price

Compilation speed is more than 7000 lines a minute, which makes anything less than Turbo C an exercise in slow motion. Expect what only Borland delivers: Quality, Speed, Power and Price.

Turbo C: The C compiler for amateurs and professionals

If you're just beginning and you've "kinda wanted to learn C," now's your chance to do it the easy way. Like Turbo Pascal, Turbo C's got everything to get you going.

If you're already programming in C, switching to Turbo C will considerably increase your productivity and help make your programs both smaller and faster. Actually, writing in Turbo C is a highly productive and effective method—and we speak from experience. Eureka: The Solver and our new generation of software have been developed using Turbo C.

Turbo C: a complete interactive development environment

Free MicroCalc spreadsheet with source code

Like Turbo Pascal and Turbo Prolog, Turbo C comes with an interactive editor that will show you syntax errors right in your source code. Developing, debugging, and running a Turbo C program is a snap.

Turbo C: The C compiler everybody's been waiting for. Everybody but the competition

Borland's "Quality, Speed, Power and Price" commitment isn't idle corporate chatter. The $99.95 price tag on Turbo C isn't a "typo," it's real. So if you'd like to learn C in a hurry, pick up the phone. If you're already using C, switch to Turbo C and see the difference for yourself.

System requirements

IBM PC, XT, AT and true compatibles. PC-DOS (MS-DOS) 2.0 or later. One floppy drive. 320K.

Technical Specifications

- ☑ *Compiler: One-pass compiler generating linkable object modules and inline assembler. Included is Borland's high performance "Turbo Linker." The object module is compatible with the PC-DOS linker. Supports tiny, small, compact, medium, large, and huge memory model libraries. Can mix models with near and far pointers. Includes floating point emulator (utilizes 8087/80287 if installed).*
- ☑ *Interactive Editor: The system includes a powerful, interactive full-screen text editor. If the compiler detects an error, the editor automatically positions the cursor appropriately in the source code.*
- ☑ *Development Environment: A powerful "Make" is included so that managing Turbo C program development is highly efficient. Also includes pull-down menus and windows.*
- ☑ *Links with relocatable object modules created using Borland's Turbo Prolog into a single program.*
- ☑ *ANSI C compatible.*
- ☑ *Start-up routine source code included.*
- ☑ *Both command line and integrated environment versions included.*

*Introductory price—good through July 1, 1987

Sieve benchmark (25 iterations)

Execution time	***5.77***	*.51*	*13.79*
Object code size	***274***	*97*	*301*

[illegible] *Linker version 1.0; Microsoft C version 4.0 and the MS overlay linker version 3.51; Lattice C version 3.1 and the MS object linker version 3.05.*

$99.95!*

Inquiry 43 for End-Users.
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BYTE

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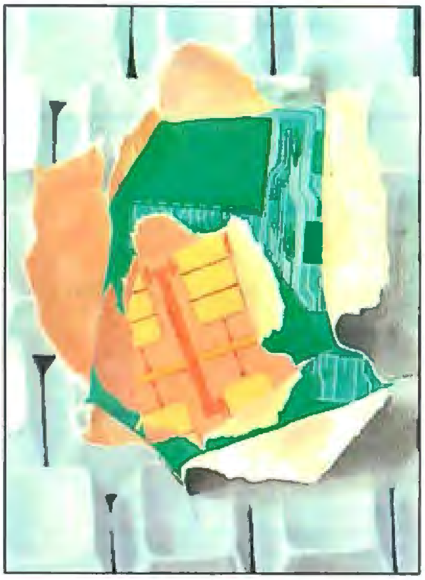

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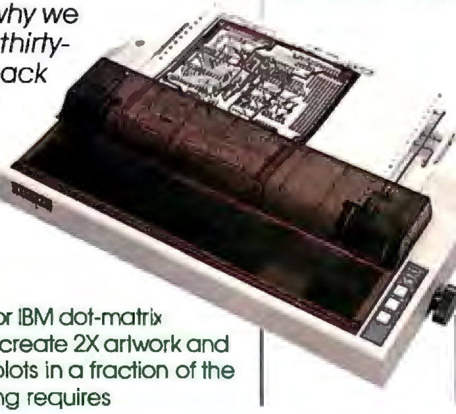

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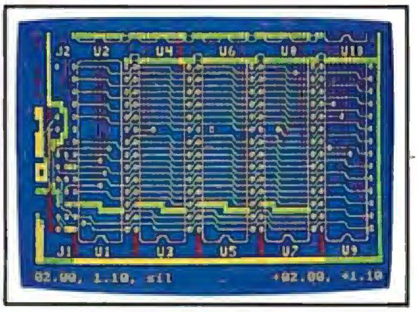

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Inquiry 349

EDITORIAL

All or Nothing in Local Mass Storage

Computer architecture adapts quickly to different business and social needs. Two industry pioneers, Bob Metcalfe of 3Com and Chuck Peddle of Tandon, have introduced new and contrasting products that illustrate well the adaptability of computer architecture. Metcalfe's new product is an elegant diskless workstation—a personal computer with no mass storage of its own. Peddle and his longtime associate Bob Taylor developed Tandon's new Personal Data Pac—a 30-megabyte removable hard disk drive that you can easily remove from your personal computer, carry anywhere, mail, and even drop. Note that the storage medium itself is not removable—the platter remains sealed inside the drive.

Peddle and Taylor have collaborated on important projects for several years. Peddle developed the 6502 microprocessor, the KIM-1, and the Commodore PET. Immediately before moving to Tandon, Peddle and Taylor developed the Victor 9000, an outstanding computer whose success was muted by Victor's financial difficulties.

The Personal Data Pac takes local data storage to new heights because each Pac can carry your entire computing environment in one small, convenient package. The 30-megabyte capacity of each Pac not only lets you carry large amounts of data anywhere but also take along all your software, including terminate-and-stay-resident applications like Ready! and SideKick. This makes any computer equipped with Personal Data Pacs a congenial work environment for those who bring along their own Pacs. Coworkers can easily exchange all the data relating to major projects.

The Pacs are shock-resistant to 300 Gs, so the data is secure in a traveler's briefcase and even in an overnight express package. Furthermore, a system like Tandon's new IBM PC AT compatible, the PAC 286, which has two slots for Personal Data Pacs, provides the fastest and most convenient backup now available—30 megabytes in two and a half minutes.

Tandon has designed some interesting security features into the Personal Data Pac. A password utility provides optional password protection for each Pac. Each Pac has its own coded, permanent serial number. Furthermore, the design of the Personal Data Pac provides support for encryption of all the data on the disk.

Personal Data Pacs from Tandon.

The 3Station diskless workstation.

In an article beginning on page 85, BYTE editors Jon Erickson, Mike Vose, and Chuck Weston give further depth and detail about the new Tandon PAC 286 and the Personal Data Pac.

Diskless Workstations

The obvious reason for buying a diskless workstation instead of a normal personal computer is to enable a company or government agency to keep data secure. If there is no local removable mass storage for employees to carry with them, they will have a hard time walking out with sensitive financial or military data.

Many companies are selling diskless workstations. 3Com has just introduced a particularly nice one, pictured here. Called the 3Station, the system is a high-performance AT compatible with a memory cache for network communications and battery-backed RAM to configure the system to the needs of the individual user.

The 3Station is the brainchild of Bob Metcalfe, chairman of 3Com and principal developer of Ethernet. Because there is no local mass storage, the power supply for the 3Station is small, the footprint is tiny, and there is no need for a cooling fan. The 3Station has the convenience of built-in networking hardware, and the reduced number of components gives it an attractive price. (More on the 3Station will appear in the June issue.)

For many computer users, the cost and security advantages of the diskless workstation can't make up for the absence of local, personal data storage. Bob Metcalfe stresses that any user on the network may prefer to use a PC and have local data storage—there's nothing about the 3Station or other diskless workstations to prevent other network users from having individual disk drives. Metcalfe argues that diskless workstations are ideal for some situations, not mandatory for all.

Nevertheless, diskless workstations do have some disadvantages. Without local data storage and the ability to insert a floppy to try new software, individual users will experiment less and develop fewer new solutions to office problems.

Another Voice

During a discussion of diskless workstations at Esther Dyson's 1987 Personal Computer Forum in Phoenix, a voice from the financial community suggested a different approach to data security on networks. Barry Margolius, assistant vice president, corporate staff, Financial Information Systems, Merrill Lynch Pierce Fenner & Smith Inc., pointed out that giving each workstation its own built-in, nonremovable hard disk would prevent people from making off with disks of data and also provide flexibility for each user. This sounds like a good solution to us for both user and company or government agency.

—Phil Lemmons
Editor in Chief

Important Error Correction

Our April review of 50 dot-matrix printers contained an important error. Table 1 greatly overstated the sound in decibels of all the printers in graphics mode. Complete corrected data appears in Review Feedback in this issue. Our apologies for the error.

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MICROBYTES

Staff-written highlights of developments in technology and the microcomputer industry.

U.S. Losing Ground in Development of Pure Semiconductors, NASA Exec Says

The United States is rapidly losing ground in the development of "pure semiconductors," semiconductors that can be made only in outer space, NASA administrator James C. Fletcher says. Fletcher was interviewed by Microbytes Daily after the dedication of the NAS (Numerical Aerodynamic Simulator) supercomputer in Moffett Field, CA. "Most of the interest in microgravity semiconductor research," he said, "is on the part of Japan and Germany. The Department of Defense and NASA want to do things, but U.S. manufacturers just aren't that interested as of yet."

Fletcher said that the development of pure semiconductors offers the greatest commercial opportunity of all possible microgravity projects (projects that must be completed in zero-gravity environments, such as that of a space station). He said that pure semiconductors, which will be made from gallium arsenide (GaAs), are necessary for the development of cheaper, faster, and more powerful computers. Fletcher pointed out that the most extensive research in GaAs development is taking place in Japan. "We really have got to start worrying about this a little bit," he said. "Nearly all of our silicon is purchased from Japan now . . . and the greatest interest in gallium arsenide is in Japan." Fletcher then commented that, in the U.S., "the Department of Defense has a very large terrestrial program in producing gallium arsenide, and they have an interest in producing pure gallium arsenide in space."

Key to the development of pure GaAs semiconductors is the building of the first U.S. space station, which would accommodate various microgravity research projects in addition to pure semiconductor development. Scientists can do things in a zero-gravity environment, Fletcher explained, that simply aren't possible on Earth, such as actually mixing gas and water. With semiconductors, "you want pure gallium arsenide to start with and you add the appropriate [impure] materials to make a semiconductor," he explained. In response to questions about the questionable status of the U.S. space station project, Fletcher said that "not building the space station would be the beginning of the end for the manned U.S. space program," and with it, the hope for pure semiconductors.

Walking Two-Legged Robot Controlled by Personal Computer

At the Spring National Design Engineering Show in Chicago recently, a professor from Clemson University (Clemson, SC) demonstrated what is probably the world's first walking two-legged robot. The most impressive feature of the new robot is the fact that it is controlled not by a minicomputer or an expensive parallel-processing system, but by a personal computer.

The robot, which is about two feet tall, is named CURBi, short for Clemson University Robot Biped. It was designed by Yuan Zheng, an assistant professor at Clemson.

CURBi is controlled by an NCR PC6, an IBM PC XT–compatible desktop computer running at 8 MHz. According to Zheng, the robot uses a 900-line program and four databases that take up 512K bytes of memory for each step. Like humans, the robot takes a step, momentarily loses its center of gravity, and then readjusts itself by planting its foot for the next step.

Zheng suggests that bipedal devices may someday replace wheelchairs, allowing physically impaired persons easier access to stairs and uneven outdoor terrain. In addition, a bipedal robot would have an advantage over multilegged robots when climbing ladders or moving around in small confined spaces.

continued

Nanobytes

Maynard Electronics (Casselberry, FL) says it's working with several disk drive makers to develop its **ERLL** (enhanced run length limited) as a standard. ERLL is intended to double the capacity and speed of a hard disk drive. Maynard reports it has sent beta ERLL controller boards to **Seagate**, **Fuji**, **Maxtor**, **MiniScribe**, **Newbury Data**, and others. After testing, Maynard and some of the drive makers will cooperate on specs that they hope will become an industry standard. . . . About that **new DOS** from **Microsoft** (Redmond, WA), chairman Bill Gates says it will run on existing 80286-based machines, will run most existing applications, and will "provide developers a new view of the world." New DOS won't run on 8086/8088 machines or on floppy-based systems, or on systems with less than 1 megabyte of RAM. The new OS is about as big as 500K bytes. "Microsoft will evolve the current-generation operating system *and* develop the new generation of systems software," Gates told the Personal Computer Forum. . . . **Expertware** (Santa Clara, CA) has its software-development products now running on Sun Microsystems' Sun-3 line of workstations. The company says its Configuration Management Toolkit and Documentation Support Toolkit take full advantage of the Suns' UNIX operating system and distributed computing capabilities. . . . **Kodak** (Rochester, NY) tells Microbytes that progress is being made in its quest for a 3½-inch erasable optical disk. The disk, which will hold 50 megabytes, will employ an optical-magnetic technique that uses a laser's optical energy to thermally alter the disk me-

continued

dium. On the bigger side of things, Kodak recently unwrapped a system that uses 14-inch optical disks to store as much as 1020 gigabytes; each disk packs 3.4 gigabytes. . . . **ExperTelligence** (Santa Barbara, CA) is offering a version of its ExperCommon Lisp for educational use. ExperCommon Lisp/ED is sold to schools and students for $195; it has more than 500 primitives, the company says, as well as N-dimensional arrays and an on-line symbolic debugger. It runs on a Mac Plus. . . . **Tandy** (Fort Worth, TX) brought out OS-9 Level Two for the Color Computer 3. The multiuser, multitasking operating system uses windows and includes BASIC09 and utilities. Suggested retail price is $79.95. . . . Know someone who has made an "outstanding contribution to the theory and practical application of information science" ? The folks who award the annual **J.-D. Warnier Prize** for Excellence in Information Science want to hear about him or her. The committee will accept nominations until June 1. Write to Gerald Weinberg, chairman, Warnier Prize Selection Committee, 1725 Gage Blvd., Topeka, KS 66604. Past winners include Alan Kay and Enid Mumford. . . . *Connections* is a newsletter about networking Macintoshes, aimed at Mac users who want to swap data with other microcomputers, minicomputers, and mainframes. The bimonthly publication costs $60 ($70 overseas). Connect with the staff at P.O. Box 5894, Fullerton, CA 92635, (714) 738-1492. . . . **Telesis Distributing** (Reno, NV) is selling a video-recording system, designed by Calco Digital Equipment, that can store 1230 black-and-white television-quality images on a Syquest 10-megabyte disk cartridge and offers random-access capability (maximum seek time is said to be one-fifth of a second). An analog-style recording technique makes the high storage density possible, the company says. The Video Image File connects to a

continued

Erasable Optical Storage Expected by Year's End

Look for erasable optical storage to make its presence felt before the end of this year, said speakers at the Systems Design and Integration Conference in Santa Clara, CA, recently. Several conference participants agreed that erasable optical storage media and drives will begin appearing in mass quantities during the second half of 1987.

According to Fred Geyer, general manager of Magneto-optical Drives and Media for Verbatim Corp. (Sunnyvale, CA), a number of Japanese manufacturers will introduce 5¼-inch erasable optical media that provide as much as 200 megabytes for less than $1 per megabyte of storage. Typical media will have 14,000 tracks per inch, and drives will provide a minimum access time of 40 ms. Although less than $1 per megabyte for storage media is not cheap when compared to current magnetic storage costs, manufacturers view it as a critical price point. Geyer went on to say that Verbatim will have similar evaluation units available in 1987 but will not begin production until early 1988.

In other developments related to optical storage, Phil Devin, a senior analyst for Dataquest, told conference attendees that he predicts "IBM will announce a WORM product within the next 90 days," but he would not elaborate on his comment. Later in the day, however, Kenneth Majithia, a design engineer for IBM's optical storage division, told Microbytes Daily that such an announcement was "news to me."

Scanners Hit Technical Limits; Need More Processing Power

Optical scanners, increasingly being used in desktop publishing and other applications, have just about reached their technical limits, said speakers at the Microsoft CD-ROM Conference in Seattle. According to Jim Fruchterman of Palantir Corp. (Santa Clara, CA), a manufacturer of midrange scanners, both text-only optical-character recognition scanners (OCR) and graphics/text document-processing scanners (DPS) have mastered simple character recognition, the first layer of a three-part problem. Some scanners have even mastered the second layer, character attribute identification (point size, font, etc.). However, the third and most technologically difficult layer, said Fruchterman, is for the machine to determine what the character means, a job that requires more processing power than current scanners have.

Bill Zoellick, director of the Alexandria Institute, a nonprofit CD-ROM center, went on to say that the ability to determine what the character means is tied into the concept of pattern recognition where the whole page is scanned. "This activity is right for technologies like parallel processing," he said, "where one processor is looking at the pattern on the page, others are looking at the characters, and still others at the graphics." Art Crotzer, of TMS Inc. (Stillwater, OK), a data conversion company that specializes in CD-ROM applications, added that the next generation of scanners will incorporate expert systems and artificial intelligence to make pattern recognition and textual analysis possible. Such technologies, Fruchterman said, will enable scanners to tell the difference between a 0 (zero) and the letter O or between the letter l and the number 1.

Gary Hendrix, of Symantec (Cupertino, CA), makers of the Q&A natural-language database, added that the technology to "read text and understand it as opposed to just scanning text is a long way away . . . perhaps a decade away."

XLISP Program Plays Risk

Because of its complexity, the Parker Brothers board game Risk offers a good model for AI planning systems. Scott Welser, an engineer at KnowledgeWare (Ann Arbor, MI), is designing a plan-generation program to play Risk.

The game is based on a model of world conquest. Players take turns trying to conquer countries and attempting to occupy whole continents. The outcome of each assault is decided by rolling dice.

Wesler's program, called Alex, was written in XLISP. (XLISP, by the way, is a low-cost implementation of LISP written by BIX's own programmer-in-residence, David Betz.) In its

continued

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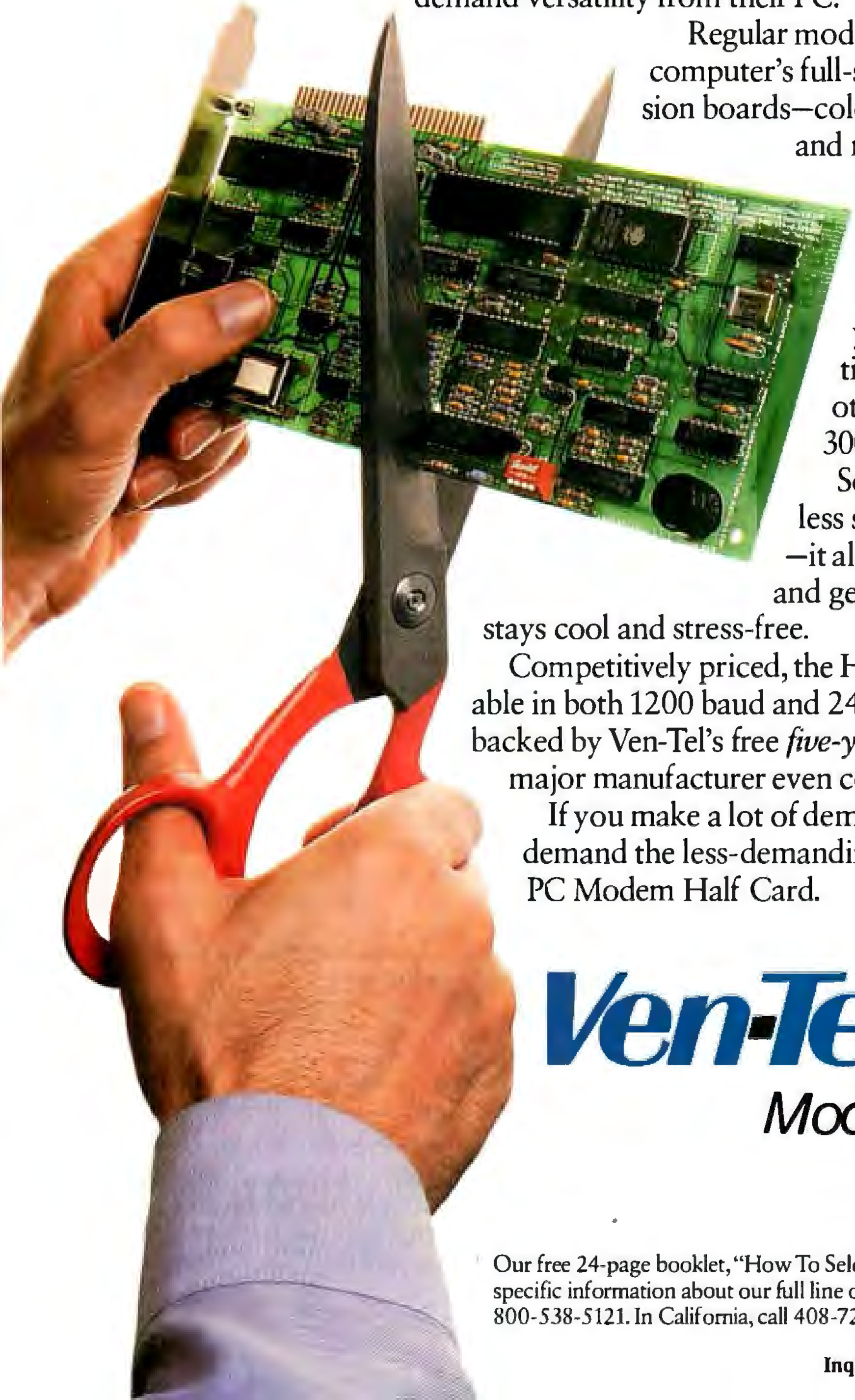

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microcomputer via the RS-232C port. . . . **TeleRobotics International** (Knoxville, TN) reportedly will start marketing this month a software package that writes programs. Course Builder, which runs on a Macintosh, lets you construct a program using flowcharts and symbols. The software then converts the input into C code. . . . **Herbert Schoor,** director of AI technology at **IBM,** told the IEEE AI Applications Conference (in Orlando, FL) that around 90 expert systems are in use at Big Blue. The systems tend to be procedural advisors helping workers perform diagnostics and usually involve fewer than 500 rules. One such program checks disk storage systems at the firm's San Diego factory.

current form, Alex runs on an IBM PC.

Because of the large number of possible moves in Risk, and the random nature introduced by the dice, a common search tree of all possible moves and countermoves would be practically impossible to build. As an alternative, Alex uses a planning system. In this system, the goal of winning the game is divided into a series of tasks, which are subdivided in turn into a series of subtasks. At each turn in the game, an Alex's Task Noticer filters out those tasks that are not possible to accomplish and ranks the desirability of those that are. Alex then executes the most desirable of the possible task plans.

Although the program cannot yet play a full game, it can plan and execute the beginning moves. Wesler said it will be relatively easy to add a number of tasks for finishing the game.

Motorola's RISC Chip to Include Hundreds of Instructions

What does Motorola's semiconductor group (Austin, TX) do for an encore after its 68000 series? The 78000 series of RISC processors.

RISC processors have fewer instructions for a programmer to use; however, the ones that are there are fast. While a true RISC machine might have only 50 very fast instructions to operate on, the 78000 is expected to have in the range of 150 to 200. Additional chips to "glue" the processor to other computer elements might also be forthcoming.

Sources tell Microbytes that the first Motorola 78000 chips will be available in limited sampling quantity by the third quarter of this year. Pricing is not firm, but it is expected to be in the low three-digit range.

Notes from the Personal Computer Forum: Warnock Compares Chips; Kahn Decries 'Look and Feel'; Kapor Sees Long Wait for 386 Applications, but Gates Doesn't

John Warnock, founder of Adobe Systems (Palo Alto, CA), was asked at the Personal Computer Forum, held in Phoenix, to compare the 80386 and the 68000 family of processors. "With the 68000," Warnock said, "the large linear address space is already there. The transition to the 68020 is very simple. There is also lots of developer support from Apple." He contrasted this with the 80386 and the Microsoft Windows environment. "There is a cost extracted by Windows in terms of memory. Our application is large. The 80386 with Windows is attractive, but the time frame is the problem."

Philippe Kahn, president of Borland International (Scotts Valley, CA), said at the Forum that neither UNIX nor the new DOS from Microsoft has a competitive advantage. "Both are multitasking," he said. "Both are memory-consuming. Both require high-powered chips. There's not a lot of advantage on either side, and we're seeing more and more interest in UNIX."

Kahn also said he deplores the current state of discussions of "look and feel" litigation in the software industry. "It's not nice to steal from other people," Kahn said. "On the other hand, it's terrible if F1 stands for something different in every single program. If there was anything to 'look and feel,' Las Vegas would have sued Atlantic City and would own it."

The man who helped bring Lotus 1-2-3 to market, Mitch Kapor, forecast a long wait for application software that takes advantage of the 80386. "The development cycle for applications for the 80386 is going to be longer than expected," Kapor said. "The 80386 needs the support of a graphics environment, development tools, and so on. We're looking at 1990 before customers derive significant value from 80386 applications."

But Bill Gates, chairman of Microsoft (Redmond, WA), disagreed. "It won't be the 1990s before you see milestone applications for the 386," Gates said. "To see what's coming, you can look up to software on high-end workstations. We'll see some pretty amazing stuff on 386s before the 1990s. Basic features of the chip have been well understood for a long time."

In a panel discussion on new directions of applications, Robert Carr, chief scientist at Ashton-Tate (Torrance, CA), said, "We're coming into an era in which stand-alone products cannot deliver the benefits users want." Carr also noted, "It's a fragmented world now with new DOS, old DOS, UNIX, and the Macintosh operating system."

Paul Allen, cofounder of Microsoft and now heading Asymetrix (Bellevue, WA), said, "Applications programs need the ability to represent users' thought processes in both procedures and data structures."

Asymetrix is developing an application using a proprietary LISP-like language that runs on top of Microsoft Windows (see Microbytes in the January issue, page 12).

TECHNOLOGY NEWS WANTED. *The news staff at BYTE is always interested in hearing about new technological and scientific developments that might have an impact on microcomputers and the people who use them. We also want to keep track of innovative uses of that technology. If you know of advances or projects that involve research relevant to microcomputing and want to share that information, please contact us. Call the Microbytes staff at (603) 924-9281, send mail on BIX to Microbytes, or write to us at One Phoenix Mill Lane, Peterborough, NH 03458.*

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AST RESEARCH INC.

LETTERS

Subsampling Revealed

In the February BYTE, you published the article "Another Approach to Data Compression," by Robert J. Sciamanda. The technique he suggests is interesting and useful to someone who knows what he or she is doing, as the author obviously must. Any procedure that helps someone understand the effects of aliasing in the data is certainly to be applauded.

However, I offer a caveat about Sciamanda's method. It is not "data compression," as the title implies, but merely subsampling.

Before any subsampling, one should plot the spectrum, or at least the Fourier transform, to see where the power lies. If there is very little power at high frequencies, then this data can be subsampled. A much better technique, however, is to filter the series to suppress the high frequencies entirely, and then subsample. The reason for this is that if there is a concentration of energy at any of the higher frequencies (that will not be sampled adequately by the lower sampling rate), this higher frequency power obviously will be aliased to some lower frequency. For example, Sciamanda uses an example of an accuracy of 0.5 percent in the "reconstructed" data. Because he knows what he is doing, this is a safe bet on only 50 samples. However, if someone decided to do it carefully, and with a longer data set produced 1000 Fourier frequencies, only 0.1 percent of the energy would be in each frequency band; therefore, *all* the power in five adjacent frequency bands could be lost or gained at the 0.5 percent accuracy criterion.

Wilton Sturges
Florida State University
Tallahassee, FL

I Have

In reference to "Anybody Here Seen Loglan?" by John Hodges (Letters, February BYTE):

James Cooke Brown is alive and well, working at the Loglan Institute Inc.

The Loglan Institute Inc.
1701 N.E. 75th St.
Gainesville, FL 32601
(904) 371-9574

John Hodges obviously appreciates the potentials of the unambiguous parsing nature of Loglan in computer programming.

The Institute has several Loglan computer tutors for learning the basic primitives and affixes. Other computer tutorial programs are being developed. The older publications are now out of print, but new materials are being prepared.

The Institute continues to operate on a shoestring. However, a small group of individuals continues voluntary contributions to the Loglan research. Contributions from Institute members and Jim Brown cover the necessary overhead. I am sure new members would be welcomed.

Glen B. Haydon
La Honda, CA

Random Questions

In the article "Testing Intrinsic Random-Number Generators" (January BYTE), the authors assert that the IBM PC has only a single cycle of random numbers, of length 65,536. This is patently false. To prove this point, generate a random number in BASIC, then compare all subsequent numbers generated without reseeding the generator, and count the number of values generated before a duplication is found. In two lines of code and five minutes, I was able to generate well over 100,000 numbers without a duplication. In less than 15 minutes, more than 250,000 were generated without a duplication.

The authors also state that Applesoft Integer BASIC can generate only a single cycle of 32,767 random numbers. However, they fail to mention that Applesoft Integer BASIC can only represent 32,767 positive integers! Is it possible that the authors testing programs for the PC rounded the floating-point random numbers generated to integers? This is never stated, but the inference is clear from their reference to the "flaws" of the Integer BASIC generator.

These inaccuracies call the integrity of the entire article into question. Amazingly, these conclusions were published before in "Interfaces." Were they not questioned previously?

Either my colleagues and I or the authors are amazingly naive concerning the details of various versions of BASIC. If the authors are defining random numbers as positive integers, they could still have generated more than 65,536 simply by multiplying the generated numbers by 1 million instead of rounding them.

I hope that either I completely misunderstood the article or some important information was inadvertently omitted. If not, publishing such an article is an insult to the normally high technical standards of your publication. I look forward to a reply concerning this matter.

Dean Shutt
Anchorage, AK

The authors' response:
My coauthors and I are pleased to respond to the questions that have been raised. The "inaccuracies" to which Mr. Shutt refers turn out not to be inaccuracies at all. We respond, point by point, as follows:

1. The IBM PC XT, when testing BASIC and BASICA, has a single cycle of 65,536 numbers prior to repetition of a sequence. The program listing shown below has been used to verify this finding.

```
10 DIM X(10),Y(10)
20 CLS
100 RANDOMIZE 111
200 FOR I = 1 TO 10
210 X(I) = RND
220 NEXT I
230 XX = X(1)
250 COUNT = 9
260 FOR I = 1 TO 25000
270 YY= RND
271 COUNT = COUNT + 1
272 LOCATE 10,10
273 PRINT USING "#######";COUNT
280 NEXT I
300 FOR I = 1 TO 1000
310 FOR J = 1 TO 1000
320 COUNT = COUNT + 1
325 IF INT(COUNT/100) < >
      COUNT/100 GOTO 400
```

continued

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

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

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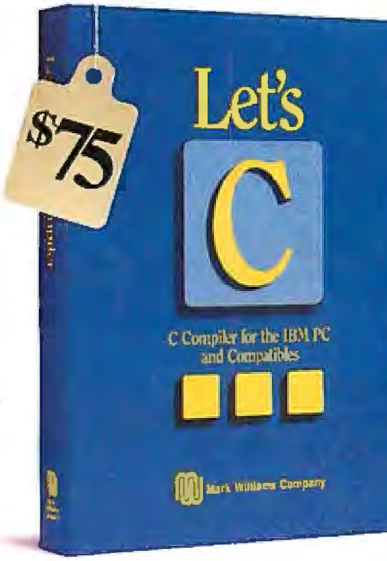

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Let's C doesn't stop with being a high performance C compiler. It includes utilities you'd expect to pay extra for–like a linker and assembler plus the MicroEMACS full screen editor with source code included. Having the source code not only allows you to customize the editor, it offers a close up, fully commented view of C programming at its best.

REVIEWERS ARE SOLD ON LET'S C, TOO.

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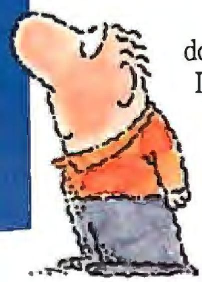

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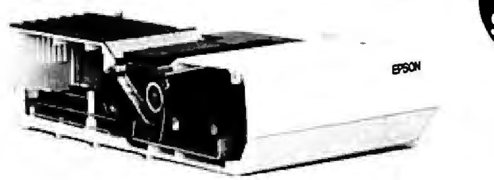

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```
330 LOCATE 10,10
340 PRINT USING "#######";COUNT
400 YY = RND
410 IF YY < > XX GOTO 500
415 Y(1) = YY
420 FOR K = 2 TO 10
430 Y(K) = RND
440 NEXT K
450 GOTO 600
500 NEXT J
510 NEXT I
600 LOCATE 12
610 FOR I = 1 TO 10
620 PRINT USING "###.############
    ###.############";X(I),Y(I)
630 NEXT I
```

We have not, of course, seen the "two lines of code" Mr. Shutt refers to in his letter, but we firmly stand by our statement. Furthermore, although we find no evidence for "leading tails" of numbers prior to entering the cycle when using BASIC or BASICA, failure to test for leading tails of random numbers accounts for the erroneous claim that the random-number generator in Applesoft BASIC has long cycles. Thus the first paragraph of the letter is without basis in fact.

2. In paragraph 2, Mr. Shutt seems to claim that since Applesoft Integer BASIC can represent 32,767 positive integers, the random-number generator is therefore exonerated. This comment misses the point, which is that 32,767 is not a sufficiently long cycle for serious simulation work. The explanation for the length of the cycle is completely irrelevant.

3. Paragraph 2 also questions whether we may have rounded off floating-point numbers to integers when testing random-number generators. We did not round off to integers, since to do so would clearly be foolish.

4. In the fourth paragraph, Mr. Shutt asserts that "they could still have generated more than 65,536 simply by multiplying the generated numbers by 1 million instead of rounding them." Any mathematical transformation of two equal quantities yields two equal quantities. The problem of cycles of random numbers cannot be avoided by any transformation, since a transformation of equal streams of numbers leaves you with numbers that are changed in magnitude, but still equal.

Doan T. Modianos
Robert C. Scott
Larry W. Cornwell

Inside and Out

I read with interest the article "Calculating the Area of an Irregular Shape," by Rene Stolk and George Ettershank (February BYTE). A similar article, "The Universal Area Calculator" by Frank Ty-

continued

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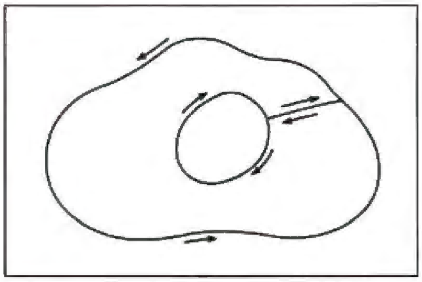
mon, appeared in the September 1986 issue of *Computer Shopper*. Both articles noted that the sign of the area would be positive if the perimeter were traced in one direction, and negative if the perimeter were traced in the opposite direction. But both articles failed to mention an important extension of the area-finding idea which relies on the sign difference.

Typically, the technique yields a positive area if the vertices are taken in a counterclockwise direction, and a negative area if the vertices are taken in a clockwise direction. Thus it is possible to find the area between two closed curves by traversing the outer curve in a counterclockwise direction, making a "cut" to go from the outer curve to the inner curve, traversing the inner curve in a clockwise direction, and returning along the cut to the outer curve. The user only needs to be sure that the cut from the outer curve to the inner curve is retraced when returning to the outer curve.



Of course, this is just a computerized mechanization of the old surveyor's area-finding tool, the planimeter. The technique is a limiting case of the method for finding the area of a triangle, which appears in many analytic geometry texts.

Palmer O. Hanson, Jr.
Largo, FL

Easy as π

BYTE readers may be interested in a little-known pair of formulas that can be used to calculate π, the ratio of the circumference of any circle to its diameter. These simple, fast-converging formulas were not mentioned in the interesting article "Computing Pi," by David J. Crawford (May 1985 BYTE), nor have I seen them elsewhere in computing or mathematical literature. Yet they are so simple and effective that they must have been discovered and published by others.

To illustrate, it is hard to imagine a shorter Microsoft BASIC program than the following one-liner, to compute π and print out intermediate results:

```
10 P=2: FOR K=1 TO 12:
   S=SQR(S+2): P=2*P/S:
   PRINT P: NEXT
```

```
RUN
  2.828427  3.061468  3.121445
  3.136548  3.140331  3.141277
  3.141514  3.141573  3.141588
  3.141591  3.141592  3.141593
```

The two formulas, used with suitable starting values, are given as follows:

$$\text{Let } s_k=\sqrt{s_{k-1}+2}$$

and

$$p_k=2p_{k-1}/s_k,$$

starting with $k=1$, $s_0=0$, and $p_0=2$.

It can be shown that the limit of p_k is π and that this sequence increases monotonically (i.e., each p_k is equal to or larger than its predecessor).

The formulas are derived from summing the chords of central angles of a unit circle starting first with a 180-degree angle, then with two 90-degree angles, then four 45-degree angles, and so on. It is intuitively evident that each succeeding sum of these chords approaches more closely the arc length of the semicircle, and hence π, as an upper bound.

Further, it can be shown that a q_k can be defined in terms of the pair of values s_k and p_k, to be the sum of outside tangents parallel to the chords, and will always be larger than, but decrease monotonically to, π. q_k can be calculated jointly with p_k on each iteration to serve as a decreasing upper bound, matching p_k as an increasing lower bound, and pinning the value, π, between them. q_k is calculated as follows:

$$q_k=2p_k/s_k$$

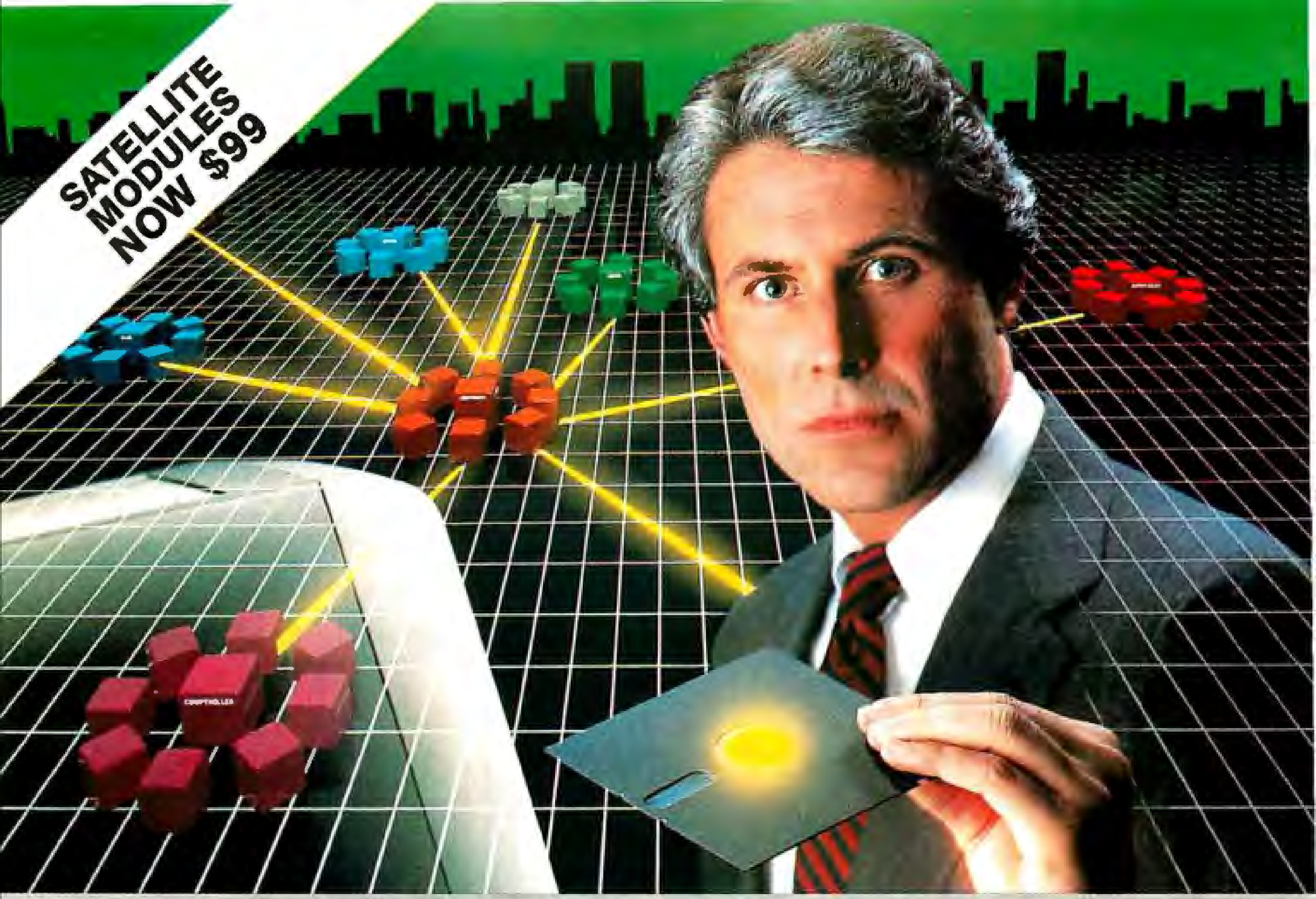
Of still further importance, a suitable "average" of p_k and q_k, denoted r_k, also forms a monotonically decreasing sequence converging to π, but twice as fast. r_k is two-thirds p_k and one-third q_k, and given as:

$$r_k=(2p_k+q_k)/3$$

A two-line BASIC program that exhibits p_k, q_k, and r_k, starts with a 60-degree angle instead of 180, and reduces the required iterations from 12 to only 4 by computing and relying on r_k, is given as follows:

```
10 PRINT " K    P(K)" SPC(8)
   "Q(K)" SPC(10) "R(K)":
   S=SQR(3): P=3
20 FOR K=1 TO 4: S=SQR(S+2):
   P=2*P/S: Q=2*P/S:
   R=(2*P+Q)/3: PRINT K;P,Q,R:
   NEXT
```

continued



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```
RUN
 K      P(K)       Q(K)       R(K)
 1  3.105829  3.215391  3.142349
 2  3.132629  3.15966   3.141639
 3  3.13935   3.146086  3.141595
 4  3.141032  3.142714  3.141592
```

Another "two-liner" can be used to compute π to 16 digits of accuracy in Microsoft BASIC. (Exchange NEXT and PRINT in 20 to see intermediate results.)

```
10 DEFDBL P-S: DEF
   FNP(S,P)=(P+S/P)/2: DEF
   FNS(S)=FNP(S,FNP(S,SQR(S)))
20 S=FNS(3): P=2:FOR K=1 TO
   12: S=FNS(S+2): P=2*P/S:
   NEXT: PRINT P+P/S

RUN
3.141592653589793
```

The definition of the function FNS(S) in terms of FNP(S,P) is in lieu of a built-in double-precision square root function in Microsoft BASIC. Line 20 is actually the entire program with FNS( ) used to calculate the square root. Incidentally, 100 evaluations of π to 16 digits takes 54 seconds on my Panasonic Sr. Partner in Microsoft BASIC, but only 6 seconds in QuickBASIC.

This method provides a practical means of computing π to extended accuracy, using a logically satisfying mathematical derivation based directly on the definition of π. The derivation requires only a knowledge of algebra, use of the Pythagorean Theorem from geometry, and accepting intuitively that the sum of an ever-larger number of smaller chords (and outside tangents) approaches the arc of the intercepted semicircle as a limit.

The formulas are truly elegant in their simplicity and illustrate the considerable power of recursive computation. Their obvious value as a pedagogical tool makes it surprising that they are not well known and used in classrooms.

John T. Godfrey
Punta Gorda, FL

Please Pass the Filename

When programming an application in BASIC, whether it be interpreted or compiled, you often need to pass a filename or a parameter from the DOS level, or from a batch file, into the BASIC program. Although such a feature is clearly a necessity, it is not covered in the standard PC-BASIC, GW-BASIC, or compiled BASIC. It may, however, be constructed using the environmental feature of DOS and, although this is a one-way street (that is, it works only from DOS to BASIC), it clearly takes care of the parameter-passing problem. Now, let's get on to business:

The following batch file accepts a filename as a parameter, types the file (just for fun), and then calls a compiled BASIC program, which could just as well be an interpreted version of the same. The BASIC program, in turn, prints the filename on the screen just to show that it got the name passed on right.

```
CALLING SEQUENCE

batch myfile.ext

BATCH FILE

type %1
path %1
parms     (Could be "BASIC PARMS")

COMPILED BASIC PROGRAM

10 'SAVE"PARMS",A
20 PRINT "Pass BATCH parameters to
   BASIC"
30 P$="PATH":FILNAM$=
   ENVIRON$(P$)
```

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```
40 IF FILNAM$< >" " THEN 60
50 INPUT "No filename passed.
     Please enter filename manually",
     FILNAM$
60 PRINT FILNAM$
70 'Here comes the program !!
80 END
```

The first BASIC line is my convention of remembering the name of the program whenever I want to resave a new version.

One significant problem is the possibility of getting an "Out of environment space" error message. I have not yet found a way to increase the available environment space from my BATCH program. I hope someone can, without resorting to too much assembly code.

Thorleif Bundgaard
Maarslet, Denmark

Information Wanted

I am an occupational therapist at a Rehabilitation Center in Burlington, Vermont. I would be interested in any information regarding computers and the handicapped.

Julie Sonack, OTR
Doquesbriand Unit, OT Dept.
1 So. Prospect St.
Burlington, VT 05401

I'm interested in finding out more about how computers can enhance or improve the quality of life for mentally retarded and developmentally disabled individuals. I'd welcome any information on computers and handicapped individuals.

Helen Emmons
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FIXES

MSC/pal

In the February What's New section, on page 46, we stated that the program MSC/pal was copy-protected. However, according to the MacNeal-Schwendler Corp., it is not.

UMI and the RTX Robot Arm

We have a new price and a U.S. address for the RTX robot arm mentioned by Dick Pountain in his BYTE U.K. column in the March issue. The price is £6800, or $12,000 U.S., with a 30 percent discount for educational users. In the U.S., contact UMI Inc., 3135 South State St., Ann Arbor, MI 48104; phone (313) 995-5115.

Correction

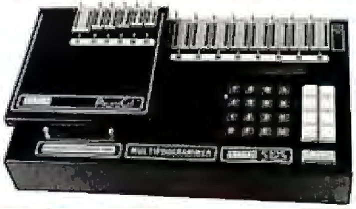
On page 90 of "The Apple Macintosh II" article in the April issue, the sentence beginning "A read or write . . . begins with a START* . . ." should read: "A read or write . . . begins with a START* cycle, followed by multiple bus cycles to transfer data . . ." NuBus presents the address with the START* cycle, not during the data transfer.

Wayward Diodes

If you want to get the IRCOMM receiver diagrammed in figure 5 on page 106 of our February issue to work, find all three instances of diode 1N4148, and reverse the way each is oriented in the schematic.

2-Bit Correction

In the article "Low-Cost Image Processing" in the March issue, our description of the EGA board for the IBM PC was flawed. The maximum resolution of the EGA is 640 columns by 350 rows of 4-bit pixels, not 6-bit pixels as we reported. Although the EGA does have a palette of 64 possible colors, only 16 colors are available on screen at any given time. ■



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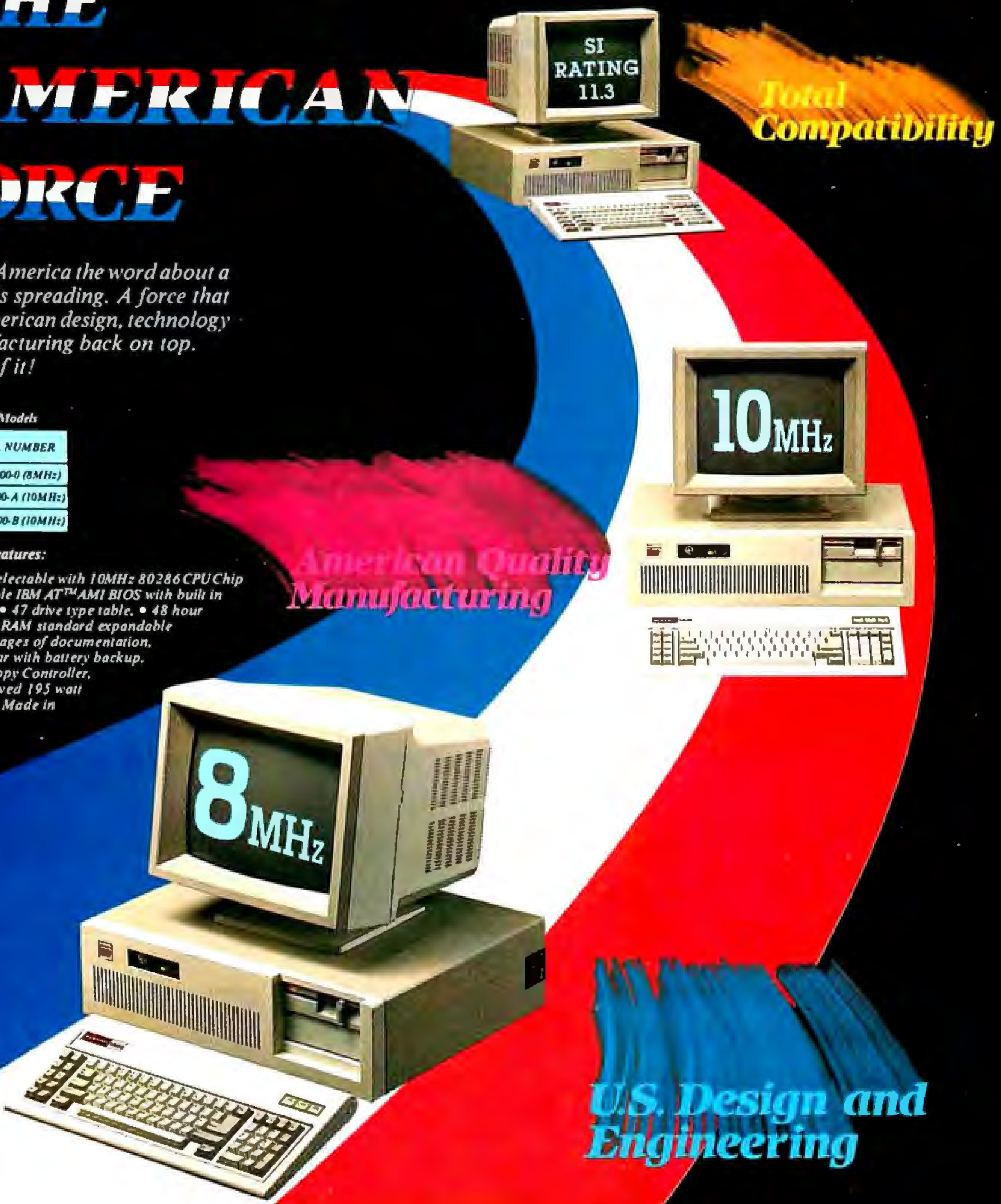

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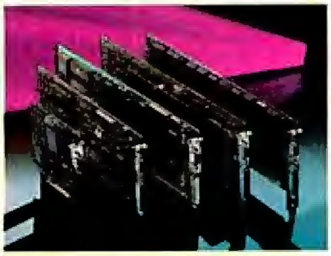

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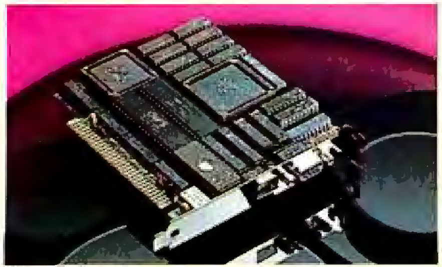

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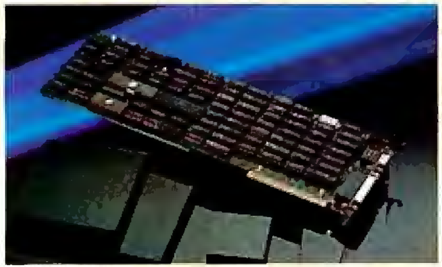
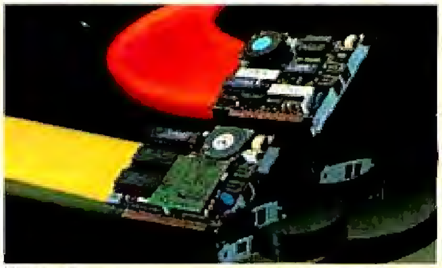


Everex Edge

Excel Stream 60-8



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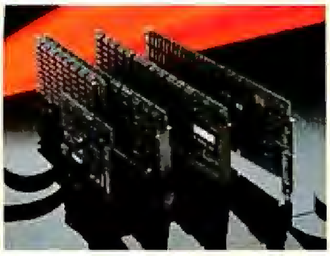


MULTIFUNCTION

Excelerator

- 80286 8MHz processor replaces 8088 on PC/XT*
- 33% faster than standard IBM AT®
- Add up to 640K of cache RAM memory
- Socket for 80287 math coprocessor

Magic I/O

- I/O plus clock/calender
- For XT/AT and compatibles
- Serial ports COM1-COM-4
- Parallel ports LPT1-LPT3
- Software included

Magic Card 16

- Up to 2MB of extended memory for AT
- Flexible memory addressing
- Configurable parallel and serial ports

HARD DISK DRIVES

Everdrive 20MB External

- Half-height, 20MB formatted capacity
- ST-506/ST-412 interface
- 65 msec average access time
- Dedicated head shipping zone

Everdrive 40MB Internal

- Half-height, 40MB formatted capacity
- 40 msec average access time
- ST 412 interface
- 20,000-hour MTBF

Everdrive 72/80MB External

- 72/80MB formatted capacity
- 30 msec average access time
- 20,000-hour MTBF
- 25-5 Watts power consumption

OEM PRODUCTS

EV-826 Tape Formatter

- Onboard 8K RAM for data buffer
- Standard QIC-36 drive interface
- QIC-02 interface for host adapter

EV-332 Hard Disk/Floppy Controller

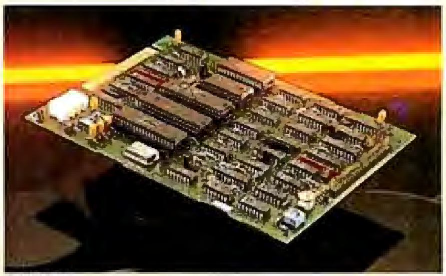
- Reduced height
- ST506/412 interface supports 2 hard drives
- 2:1 interleave factor
- 32 bit ECC
- Supports 2 floppy drives

EV-1800 AT Mother Board

- 10MHz zero wait state 80286 CPU
- 512K RAM, expandable to 1MB
- Six 16-bit and two 8-bit slots
- I/O ports and clock calendar

Excelerator

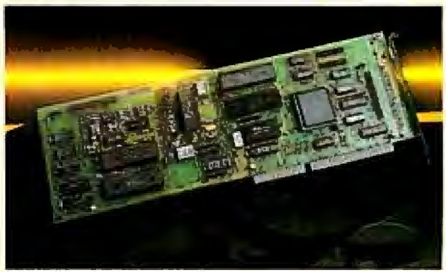
Everdrive 20MB External



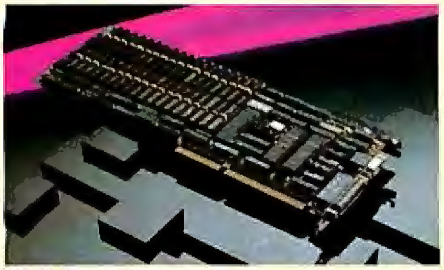
EV-826

Magic I/O

Everdrive 40MB Internal



EV-332



Magic Card 16

Everdrive 72/80MB External

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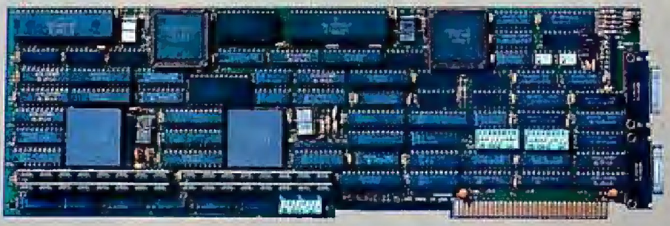
EXPAND YOUR PC TO NEW HORIZONS

PC-Slave II
The Ultimate Two-User Card

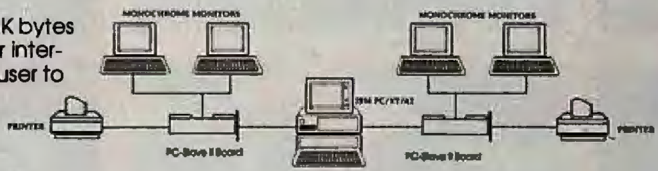


Advanced Digital now offers you two additional users for the price of one!

With our PC-Slave II®, you can quickly turn your personal computer into a host computer for a complete 3-user system. The PC-Slave II lets two additional users share one PC and all the expensive hardware and peripherals that you've already paid for. Plus you share access and communication between users and PC's.

Each slave has two CPU's, two 512K bytes of memory, keyboard and monitor interface, making it possible for each user to work on the same program or two entirely different programs...as if they were two independent PC's.

PC users often ask us how to network their many PC's. The solutions are many but expensive and slow. Advanced Digital's answer — the PC-Slave II allows you to add additional workstands at a more reasonable cost...and with much faster performance than any local area network or software package.



All you need to complete your 3-user system is the PC-Slave II, IBM's PC-NET software, and two low-cost monochrome monitors and keyboards. No new operating system, no new commands and no complications of a LAN.

Each PC-Slave II gives your PC the full capabilities of two PC's and can support DOS 3.1 providing each user 100% compatibility with PC programs.

Advanced Digital offers many other PC products including the ADC-TAPE-60, PC-EXBUS, PC-Slave and more!

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WHAT'S NEW

Typesetting and Layout on the Mac

TEXtures, a typesetting program for the Macintosh from Addison-Wesley is based on TEX, the typesetting language developed for computerized typesetting and controlled page layout.

TEXtures' macro programming language lets you typeset complex tables, precision-ruled forms, and multicolumn layouts. It provides hyphenation, justification, pagination, kerning, and ligature insertion, and lets you number, footnote, and cross-reference pages, sections, and paragraphs.

With the program's WYSIWYG (what-you-see-is-what-you-get) editing capability, you can preview typeset pages, including graphics, magnified up to 300 dots per inch. You can also display typeset pages in a window or display the editing and viewing windows on-screen at the same time. Word processing windows let you input and edit text.

TEXtures operates on the Macintosh 512K, the 512K Enhanced, the 1-megabyte XL, and the Plus. The program supports two 800K- or 400K-byte floppy disk drives, although a hard disk drive is recommended. TEXtures uses standard Macintosh printer software for laser printers, according to Addison-Wesley. It also works with typesetters and the Apple Imagewriter.
Price: $495.
Contact: Addison-Wesley Publishing Co., Jacob Way, Reading, MA 01867, (617) 944-3700.
Inquiry 576.

Desktop typesetting with TEXtures on a Mac.

Tandy Emulates Apple II

If you own an IBM PC–compatible Tandy 1000 or Tandy 1000 SX, you can run most of the software available for the Apple II family of computers by using Tandy's Trackstar 128 emulation board.

The Trackstar 128 includes a 65C02 processor, 128K bytes of RAM, and dual game-controller connectors (compatible with both the 16-pin Apple IIe and the 9-pin Apple IIc).

The board provides both 80- and 40-column displays on either RGB or composite-video monitors and supports Apple ProDOS and Apple DOS 3.2. Printer and serial ports, as well as music and sound support, are provided through the Tandy 1000.

Although most Apple software will run on the 1000's internal drives, the Trackstar can also connect an external Apple-compatible disk drive. This is particularly useful for running heavily copy-protected programs.

Tandy says the results of an independent study showed that 99 percent of the more than 400 pieces of Apple software ran on the Trackstar.

The board must be installed by an authorized Tandy service center.
Price: $399.95 plus installation.
Contact: Tandy Corp., 1800 One Tandy Center, Fort Worth, TX 76102, (817) 390-3011.
Inquiry 577.

The Scoop from Target

Scoop, a desktop publishing program from Target Software, offers a WYSIWYG text editor with page-layout and composition capabilities, enabling you to display and edit files up to 100 pages long.

Scoop lets you fill or wrap text around irregularly shaped graphics, automatically or manually hyphenate, slant margins, and use fractional font sizes. The spelling checker MacLightning 3.0 is included.

Scoop requires a Macintosh 512K or Plus and supports PostScript-compatible output devices.
Price: $495.
Contact: Target Software Inc., 14206 Southwest 136th St., Miami, FL 33186, (800) 622-5483; in FL, (305) 252-0892.
Inquiry 578.

Low-Cost Networking

Avatar Technologies' Alliance ZSL local area network, combines hardware and software to connect up to 20 IBM PCs, compatibles, and devices via each connected system's serial port. Avatar calls it a "zero-slot" network, because you don't need adapter cards. You can also connect any computers that have RS-232C serial ports.

The network is configured as a star, with each device connecting to the Alliance ZSL network processor. Each workstation and device is connected by standard telephone wire to the network processor.

The program is memory-resident and supports file-transfer rates of up to 115k bits per second. Print spooling is offered, so you can print in the background. A bulletin-board system enables you to send messages between workstations on the network. You can also share peripherals and transfer files between workstations. A 3270 interface is supported letting you connect to IBM mainframes.

Alliance ZSL is available in 8-node, 14-node, and 20-node versions.
Price: $1195 for 8-node; $1595 for 14-node; and $1995 for 20-node version.
Contact: Avatar Technologies, 99 South St., Hopkinton, MA 01748, (617) 435-6872.
Inquiry 579.

continued

A Lighter and More Inexpensive GRiD

The GRiDLite Model 1030 from GRiD is an IBM PC-compatible laptop with an 80C86 processor running at 4.77 MHz and a supertwist yellow LCD that displays 80 characters by 25 lines.

Weighing 8½ pounds, the GRiDCase measures 11 by 13 inches and includes a single 3½-inch floppy disk drive and 128K bytes of RAM (expandable to 640K). You can also install up to 1 megabyte of EMS RAM.

GRiDLite is powered either through the AC power line or through an internal rechargeable battery. The unit's rear panel includes an RS-232C serial port, parallel printer port, an RGB video-out connector, and a connector for an external floppy disk drive.

You can install up to eight application ROMs (up to a megabyte total memory). GRiD sells InteGRiD, a multitasking applications environment, as well as analytical and communications software—all in ROM. You can also integrate custom applications.

GRiDLite options include a 640K-byte memory upgrade, half-megabyte and 1-megabyte EMS RAM expansions, an external 3½-inch floppy disk drive, and an internal 300/1200-bps direct-connect modem.

Price: $1750; 640K RAM expansion, $600; half-megabyte EMS RAM expansion, $295; 1-megabyte EMS RAM expansion, $395; internal modem, $495; external 3½-inch floppy disk drive, $295.

Contact: GRiD Systems Corp., 2535 Garcia Ave., Mountain View, CA 94039-7535, (800) 222-4743, (415) 961-4800.

Inquiry 580.

The PC-compatible GRiDLite laptop.

PageMaker for the IBM PC and the Macintosh II and SE

With the new IBM PC and Macintosh II and SE versions of PageMaker, Aldus's desktop publishing program, you can design, edit, and print using word-processing and graphics programs from a variety of manufacturers.

The Macintosh version lets you work with PC PageMaker files on your Mac, and built-in and installable word-processing import filters let you use IBM PC-based word-processing documents in your PageMaker publications. You can also save text files created on the Macintosh PageMaker as Word 3.0 word-processing files. PageMaker 2.0 for the Mac requires a Macintosh Plus, II, or SE with a hard disk.

PageMaker for the PC runs under Microsoft Windows and can import preformatted text files from Microsoft Word, WordPerfect, MultiMate, WordStar 3.3, XyWrite III, and Microsoft Windows Write. PageMaker for the PC runs on IBM PC ATs or compatibles with at least 640K bytes of RAM, a 20-megabyte hard disk, a graphics card, and a mouse.

Price: Macintosh version, $495; IBM PC version, $695.

Contact: Aldus Corp., 411 First Ave. S, Suite 200, Seattle, WA 98104, (206) 622-5500.

Inquiry 581.

New Mouse Systems Mice

Mouse Systems has enhanced the serial-port and the bus models of its PC Mouse and has also lowered the prices on both. The mice's performance is enhanced by new application-specific integrated circuits (ASIC). On the serial-port model, the new circuitry means the mouse no longer needs an external power supply.

The mice are being shipped with an expanded library of 24 Designer Pop-Up menus for popular PC business applications, including Lotus 1-2-3, PFS:Professional Write, WordStar 2000, dBASE III, and WordPerfect 4.2. Instructions are included for developing custom pop-up menus, and the mice are shipped with software that make them compatible with the Microsoft mouse applications.

Price: PC Mouse, $159; PC Mouse Bus Plus, $179.

Contact: Mouse Systems Corp., 2600 San Tomas Expressway, Santa Clara, CA 95051, (408) 988-0211.

Inquiry 582.

IBM Upgrades RT

IBM's three new models of its RT Personal Computer have four times the memory, two to three times the processing speed, and an eightfold increase in floating-point performance. The RT's Advanced Interactive Executive (AIX) operating system has also been upgraded. All use IBM's 1-megabit memory chips, and incorporate a memory-management unit that lets you access up to a trillion characters of virtual memory.

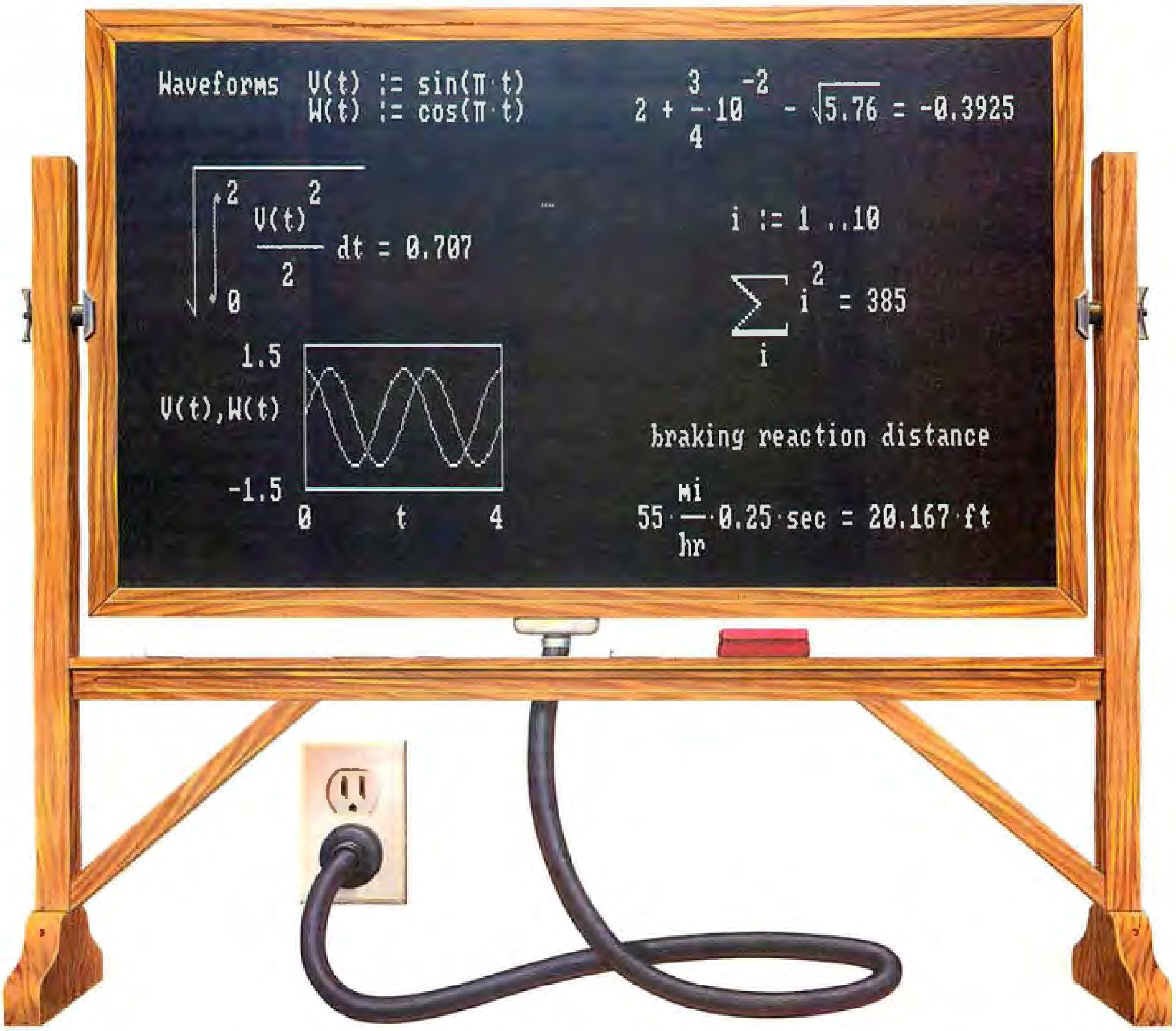
The RT 6151 Model 115 is a desktop unit, and the RT 6150 Models 125 and B25 are floor-standing units. All feature an advanced processor card with a 32-bit reduced instruction set computer (RISC) processor with a memory management chip, a built-in floating-point unit, and 4 megabytes of fast CMOS memory. There's also an extended ESDI magnetic media adapter that will accommodate up to three internal fixed disks.

Owners of the original RT models can upgrade to new desktop and floor-standing models by purchasing an upgrade kit.

Price: 6151 Model 115, $10,600; 6150 Model 125, $16,100; 6150 Model B25, $17,670 (all single-unit quantities). Upgrade kit for existing RTs, $2495; 4-megabyte fast-memory expansion, $3800; 8-megabyte fast-memory expansion, $5000.

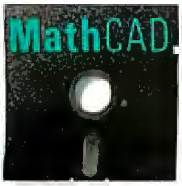
Contact: IBM Corp., Information Systems Group, 900 King St., Rye Brook, NY 10573, (914) 765-1900.

Inquiry 583.



Engineering calculation raised to a new power.

The only software program to combine the flexibility of a blackboard, the simplicity of a calculator, and the power of a personal computer.



Now you can write calculations on your PC in standard math notation—mixing text, formulas and graphics with the same free-form ease you have on a blackboard or scratchpad.

No new languages to learn.
Simply type equations anywhere on the screen and MathCAD automatically calculates and displays your results as numbers or graphs—exactly as you want to see them. Change anything, and MathCAD instantly recalculates the results. Add text at any point to support your work. Then print and save your entire calculation as an integrated document.

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MathCAD handles both real and complex numbers and does automatic unit conversion and dimensional analysis. It has a full range of built-in functions including integration, differentiation, fft's and cubic splines. Or you can define your own. No wonder thousands of engineers use MathCAD every day, for everything from robotics to signal processing and thermodynamics to fluid mechanics.

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MathCAD. Once you've tried it, you'll wonder what you ever did without it. Order today.

Requires IBM PC® or compatible, 512KB RAM, graphics card. IBM PC is a registered trademark of International Business Machines Corporation. MathCAD™ MathSoft, Inc.

MathCAD

MathSoft, Inc., 1 Kendall Sq., Cambridge, MA 02139

Drawing on the Apple IIGS

With TopDraw, a mouse-based object-oriented drawing program from StyleWare, you can create drawings that are several pages in length and width on the Apple IIGS with 512K bytes of RAM. You can move, group, separate, reshape, resize, or fill shapes and objects with patterns and colors. You can also flip objects, rotate them in 90-degree increments, and protect them from unintentional editing.

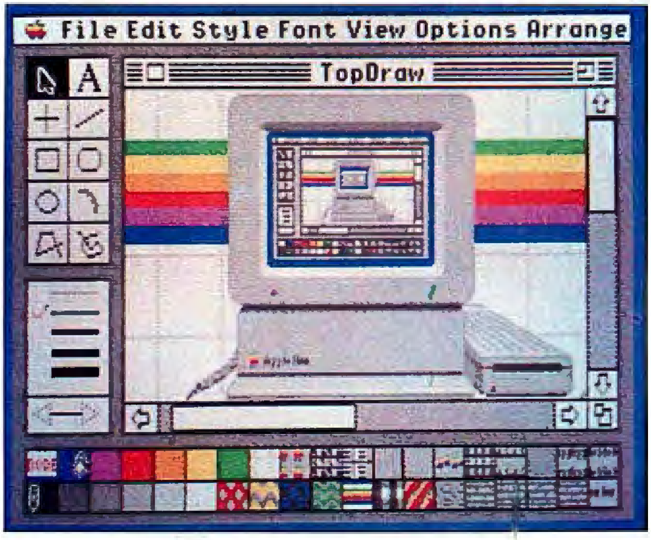
TopDraw features the ability to edit colors and lets you draw with as many as 16 colors at a time, from a palette of 4096 colors. The program gives you a choice of fonts, type styles, and sizes for incorporating text into your drawings.

TopDraw supports the LaserWriter and the Imagewriter II.

Price: $99.95.

Contact: StyleWare Inc., 5250 Gulfton, Suite 2E, Houston, TX 77081, (713) 668-4046.

Inquiry 584.



TopDraw lets you choose from a palette of 4096 colors.

Hard Disk Expansion for Toshiba T1100+

ThinWin and ThinPack are two expansion systems for the Toshiba T1100+ portable laptop computer. The ThinWin is an internal hard disk that replaces drive B. It's available in 10- and 20-megabyte versions and adds 8 ounces to the computer's weight. The ThinWin must be installed by an authorized dealer.

The ThinPack 1100 is an external expansion chassis that adds 1½ inches to the thickness of the computer. Also available with both 10- and 20-megabyte hard disks, it adds two IBM PC-compatible slots that take half-size cards, as well as an internal rechargeable battery system with a proprietary low-power mode.

The ThinPack weighs 4½ pounds. Axonix says they'll be offering several half-length cards for it, including LAN, terminal emulators, expansion memory, ROM, data acquisition, EGA, data encryption, and a high-speed radio frequency wireless modem.

Price: from $995 to $1395.

Contact: Axonix Corp., 417 Wakara Way, Salt Lake City, UT 84108, (801) 582-9271.

Inquiry 585.

Two RLL Hard Disk Controllers

The Perstor 200 series of hard disk controllers includes two new models: the PS180 and the PS200. Both controllers use the Advanced run length limited 2,7 encoding method. The PS180 transfers data at 9 megabits a second, provides 31 sectors per track, and increases hard disk capacity by at least 90 percent over a standard controller. The PS200 transfers data at 10 megabits a second, provides 34 sectors per track, and increases hard disk capacity by 100 percent.

The controllers work with any Winchester hard disk drive that's compatible with the IEEE ST506/412 interface. The PS180 works with MFM- and RLL-approved drives with either plated or oxide media. The PS200 works best with plated-media RLL-approved drives. Both use a standard IBM BIOS and are compatible with MS-DOS, PC-DOS, UNIX, XENIX, and CP/M. Both are also capable of supporting drives with up to 15 heads and 2048 cylinders. They come with an advanced error-checking-and-correction capability using a 56-bit fire code to allow twice the bit dropout factor of normal controllers. Both controllers have a 25-megabyte data-recovery circuit and sector-buffering RAM.

The 200 series can be used as primary, coresident, or multiple controllers, and can be set for BIOS or non-BIOS use, as well as for either direct memory access or programmed input/output.

Price: PS180, $495; PS200, $595.

Contact: Systems and Software Inc., 7825 East Redfield Rd., Scottsdale, AZ 85260, (602) 948-7313.

Inquiry 586.

Battery Pack for Toshiba Portable

AdaptaPAK, a rechargeable battery pack from Product R&D will run the Toshiba T3100 portable laptop computer for over an hour. It consists of an adapter, battery, charger, and a zippered carrying case with a shoulder strap. The adapter's output power cord plugs directly into the Toshiba's AC receptacle, and the adapter's input cord plugs into the portable battery or into a 12-volt vehicle lighter.

The rechargeable battery of the AdaptaPAK weighs 7 pounds. The battery adapter is also available as a standalone product called the Adapt80. Its primary application is for people who want to use the Toshiba in a vehicle, or those who want to use a different source of 12-V power.

Price: AdaptaPAK, $399; Adapt80, $299.

Contact: Product R&D Corp., 1194 Pacific St., Suite 201, San Luis Obispo, CA 93401, (805) 546-9713.

Inquiry 587.

Protect Your Modems

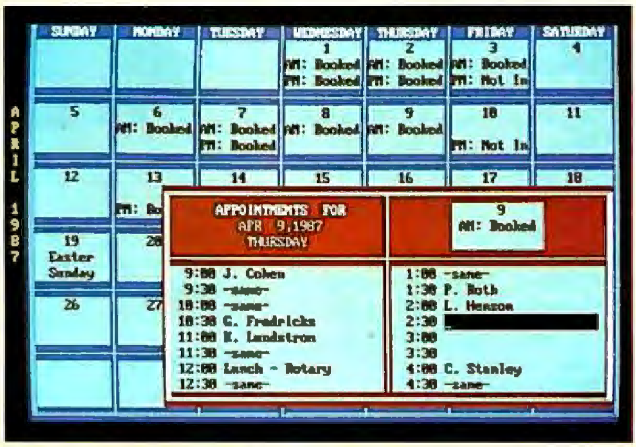
The Diamond Chip is a low-cost, high-voltage phone-line surge protector from Curtis Manufacturing. It has a swivel mount that rotates 360 degrees for easy positioning and installation.

The unit protects modems, and all equipment that is directly connected to the telephone lines, from power surges, which the company says is extremely common.

The Diamond Chip also protects data during transmission through unprotected telephone lines by helping to prevent loss or damage from surges or spikes. The unit plugs directly into any standard AC wall outlet. It uses the ground only and does not draw any power. A 6-foot telephone-line patch cord is included.

continued

BOB STANTON HAD A GREAT IDEA. AN HOUR LATER HE WAS TESTING IT.



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APPOINTMENTS FOR
APR 9,1987
THURSDAY

 9:00 J. Cohen            1:00 -same-
 9:30 -same-              1:30 P. Roth
10:00 -same-              2:00 L. Henson
10:30 G. Fredricks        2:30
11:00 K. Lundstrom        3:00
11:30 -same-              3:30
12:00 Lunch - Rotary      4:00 C. Stanley
12:30 -same-              4:30 -same-
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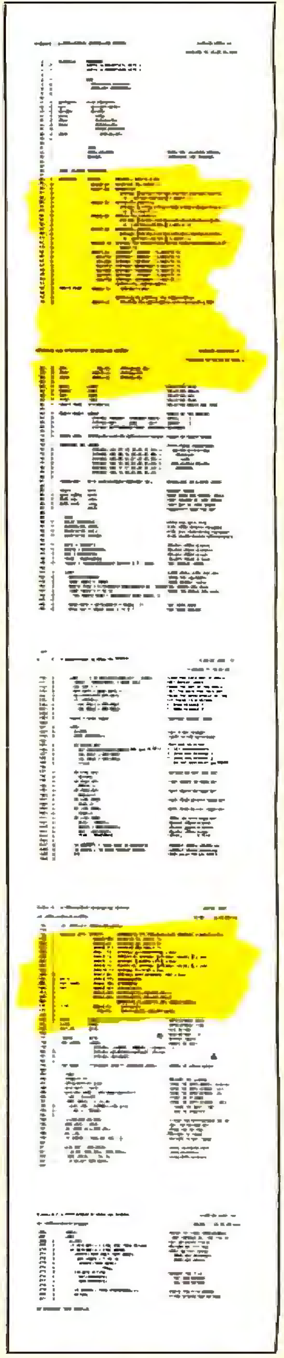

Appointments. Everybody takes them — dentists, autobody shops, dance instructors. And lots of computer applications need appointment screens.

Bob thought that a calendar made a terrific graphic metaphor for taking appointments. Simply use the arrow keys to pick an open date, then press the Enter key, and up pops an appointment window.

Lucky for Bob, he's a CLARION programmer, one of a fast growing cadre of super-productive application developers.

With CLARION's Screener utility, he painted a white calendar on a black background. Then he drew a white-on-blue track around the page and between the days. He typed in the days of the week — and *voila!* — a calendar!

CLARION knows that a PC monitor is refreshed from memory, so it treats a screen layout like a group of variables. Just move data to a screen variable, and it shows up on the monitor.

Bob set up dimensioned screen variables for the days of the month and a screen pointer for selecting a date, and he was done. Then Screener generated the code.

Then Bob drew the appointments window, built an appointment file, filled in the connecting code and tested it — ONE HOUR AFTER HE STARTED!

Testing was a breeze. Screener doesn't just write code, it compiles your source, displays a screen, gets the changes, then replaces the old code in your program.

So here are Bob's appointment screens. You can see the source listing to the right. We marked all the code Screener wrote for him.

WHY CLARION?

Why are application developers everywhere changing to CLARION?

Because CLARION gives you all the tools you need: a coupled compiler and editor; screen, report, and help generators; an import/export utility; a sort/backup/restore utility; a formatted file dump; a DOS shell — and much more.

Because with CLARION 's comprehensive data management routines, records can be locked and files shared on Novell®, 3COM®, IBM® PC Net & Token Ring, Multi Link®, and most other networks.

Because CLARION is *not* hardware locked or copy protected. Run-time systems are *free* and soon you will be able to translate CLARION into native machine code (.EXEs).

And best yet, the price of CLARION v1.1 is just $395 plus shipping and handling.

You'll need an IBM PC or true compatible with 320KB of memory and a hard disk drive. CLARION v1.1 also comes with a 30-day money back guarantee.

So call now and order CLARION v1.1. or ask for our detailed 16-page color brochure and reprints of major reviews.

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CLARION®
from BARRINGTON SYSTEMS, INC.

150 EAST SAMPLE ROAD **POMPANO BEACH, FLORIDA 33064** **305/785-4555**

Price: $19.95.
Contact: Curtis Manufacturing Company Inc., 305 Union St., Peterborough, NH 03458, (603) 924-3823.
Inquiry 588.

Turbocharged Amiga Tower

For Amiga users who want the ultimate in performance, Computer System Associates' Turbo-Amiga Tower attaches to the side of an Amiga A1000 and upgrades it to include all the features of the Amiga 2000, including IBM compatibility. The unit sports a 68020 processor running at 14 MHz, a 68881 math coprocessor, up to 12 megabytes of 32-bit memory, and up to 75 megabytes of hard disk storage.

The Tower comes with a 200-watt power supply, seven 100-pin Zorro-bus Amiga slots, four IBM PC AT-compatible slots, and one 86-pin auxiliary CPU slot. A special Commodore 8088 bridge card provides IBM compatibility with an 8088 coprocessor running simultaneously with the Tower's 68020 processor.

For data storage, the Tower has optional removable hard disk cartridges available in sizes of 20 to 75 megabytes. These Winchester Secure Data Cartridges (SDC) are primarily designed for environments where high security is required. The Winchester disk drive or an optional fixed internal hard disk drive is connected to the system by an SCSI card. The SCSI connector is also available for external control of any SCSI product.

68020 power for the Amiga.

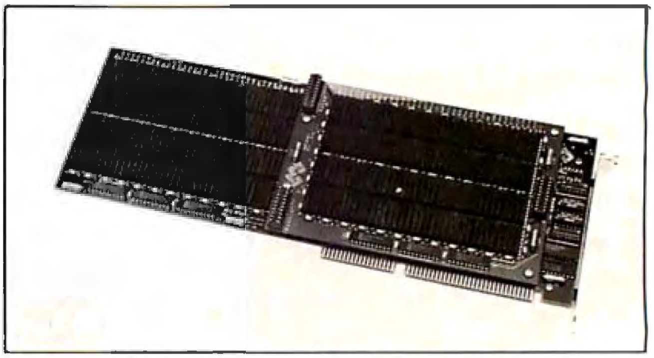
Price: Starting at $5475.
Contact: Computer System Associates Inc., 7564 Trade St., San Diego, CA 92121, (619) 566-3911.
Inquiry 589.

PC-File+ Features Report Writer and Other New Capabilities

ButtonWare's PC-File+, now written in C, is 5 times faster than previous versions and searches up to 10 times faster than PC-File II. The enhanced program is menu-driven, offers a teach mode, has over 175 help screens, and features a macro capability.

A new report writer features a report command language and the ability to paint reports on-screen. Enhanced searching capabilities let you retrieve data from multiple databases, sort fields, and perform global searches and updates on all or part of a field.

PC-File+ requires an IBM PC or compatible with at least 384K bytes of RAM, MS-DOS or PC-DOS 2.0 or higher, and two floppy disk drives or one floppy and one hard disk drive.
Price: $69.95.
Contact: ButtonWare Inc., P.O. Box 5786, Bellevue, WA 98006, (206) 454-0479.
Inquiry 590.



JustRAM packs up to 8 megabytes.

8 Megabytes in a Single AT Slot

Monolithic System's JustRAM board is designed for IBM PC AT and compatible owners who want to cram all the memory they can into a single expansion slot.

JustRAM comes in 4- and 8-megabyte configurations. It's compatible with the Lotus/Intel/Microsoft Expanded Memory Specification (LIM/EMS) and can be used as conventional, expanded, or extended memory. If you use a non-DOS operating system such as XENIX, you can access a full 16 megabytes of conventional memory using a pair of JustRAM boards.

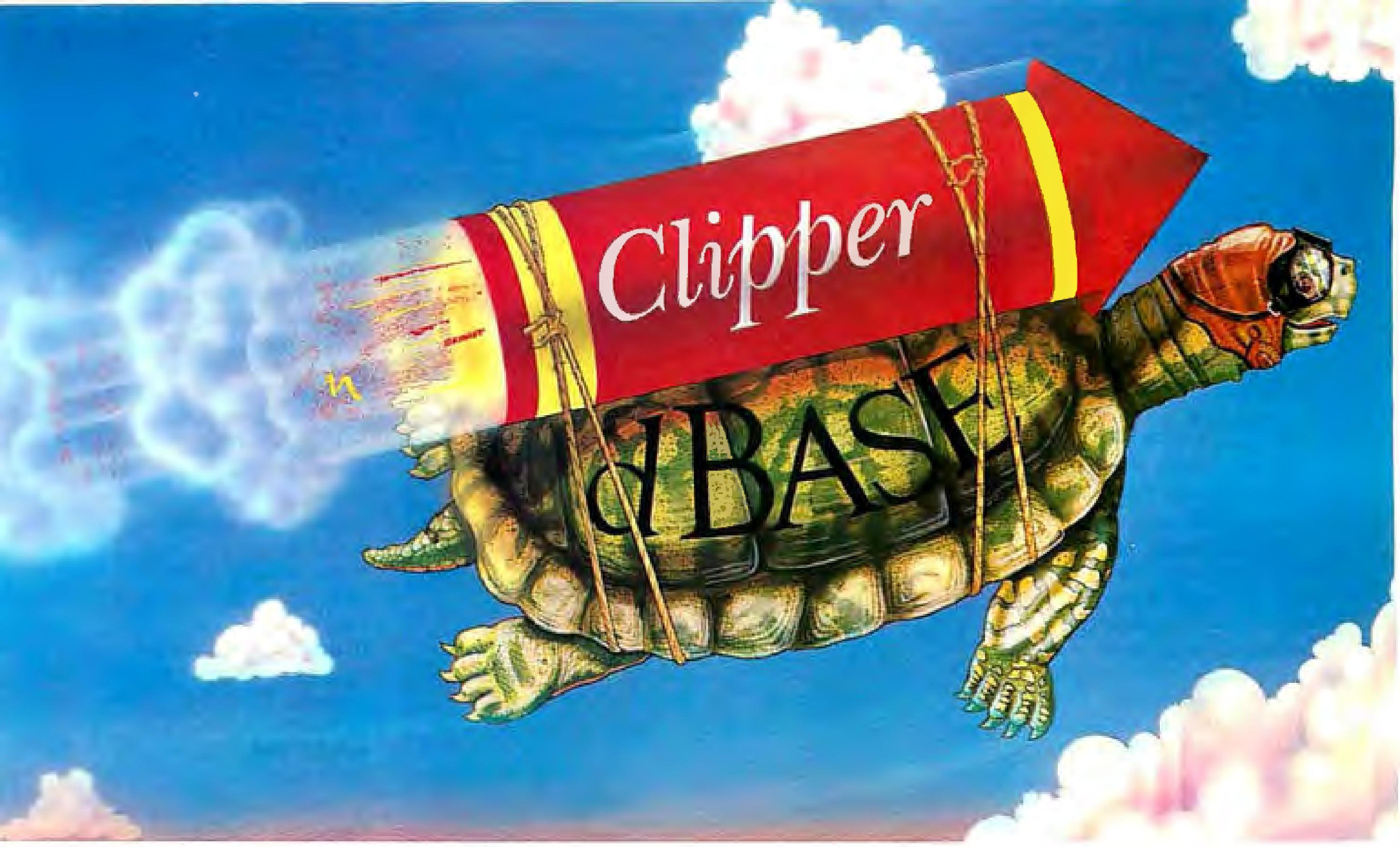
The board will operate at up to 12 MHz with wait states, and up to 8 MHz with no wait states. It has on-board DIP switches that let you set the I/O address and gives you the option of backfilling conventional memory to 512K or 640K bytes.

JustRAM uses soldered 256K-bit ZIP RAM chips and is filled to 8 megabytes using a mezzanine board that installs on top of the existing board. MSC says they use a proprietary noise-reduction technique that allows them to tightly pack the board.
Price: $1495 with 4 megabytes; 4-megabyte add-on mezzanine board, $1195; 8-megabyte combination board, $2690.
Contact: Monolithic Systems Corp., 84 Inverness Circle E, Englewood, CO 80112, (303) 790-7400.
Inquiry 591.

Leading Edge's AT-Compatible

The Model D2 is an IBM PC AT-compatible system from Leading Edge Hardware Products. Built around an 80286 processor, the D2's standard configuration includes 640K bytes of RAM (expandable to 1 megabyte on the motherboard), a single 5¼-inch 1.2-megabyte floppy disk drive, a monochrome monitor with an enhanced graphics adapter, and a 101-key AT-style keyboard.

The D2 system unit's footprint is one-third smaller than the AT and measures 16 by 15½ by 6 inches. Six expansion slots are included, and the D2 is switchable between clock speeds of 6 MHz, 8 MHz with no wait states, or 10 MHz with one wait state. The system is also available with an internal 30-megabyte hard disk drive.
Price: $1936; with 30-megabyte hard disk drive, $2914.
Contact: Leading Edge Hardware Products Inc., 225 Turnpike St., Canton, MA 02021, (617) 828-8150.
Inquiry 592.



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Fast screens that can be treated as memory variables and eliminate the need for direct screen writes and all that tortuous heap management code.

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In Europe: Nantucket Corporation (Europe) 2 Bluecoats Avenue, Fore Street, Hertford, Herts SG14 1PB Telephone 0992 554621.

Inquiry 213 for End-Users. Inquiry 214 for DEALERS ONLY.

SYSTEMS

Three New APCs

NEC's three new Advanced Personal Computer models are based on the 80286 processor and are fully IBM PC AT-compatible.

The PowerMate 1 is the lowest-priced of the three, with a smaller footprint than comparable AT clones. Its standard features include 8-MHz processor speed and 640K bytes of RAM (expandable to 8.6 megabytes). The base unit includes six full-length expansion slots (five 16-bit and one 8-bit), an RS-232C serial port, a parallel printer port, and a clock/calendar. Also included are two 5¼-inch floppy disk drives and a single 3½-inch disk drive.

The PowerMate 2 operates at either 8 or 10 MHz. It also comes with 640K bytes of RAM but is expandable to 10.5 megabytes. In addition to the parallel port, it has two RS-232C serial ports.

The BusinessMate is a high-performance multiuser system to which you can attach up to eight terminals. Its 80286 processor is software-switchable between 8 and 10 MHz and is configured with 640K bytes of RAM, expandable to 10.6 megabytes. It has a single 1.2-megabyte floppy disk drive and a standard 40-megabyte hard disk drive. The BusinessMate can support up to nine users operating under XENIX.

Video boards and monitors are optional with all three models.

Price: PowerMate 1, $1995; PowerMate 2, $2595; BusinessMate, $6000.

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

Inquiry 593.

NEC's newest AT clone.

Commodore Upgrades 128

The 128D is Commodore's enhanced version of the C-128 with several new features. It has a detachable keyboard, a built-in 350K-byte 1571-compatible 5¼-inch floppy disk drive, and three operating modes.

The unit, which is smaller than the C-128, has 128K bytes of RAM (expandable to 640K). The C-128 operating mode takes full advantage of the unit's memory and 80-column display; the C-64 mode fully emulates a Commodore 64. The 128D also has a built-in Z80A processor for running CP/M programs.

The full-size detachable keyboard includes a 14-key numeric keypad, eight function keys, six cursor keys, and a separate Help key. The 128D also comes complete with a serial communications port, a cartridge port, and two joystick ports.

Price: $550.

Contact: Commodore Business Machines Inc., 1200 Wilson Dr., West Chester, PA 19380, (215) 431-9100.

Inquiry 594.

Compaq Upgrades Deskpro 286

Compaq's upgraded Deskpro 286 desktop AT-clone now runs at 12 MHz, increased from its prior 8-MHz top speed. The Deskpro is also equipped with faster (100-nanosecond) RAM and available hard disk storage of up to 80 megabytes.

The processor speed of the enhanced Deskpro 286 is keyboard-switchable to 8 MHz for applications that require a slower speed. Meanwhile, to ensure compatibility with AT-type expansion boards, the expansion bus of the Deskpro 286 always runs at 8 MHz.

The Deskpro has seven available expansion slots. The enhanced Deskpro 286 is available in three standard configurations. The Model 1 has a single 1.2-megabyte floppy disk drive and 256K bytes of RAM; the Model 20 adds a 20-megabyte hard disk, and 640K bytes of RAM; the Model 40 has a 40-megabyte hard disk drive. Many options are also available.

Price: Model 1, $2999; Model 20, $3999; Model 40, $4999.

Contact: Compaq Computer Corp., 20555 FM149, Houston, TX 77070, (713) 370-0670.

Inquiry 595

Two 386 Machines

The Noble 386 from PC Discount is an 80386-based personal computer that comes with the same standard features as the Compaq 386, including a 40-megabyte hard disk drive, 1.2-megabyte floppy disk drive, and 1 megabyte of RAM.

Price: $3999.

Contact: PC Discount, 2000 Travis, Suite 630, Houston, TX 77002, (713) 864-0295.

Inquiry 596.

American Micro Technology's AMT-386 runs at either 6 MHz or 16 MHz and has a 64K-byte cache memory that allows operation with no wait states. The base unit has eight expansion slots and 1 megabyte of memory (expandable to 4 megabytes on the motherboard). It comes with a single 1.2-megabyte floppy disk drive. A hard disk is optional.

Price: $2995.

Contact: American Micro Technology, 14751-B Franklin Ave., Tustin, CA 92680, (714) 731-6800.

Inquiry 597.

continued

It takes four of theirs to display the same text and graphics as one Amdek 1280.

Now, you can create more comprehensive and detailed documents using the most popular Desktop Publishing packages. Because Amdek's 1280 graphics subsystem puts 1280 X 800 pixels on a big 15″ white phospher CRT.

There are a total of 11 modes. What's more, the 1280 provides complete monochrome and color graphics compatibility.

Price? The Amdek 1280 monitor and video board cost only $999. So, if you work with desktop publishing, CAD or Lotus, Amdek's 1280 graphics subsystem is clearly your best buy.

The Amdek 1280 provides 1280(H) X 800(V) resolution with these software packages:

GENERAL PC SOFTWARE

Lotus 1-2-3
Symphony

DESKTOP PUBLISHING

AdvanTex
Venture Publishing
PageMaker/PC
Frontpage
DeskSet
Pagemaster
Rim Systems
Compound Document Processor
Display Ad Make-up System

COMPUTER-AIDED DESIGN

AutoCAD
Cadvance
Drafix 1
In-A-Vision
Generic CADD
VersaCAD ADVANCED
Workview
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Clearly the finest in monitors.

2201 Lively Blvd., Elk Grove Village, IL 60007
Phone: (312) 364-1180 TLX: 280-803

Inquiry 20

PERIPHERALS

Networking High-Speed Printer

Output Technology's TriMatrix 850 PrintNet is a dot-matrix printer with built-in networking capabilities. Up to five users can connect directly to the PrintNet through serial ports. Besides being a printing station for multiple users, the unit also acts as a network communications controller and memory storage unit. Any device capable of serial communications (computers, printers, modems, etc.) can be connected to the 850 PrintNet and can exchange data in RS-232C or RS-422 formats at speeds of up to 19.2k bps. The PrintNet 850 handles forms up to 136 columns wide and forms with up to six parts. The company claims the printer throughput is 240 lines per minute, with a burst speed of up to 850 characters per second. It has 256K bytes of internal memory, and a 1.5-megabyte option is available.

Price: $2995.

Contact: Output Technology Corp., East 9922 Montgomery, Suite 6, Spokane, WA 99206, (509) 926-3855.

Inquiry 598.

A printer with networking capabilities.

Bizcomp 2400-bps Echo-Canceling Modems

The IntelliModem 2400 is available in both external and internal configurations, is fully Hayes-compatible, and uses the company's proprietary Adaptive Echo Cancelation (AEC) for augmenting traditional adaptive equalization. AEC creates a lookalike copy of the near-end echo signal it expects back from the telephone line, then inverts it. When the synthetic negative echo adds to the genuine positive echo, they cancel each other out. The purpose of the AEC is to cut down transmission errors caused by poor line conditions.

The IntelliModem 2400 also supports 1200 or 110 to 300 bps and includes audio call-progress monitoring with adjustable volume controls and RJ-11 connectors for connecting telephone sets.

The external model features a multicolor signal quality bar graph display and easy access to option switches. The internal model is a half-card for short slots in PCs and compatibles.

Price: $599.

Contact: Bizcomp Corp., 532 Mercury Dr., Sunnyvale, CA 94086, (408) 733-7800.

Inquiry 599.

Disk Drive for Tandy Portables

The Tandy Portable Disk Drive 2 is a new version of a 3½-inch floppy disk drive that works with the Tandy 102 and Tandy 200 portable computers. Measuring 2⅛ by 5¼ by 6⅜ inches, the unit weighs less than 2 pounds and operates off AC power with an included adapter, or off four AA alkaline batteries. Tandy says the batteries will operate the drive continuously for 1½ hours.

The Drive 2 stores 200K bytes of data on a single-sided 3½-inch disk and has both disk-access and low-battery indicators. It transfers data through the computer's serial port at 19.2k bps.

Price: $199.95.

Contact: Tandy Corp., 1800 One Tandy Center, Fort Worth, TX 76102, (817) 390-3011.

Inquiry 600.

HP's Desktop Scanner

Hewlett-Packard's HP ScanJet scanner is a flatbed desktop scanner that enables you to electronically scan documents for use in desktop-publishing applications. The flatbed scanning surface is 8½ by 11 inches, but by adding the optional automatic feeder, you can scan both larger pages and multiple-page documents.

After selecting a resolution from 38 to 300 dots per inch, you can scan a document for on-screen preview or input a full-page image and store the data on a hard disk. The scanner is also capable of image enlargement and reduction; you can reduce image size to as little as 13 percent or enlarge it up to 1578 percent.

The HP ScanJet scanner can distinguish among 16 different levels of gray. It supports three image-data types: binary, dithered, and 4-bit gray scale.

MS-DOS and MS Windows versions of HP Scanning Gallery are included with the HP ScanJet scanner. They let you store scanned data in several different file formats.

The HP unit features a Centronics parallel interface card. The card will work with the HP Vectra PC, IBM PC XT, AT, and compatibles.

Price: $1495.

Contact: Hewlett-Packard Co., 1820 Embarcadero Rd., Palo Alto, CA 94303, (800) 367-4772.

Inquiry 601.

Nine-ounce Portable Modem

The Pocket Modem from Migent runs at 1200 bps, weighs only 9 ounces, and measures 1.3 by 2.5 by 5 inches; small enough to fit in a shirt pocket. It operates either off a standard 9-V battery or with a 110-V AC adapter and uses surface-mount technology.

The unit has dual telephone jacks, busy and dial-tone monitoring, and can sense remote rings and tones. It also has a 28-character nonvolatile memory for storing telephone numbers and access codes.

Included with the Pocket Modem are a communications software package, a 7-foot telephone-line cord, an 18-inch serial cable, and a 9-V battery.

Price: $259.99.

Contact: Migent Inc., P.O. Box 6062, Incline Village, NV 89450, (702) 832-3700.

Inquiry 602.

continued

New! In•a•Vision is Compatible with AutoCAD

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We created In•a•Vision just for you. The engineer who needs more productive drafting support. The designer who needs versatility for alternate ideas or quick revisions. The architect who needs to manage a variety of working drawings. And the businessman who needs first-class presentation materials as well as detailed flow charts and organization charts.

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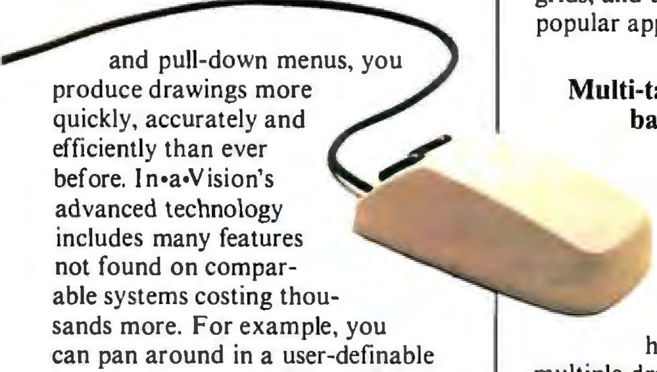
Now all you do to create complex technical drawings, systems designs, blueprints, diagrams, illustrations, and proposals is point, click and draw. With In•a•Vision's mouse support, windowing, icons, and pull-down menus, you produce drawings more quickly, accurately and efficiently than ever before. In•a•Vision's advanced technology includes many features not found on comparable systems costing thousands more. For example, you can pan around in a user-definable drawing space up to 68″ x 68″ and zoom in on specific areas for greater detail. Scale, rotate and dimension symbols, fill an area with your choices of predefined colors and patterns, as well as draw lines with multiple styles and widths. Other features include overlays, predefined and user-definable page sizes, rulers, grids, and templates to speed popular applications.



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Demo disk** or brochure available to qualified customers. In Texas or for customer support, call (214) 234-1769. MICROGRAFX, Inc., 1820 North Greenville Avenue, Richardson, Texas 75081.

Inquiry 199

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Microsoft Windows-compatible. Call for specific operating environment requirements.
*Offer good only on purchases after January 1, 1987
**Demo requires MS Windows. Full demonstration system for users without Windows available for $49.00.

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Introducing the Hercules InColor Card.

It runs more software at a higher resolution than any other color graphics card.

The Hercules® InColor™ Card offers everything you'd expect from a high resolution color graphics card from Hercules — and more.

Compatibility: The InColor Card is compatible with the thousands of programs that run on our monochrome cards.

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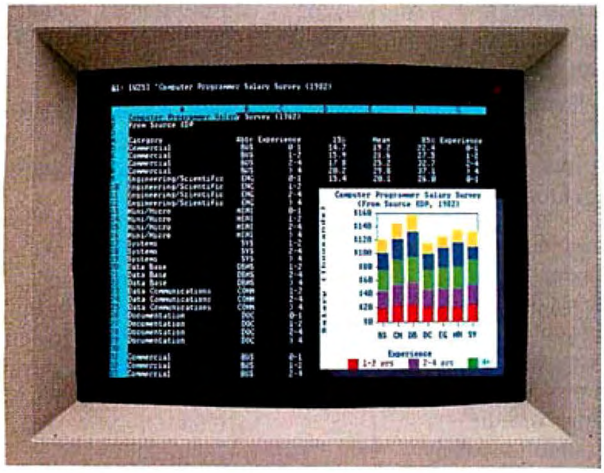
Resolution: The InColor Card's resolution of 720x348 is the highest of any widely supported standard.

RamFont: The InColor Card has our unique RamFont mode — in color.

Better graphics.

Hercules is known for bringing high resolution monochrome text and graphics to programs like 1-2-3® and AutoCAD®.



The InColor Card's RamFont mode gives Lotus 1-2-3 a pop-up graphics window and lets you view nearly twice as much spreadsheet data—all in full color.

Now the InColor Card gives you the same high resolution 720x348 graphics in up to 16 colors using an IBM® Enhanced Color Display, multisync monitor, or equivalent.

That's the highest resolution of any widely supported graphics standard.

And no other color graphics card allows you to move back and forth between color and monochrome systems *without changing drivers.*

Runs more software.

All Hercules-compatible text, graphics and RamFont software runs on the InColor Card in black and white, or at least two colors.

And many popular programs like 1-2-3, Symphony,® AutoCAD and Microsoft® Windows that use graphics or RamFont, run in full color.

More powerful RamFont.

RamFont is a new mode developed by Hercules that gives your software the ability to display multiple fonts at lightning fast speeds.

RamFont transforms advanced word processors like Microsoft Word from slow to text-mode fast.

Technical word processors like Lotus Manuscript™ use RamFont to display onscreen the text you want to print.

Even 1-2-3 uses RamFont to almost double the size of the spreadsheet picture.

And now, with the InColor Card, you get an enhanced RamFont with 3,072 programmable characters in up to 16 colors.

All the way up to 12,288 characters in four colors.

With the InColor Card's RamFont, no program should run out of speed, color or fonts ever again.

What the InColor Card could mean to your company.

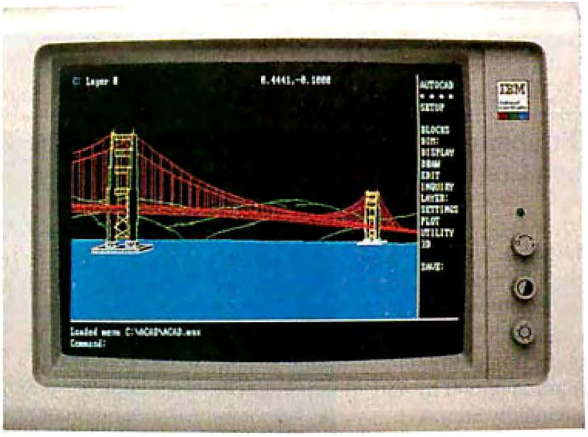
The InColor Card allows you to run a program in color, and then move to a Hercules Graphics Card Plus and run the same program in monochrome.

Without changing drivers.

Compatibility between the InColor Card and our monochrome card allows you to network around one standard Hercules. At last your PCs will have compatible graphics, in color or monochrome.

Remember, only the InColor Card has color-to-monochrome compatibility, high resolution text and graphics, and the power of color RamFont.

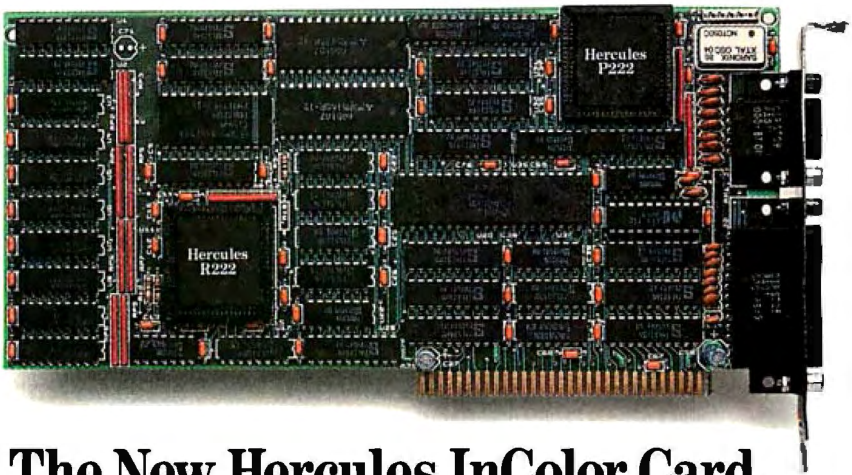
To find out more about the new Hercules InColor Card, call 1-800-532-0600 Ext. 502. (In Canada, call 1-800-323-0601 Ext. 502.)



AutoCAD gets the same high resolution 720x348 graphics as our famous monochrome cards—only now in full color on an IBM Enhanced Color Display.

Features of the Hercules InColor Card

- Hi-res text with 9x14 character size in up to 16 colors with attributes
- 720x348 Hercules graphics in 16 colors selected from 64 color palette
- Special RamFont mode displays 3,072 programmable characters in 16 colors with attributes, up to 12,288 characters in 4 colors
- Runs Hercules-compatible graphics software in b&w or any two background colors
- Designed for use with the IBM Enhanced Color Display, multisync monitors, or equivalents
- Software diskette includes font editor, sample fonts, and Hercules utilities
- Parallel printer port
- Two year warranty



The New Hercules InColor Card.

Hercules Computer Technology, 2550 Ninth St., Berkeley, CA 94710 Ph: 415 540-6000 Telex: 754063 Fax: 415 540-6621 Trademarks/Owner: Hercules, InColor, RamFont/Hercules; Lotus, 1-2-3, Symphony, Manuscript/Lotus; Microsoft/Microsoft; AutoCAD/AutoDesk; IBM/IBM

Inquiry 139 for End-Users. Inquiry 140 for DEALERS ONLY.

ADD-INS

NEC's Ultrahigh-Resolution Graphics Board

The MultiSync Color Graphics Board from NEC Home Electronics U.S.A. is an ultrahigh-resolution 16-color display card with a resolution of 640 by 480 pixels, functionally equivalent to the IBM Professional Graphics Adapter.

The board requires an NEC MultiSync monitor (or equivalent). Compatibility for running software in CGA (color graphics adapter), EGA (enhanced graphics adapter), MDA (monochrome display adapter), and Hercules modes is made possible through the board's high-speed hardware, which also supports all true EGA functions. It includes extended text modes, which let you display text of 80 characters by 60 lines, or spreadsheets with up to 132 columns by 44 lines.

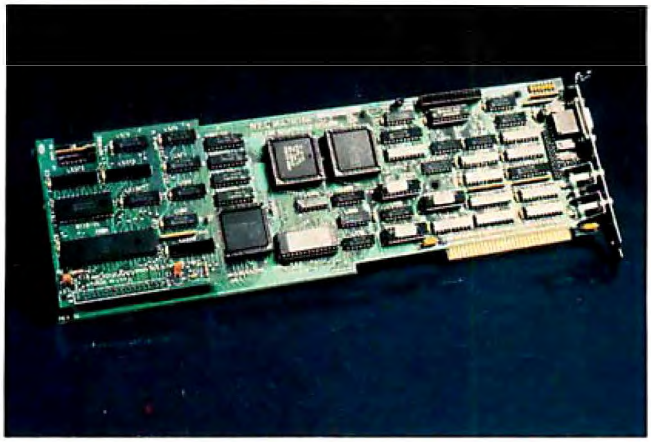
Screen drivers are provided to let users of Lotus 1-2-3, Dr. Halo, and AutoCAD take full advantage of the 640 by 480 resolution mode with Microsoft Windows.

Other features include a parallel printer port, print spooler software, and hardware zoom and viewport to let you zoom in on an image at up to eight times magnification for detailed viewing or pixel editing. The MultiSync Color Graphics Board uses an ET2000 chip set with a microengine that assumes certain CPU functions such as bit-mapped graphics memory read/write. NEC claims this results in a speed improvement of up to 300 percent.

Price: $649.

Contact: NEC Home Electronics (U.S.A.) Inc., 1255 Michael Dr., Wood Dale, IL 60191, (312) 860-9500.

Inquiry 603.



MultiSync board for the MultiSync monitor.

Atari Upgradable RAM Board

The ST Solderless RAM board is a RAM upgrade for the Atari 520ST computer. It features solderless plug-in installation and comes with enough RAM to upgrade a 520ST to 1 megabyte.

After installation, upgrading the board to 2.5 or 4 megabytes is simply a matter of plugging in 1-megabit RAM chips into the empty sockets.

Price: $199.95.

Contact: E. Arthur Brown Co., 3404 Pawnee Dr., Alexandria, MN 56308, (612) 762-8847.

Inquiry 604.

Hercules Color Graphics Card

The InColor Card is a color version of the Hercules Graphics Card Plus. It's compatible with all standard text programs, with programs that support the Hercules monochrome graphics standard, and with programs that make use of the Hercules RamFont display mode.

The new card is capable of displaying 16 colors out of a palette of 64 in 720- by 348-pixel resolution. The board can also display any application in white on black or in any other two colors that you select. The InColor Card requires a MultiSync color monitor and meets the specifications of the IBM Enhanced Color Display.

The board includes the Hercules printer port on a chip, which can be disabled to prevent conflicts with other cards in the system. Also included are FontMan, a font editor for creating new character fonts for use in the RamFont mode, and a graphics-mode screen dump for use with Epson and IBM graphics printers.

Price: $499.

Contact: Hercules Computer Technology, 2550 Ninth St., Berkeley, CA 94710, (415) 540-6000.

Inquiry 605.

PC Accelerator: Kit or Assembled

NRG Electronics' PC Accelerator (PCA) speeds up your IBM PC or clone by increasing the system's clock speed by 30 percent or more. The 8284A chip is replaced by a plug-in PC board containing two crystals. The processor speed is increased from 4.77 to 6 MHz while other system clocks are left undisturbed.

Depending upon the system in which it's being installed, the PCA circuit board can be installed horizontally, vertically, or remotely using a ribbon cable. A remote-control box is included that mounts on the keyboard and has a normal/fast speed-selection switch, an LED indicator, and a hardware reset selector switch that lets you reset it when the system locks up without turning the power off.

You can use the PCA with any computer that has an 8248A clock chip running at 4.77 MHz (14.318-MHz crystal). It cannot be used with turbo boards or other speed-enhanced systems where the clock frequency is greater than 4.77 MHz. The PCA is available either as a kit or a fully assembled unit.

Price: Kit, $29.95; assembled and tested, $49.95.

Contact: NRG Electronics, P.O. Box 24138, Fort Lauderdale, FL 33307, (305) 971-3823.

Inquiry 606.

Amber CRT for the Mac

The Amber Mac is an amber replacement CRT for the Apple Macintosh. With Italian-designed 30-millisecond long-persistence phosphors, the Amber Mac is compatible with European VDT standards and is an exact electrical and mechanical replacement for all Macintosh computers with the exception of the Macintosh II.

Detailed, illustrated installation instructions are included, and the company claims installation and adjustment takes 15 minutes. The patented "Orange Drop" tube also has special additives that reduce phosphor etching.

Price: $99.

Contact: Systems Research, 1111 West El Camino, Suite 109, Sunnyvale, CA 94087, (408) 730-5217.

Inquiry 607.

continued

VAROOMM

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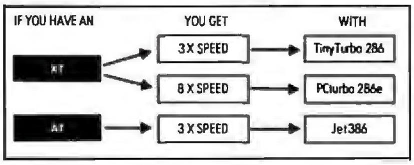
ORCHID'S TURBO FAMILY

	TinyTurbo 286	PCturbo 286e12	Jet 386
Host Computer	PC,XT	PC,XT,AT	AT
Reference Speed	3 x XT	8 x XT	3 x AT
Accelerator Type	Replaces 8088	Co-processor	Replaces 80286
CPU	8 MHz 80286	12MHz 80286	16MHz 80386
RAM	8 K Cache	1 or 2MB EMS	64 K Cache



GET THE EDITOR'S CHOICE: TinyTurbo 286.™

The TinyTurbo 286™ supercharges your XT to run *three times faster.* Yet it's so small it takes up only half a slot in your computer. Just two reasons why *PC Magazine* named it the Editor's Choice.

TinyTurbo 286 gives you a high level of compatibility. So you can run software like Lotus and Windows—with EGA graphics, EMS memory, or networking cards—at AT speed. You can even go back to your PC's regular 8088 chip, which remains in the system, giving you 100% hardware compatibility.

ADD AWESOME PERFORMANCE: PCturbo 286e.™

For power users, the front runner today in accelerators is clearly the PCturbo 286e.™ It revs up to *8 times faster* than an XT, or up to *2.5 times* AT speed—giving you the world's fastest screen I/O. Plus the PCturbo 286e comes factory equipped with 1 Megabyte of fast RAM, expandable to 2.

The PCturbo 286e is also a powerful tool for developers and systems integrators. With features like an optional 10-MHz 80287 math chip, and coprocessing software for concurrent foreground/background tasks, the PCturbo 286e lets you build minicomputer-like performance into standard PCs.

MOVE YOUR AT UP TO 386 HORSEPOWER NOW: Jet 386.™

Take a look today at the price/performance leader in desktop computing: the Jet 386.™ Depending on the application, it's up to *three times faster* than an AT. And *twice as fast* as some high-performance minicomputers. Yet you don't have to buy an expensive 386-based computer to get this kind of horsepower.

More importantly, the Jet 386 uses next generation technology, the 80386 microprocessor. So you can run all of the current software for the AT now, and 386 software too. Add a Jet 386 to your AT today, and you can extend the life of your investment—for a fraction of the cost.

FROM THE COMPANY THAT STARTED IT ALL.

Orchid introduced the first turbo for PCs, and has since become the number one supplier of PC accelerators. For details on our full line of accelerators, graphics, networks and multi-function cards, call **(415) 683-0300** today. Or contact your local dealer.

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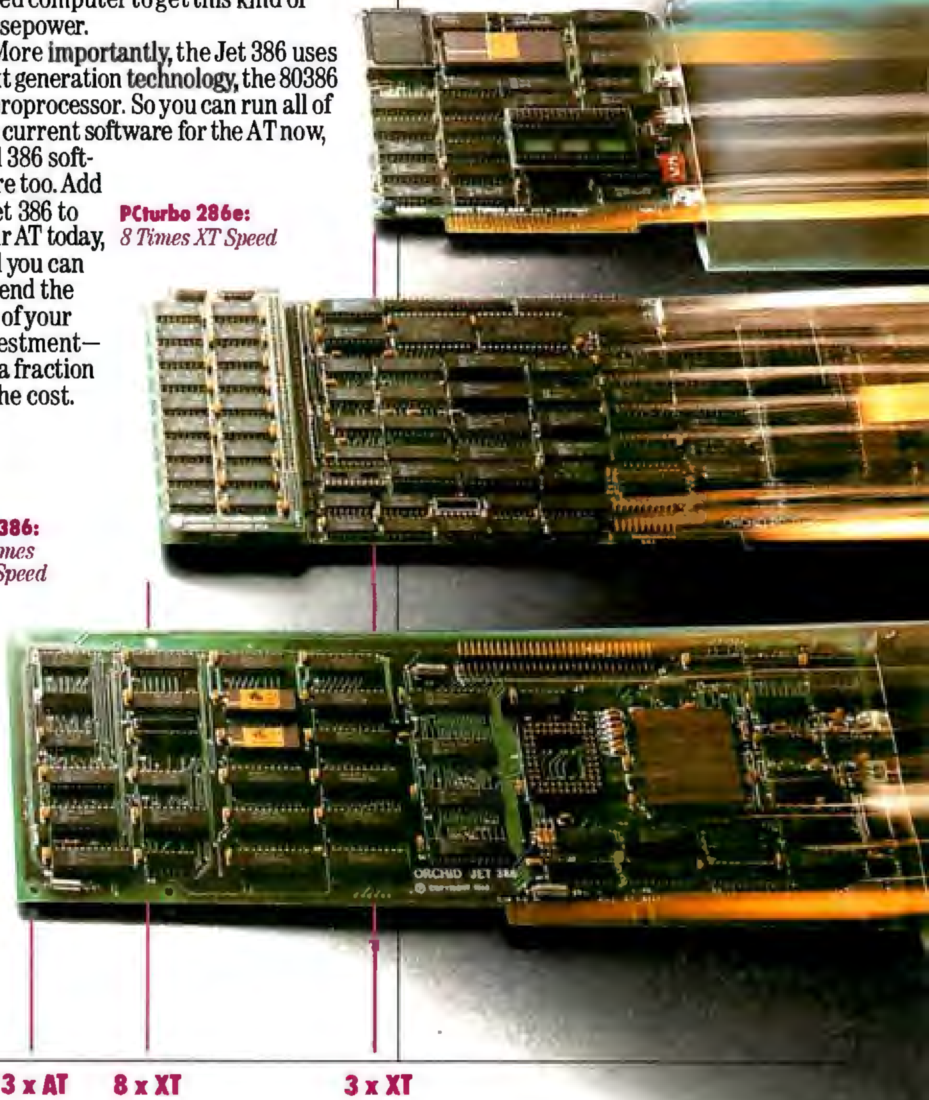
(415)683-0300; TLX 709289.

ORCHID


TinyTurbo 286: *3 Times XT Speed*

PCturbo 286e: *8 Times XT Speed*

Jet 386: *3 Times AT Speed*

3 x AT **8 x XT** **3 x XT**

Inquiry 362 for End-Users.
Inquiry 363 for DEALERS ONLY.

Soft PC Provides MS-DOS Simulation on Non-Intel Processors

Soft PC from Insignia Solutions lets you run MS-DOS programs on other systems. Its CPU module reproduces the 8088's instruction operations, the effective hybrid addresses, and the condition codes.

The I/O devices module provides the interface between Soft PC and the host environment. To interact with IBM PC peripherals, the program intercepts the commands to the peripheral controllers, simulates the commands, and substitutes equivalent operations to the peripherals of the host environment.

Soft PC includes an alternate BIOS that doesn't depend on IBM code and is written in C.

Insignia Solutions reports that Soft PC is capable of running virtually all PC-DOS and MS-DOS applications, but those that incorporate timing dependencies peculiar to a real IBM PC (for example, real-time process control) can create problems. The company also reports that the speed of operations is related to the performance of the host machine, and the minimum speed provided is equal to that of an IBM PC XT.

The program runs on XTs and compatibles with an 8088 microprocessor, 1 megabyte of RAM, and a 20-megabyte hard disk drive. It also requires two RS-232C ports mapped to serial ports on the host machine. Insignia claims that because the software involves no hardware, it can run on machines with no expansion slots.

For output, you can use an IBM-compatible serial printer attached to serial ports on the host, and you can direct output to the host printer or file. The program also supports the IBM Color Graphics Adapter.
Price: $500 to $750.
Contact: Insignia Solutions Inc., 1255 Post St., Suite 625, San Francisco, CA 94109, (415) 771-7001.
Inquiry 608.

Soft PC from Insignia Solutions.

Datalight C Compiler

Optimum-C is a global-optimizing C compiler from Datalight that analyzes a function and generates executable code based on the total view of the function. It uses the technique of data-flow analysis to gather information about the function. An optimizer phase, which is slower than the development and debug phases, is optional. During the development and debug phases, the optimizer is not used. However, it is used when you compile a production version of the program.

The compiler supports the UNIX System V C language, along with several proposed ANSI extensions, according to Datalight. Other features of Optimum-C include 8087 and floating-point support, strong type checking, ROMable code generation, a Make program, MS-DOS object files format, and compatibility with Lattice C. It includes a library that contains over 185 UNIX-compatible and MS-DOS functions, along with the source code for the library and start-up routines.

Optimum-C runs on IBM PCs with 192K bytes of free memory, a hard disk drive, and MS-DOS or PC-DOS 2.0 or higher.
Price: $139.
Contact: Datalight, P.O. Box 82441, Kenmore, WA 98028, (206) 367-1803.
Inquiry 609.

Graph-in-the-Box Application Development

New England Software's Application Development Kit for Graph-in-the-Box, a RAM-resident graph program, can be integrated into your application programs. It allows you to add 11 chart types, 10 fill patterns, 10 line types, 16 colors, explodable pie sections, 500 observations, and 15 variables.
Price: $187.60.
Contact: New England Software, Greenwich Office Park 3, Greenwich, CT 06831, (203) 625-0062.
Inquiry 610.

Tree-Structured Scheduling Tool

Trees-pls is a programming language that Avyx calls a resource-management tool. It was originally developed for NASA to utilize as a scheduling tool, and Avyx has adapted it to the IBM PC.

The program is a toolkit that lets you create applications for scheduling time-restricted projects. One of the program's features is its ability to manipulate tree structures, letting you use it in artificial intelligence applications. You can also use Trees-pls for scheduling, allocating resources, controlling projects, and managing information. Interfaces to graphics, C, and FORTRAN are supported.

Trees-pls runs on IBM PC, XT, AT, and compatibles with at least 512K bytes of RAM with PC-DOS or MS-DOS 2.0 or higher.
Price: $995.
Contact: Avyx Inc., 265 Honeywell Center, 304 Inverness Way S, Englewood, CO 80112-5819, (303) 790-0514.
Inquiry 611.

FORTRAN, C, and Pascal Compilers for the Macintosh II

UniSoft's FORTRAN 77, C, and Pascal compilers for Macintosh IIs that run Apple's A/UX operating system generate code that is 30 percent smaller and two to four times faster than other compilers.

Green Hills Software designed the compilers and UniSoft ported them to A/UX, the implementation of the UNIX System V operating system developed by Apple Computer and UniSoft.
Price:$700.
Contact: UniSoft Corp., 739 Allston Way, Berkeley, CA 94710, (415) 644-1230.
Inquiry 612.

continued

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- **Maintainability**
- **Translator from Turbo and ANSI Pascal**

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In California:

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☐ Window Package	$49
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In Italy:
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Two CAD Updates

CADKEY 3.0, from Micro Control Systems, offers a three-dimensional programming language, CADKEY Advanced Design Language, which includes three-dimensional data primitives, CADKEY command access, unlimited program size, and macro table management.

Enhanced two-dimensional drafting capabilities include the addition of ordinate dimensioning, European and English drafting standards, and fractional dimensioning.

Another addition to version 3.0 is an on-line calculator that supports trigonometric and algebraic functions. Other improvements include a unified database that lets you describe a 3-D wire-frame model, shade the model, and transmit interactively synthesized solid primitives to an engineering analysis and animation utility. You can also output vector or rasterized images to desktop-publishing programs.

CADKEY runs on the IBM PC and compatibles with 640K bytes of RAM and MS-DOS 2.0 or higher. It also requires one hard disk drive and one floppy disk drive.
Price: $3195.
Contact: CADKEY Division, Micro Control Systems Inc., 27 Hartford Turnpike, Vernon, CT 06066, (203) 647-0220.
Inquiry 613.

CADKEY 3.0 with three-dimensional programming language.

Generic CADD version 3.0 is 20 percent faster than version 2.0, according to Generic Software, and it offers more control over views and line types. You can choose from 10 standard line types and call out any line width. "Named views" is a new feature that lets you name a portion of a drawing displayed on the screen and later recall or plot it.

You can use Generic CADD 3.0 as a base module for a system of computer-aided design tools, including DotPlot 3.0, which lets you use over 100 dot-matrix and laser printers. AutoConvert 3.0 uses the Drawing Exchange Format, so you can exchange drawings with AutoCAD and other software using the DXF format. AutoDimensioning 3.0 adds dimensions, legends, extension lines, leaders, and arrows. Drafting Enhancements-1 3.0 adds solid fill and crosshatching with standard or user-defined patterns. And the Generic IGES module lets you exchange drawings with mainframe and minicomputer CAD programs that support the International Graphics Exchange Standards.

Generic CADD 3.0 runs on IBM PCs and compatibles with at least 384K bytes of RAM, MS-DOS or PC-DOS 2.0 or higher, and two floppy disk drives or one floppy and one hard disk drive. A Hercules graphics card, CGA, or EGA is also required. Generic recommends an 8087 or 80287 math coprocessor, 640K bytes of RAM, two serial ports, and a mouse or digitizer tablet.
Price: $99.95.
Contact: Generic Software Inc., 8763 148th Ave. NE, Redmond, WA 98052, (206) 885-5307.
Inquiry 614.

Chemical Document Processing

ChemText is a chemical document processor that lets you accent chemical structures, create reaction schemes, flowcharts, process diagrams, and create other drawings that include boxes, lines, arcs, circles, and arrows. The program is part of the Chemist's Personal Software Series from Molecular Design.

ChemText's drawing editors let you produce molecules, reactions, forms, and equations. A set of science and math symbols is included that let you build complex multilevel equations in ChemText documents. You also have the ability to insert images from other sources into ChemText documents.

Fonts include Greek, large and undersize Roman, Fraktur, European Roman, Cyrillic, and script.

It runs on IBM PC, XT, AT, and compatibles with at least 640K bytes of RAM with MS-DOS or PC-DOS 2.0 or higher. You need a Hercules graphics card, a CGA, or EGA to run the program. With the Enhanced Graphics Adapter you'll need at least 128K bytes of graphics memory. It also requires a 10-megabyte hard disk drive and a 360K-byte floppy disk drive.
Price: $1500.
Contact: Molecular Design Limited, 2132 Farallon Dr., San Leandro, CA 94577, (415) 895-1313.
Inquiry 615.

Engineering Design

VersaCAD/Mechanical is an add-on to VersaCAD or VersaCAD Design that helps you to improve productivity in mechanical-part design and automated manufacturing. The program offers you design features on a tablet overlay. Geometric tolerancing, enhanced dimensioning, and mechanical construction features are included.

Dimensioning features include ANSI Y.14.5M-1982 standard dimensioning symbols. Dimensioning capabilities include limit dimensioning, which provides upper- and lower-limit dimensions, and tolerance and radial dimensioning. VersaCAD/Mechanical supports full- and small-cross-hair center lines for circles and arcs, as well as interactive leader lines for text. It also supports construction tools such as chamfers, fillets, tangents, and line stretch.
Price: $495.
Contact: Versacad Corp., 7372 Prince Dr., Huntington Beach, CA 92647, (714) 847-9960.
Inquiry 616.

continued

We put our money where our Mouse is.

LOGITECH C7 MOUSE

$99

PC MAGAZINE "EDITORS CHOICE"

> *"...To sum up my feelings about this mouse and menu generating system: this is the one I want."* *Phil Wiswell*
> *PC Magazine, Jan 27, 1987*

At LOGITECH we've spent years perfecting our high-quality mouse hardware and software. And every LOGITECH Mouse reflects the engineering we've devoted to it.

MAXIMUM COMPATIBILITY

The programmable LOGITECH Mouse works with virtually ALL hardware and application software.

BEST MOUSE TECHNOLOGY

The opto-mechanical LOGITECH Mouse offers the best of all worlds. Mechanical tracking (a ball) and optical decoding (precise, reliable optical encoders). Every major computer manufacturer, including Apple, IBM and DEC, has chosen opto-mechanical mouse technology. LOGITECH offers the only opto-mechanical mouse on the retail market.

BEST MOUSE FOR GRAPHICS & CAD

High (200 dot per inch) resolution, precise tracking, and a 3-button design are essential for graphics and CAD.

BEST MOUSE FOR DESKTOP PUBLISHING

Ergonomic styling is a must for all mouse-intensive desktop publishing applications. High resolution is essential for high-resolution screens.

BEST MOUSE FOR SPREADSHEETS & WORD PROCESSING

The smooth-tracking LOGITECH mouse is a productivity tool for all types of data entry and editing. We've even created a special mouse interface for 1-2-3 which makes 1-2-3 users up to 30% more productive!

BEST MOUSE SOFTWARE

> *"Logitech's Plus Package adds an excellent menu builder (with useful examples), a fast windowing text editor, and an outstanding Lotus 1-2-3 interface."* *Ezra Shapiro*
> *Byte, Dec. '86, pg. 324*

Our Plus Software also includes our Microsoft-compatible drivers, and CLICK which sets the mouse automatically for any application.

Inquiry 183.

BEST DEALS

We offer either our C7 or Bus mouse, with Plus software, packaged with some of the most exciting applications on the market, at very exciting prices.

LOGIPAINT **Special Offer! $149**

The LOGITECH Mouse with PC Paintbrush is the most advanced paint set available for the PC. It offers 11 type fonts, a pallet of 16 colors, and the ability to import and embellish files from other applications.

LOGICADD **$189**

The LOGITECH Mouse packaged with Generic CADD and Dot Plot turns your PC into a complete CADD workstation. Generic CADD offers the features and performance of high priced CADD at an unbelievably low price. DotPlot is the add on utility that enables you to produce crisp, high resolution drawings from your dot matrix printer.

LOGIPAINT-&-DRAW **$219**

The LOGITECH Mouse packaged with LOGIPAINT and LOGICADD. Together they are the complete graphics toolkit for combining freehand and technical drawings.

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LOGITECH BUS MOUSE
$149 with LogiPaint

100% Microsoft Bus Mouse Compatible!

It has all the features of the LOGITECH C7 MOUSE, plus it leaves the serial port on your computer free for other peripherals. It comes standard with our-top-of-the-line Plus Software and LogiPaint.

Lotus and 1-2-3 are trademarks of Lotus Development Corp. Generic CADD is a trademark of Generic Software, Inc. PC Paintbrush is a registered trademark of ZSoft Corp.

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- ☐ LOGITECH C7 Mouse w/Plus Software $119
- ☐ LOGITECH BUS Mouse w/Plus Software and LogiPaint $149

Additional Software
(with C7 and Plus or Bus Mouse and Plus.)

- ☐ LOGIPAINT $149
- ☐ LOGICADD $189
- ☐ LOGIPAINT-&-DRAW $219

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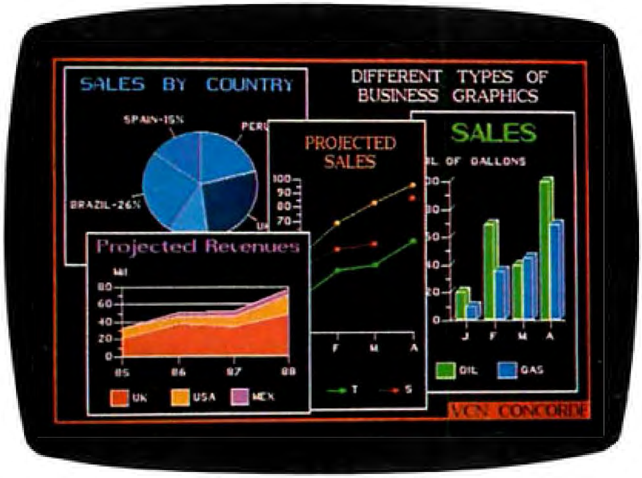
Using the Macintosh II and SE to Create Presentations

PowerPoint from Forethought lets you create and manage presentations with the use of overhead transparencies, flipcharts, speaker's notes, and handouts. Some of the features include word-processing capabilities, diagram drawing tools for illustrations, and on-screen slide sorters. It also includes a disk of predesigned formats and slide layouts. PowerPoint gives you the ability to import graphics and text from Macintosh programs, and you can use slides created with PowerPoint in desktop-publishing documents.

The program is compatible with the Macintosh II and SE and runs on other Macs that have at least 512K bytes of RAM and one 800K-byte or two 400K-byte disk drives.
Price: $395.
Contact: Forethought Inc., 250 Sobrante Way, Sunnyvale, CA 94086, (408) 737-7070.
Inquiry 617.

VCN Concorde 2.0



Create and edit fonts with version 2.0 of Concorde.

Visual Communications Network's version 2.0 of their graphics program, Concorde, lets you create slide shows on-screen incorporating graphics, pictures, text, music, animation, and special effects. New to version 2.0 is the ability to create and edit your own fonts.

You can also use Concorde to create charts and diagrams, interface with Lotus 1-2-3 or other spreadsheets, and run word-processing and graphics packages through Concorde's screen-capture function. The menu-driven program can exit to DOS at any time, execute another program, and then return to Concorde.

Input devices you can use include the keyboard, mouse, digitizer, and scanners. Concorde 2.0 supports output devices in bit-mapped and vector-based formats. The bit-map mode enables you to print or plot images of varying complexity. The vector mode offers faster speeds, and you can obtain higher resolutions using pen devices, according to VCN.

Output devices supported include film recorders, ink-jet printers, color plotters, and 24-pin color printers.

The U.S. version of Concorde 2.0 is not copy-protected. It runs on IBM PC, XT, AT, and compatibles with at least 384K bytes of RAM in medium resolution and 640K bytes in high resolution. It supports CGA and EGA, along with Hercules monochrome graphics.
Price: $695.
Contact: Visual Communications Network Inc., 238 Main St., Cambridge, MA 02142, (617) 497-4000.
Inquiry 618

Graphs and Charts with Microrim's R:BASE

Using Microrim's R:BASE System V, 5000, or 4000 database-management systems with R:BASE Graphics, you can create graphics and charts. You can also graph using data from other programs by implementing the FileGateway import/export utility in R:BASE database managers.

R:BASE Graphics reads R:BASE databases directly, letting you reduce the data into a graphable subset.

You can run the program as a stand-alone or in local area network environments on IBM PCs, XTs, and ATs. For single-user operation, you'll need at least 512K bytes of RAM and MS-DOS or PC-DOS 2.0 or higher. For LANs you'll need at least 640K bytes, MS-DOS or PC-DOS 3.1 or higher, and a dedicated file server.

The program supports IBM CGA and EGA, the Hercules Graphics Card Plus, the monochrome graphics card, and others compatible with Graphics Software System device drivers. You can output to a variety of plotters and printers.

Other features of the program include a split-screen display that lets you display graphics in up to 32 separate windows on-screen or in your output. It has seven text fonts, and you can use up to 4 of the 14 colors at a time in EGA- or CGA-display mode.
Price: $295.
Contact: Microrim, P.O. Box 97022, Redmond, WA 98073-9722, (206) 885-2000.
Inquiry 619.

StatView II

StatView II is a Macintosh II and SE version of the statistics program StatView 512+ from BrainPower. Enhancements to the program include a color capability and the ability to support multiple screen sizes. You can also customize your graphs by scaling them to any size and choosing text color, font, style, and point size for text placement within the graphs. According to the company, the program takes advantage of the Mac II's 68881 coprocessor in its calculations and provides the ability to address up to 2 gigabytes of RAM.
Price: $450.
Contact: BrainPower Inc., 24009 Ventura Blvd., Suite 250, Calabasas, CA 91302, (818) 884-6911.
Inquiry 620.

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, One Phoenix Mill Lane, Peterborough, NH 03458.

TEKTRONIX NEW ADVANCED PC GRAPHICS STANDS ALONE.

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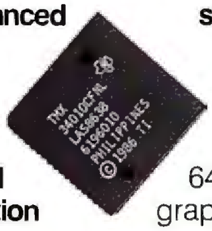
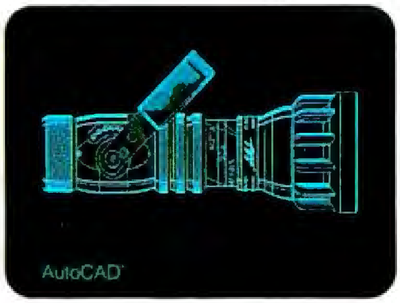
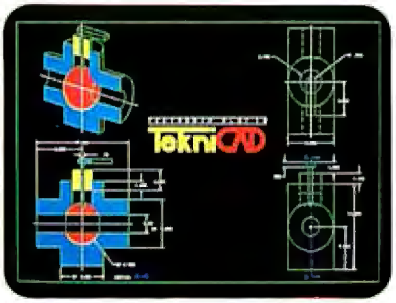


Introducing Tek Advanced PC Graphics: a fully integrated system of high-performance graphics, easy system connectivity, and unparalleled application software for your PC. Tek Advanced PC Graphics starts with a flexible multiple-rate color graphics monitor that provides 640x480 Tektronix-style graphics as well as EGA and CGA software compatibility.

Driving your monitor to a whole new level of graphics speed is Tek's PC4100 graphics coprocessor board. It features Texas Instruments® powerful TMS 34010 32-bit






PRINTGRAPH
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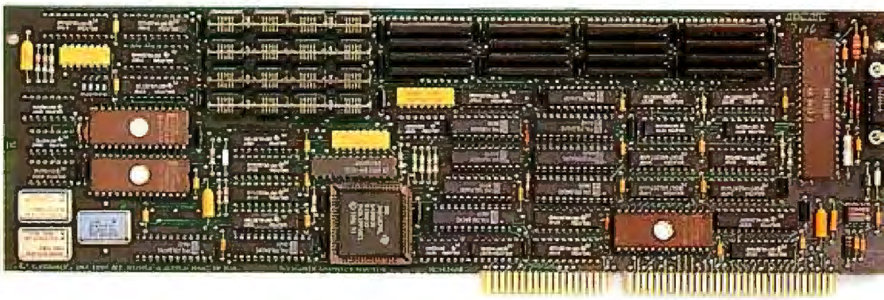
Release 2

Graphics System Processor for ultra-fast throughput of your design applications. Add to that Tek's PC-05 or PC-07 terminal emulation software, and you're ready for stand-alone computing or access to a world of mainframe graphics.

To bring those applications to life, you can connect a Tek color ink-jet printer. And start producing high-resolution, vibrant hardcopy output on either paper or transparencies.

Couple all that with Tektronix worldwide support and service, and your PC can gain the same productive advantages that host-based systems in scientific and engineering environments have had for close to two decades.

Tek's PC4100 graphics coprocessor board delivers serious graphics on a stand-alone basis. Built around the Texas Instruments Graphics System Processor(GSP),™ the graphics coprocessor board achieves a combination of sophisticated graphics and fast throughput your PC just couldn't deliver before. The GSP assumes the complete graphics processing workload, freeing your PC processor for other requirements.



New companion monitor brings together fine detail and maximum flexibility. You'll view your applications on Tek's new multiple-rate monitor. In true Tek tradition, it provides ideally balanced, 640x480 addressability and a 60 Hz non-interlaced refresh rate. So you can use advanced packages like AutoCAD,® Zenographic's Mirage™ and VersaCAD.®

Then, to move from GSP graphics to emulation of the IBM® Enhanced Graphics Adapter(EGA) mode, you simply soft-switch. And you're ready to run the popular PC packages you probably already use in CGA/EGA mode—standards like Lotus® 1-2-3,® Microsoft® WORD® and Microsoft® Windows,® to name just a few.

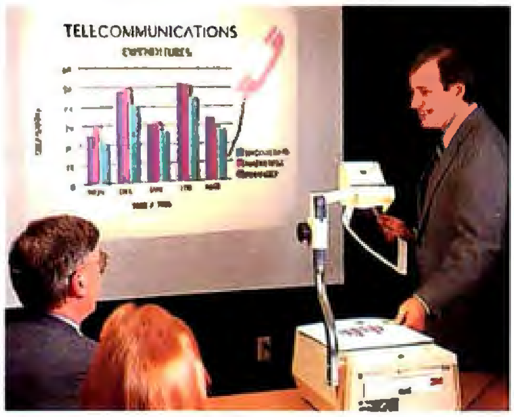
Last, but not least, Tek's PC4100 links you to a world of mainframe graphics. All you do is load Tek PC-05/PC-07.

Tek PC-05/PC-07 terminal emulation software gives you mainframe accessibility with the local processing power of your PC. Because Tek PC-05 and PC-07 terminal emulation software runs under MS-DOS® 2.0 and higher, you can run your mainframe-based

AND SETS YOU APART.

applications software on your PC as if it were a Tek 4105 or 4107 terminal.

Which means you can quickly access the power of Tek graphics—including 4107 segments, true zoom and pan, rubberbanding, definition of up to 64 viewports and more. You can use these highly productive features with a wide range of well-known designer software packages such as ISSCO's DISSPLA® and TELL-A-GRAF,® MCS's ANVIL-5000,™ SAS Institute Inc.'s SAS/GRAPH, Precision Visuals' DI-3000,® Swanson Analysis Systems' ANSYS® and McNeal-Schwendler's NASTRAN.



In addition, you can utilize software development tool sets like Tektronix PLOT 10® GKS, IGL, TCS and STI software as well as numerous driver support packages created for the 4105 and 4107.

Completing the picture: perfect color output with Tek's reliable ink-jet printers. At the push of a button, the Tek 4696 lets you produce exacting color reproductions of your on-screen display on either paper or transparencies.

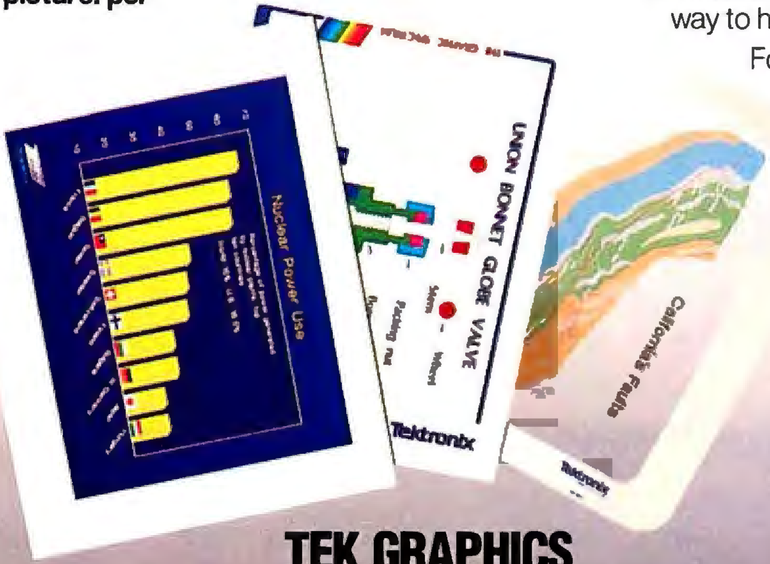
Because of its 120 dots per inch addressability in both horizontal and vertical directions, you can achieve resolution of up to 1280 points x 960 points per "A" size image.

All the key tools for software development, right from the outset. The new Tektronix Graphics Interface™ (TGI) for the PC provides the basics of Tek graphics functionality to application programs running under MS-DOS. What's more, in-circuit emulator, C-compiler, assembler and linker are all available from Texas Instruments to help software developers write applications packages for the PC4100 graphics coprocessor board.

To enable sufficient workspace for custom interfaces or specific application programs, the PC4100 graphics coprocessor board comes standard with a full megabyte of program memory.

Put yourself on the sure path of Tek graphics evolution. Whether you choose Tek PC stand-alone graphics, Tek's high-resolution monitor, Tek terminal emulation or all three, you can be assured Tek will keep you current with the best and most productive graphics. Because like all our products, Tek Advanced PC Graphics features a smooth built-in pathway to higher-level graphics.

For more information about how Tek lets you stand alone and work together, contact your local Tek representative about Tek Advanced PC Graphics. Or call, 1-800-225-5434. In Oregon, 1-235-7202.



TEK GRAPHICS PROCESSING SYSTEMS

Tektronix
COMMITTED TO EXCELLENCE

VPT 102 11W-7050

EVENTS AND CLUBS

May 1987

EVENTS

Lighting & Optics for Machine Vision, Boston, MA. Joanne Rogers, Program Administrator, Special Programs Division of the Society of Manufacturing Engineers, One SME Dr., P.O. Box 930, Dearborn, MI 48121, (313) 271-1500, extension 399. *May 5–6*

National Online Meeting, New York, NY. Thomas H. Hogan, National Online Meeting Organizer, Learned Information Inc., 143 Old Marlton Pike, Medford, NJ 08055, (609) 654-6266. *May 5–7*

Hands-on Expert Systems Design & Development, Ottawa, Ontario, Canada. Marilyn Martin, Integrated Computer Systems, 5800 Hannum Ave., P.O. Box 3614, Culver City, CA 90231-3614, (800) 421-8166; in Canada, (800) 267-7014. *May 5–8*

Intelligent Infrastructure Technology, New York, NY. Jerry Robinson, Editor, *F-M Automation Newsletter,* 9501 West Devon Ave., Suite 203, Rosemont, IL 60019-4804, (312) 823-0555. *May 6*

Midwest Electronics Expo, St. Paul, MN. MG Expositions Group, 1050 Commonwealth Ave., Boston, MA 02215, (800) 223-7126; in Massachusetts, (617) 232-3976. *May 6–7*

The Great Lakes LOGO Conference, Cleveland, OH. Alice Fredman, ECCO, 1123 S.O.M. Center Rd., Cleveland, OH 44124, (216) 461-0800. *May 7–8*

Third International Conference on Artificial Intelligence and Education, Pittsburgh, PA. Jane Parlett, Room 811 LRDC, University of Pittsburgh, Pittsburgh, PA 15260, (412) 624-7478. *May 8–10*

APL87, the International APL Conference, Dallas, TX. APL87 Registrar, 440 Northlake Shopping Center, Suite 210, Dallas, TX 75238, (214) 539-9281. *May 10–14*

Simulation Techniques for Personal Computers, Washington, DC. Continuing Engineering Education Program, The George Washington University, Washington, DC 20052, (800) 932-2337. *May 11–15*

Hardware and Software Evaluations in Expert Systems Building, Atlanta, GA. Deidre Mercer, Department of Continuing Education, Georgia Institute of Technology, Atlanta, GA 30332-0385, (404) 894-2547. *May 12*

Hands-on Programming in C, Los Angeles, CA. Marilyn Martin, Integrated Computer Systems, 5800 Hannum Ave., P.O. Box 3614, Culver City, CA 90231-3614, (800) 421-8166; in Canada, (800) 267-7014. *May 12–15*

Atari Trek '87, Seattle, WA. Atari Trek '87, 2442 North West Market St., P.O. Box 97, Seattle, WA 98107, (206) 232-3009. *May 16–17*

1987 International Industrial Engineering Conference and Pro-Tech 87, Washington, DC. IIE Registrar, 25 Technology Park/Atlanta, Norcross, GA 30092, (404) 449-0460. *May 17–20*

Introduction to Artificial Intelligence and Expert Systems, El Segundo, CA. UCLA Extension, 10995 Le Conte Ave., Los Angeles, CA 90024. *May 18–22*

LISP and LISP Environments: Hands-on AI Workshop, Washington, DC. Marilyn Martin, Integrated Computer Systems (see address above). *May 19–22*

IBM PC Microcomputer Interfacing, Scientific Instrument Automation, and Control, Blacksburg, VA. Adult Registrar, Donald Brown Center for Continuing Education, Virginia Tech, Blacksburg, VA 24061-0102, (703) 961-5182. *May 28–30*

Second Symposium on Computer Conferencing: Allied Technologies & New Applications, Guelph, Ontario, Canada. University of Guelph, School of Continuing Education, Guelph, Ontario, Canada N1G 2W1, (519) 824-4120. *May 31–June 3*

If you send notice of your organization's public activities at least four months in advance, we will publish them as space permits. Please send them to BYTE (Events and Clubs), One Phoenix Mill Lane, Peterborough, NH 03458.

CLUBS

MED Journal, the journal of the Medical Electronic Desktop; c/o JAM Software Pty, Ltd., 27A Nowranie St., Summer Hill, Australia NSW 2130.

The Communications Connection News, The Information Exchange, 3825-I South George Mason Dr., Falls Church, VA 22041.

PolyLetter, the newsletter for PolyMorphic systems owners and users; 191 White Oaks Rd., Williamstown, MA 01267, (413) 458-8421.

INTEREX, International Association of Hewlett-Packard Computer Users; Robert Grenoble, 680 Almanor Ave., Sunnyvale, CA 94086-3513, (408) 738-4848.

Prolog Users Group (PUG), Jack Ellis, 2252 Main St., Suite 15, San Diego, CA 92011, (619) 423-0538.

Amiga Atlanta, Andre Frech, 2001 Old Concord Rd. M-9, Smyrna, GA 30080, (404) 435-4386; BBS: (404) 953-6228.

Mensa MacNews, Mensa MacSIG, P.O. Box 11626, St. Paul, MN 55111-0626.

A SNOBOL's Chance, c/o Catspaw Inc., P.O. Box 1123, Salida, CO 81201, (303) 539-3884; BBS: (303) 539-4830.

Computers in Education, Macaulay Rd., RD2, P.O. Box 119, Katonah, NY 10536.

Macintosh Users Group, c/o Kinell, Pilgatan 15, 90245 Umeaa, Sweden.

Rattlesnake Atari Computer Enthusiasts (RACE), Skip Leininger, 2110 Strand, Missoula, MT 59801.

National Capital Macintosh Club (NCMC), Paul Lardner, P.O. Box 5685, Station "F," Ottawa, Ontario, Canada K2C 3M1, (613) 236-6262.

Computer Users of Texas, c/o Patrick Grimaldo, 516 52nd St., Lubbock, TX 79404, (806) 762-3131.

ARK: Amiga Users Group, c/o Howard Couch, 512 Stonewall Dr., Suite 120E, Jacksonville, AR 72076. ■

abc

ABC Company Newsletter — August — Technical Report on Desktop Publishing

Desktop Publishing Terms

At the heart of the personal computer publishing movement is a set of skills almost unknown to anyone outside the typesetting trade. A unique lexicon of terms describes the methods used to arrange letters on a page in an eye-pleasing manner. The typographer's language contains terms dating back to Gutenberg's time.

Crispness and clarity are the measures of good typography. These two elements are a function of image resolution, point size and typeface. The eye is very sensitive to the spacing of letters and the placement of words on the page.

Measurements

Pica and point are two important words. They are the fundamental units of typographic measurement. A pica equals .166050, or about one-sixth, inch. The pica is in turn divided into 12 points. Using these typesetting terms will ease your communication with the professional graphic arts industry.

A standard measure for open space is the em, named for the width of the M, which is usually the widest letter in a typeface's character set. The size of an em is always equal to the current point size. When you're setting a line in 12 point type, an em is 12 points wide.

Related to the em is the en, which is equal to half the width of an em or the width of the letter N. The thin space, is a user-definable unit, usually half an en. Typographers adjust the space between letters to improve readability. The process, called kerning, is determined by the shapes of the adjacent letters. In electronic publishing, typographic attributes are imposed by embedding codes within unformatted text. A hyphenation and justification program then interprets the codes and makes the line-ending decisions.

Because the letter blocks were originally made out of lead alloy, the vertical space between lines of type

Figure 1.1 The art of typography is now combined with the power of the PC.

IN THIS ISSUE

XEROX

Now, desktop publishing software of such genius, you don't have to be a 'Leonardo' to use it.

Until now, if you were in the IBM PC world and wanted to join the desktop publishing revolution, the software was hard to use, expensive, and often rewarded you with documents that were technically correct, yet visually disappointing.

Enter Xerox genius for creating perfect documents and a new generation of desktop publishing software—Xerox Ventura Publisher. It combines the best of current page-oriented systems with the best of document-oriented systems to make desktop publishing easy as well as productive.

The special genius of Xerox Ventura Publisher is "stylesheets"—20 built-in formats that arrange text and graphics automatically. Choose a stylesheet (or create your own), combine your text and graphics, and Xerox Ventura Publisher goes to work at the amazing rate of 20,000 characters per second, formatting as many as 64 100-page chapters. Most other programs format a page at a time, just like the cut-and-paste process you're escaping.

It's easy. You manipulate text and graphics with a mouse. What you see is what you get when you print. (Buy a new Xerox full-page display, and you won't have to scroll to see your entire page layout.) Make a change on page 1 and before you can say "Leonardo da Vinci," the entire document reformats. Tables of contents, indexing and numbering of pages, sections, tables, captions and figures are automatic.

Unlike most other programs, Xerox Ventura Publisher runs on a standard IBM PC XT/AT or compatible—AT power is not required. Text can be created on, and converted from, most major word processing programs. Graphics can be imported from many graphics and paint programs—even scanned images are easily incorporated. It supports dot matrix, color ink jet and laser printers as well as PostScript printers and typesetters.

Team Xerox

What price genius? The money you'll save by producing your very first 16-page booklet instead of sending it out will probably cover the cost of your very own Xerox Ventura Publisher software.

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Xerox Corporation, P.O. Box 24, Rochester, NY 14692. 143B

Begin your career as a desktop publishing "Leonardo" by stopping in at any computer store featuring Xerox desktop publishing software, by calling your local Team Xerox sales office or 1-800-TEAM-XRX, ext. 143B.

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ASK BYTE

Conducted by Steve Ciarcia

Home Study

Dear Steve:

Most of the articles in BYTE are beyond my technical ability. I have tried other magazines, but their articles are considerably beneath my competence.

Could you please indicate a recommended reading list or, better yet, a good home study program in electronics and computers?

Alfred W. Thompson
Shrewsbury, MA

I have always had respect for the Heathkit series of home study courses, in both electronics in general and computers. You might even have one of their stores near you, so a check in the phone book might be rewarding. If not, they would be happy to send you a catalog. They advertise heavily in hobbyist electronics magazines like Radio-Electronics, *with postage-paid reply cards for convenience.*

Because there are so many books on so many aspects of computers and electronics, I find it hard to recommend any specific text, especially since I am not completely sure of your level of understanding. What I can recommend heartily is The Reader's Guide to Microcomputer Books, *by Michael Nicita and Ronald Petrusna, published by Golden-Lee, 1000 Dean St., Brooklyn, NY. This 400+-page book is a review of hundreds of books—covering mostly software books, but some hardware books as well. A half- to full-page review plus a numerical rating within categories make it easy to find books that will meet your needs.*

Hands-on experience is always helpful. Many community colleges offer beginning computer and/or electronics courses in the evenings. Books are great, but human beings usually answer questions a lot better.—Steve

Mystery Machine

Dear Steve:

I am in great need of information on two subjects.

First, could you direct me to any information on Vector Graphics computers? I have been picking up bits and pieces at the swap meets with the goal of putting together a working computer.

Second, I have a mystery computer that I hope you can help identify. Following is a list of its features:

- It is manufactured by Bi-M Instrument, Houston, Texas.
- The unit is approximately 12 by 24 by 6 inches, enclosed in an aluminum chassis with provisions for a vertical wall mounting. It is labeled Model 1600 A.
- The unit is composed of two circuit boards. The top board is labeled "CPU computer"; the bottom board is labeled "Video Computer Z-80B."
- There is no enclosed power supply. The required 5, 12, and 24 volts come in through an amphenol connector. The 24 V is for a muffin fan.
- Along the right side of the computer are ports labeled: channels 1-5 RS 232 DB 25 ports, serial keyboard DB 9 port, channel 1-2 HDLC DB 15 ports, parallel I/O DB 25 port, light pen DB 9 port, coax connector for RGB video, and peripheral expansion 60-pin ribbon connector.

The two PC boards are connected by a ribbon cable. I do not know what HDLC stands for. The upper CPU computer board is marked as assy. 8-14-0024C. Overall, the unit is high-quality; my guess is that it's from a commercial arcade video game.

Wade Bjerke
San Juan Capistrano, CA

Vector Graphics was one of the larger S-100 manufacturers in the late 1970s, but the company is no longer in business. You can get much of the information you need from one of the many S-100 hardware books and a CP/M book. The best approach, however, is to find someone using a Vector Graphics system in your area.

Your Bi-M computer is not from a video game. HDLC is the acronym for IBM's High Level Data Link Control protocol, a protocol for mainframe-to-intelligent peripheral communications using a byte-synchronous signaling technique. The light pen and RGB connectors indicate that it is to be connected to an RGB monitor, probably of fairly high resolution. I would try to power this unit up, and see what signals are present at the video connectors. If you don't have an RGB monitor, sync is likely to be present on the green output, and this is likely to be an RS-170 analog video signal rather than the more common TTL of today.

I'm sorry that I don't have any more information. By powering up the system and also dumping the contents of the ROMs on the CPU board, you could learn a lot about this unit.—Steve

Desperately Seeking Chip Set

Dear Steve:

Some years ago, I saw some Intel information on a processor chip set they called the iAPX432. The processor was a high-level object-oriented chip. I have been unable to locate any information on this chip set. Where can I write to find out more about the iAPX432? Are you aware of any computers assembled using this processor? My interest was sparked by the processor's resemblance to IBM's System/38 processor.

Mike Calabro
Schenectady, NY

The iAPX432 chip set is still alive. The original version of this chip set was not a good performer, but the revised version stands up remarkably well against a 12-MHz 68000. The language it was designed for is ADA. The remarkable thing about the architecture of object-oriented computers is that you can hook several of them together to boost performance without any reprogramming.

continued

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

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Due to the high volume of inquiries, we cannot guarantee a personal reply, but Steve and the Ask BYTE staff answer as many as time permits. All letters and photographs become the property of Steve Ciarcia and cannot be returned.

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MICROSOFT LANGUAGES NEWSLETTER VOL. 2, NO. 5

News about the Microsoft Language Family

Writing Faster Macro Assembler Programs

Fast execution speed is probably the biggest advantage a program can have—and the Microsoft® Macro Assembler is the language of choice for writing the fastest programs. Our software engineers would like to give you a hint that can make your fast Macro Assembler programs even faster!

If you need to take the absolute value of a number held in the AX register, try this method:

```
        cwd          ; replicate the high bit into DX
        xor ax, dx   ; l's complement if negative, no change if positive
        sub ax, dx   ; AX is 2's complement if it was negative
```

The standard absolute value method works on any register but is much slower:

```
        or bx, bx    ; see if number is negative
        jge notneg   ; if it is negative
        neg bx       ; make it positive
notneg:              ; jump to here if positive
```

This fast method achieves part of its speed by avoiding the use of a jump instruction to keep the 8086's pre-fetch queue full. The 8086 always tries to fetch the next instruction from memory while it is processing the current instruction in order to save time while a program is running. A jump instruction, however, moves the location of the next instruction to fetch, making the instruction that the 8086 just fetched into its pre-fetch queue invalid. This forces the 8086 to spend time fetching the correct instruction from memory after the jump. Whenever possible, avoiding jumps will increase the execution speed of your Microsoft Macro Assembler programs.

New Microsoft COBOL Version Includes Symbolic Debugger, Cross-reference Generator, and Other Utilities

Microsoft COBOL Compiler Version 2.2 now includes COBOL Tools which was formerly sold as a separate package at a suggested retail price of $350. This powerful set of productivity aids minimizes coding time and reduces the cost of program development and maintenance. Both the MS-DOS® and XENIX® 286 versions of the compiler packages have been updated. Microsoft COBOL now includes ViewCob, the most intuitive, interactive symbolic debugger for COBOL on the market; CobRef, an advanced cross-reference generator; Menu Handler, an innovative utility to enhance your Microsoft COBOL applications with a menu-oriented user interface; and CbMouse (only in the MS-DOS version), an object module to interface the Microsoft Mouse to your applications.

ViewCob has an easy-to-learn, menu-driven interface similar to that of Microsoft Multiplan® It supports multiple windows for viewing source code, program execution history, breakpoints, and memory locations while your program is executing. Powerful execution control, breakpoints, and tracing provide the programmer with a tool for analyzing all aspects of a Microsoft COBOL program. Modify any data-item at any breakpoint to test different conditions in your program without cumbersome data input or recompilation. Trap runtime errors. In some cases (e.g., non-numeric data), you can correct the situation and continue execution. On-line help messages are available for descriptions of command functions and general operational procedures.

CobRef allows the COBOL programmer to cross-reference source code listings to data-items, files and procedure calls in a program. In addition to name and type, listings include details on where an item is defined and referenced.

Menu Handler provides a program skeleton for creating applications with a menu-oriented user interface that is similar to the interface for the popular Microsoft Multiplan. Entries in the command area are mapped to the procedure calls in your Microsoft COBOL application.

CbMouse object module is linked to the program runtime. It translates the COMP-0 data-items defined by the programmer into the format that the mouse system calls are expecting. It converts the pixel values needed by the Microsoft Mouse to row/column values used by COBOL without the application needing to go through the conversions.

For more information on the products and features
discussed in the Newsletter,
write to: Microsoft Languages Newsletter
16011 NE 36th Way, Box 97017, Redmond, WA 98073-9717.
Or phone:
(800) 426-9400. In Washington State and Alaska,
call (206) 882-8088. In Canada, call (416) 673-7638.

Latest DOS Versions:

Microsoft C Compiler	4.00
Microsoft COBOL	2.20
Microsoft FORTRAN	4.00
Microsoft Macro Assembler	4.00
Microsoft Pascal	3.32
Microsoft QuickBASIC	2.01

Look for the Microsoft Languages Newsletter every month in this publication.

The chips in the set are called the 43201 (CPU), 43202 (MMU), and the 43203 bus interface.

I do not know of any commercial computer system using the iAPX432, and I am not aware of any operating systems for it, either.

You can call Intel at (914) 297-6161 in Wappingers Falls, New York, for additional information.—Steve

Expanding a Clone

Dear Steve:

I recently purchased a cabinet, eight-slot backplane, and power supply to make an expansion box for my IBM clone. When I hooked the clone's bus directly to the backplane with a ribbon cable, however, my computer would not even display the monitor prompt.

Do you have any suggestions on how to hook the new backplane and power supply to the clone's bus?

Ed Cabler
Port Ludlow, WA

The IBM Hardware Technical Reference Manual *shows one way to connect an expansion unit. The description is in Chapter 1 under "Expansion Unit." They use a driver card in the main unit expansion bus, a receiver card in the expansion box, and a shielded cable that carries all bus signals except OSC (the clock). The expansion box has its own power supply and clock oscillator, and a wait state is inserted to allow for lack of synchronism between the main and expansion unit clocks.*

Logic diagrams, which are almost complete schematics, are also included in the Technical Reference Manual*'s Appendix D.*

This is not the only way to interface the units. If you use a very short cable, are very careful about noise, and use proper termination, you might be able to carry all the signals.

A card with a set of buffers on each end may also work, but your experience shows why IBM suggests a driver/receiver card combination.—Steve

Atari and IBM Interface

Dear Steve:

As a user, I am tempted by all sorts of hardware currently on the market. One of the things that I've been considering is a new toy, something like an Atari ST or an Amiga, capable of nice graphics and at a reasonable price. On the other hand, IBM and its clones, with their marvelous outpouring of software packages, are threatening to seduce me away from my thousands of dollars worth of CP/M equipment.

I imagine I can take the plunge, buy two more machines, and retire my favorite S-100 equipment to a closet to make room. But the biggest problem with two or more machines is where to put the keyboards and monitors.

Would it be possible to build an interface board to stick into an IBM to translate input from the foreign keyboard of an Atari ST (or Amiga) to run IBM programs, and then translate output to use the Atari's monochrome and/or color display?

If such a board allowed the Atari to use the IBM's RAM memory and floppy and hard disk storage, interchange Atari and IBM data at will, and run most IBM software when operated as a terminal program, I would scurry out and buy one today. It would solve the problems of desk space, expanded memory for the Atari (or Amiga) graphics, lack of top-notch graphics for the IBM, and laser-printer graphics output. And besides, with a terminal program I could keep at least one S-100 on the same desktop, like an old friend to commune with about the folly of the younger generation.

C. M. Kotlan
O'Brien, OR

It is fairly easy to use a computer as a terminal to run an IBM PC. PC-DOS has features to allow this, and there is one software system that I know of that allows remote running of one IBM from another. As far as I know, however, this software does not have a version that will link IBMs with non-MS-DOS computers.

The simplest method would be to use an IBM, Amiga, or Atari as a "dumb" terminal to run your S-100 system. I'm guessing that you do little or no graphics on the system, so a straight-ASCII serial (RS-232C) interface is adequate.

The basic communication between computers is fairly easy as long as all data is ASCII, and the PC can be set up to accept commands from and redirect text output to the serial port.

Generally, however, the type of interface you are seeking is either very difficult or impossible to construct. It might be possible to write software to run on an IBM PC so that output would be sent to an Amiga or an Atari ST to be displayed in graphics form, but there is no practical way to make commercial software for the IBM PC send graphics output to either computer.

Direct use of a remote computer's memory as expansion memory is also generally not possible. Programs are written to access memory directly in a random fashion, with data being taken sequentially only in short segments. Using a remote computer as storage for

continued

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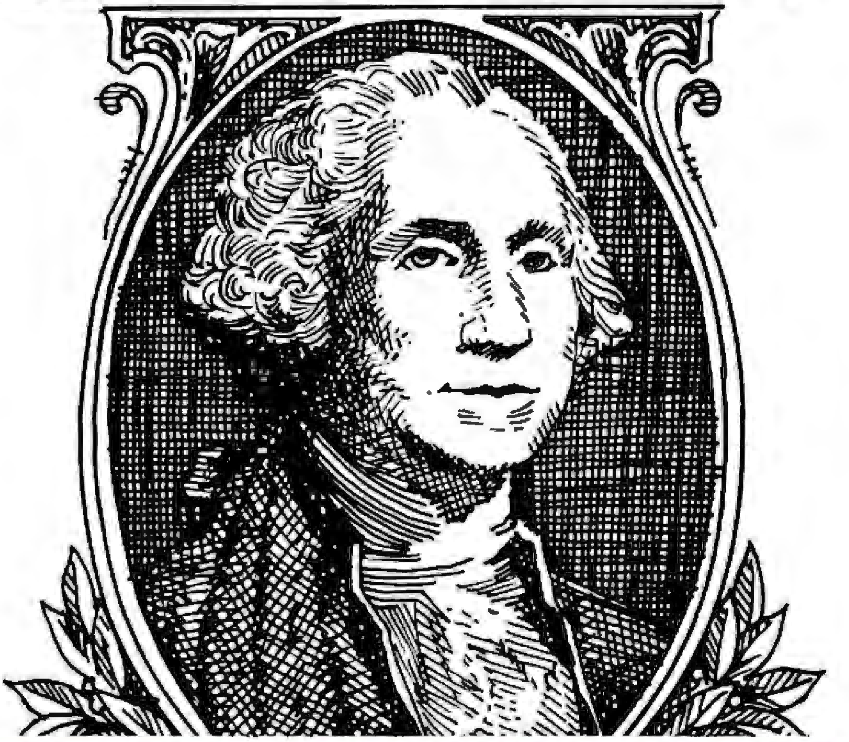

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large programs would be like having most of the program on disk, and paging sections in and out as needed would be slow.—Steve

---

CIRCUIT CELLAR FEEDBACK

Expanding a Kaypro

Dear Steve:

Since coming across your Circuit Cellar articles on the SB180, I am very intrigued by the possibilities offered by the HD64180 chip. I have a Kaypro 1, which I use primarily for word processing with WordStar. I am very pleased with the Kaypro, but I would like to enhance it, particularly by speeding it up and adding a RAM disk. The HD64180 seems like just the answer, and your design of the SB180 in combination with the Z-System seems to be what I am looking for.

Southern Pacific offers an HD64180 board for the Kaypros, but it uses CP/M Plus rather than the Z-System, and your account of the capabilities of the Z-System have sold me on it. I wonder if the Z-System can be used with a board other than the SB180?

My only regret about the SB180 is that it doesn't use the full 512K RAM that the chip is capable of addressing, but I can see that it would take a larger board to accommodate the added memory chips.

Wendell J. Fay
San Diego, CA

I am not familiar with the Southern Pacific HD64180 board for the Kaypro, but I do know that Echelon, Inc., the company that wrote ZCPR3 and the rest of the Z-System software, does have versions available for many computers other than the SB180. Their address and phone number are:

Echelon Inc.
885 N. San Antonio Rd.
Los Altos, CA 94022
(415) 948-3820

A newer, more powerful version of the SB180 is now available. Called the SB180FX, it supports a larger RAM disk (up to 4 megabytes with a new memory expansion card) and has a SCSI hard disk interface on the main circuit board. —Steve

Graphics and MIDI

Dear Steve:

Do you know of a graphics chip I can use to produce a 256- by 256-pixel black-and-white display? Each horizontal line would require 32 bytes, so that 256 rows would amount to 8K bytes of RAM.

Also, I am interested in MIDI; what register and crystal values would let the Z8671 microcontroller's serial I/O port run at MIDI's 31.25K bps? Any input you can offer would be appreciated.

Matthew Taylor
Austin, TX

My GT180 graphics board, which appears in the November 1986 issue of BYTE, describes the application of the Hitachi HD63484 Advanced CRT Controller chip. This system would give you a high-quality, high-resolution color display. Other graphics chips that are suitable include the Motorola 6845 and 6847.

There is no single-chip graphics system, although the NEC 7220 will put a full graphics system together with a minimum of parts. A shift register, the RAMs, a RAM timing generator, and a video sync mixer are all that it requires.

For the Z8671, use an 8-MHz crystal. Set the prescaler for the T0 timer to 1, then set the counter to divide by 4, and the UART section divides by 16 to give 31.25K bps. The chip divides the clock frequency by 4.

I think you might have some trouble running a synthesizer with this chip in interpreted BASIC, however. If you are just going to use it to upload and download waveforms and control one voice it should work, but it would probably be too slow to handle several voices and a keyboard. —Steve

Striking Out Alone

Dear Steve:

I have recently been considering starting a custom programming business. As a result, I would like to obtain some information that could help educate me on all of the trials and tribulations that would be in store for me, as well as give me hints on streamlining such an operation.

Roy Anderson
Long Beach, CA

The first principle of consulting (that's what you're getting into, even though you may think of it as custom programming) is that free advice is worth every penny you pay for it.

I have to make a few assumptions:

- *You are starting out as a one-man operation.*
- *You are pretty competent at writing code.*
- *You have a moderate amount of get-up-and-go.*

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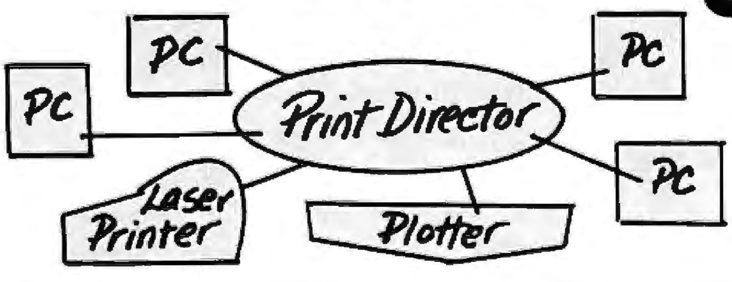

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Make sure that you've got enough money saved up to last for six months without any income at all. You should have some income, but you'll be surprised (everyone is) at how long it takes to land jobs. It's better to have too much money saved up than slightly too little. If you're thinking of getting new credit cards or lines of credit, do it while you've got a "steady job" because banks have little enthusiasm for loaning money to a new business.

As for streamlining your operation, I think the best advice is not to make things too complicated in the first place. You can probably keep your finances in a simple single-entry register and business checkbook; you won't need a fancy accounting system right away. Because the whole tax situation has changed, all of the old wisdom about incorporating is wrong, so beware of free advice about your business structure (even from me!).—Steve

Multiprocessing PC

Dear Steve,

I am trying to decide whether to use an IBM PC XT in a multiprocessing mode using a program like Microsoft Windows, or an IBM PC AT using a multiuser operating system such as XENIX. What is your suggestion?

Harvey Horn
Flushing, NY

The main problem with XENIX is that it's pretty much a turkey on an XT and only mediocre on an AT. Also, it really doesn't function as a real-time operating system. Finally, everything you think you know about PC software will change; you'll have to get software that runs under XENIX rather than PC-DOS . . . and such software isn't cheap, either.

Microsoft Windows gives the illusion of concurrent operation, but in reality it's not quite as nice as they would have you believe. For example, applications with an active window are time-sliced, but applications represented by an icon are not (with the exception of the clock application, which is a special case). The Windows Development Kit ($500) gives you the programming tools to write code to run with Windows, but from what I've heard, the I/O interrupt handling isn't pretty.

Set up your software on an XT and buy

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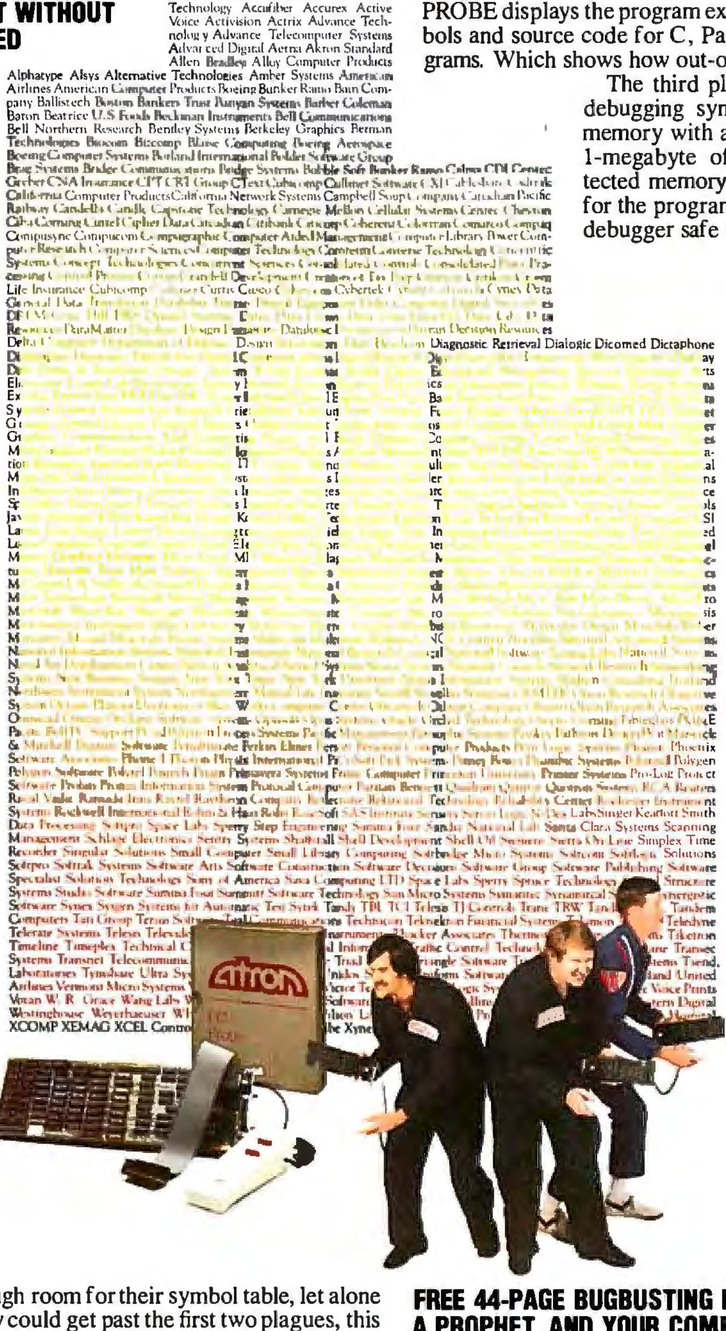

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PLAGUES OF BIBLICAL PROPORTIONS

The first and most difficult plague was impossible to trap with software debuggers. These were carnivorous bugs which randomly overwrote programs, data, even the debugger. Nastiest were the ones that slipped in once every few hours, or changed their behavior after each new compile. Forty days and forty nights of recompiling, *trying something else*, caused many a would-be resident of the city to run screaming into the wilderness, never to be heard from again.

Second came the plague of not knowing where the program was, or where it had recently been. This compounded the first plague: How could anyone know *what* caused the random memory overwrites? Add to this random interrupts and timing dependencies, and you begin to understand *The Fear* that gripped the city.

Then came the last plague, which brought the wizards to their knees before they even started debugging. Their towering programs consumed so much memory, there wasn't enough room for their symbol table, let alone debugging software. Even if they could get past the first two plagues, this one killed their firstborn software.

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The second plague, not knowing from whence you came, was cured with PROBE'S real-time trace memory. The history of program execution is saved on-board, in real time. Once a hardware trap has occurred, PROBE displays the program execution in detail, including symbols and source code for C, Pascal, or assembly language programs. Which shows how out-of-range pointers got that way.

The third plague, not enough room for the debugging symbol table to be co-resident in memory with a large program, was cured with 1-megabyte of on-board, hidden, write-protected memory. System memory was then free for the program, keeping the symbol table and debugger safe from destruction.

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another one with the money you'll save by not getting involved with debugging a multitasking system.—Steve

Lis'ner 1000 for the PC

Dear Steve:

As an undergraduate honors student at Iowa State University I will be developing both the software and hardware for a speech recognition and speech synthesis system for the IBM PC. As the start of the project approaches, I need to solve two pressing problems: first, gaining access to an IBM PC to which I'll be allowed to interface my project, and second, choosing speech recognition and speech synthesis ICs for the project.

This letter is mainly concerned with solving the second problem. I am referring to your Lis'ner 1000 project in the November 1984 Circuit Cellar. Specifically, I need information on the status of the Lis'ner 1000 version for the IBM PC. Would it be possible to obtain just the schematics for this project? I would truly appreciate any information and documentation concerning other available speech recognition and speech synthesis ICs.

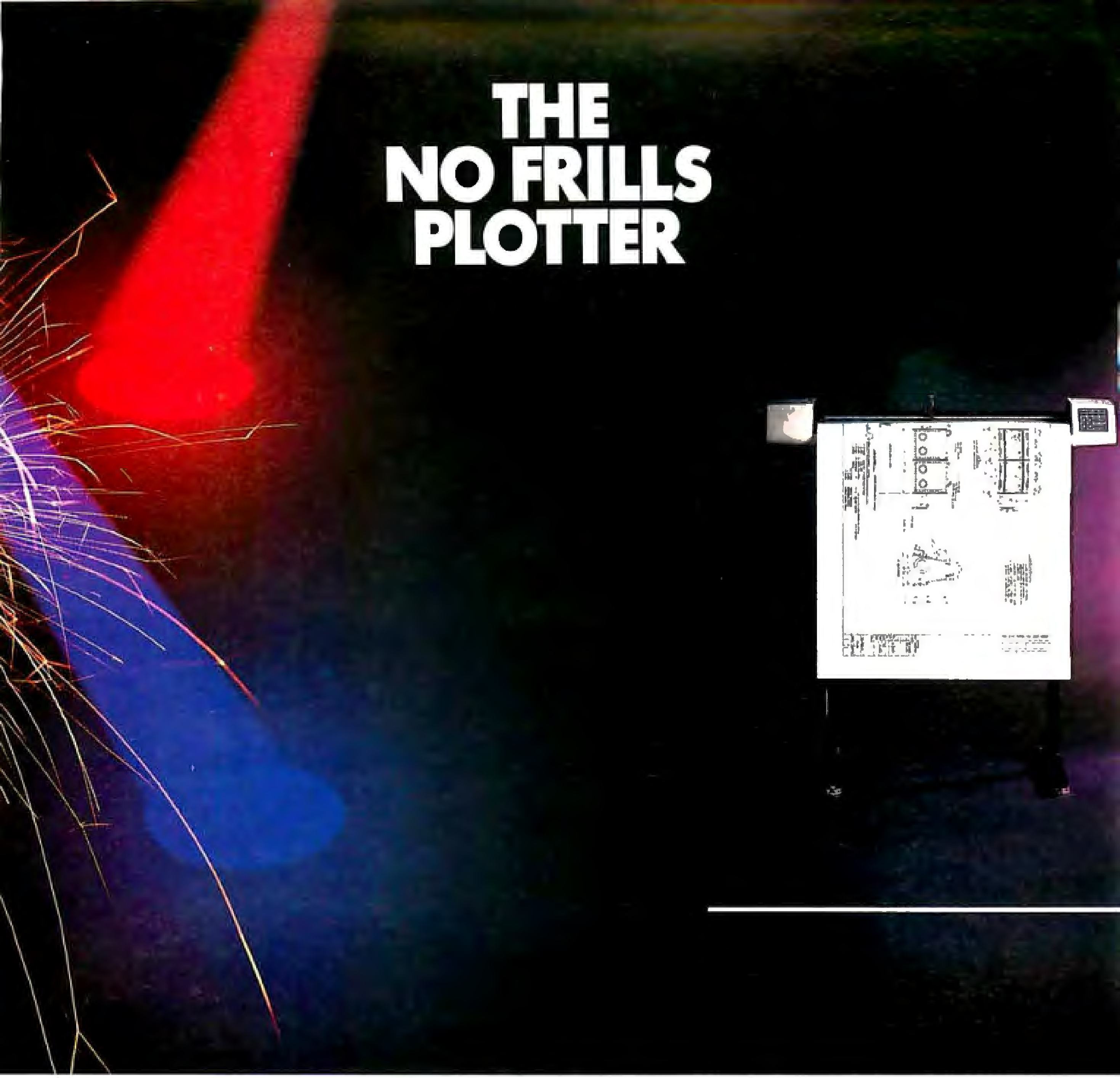
Gabriel M. Cuka
Ames, IA

I would think that at a university the size and quality of Iowa State, there would be many personal computers on campus. You should be able to get access to one of those computers to finish your project. Two approaches that might get results are a classified ad in the campus newspaper and notices placed on bulletin boards in strategic locations. Your academic department also may be able to assist you.

There is no schematic available for an IBM SP-1000 interface comparable to the Lis'ner 1000 circuit published in the November 1984 Circuit Cellar. There is an IBM interface using the SP-1000 chip made by AudoPilot. The AudoPilot 1000 is a simple board that features a powerful software interface system. Further information can be obtained from:

AudoPilot Inc.
P.O. Box 3006
516 Walt Whitman Rd.
Huntington Station, NY 11746
(516) 351-4862

There are several manufacturers of voice synthesis and recognition ICs, including Texas Instruments and National Semiconductor. Details on these and other chips can be found in their data books and their supplemental literature. Your best source for this type of information is probably the engineering library at your university.—Steve ■



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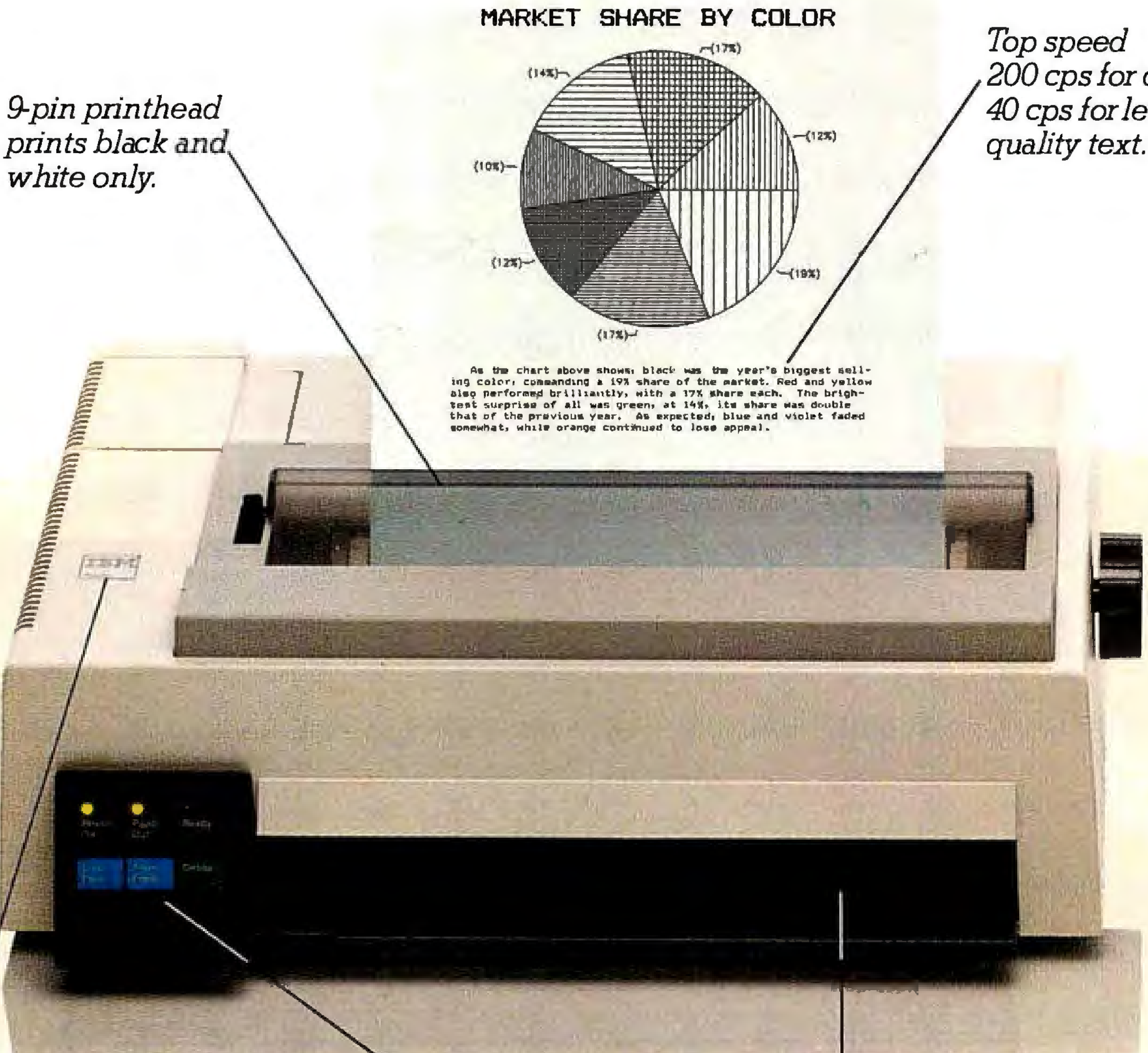

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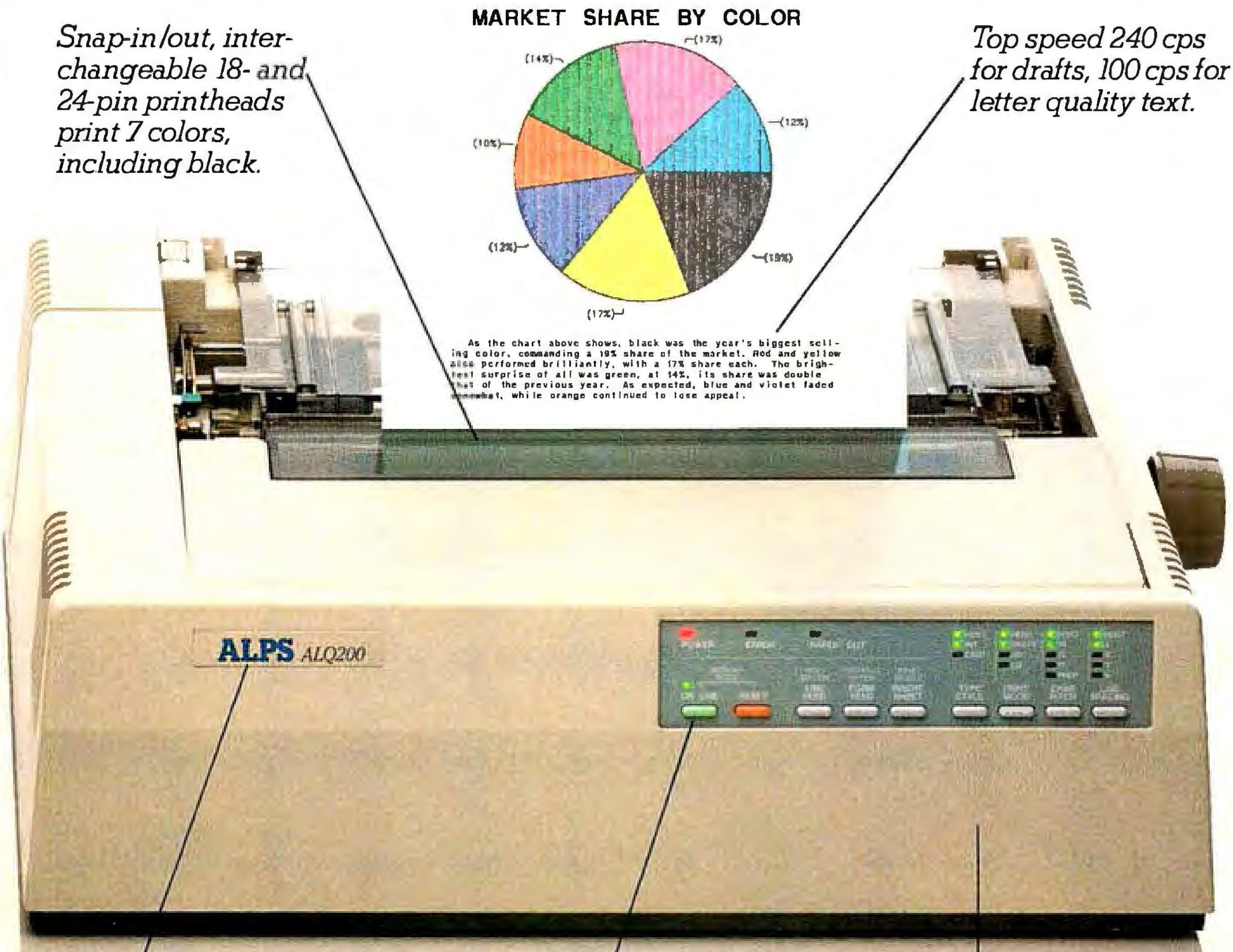

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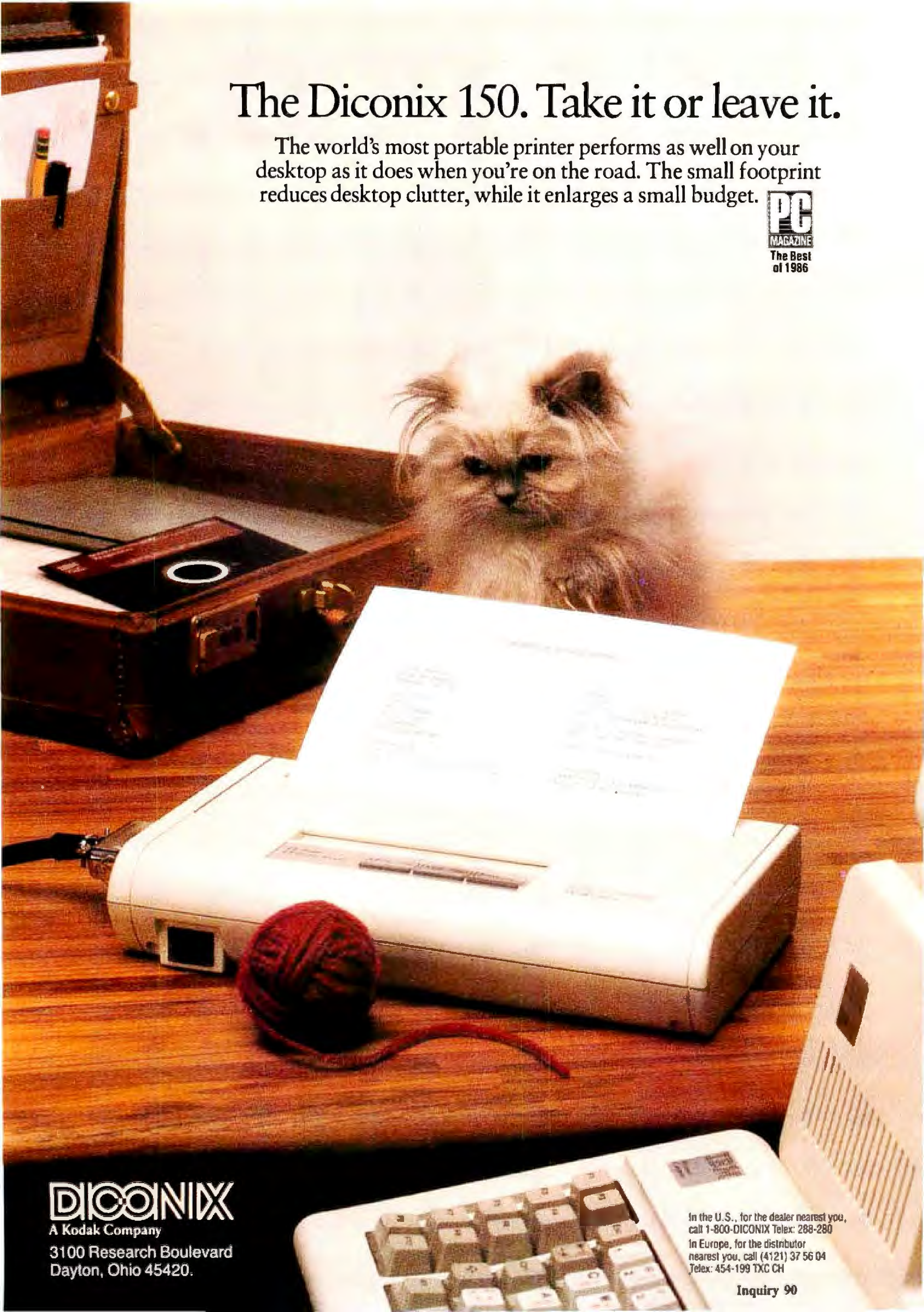

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ISBN 0-387-15851-0
199 pages, $35

Reviewed by
Eric A. Bobinsky

A Julia-set fractal of Period 11. Reprinted with permission of Springer-Verlag.

KERMIT: A FILE TRANSFER PROTOCOL
Frank da Cruz
Digital Press
Bedford, MA: 1987
ISBN 0-932376-88-6
379 pages, $25

MAC INSIGHTS
Lon Poole
Microsoft Press
Redmond, WA: 1986
ISBN 0-914845-73-X
276 pages, $18.95

THE POWER USER'S MANUAL
Randal L. Kottwitz
MacUser Publications Inc.
New York: 1987
ISBN 0-9617462-0-3
168 pages, $17.95

BALANCE OF POWER: INTERNATIONAL POLITICS AS THE ULTIMATE GLOBAL GAME
Chris Crawford
Microsoft Press
Redmond, WA: 1986
ISBN 0-914845-97-7
306 pages, $10.95

Anyone with an interest in fractals, computer graphics, mathematics, physics, art, or philosophy will find *The Beauty of Fractals: Images of Complex Dynamical Systems* a synthesis of the meaning of fractal geometry in each of these distinctive domains.

Written by Heinz-Otto Peitgen, a mathematician, and Peter Richter, a physicist, both professors at the University of Bremen, the book is the outgrowth of a 1984 exhibition of fractal art and its underlying mathematics. The authors had previously produced a brochure to accompany an exhibition called "Harmonie in Chaos und Kosmos," which served as a catalog of the fractal art and as an intelligent layman's explanation of its scientific foundation. From that first show sprang an international exhibition called "Frontiers of Chaos," which *The Beauty of Fractals* was written to accompany.

Three Potential Audiences

This book is, in a way, a three-in-one volume. First, it is a "philosophical physics" treatise, since the authors don't hesitate to relate fractal geometry to the nature of the universe, and they offer an exciting glimpse into new areas of science opened up by the development of fractal mathematics.

Throughout the opening chapters, the book stresses the importance of nonlinear processes in natural systems and, perhaps more important, that the long-term state of a given system (the stability of the solar system at some future date, for example) can't necessarily be determined by the initial values of its parameters. To quote from the book: "It is true that our spaceships can trust Newton's laws of motion and modern computers to guide them to their goals, but the fact remains that the route becomes unpredictable over *very long periods of time*."

Second, this is a very well illustrated mathematics textbook. Although it is not, as the authors state, mathematically rigorous, it is nonetheless rich in equations and mathematical notation. But those readers who are either uncomfortable with or uninterested in the mathematical sections can simply skip them without missing the flavor and the impact of the text and its accompanying illustrations (see the example above).

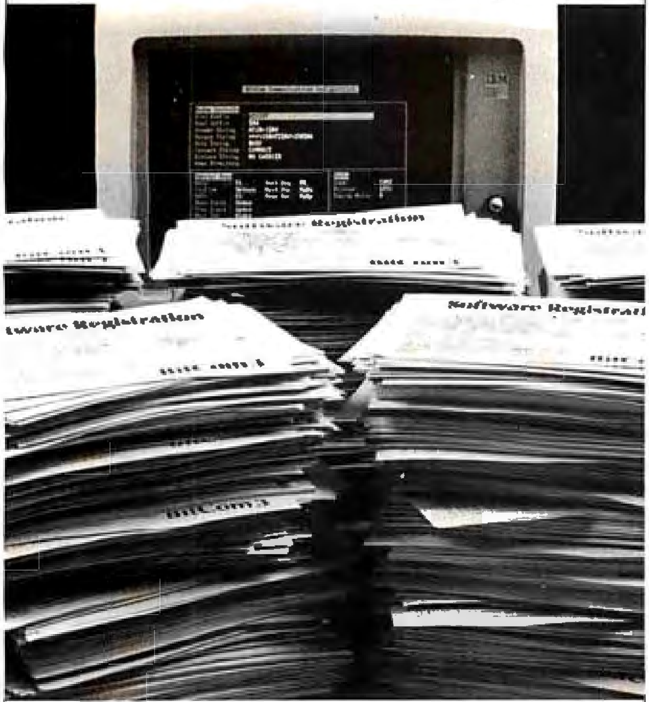
Third, this is a book for computer programmers, particularly those "renaissance coders" whose interests tend to range over the frontiers of both science and technology.

Acknowledging the Computer's Role

The authors acknowledge the assistance of two university computing departments and several programmers in the production of the graphics for the book, and they have returned the favor to the programming community at large by providing a sound mathematical and algorithmic treatment of fractal geometry. The last few pages of the book, titled "Do It Yourself," contain several fundamental algorithms, along with commentary, that can be programmed easily on a small computer.

Early on, the authors bring up the fact that this book—and, in fact, the entire field of fractal geometry—owes its current state of development to the computer. "Where scientists of earlier generations had to simplify their equations drastically or give up

continued



completely, we are able to see their full content on the display monitor. In graphical representation, natural processes can be comprehended in their full complexity by intuition. New ideas and associations are stimulated, and the creative potential of all those who think in pictures is awakened."

Contributions to the Book

At $35, *The Beauty of Fractals* is not inexpensive. For that price, however, readers get a true potpourri of scholarly information on fractals that they can dig into as deeply as they wish. Each of 10 special sections has a self-contained treatise on some esoteric aspect of fractal geometry or its applications. The book's price is largely due to the 40 stunning color pages bound into the hardcover volume, amounting to about 80 plates.

Two of the sections will be of definite interest to programmers, namely, "Julia Sets and Their Computergraphical Generation" and "The Mandelbrot Set." The other sections deal mainly with mathematical issues such as "Verhulst Dynamics" and "Newton's Method for Real Equations" or physical issues like "Magnetism and Complex Boundaries." Even if the technical issues may be beyond the average reader in these sections, the illustrations of the fractals are fascinating.

Four of the chapters are contributed: one by Benoit B. Mandelbrot himself, one by French mathematician Adrien Douady, another by German physicist Gert Eilenberger, and a fourth by the German journalist Herbert W. Franke. These four chapters are nontechnical and are probably the most enjoyable parts of the book, particularly Mandelbrot's "Fractals and the Rebirth of Iteration Theory," a reminiscence of Mandelbrot's discovery of the set that now bears his name (see "Plotting the Mandelbrot Set" by Peter B. Schroeder in the December 1986 BYTE).

The Beauty of Fractals deserves high praise for uniting a new science—fractals—with a new art—computer graphics—and merging them with a humane and challenging view of our physical and intellectual universe.

Eric A. Bobinsky is a mathematician at the NASA Lewis Research Center. He can be reached at MS 54-8, NASA Lewis Research Center, 21000 Brookpark Rd., Cleveland, OH 44135.

KERMIT: A FILE TRANSFER PROTOCOL

Reviewed by Joel West

As many will recall, Kermit the Frog is a greenish children's puppet that found crossover success several years ago as a movie star. And, as author Frank da Cruz recounts in this book, a Muppets wall calendar inspired the name of a data protocol under development at Columbia University in 1980. Da Cruz and his colleagues had to pretend otherwise until, at the suggestion of a BYTE editor, they requested and received permission from Jim Henson to use the trademarked name of Kermit (the Frog) for Kermit (the file-transfer protocol).

Kermit: A File Transfer Protocol is the first and definitive text on the latter Kermit, previously described by codesigners da Cruz and Bill Catchings for BYTE readers in a two-part series (see "Kermit: A File-Transfer Protocol for Universities," BYTE, June and July 1984). It supplements earlier manuals distributed by Columbia University with a variety of Kermit programs, both as manuals shipped in printed form with Kermit tapes and in electronic form through various research networks.

The Importance of Being Kermit

Most of the writing about data protocols has focused on local and wide area networks, such as the ISO reference model.

continued

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These protocols have been designed by computer vendors for use by their largest customers, transparently providing high-speed access for dozens (or hundreds) of computers.

Those with a single microcomputer and a modem have largely been ignored, even when their goals are far less ambitious. As an ASCII serial communications protocol for transferring files over a line or an RS-232C cable, Kermit provides an answer for the hobbyist, student, or small businessperson.

Kermit was originally designed by da Cruz and Catchings, but later enhancements came from a dialogue with its users. The latest extensions are designed for use with the current crop of high-speed modems and transmission through packet-switched networks.

Kermit has two advantages over other ASCII serial protocols: First, it was designed to run on many computer systems; and second, it is completely public and nonproprietary.

A valuable section of the book contrasts Kermit (the protocol) with another public domain microcomputer protocol, Ward Christensen's XMODEM/MODEM7, independently designed at about the same time. However, unlike the CP/M bias of XMODEM, Kermit has been successfully implemented on a wide range of microcomputers, workstations, and mainframes.

As independent software vendors crack the compatibility problem, they lock up their solutions in proprietary data protocols. In contrast, Columbia University has not only placed the specification of the Kermit protocol in the public domain but has freely distributed the source and object code for the several dozen programs that support it. By doing so, Columbia has performed a valuable educational service for the entire computer science community. As the sole participant at Columbia to remain from day one until the present, da Cruz is uniquely qualified to bring this project to the general computer public.

Levels Outlined in the Book

Kermit has three levels of target readers. The first such reader is the user of Kermit programs who may also be interested in the primer on data communications. The second is the local Kermit professional who supports such users. The third reader is someone who is writing a communications program that supports the Kermit protocol and who needs answers to specific questions.

A technical writer always faces a dilemma in trying to combine an easy-to-understand text with one that is technically detailed and precise, and the disparate audience makes the task even more difficult here. Da Cruz has done much better than most by addressing these distinct goals in separate sections. Witty drawings by George Ulrich enhance the book's light tone.

The goals and history of the Kermit effort include walks through several representative file-transfer sessions. Unfortunately, a published book in this field is a fixed snapshot of a moving target or, in this case, of the many evolving targets of the 42 different supported computers. The tutorial cannot list all possible systems or combinations and thus cannot supplant the specific, up-to-date documentation supplied by Columbia with each program. The documentation problem is made only slightly less grim by the use of a common command interface in many Kermit programs. It is doubtful, then, that any Kermit user would plunk down $25 solely for the first 45 pages of this book.

Goals are followed by a primer on computers and serial communications. The novice should find it a reasonable introduction to these topics. For the experienced programmer, the most interesting sections document the differences in file formats for a variety of computers.

Next, a user's reference guide includes a complete description of the command interpreter developed by Columbia for the DECSYSTEM-20 implementation and used by many Kermit programs. When used with programs that feature this inter-

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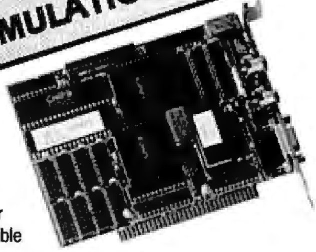

preter, the section will likely prove a well-thumbed reference for the user familiar with Kermit.

The remaining six chapters (some 100 pages) of Part IV walk through a complete program implementing the Kermit protocol with the most detailed commentary yet available. The narration covers Columbia's portable Kermit program written in C, which is the basis of Amiga, Macintosh, UNIX, XENIX, and other implementations.

In addition to describing the protocol's design and philosophy, the last section also includes practical efficiency calculations and many implementation caveats. The protocol description includes the two latest extensions: expanding the maximum packet size from 96 bytes to 837K bytes and support for multiple active data packets, the so-called sliding windows extension. Also included are valuable comparisons with the ISO's Open Systems Interconnection (OSI) reference model, Christensen's protocol, and a frank discussion of Kermit's design errors.

Dampening My Enthusiasm

The book has a number of weaknesses. The C example is the most portable implementation at Columbia, but the choice of C is unfortunate: Pascal programs are generally more readable to C programmers than vice versa. Although the use of short (five- and six-character) identifiers is proposed as a virtue for portability to archaic compilers, it is unnecessarily cryptic for a teaching example. The example also follows every trick for compactness in a C program at the expense of readability.

Despite the author's preeminent experience with Kermit (the programs), the book seems biased toward those programs where he has firsthand knowledge. The interest in the now-obsolete DEC-20, for example, seems to be to the detriment of its popular VAX/VMS cousin. The discussion of how to test a new program under IBM protocol converters may be important at Columbia, but it has little relevance to a developer hooking an Amiga to a UNIX box.

Finally, as da Cruz self-mockingly notes, the book is part "political tract" and part "polemic." Whether he's arguing against selling software or apologizing for the sexism of "male" and "female" labels on DB-25 connectors, da Cruz's infrequent diatribes grow tedious. His admonitions against military uses of Kermit seem particularly ironic when considering that the network sponsored by DARPA (Defense Advanced Research Projects Agency) has greatly facilitated Kermit's distribution.

Kudos to Columbia

Anyone not already familiar with Kermit (the program) should seek out a copy. Due to the efforts of those at Columbia and elsewhere, the programs are free and readily available from several user groups. Heavy users of Kermit, and those who must support such users, will find the book a valuable reference. It's essential for anyone writing a terminal program.

Joel West (P.O. Box 2733, Vista, CA 92083) has used or installed Kermit on six different computer types since 1984. His most recent article for BYTE was "Debugging Macintosh Applications" (December 1986).

MAC INSIGHTS and THE POWER USER'S MANUAL

Reviewed by Bonnie L. Walker

The authors of both *Mac Insights* and *The Power User's Manual* set out to write a comprehensive source of hints, tips, and shortcuts for using the Macintosh. If you are looking for a collection of tidbits about the Mac and its most popular

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software, either book will probably suit your needs. There are, however, a few differences between the books that may help you select the best one for you.

MAC INSIGHTS

Mac Insights is written by Lon Poole, the "get Info" columnist for *Macworld* magazine. His book consists of information that has appeared in his column and pointers he has gleaned from other publications, experts, and user groups. The tips are arranged by topic: troubleshooting, hardware hints, word processing, communications, and so on. Information about specific applications is located under appropriate topics. For example, under Word Processing you'll get tips about both MacWrite and Microsoft Word.

Topical Arrangement

Within each main grouping, the subtopics are not arranged in any particular order. For example, under the main topic Word Processing, Poole begins with a subtopic called Getting Around, in which he discusses the insertion point, followed by Keyboard Navigation and Place Markers. Under Place Markers, he suggests typing an unusual symbol and using FIND to locate the markers later. Under Selecting, he explains how to select lines, sentences, phrases, and paragraphs.

Throughout the book, Poole's emphasis is often on creative or commonsensical ways to use an application rather than on technical tips. Scattered among the practical tips, however, he does include some valuable technical tips such as the one that appears under the heading "Converting Documents." Here Poole explains how to remove unwanted return characters from an entire document using Microsoft Word, a situation that often occurs when transferring files from one computer to another.

More often though, Poole gives us information on how to use a particular application. For example, he explains in detail how to accommodate printed letterheads. "If your letter is only one page long," he writes, "the easiest and most reliable method of accommodating a letterhead in MacWrite is to insert the appropriate number of blank lines above the text of the letter."

Under the topic Editing, Poole's subtopics are so specific that only he would be able to find information in this book if he needed it. Examples are Saving often to avoid clogging memory, Efficient correction when typing, and Restoring backspaced text. Another topic in this category is Evaluating phrasing options. Fortunately, the book has a detailed index that helps to bridge the gap.

One of the best sections in *Mac Insights* is Resources. Poole provides detailed instructions on using ResEdit. He explains how to change a font, personalize an icon, and change Get Info comments, among other hints. More than 50 tips on graphics make the Graphics section among the most useful. The section of Communication tips focuses primarily on MacTerminal. About 50 applications are mentioned.

THE POWER USER'S MANUAL

The Power User's Manual was commissioned by *MacUser* magazine, in which author Randal Kottwitz's "Tip Sheet" column appears. Kottwitz also likes descriptive titles rather than generic ones, but since he has organized his book somewhat differently from *Mac Insights*, it's not as difficult to locate specific facts. The book begins with a section titled General Information and proceeds to group tips by application or hardware item, starting with Finder, Macintosh, and Macintosh Plus.

Desk Accessory Tips

Four full pages about desk accessories complement many useful tips. For example, Kottwitz warns us to always close all desk

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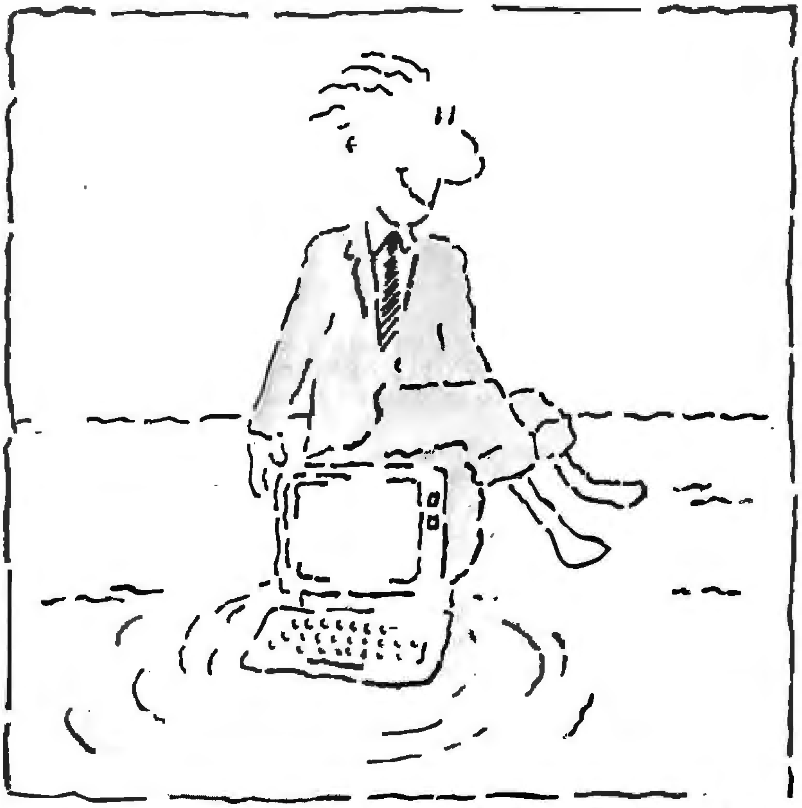

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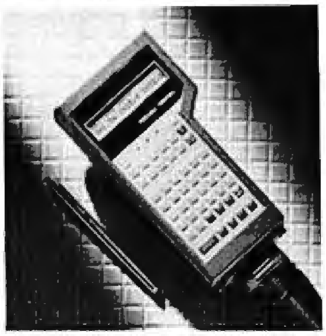

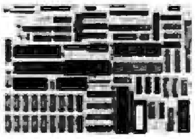

accessories before quitting an application or shut down from the Finder. If not, you could damage your System file, data files, or the application itself.

Sections about major applications are each like a short user manual for the application with only a few hints for advanced users. Other topics have one short tip and that's it.

For readers looking for communications information, this book offers a section on telecommunications and sections on MacTerminal. In addition, Kottwitz offers a section on Red Ryder plus Hayes modems and the Courier 2400 modem. *Mac Insights* focuses mainly on MacTerminal.

Because it is 100 pages shorter than *Mac Insights, The Power User's Manual* has less information about most of the topics it addresses. While Poole offers rather detailed, step-by-step instructions, Kottwitz focuses almost entirely on brief tips.

The Power User's Manual and *Mac Insights* both have fairly detailed indexes. Neither book has very many illustrations, although both contain lots of little icons.

Ingredients of Tip Books

To my way of thinking, a book of tips should offer information that is not in the applications' manuals. It might also include information that is in the manual but that is likely to be overlooked. A tip book should contain new ways of using applications that most people would not think of on their own.

Both these books follow that prescription, but both have significant flaws in organization, content, and clarity. Both books would benefit from a glossary of terms and a heavier emphasis on technical details, like a list of Finder versions and their specific characteristics, for example. Both would be improved by including more screen dumps from the applications they discuss.

Poole and Kottwitz have included as much current information as possible, given publishing constraints. There is a considerable amount of information about the Mac Plus, for example, in both books. One important piece of software was not included in either book, however: Microsoft Word 3.0 may well revolutionize word processing on the Mac. It will undoubtedly result in the need for new editions of both of these references.

Bonnie L. Walker, an independent consultant in Bowie, Maryland, is an instructional design specialist and systems analyst.

BALANCE OF POWER: INTERNATIONAL POLITICS AS THE ULTIMATE GLOBAL GAME

Reviewed by Rick Grehan

Chris Crawford is a designer of games noted for their unparalleled depth of perception. His latest creation—Balance of Power—is no exception. The game, about geopolitical interactions in the nuclear age, runs on the Macintosh. You play the role of either the President of the United States or the General Secretary of the Soviet Union. The computer plays the head of the opposing superpower. One goal of Balance of Power is to make it through to the end of 1994 alive, without engaging in a nuclear exchange. Another goal is to have as many powerful countries respecting your country as possible. The game refers to this latter accomplishment as prestige—the sum of the degrees to which countries show affinity to yours, weighted by their military strengths.

First a Game, Then a Book

Now Crawford has released a book by the same name that is as interesting as any game he has produced to date. *Balance of Power* is a carefully balanced investigation of the game's major

continued

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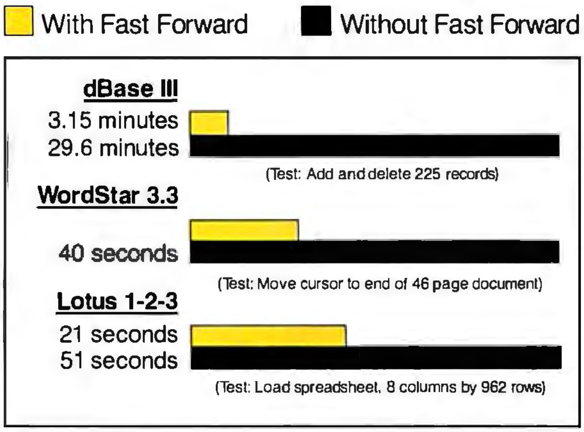

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forces. Within each of the chapters that define the game's ingredients, we are provided with a description of the real-world effect the author is attempting to simulate, a discussion of the algorithms he used, and several historical scenarios of events associated with the chapter's material. These historical outtakes demonstrate the author's meticulous research.

The Game's Design

Sprinkled throughout the book are the details of the author's efforts in designing the game. This is not Crawford's first publication on the subject: His earlier work is called *The Art of Computer Game Design: Reflections of a Master Game Designer* (Osborne/McGraw-Hill, 1984). The author reveals that this effort is composed not only of a series of additions, but more often requires the deletion of materials whose selection is derived painfully (and rarely scientifically). Particularly intriguing is the description of the feedback loop that evolved as Crawford developed the game. The act of representing (or attempting to represent) the intricacies of world geopolitics actually improved his understanding of them so much that he was able to redirect this new understanding into constructive modifications of the game.

What's Missing

As wonderful as this all sounds, the author himself points out important components missing from the game. In fact, he devotes an entire chapter to "The Unincluded Factors," the most important of which is the game's simple, bipolar view of the world (it ignores the potential emergence of China, for example, as a nuclear superpower).

Most omissions to the game, however, occurred either in response to the lack of resources (primarily memory, often time) or in an effort to make the game less overwhelming and more approachable.

Players of the game certainly appreciate its sophistication and would expect that software of such complexity was formulated using the latest development equipment. Yet it is interesting to read that the wonderfully detailed map of the world that is Balance of Power's primary screen was originally drawn freehand onto graph paper and laboriously entered into the Macintosh by hand.

Programmers who may find themselves considering yearlong stints before a display screen in an effort to produce the next great computer-game blockbuster will find the chapter entitled "How Balance of Power Was Created" particularly interesting. It details the false starts, economic pitfalls, and other sordid details that might send even the best flowcharted plans of a formative game over the brink.

The Last Straw

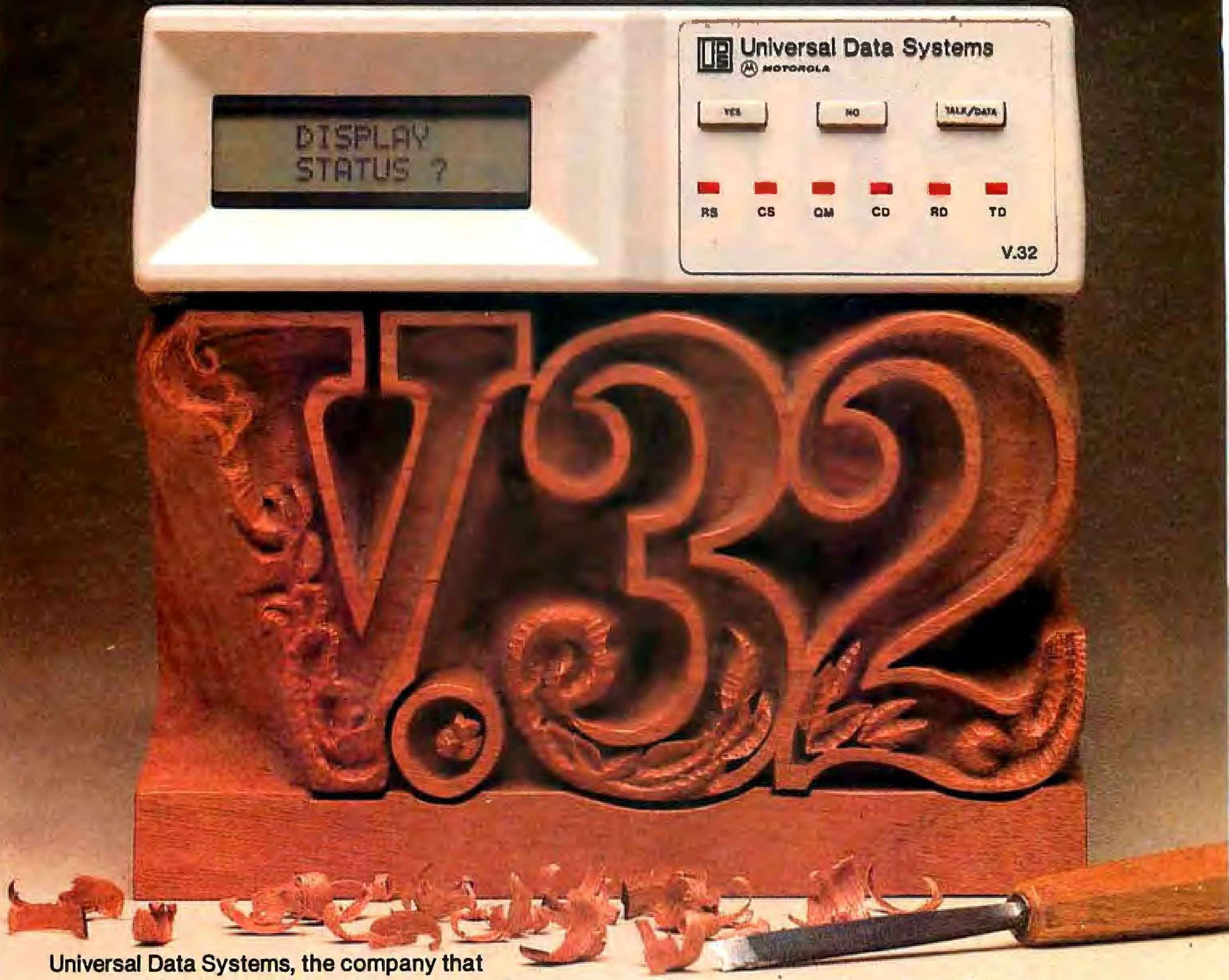
Finally, the designer confronts his own creation in the appendix. Crawford plays a sample game and leads us through a step-by-step account of the action, particularly the activities below the surface. Most revealing is the author's analysis of his own miscalculations. We must stand in some awe of a program that puts its own designer into serious deliberations.

Balance of Power is a joy to read. Crawford is witty, lucid, and overflowing with ideas. The book is full of deep and often disturbing insights, such as the author's original proposal for the game: "I intend to show that good men can still annihilate the world through miscalculation."

You needn't be a computer programmer to read this book. However, if you are and you are interested in simulation or game design, you will find *Balance of Power* absorbing. ■

Rick Grehan is a BYTE technical editor. He can be reached at BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

A special kind of craftsmanship



Universal Data Systems, the company that developed the first 9600 bps dial-up modem, has now applied its special brand of craftsmanship to the CCITT V.32 specification.

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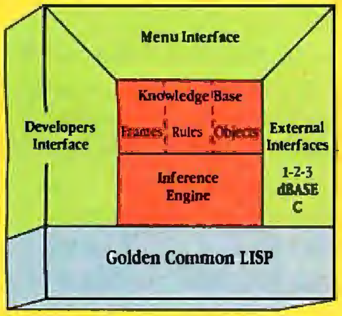

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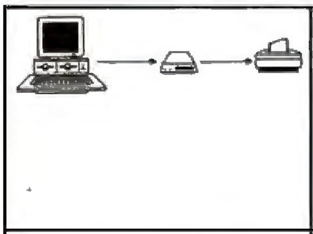
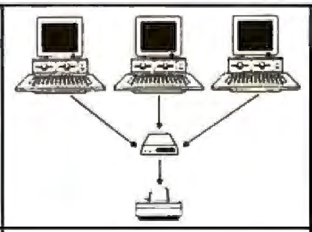
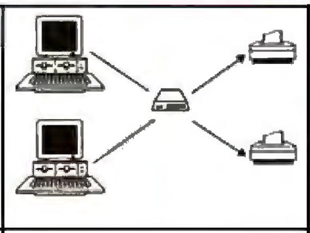
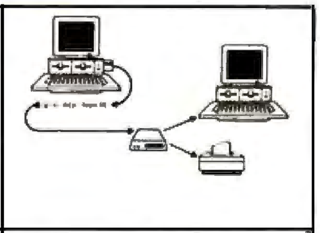
The Mega-Link can be used with virtually any computer/printer system. Its four ports (two serial, two parallel) allow 1, 2, or 3 computers to share a conventional or laser printer. Naturally, the Mega-Link has all of the advanced features you'd expect; multiple copy, single sheet mode, pause and buffer erase plus a "top of forms" mode that assures each job will start with a fresh sheet of paper. For plotter users, the Mega-Link has a unique pause mode which allows you to change paper between jobs.


1) Link any parallel computer to any serial or parallel printer. Because Mega-Link has four ports, additional devices can be added.


2) Two additional computers can share the buffer and the printer.


3) Two computers can share two printers such as a dot matrix and a laser printer.


4) Mega-Link can also be used for remote computer applications through the use of the accessory remote computer adaptor.

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Features

Special BIX Supplement: "Power Protection for Microcomputers" by Mark Costello, a guide to understanding and selecting uninterruptible power supplies, appears in the topic UPS within the BIX conference may87.sup. (For information on joining BIX, see page 256.)

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Jonathan Erickson, G. Michael Vose, and Charles Weston

The Tandon PAC 286

An AT-class computer with a unique disk subsystem and memory management unit

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

Of all the innovative technology that drives the personal computer business, none moves faster than new disk technology. Tandon Corporation, a company built on disk technology, recently developed a disk subsystem featuring portable hard disk data packs. To sell these unusual new disks, the company built an AT-class computer called the PAC 286 that uses the removable disk drive/data packs and incorporates a custom memory mapper chip to give the computer access to memory above the MS-DOS 640K-byte boundary.

The Tandon PAC 286 (see photo 1) sells for $2995. Personal Data Pacs (PDPs) cost $300 to $400 each (see the In Brief box on page 86 for a full description of the configurations of the PAC 286). A PAC 286 machine comes with two data pack receptacles, providing a total of either 30 or 60 megabytes of on-line storage capability. Data packs weigh 2½ pounds and can fit easily into a briefcase. PDPs are self-contained 15- or 30-megabyte hard disk drives with one or two 3½-inch platters and their read/write heads.

For now, PDPs can be used only in the Tandon PAC 286, although Tandon plans to offer add-on/add-in devices for existing IBM PC-, XT-, and AT-class machines later this year.

System Description

The Tandon PAC 286 features an Intel 80286 microprocessor that runs at either 6 or 8 megahertz. The machine uses a custom clock generator/bus controller with a 48-MHz oscillator. An MS-DOS software switch lets you select a processor speed that is either 1/6 or 1/8 of the oscillator frequency.

You can back up the 80286 with an optional 80287 math coprocessor for additional floating-point calculation speed. The PAC 286 features both real and protected mode operation and uses a 24-bit address bus and an 8- or 16-bit data path.

The microprocessor uses a single wait state to interface to the standard 1 megabyte of on-board, 150-nanosecond RAM. With the addition of an optional RAM expansion board, motherboard RAM can be increased to a total of 5 megabytes. This RAM expansion board attaches to the CPU board via a special 60-pin connector and therefore does not use up any of the machine's expansion bus slots. (Tandon offers this expansion board in both a 1-megabyte and a 4-megabyte configuration.) You can expand total system RAM to 16 megabytes by adding additional memory cards into the expansion bus slots. In addition, the PAC 286 uses a

continued

Jonathan Erickson and G. Michael Vose are BYTE senior technical editors. Charles Weston is a BYTE technical editor. They can be reached at BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

Photo 1: *The Tandon PAC 286.*

© Robert Fujioka Studios

IN BRIEF

Tandon PAC 286

Company
Tandon Corporation
405 Science Dr.
Moorpark, CA 93021
(805) 523-0340

Price
$2995

Microprocessor
Intel 6-/8-MHz 80286, 16-/32-bit microprocessor

Main memory
1 megabyte, expandable to 5 megabytes with optional piggyback memory expansion board

Disk memory
360K-byte or 1.2-megabyte MFM-recorded floppy; two 15-megabyte RLL 2-7 recorded Personal Data Pacs with 50-ms access time (Model 15); two 30-megabyte RLL 2-7 recorded Personal Data Pacs with 50-ms access time (Model 30)

Keyboard
Detachable 101-key AT-style keyboard

Ports
9-pin serial port; 25-pin parallel port

Slots
One 62-pin XT-compatible slot; four 98-pin AT-compatible slots

Optional peripherals
80287 math coprocessor
2- or 4-megabyte piggyback board with up to 4 megabytes of RAM
Expansion box
Mouse

proprietary memory mapper chip that lets the machine access all 16 megabytes of memory in the real address mode (see below).

Two 32K-byte by 8-bit EPROMs contain the ROM BIOS for the PAC 286. The ROM is mapped to the top of the first and last 1 megabyte of the address space of the memory installed in the machine (hexadecimal 0F0000 and FF0000).

The PAC 286 uses two 8237 direct memory access controllers cascaded to provide seven DMA channels with 16-bit data transfers permissible only through channels 5 through 7. In a similar arrangement, two 8259A interrupt controllers provide 15 levels of programmable system interrupt and one nonmaskable interrupt. In all, the PAC 286 CPU board comprises 29 chips—not counting memory parts—including five gate arrays.

The PAC 286 can be expanded even further through the use of an optional expansion box that is attached to the computer via a 100-pin printed circuit board edge connector. The expansion box can house an additional three PC, XT, or AT expansion boards, provides room for two additional half-height fixed disk drives, and is powered by its own power supply with cooling fan.

Since the PAC 286 is an AT-compatible computer, it uses the standard variety of PC, XT, or AT display adapters, from 320 by 200 monochrome output to EGA/PGA capability. The floppy disks read and write IBM-format disks. The machine uses MS-DOS 3.2 as its operating system. The PAC 286 differs substantially from AT-class computers, however, at the hard disk level.

The Personal Data Pac

From outward appearances, the one thing that sets the Tandon PAC 286 apart from other personal computers is a unique mass storage system built around 15- and 30-megabyte PDPs. Technically, a PDP is a removable hard disk, but after using one for a while, you begin to realize that it is much more than "just another hard disk." PDPs, which are fully interchangeable within a system and between systems, let you quickly, easily, and safely take your entire computing environment—productivity programs, data, memory-resident utilities, languages, macros, and so on—wherever you go. This has far-reaching implications for those who can or must use more than a single PC, are concerned about data security or data protection, or want to prevent software piracy. Additionally, each PDP has a unique software-coded serial number that permanently differentiates it from every other PDP in existence. This, too, offers many opportunities that haven't been possible before, as we'll discuss later.

Of course, removable, transportable mass storage devices have been around for some time, but the problem with them has been that they are too delicate, time-consuming to back up, and expensive to be useful for much more than archiving data. PDPs change all that. Because of their unique design, PDPs provide the most rugged PC hard disk storage environment—removable or stationary—available today. While you can't "slice it and dice it," a PDP can withstand far greater abuse than the typical PC user would ever think about subjecting a storage device to. Backing up data isn't a chore with PDPs either, since it takes only about 2½ minutes to copy 30 megabytes of information. And at only $350 to $400 per 30 megabytes, PDPs may be one of the biggest data storage bargains anywhere.

A PDP (see photo 2) is a rectangular plastic box with a raw hard disk assembly. It measures 2½ inches high by 4¾ inches wide by 7 inches deep and weighs approximately 2½ pounds. Three edges of the PDP are squared, while one edge (the lower left) is angled to prevent the PDP from being inserted upside-down or backward into its *receptacle*, the PDP equivalent of a floppy disk drive. The PDP does not have disk access lights; these are on the receptacle units. Once the PC is powered up and under system control, a PDP is *self-loading* in that once you insert the PDP into the receptacle part way, a *sled* grips the bottom of the pack to pull it all the way into the receptacle, where a 36-pin male connector (I/O, power, etc.) on the back of the PDP mates with a connector at the rear of the receptacle. A motor then aligns and engages the disk. The insertion/ejection process is similar to that of a Macintosh disk, al-

Photo 2: *Personal Data Pacs for the PAC 286 computer.*

© Robert Fujioka Studios

though PDP insertion/ejection is smoother.

By removing the plastic case (and possibly voiding your warranty), you can see that a PDP's main internal components are a Tandon Model 383 hard disk unit, a printed circuit board with an attached 36-pin connector, and a solenoid, all fastened within a metal cage by four rubber shock mounts.

Like other hard disks, a 30-megabyte PDP has two double-sided platters with four read/write disk heads, while a 15-megabyte unit has a single double-sided platter with two heads. Whenever the PDP is not loaded into a receptacle, the disk platters and disk heads (and ultimately the data) are protected by a unique head-locking mechanism and process.

This process, referred to as *end unloading,* gets under way when the system receives a PDP ejection command. The first thing that happens is that track 0 is identified so that the disk heads can be parked away from the directory track. Once track 0 is located, the disk heads move in 220 tracks, the 12-volt solenoid then moves a one-of-a-kind plastic comb (also called a *separator fork,* the main physical component of the locking mechanism) between the individual head stalks (the *arms* to which the heads are attached), and the heads move out 151 tracks and finally step out 69 more tracks.

Once in position, this comb holds the disk heads away from the surface of the platters and supports the head stalks. It is this mechanism that keeps the disk heads from banging against the disk platters as the PDP unit is moved about. The entire unloading and ejection process takes about 7 seconds. When a PDP is inserted into a receptacle, *head loading* (which is the reverse of the process described above), activates.

Currently, the PDP head unloads only as part of the PDP ejection process. As long as the PDP is loaded in the receptacle, it is susceptible to the same shock dangers as standard hard disks. Tandon will include a utility for head unloading without PDP ejection in production units of the PAC 286. You cannot remove a PDP from the receptacle except under system control after an eject command is issued. (In other words, there is no "poke hole" as found on the Macintosh.) This feature prevents a PDP from being removed without first locking the head and comb mechanism. The only way to manually eject a PDP is to remove the back cover of the receptacle unit and disengage the PDP by hand. If the power suddenly fails, there is no way to remove the PDP from the receptacle unless you remove the back cover. In most cases, this will not be a problem since the PDP becomes, in effect, a conventional, stationary hard disk and should be treated as such. It may be an inconvenience, however, if you have grown used to the convenience or necessity of moving the PDP from one system to another for portability or security.

According to Tandon specifications, a PDP can withstand shocks of greater than 250 Gs or "a [flat] drop of 18 inches onto a rigid surface (such as concrete covered with vinyl tile) without sustaining functional damage." (Tandon defines functional damage as "either the case is damaged such that the PDP cannot be loaded into the receptacle or that data cannot be recovered.") Furthermore, Tandon claims that if a PDP is dropped and lands on any edge or corner, functional damage will not occur. Drops onto softer surfaces obviously can be made from greater heights.

The data transfer rate for PDPs is 7.5 megabits per second with a maximum access time of 100 milliseconds and an average seek time of 50 ms. Due to caching on the disk controller board, actual drive performance is greater than the specifications indicate. (Since a read/seek operation is performed between each read/write, the PDP is faster on reads than it is on writes.) Additionally, logical track 0 has been located in the middle of the disk to enable faster data access.

Each platter in both the 30-megabyte and the 15-megabyte PDP has 615 cylinders, while a 30-megabyte unit has 2448 tracks and a 15-megabyte PDP has 1224 tracks. Since RLL (run length limited) encoding is used on the disk controller board to physically format the unit, each PDP has 26 sectors with 512 bytes per sector. If some sectors have defects, their headers can be rewritten and reassigned to specially reserved sectors at the physical end of each track.

When compared to MFM encoding techniques, RLL encoding, which is emerging as the predominant approach to putting data onto hard disks, enables both a higher data transfer rate (1.5 times greater) and higher storage capacities. In this case, RLL data-encoding techniques enable Tandon to take a current-generation 20-megabyte hard disk design with minor modifications and allow it to be reformatted for 30 megabytes of capacity. RLL improves on conventional encoding schemes (including MFM) because it represents a binary data string as a data encoded pattern without separate clock or data bits (as does MFM encoding), hence there are fewer flux reversals and faster transfer rates.

The data transfer rate for PDPs is 7.5 megabits per second with a maximum access time of 100 ms and an average seek time of 50 ms.

In addition to supporting RLL encoding, the disk controller, which is controlled by the 80286 CPU through the BIOS, also features 56-bit error correction coding (ECC) with the ability to recover bad sectors, consecutive disk sector reads and writes without interleave, full-track read buffers for random sector access, and the ability to relocate sectors on a track.

The disk controller is physically housed on two printed circuit boards; one board contains digital components, and the other contains analog components (we'll cover this in more detail later). In addition to supporting the PDP drives, the disk controller also provides support for two standard ST-506 fixed disk interfaces.

The components on the digital board include a control processor, a RAM buffer controller, DRAM, a digital multiplexer (for selecting between PDP or ST-506 devices), a phase comparator, a CMOS LSI disk controller chip, and the ST-506 interface. The disk controller chip performs most of the data transfer functions by accepting command and status signals from the CPU to provide the appropriate controls for both the ST-506 and PDP interfaces, including head select and I/O transfer. The disk controller also contains RLL encoding and decoding logic and error detection and correction logic.

Caching, or buffering, on the controller board is accomplished by a least recently used (LRU) buffer management process. When a request for caching is sent to the controller board, the BIOS first looks to see if the sector demanded is already in the cache. If the sector is in the cache, it is transferred from there to the user space, and access returns to the disk. If the request isn't satisfied, the system goes out and finds an available buffer. If a free cache buffer is available, the system just takes that buffer. If all buffers are used, then the system finds the oldest buffer and uses it. The total cache is 128K bytes in size, roughly divided among eight buffers.

The RAM buffer controller enables the PAC 286 to avoid using system RAM for

continued

The 80286 Problem

The Intel 80286 microprocessor suffers from what can best be described as a conceptual design flaw that hampers its use in protected virtual address mode. Programmers discovered that doing context shifts between real mode and protected mode was not a trivial task. The placement of the T-bit and the permission bits within the address/segment word (see figure A) required register manipulation of the address portions of this word before any address translation arithmetic (virtual, or logical, addresses to physical addresses) could be accomplished.

Because of the position of these non-address bits, simple 32-bit arithmetic for calculating addresses is not possible in 80286 protected mode. (See listing 1 for a pseudocode description of the 80286 virtual address calculation process.) Programs written for the 8086 and PC-DOS therefore require some significant manipulation of the address segments to be able to run in 80286 protected mode.

As you can see from figure A, only 14 bits of the value loaded into the segment register are significant. Therefore, segment register values less than 4 bytes from each other point to the same descriptor table entry.

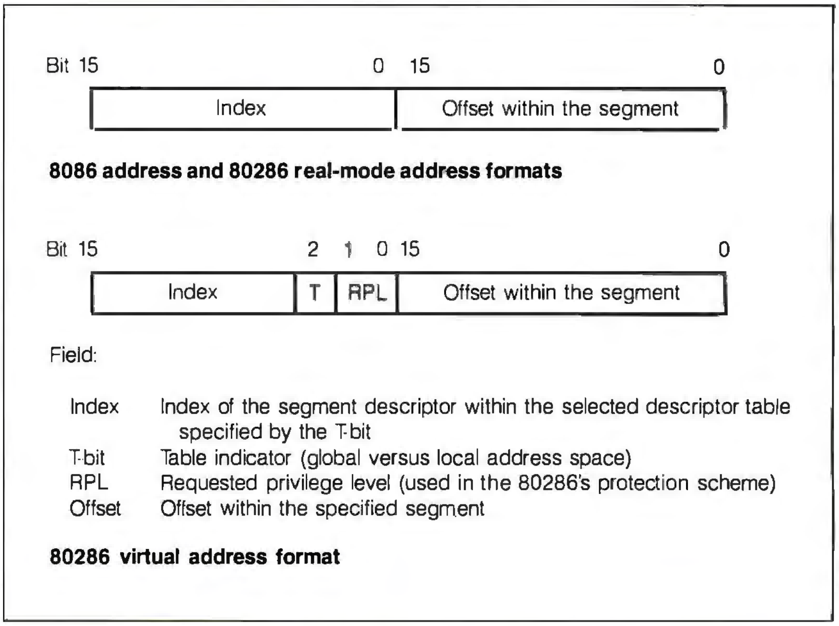
In another approach to this problem, the descriptor table is programmed to zero, which causes a descriptor table limit exception. The operating system then recovers from the exception and calculates the physical address. It takes a significant amount of time, beginning at the exception caused by loading a segment register, to trace back through the various pointers and tables to figure out the value that should be loaded into an 8086 equivalent segment register during a context shift. A descriptor table must then be created with this value as its base. (To allow for any value to be loaded into a segment register, the descriptor table would have to be 64K bytes in size.)

This problem caused programmers to be reluctant to modify existing 8086 code to make it compatible with the 80286. In addition, if the operating system was modified and succeeded in

Listing 1: *The pseudocode for the 80286 virtual address calculation process.*

```
Adding a displacement of 16 bits or less:  (offset in DX, displacement in AX)
      Add new displacement to DX.
      If carry-out then
         Move DS into BX.
         Add '0008'x to BX.        (Add 1 to index field.)
         Move BX back into DS.

Adding a displacement of more than 16 bits: (offset in DX, displacement in BX:AX)
      Add new displacement of DX.   (DX < – DX + AX)
      Add carry-out to BX.
      Left-shift BX by 3.   (Align with index field.)
      Move DS into CX.
      Add CX to BX.      (Add displacement high to index field.)
      Move CV back into DS.
```



8086 address and 80286 real-mode address formats

Field:

Index	Index of the segment descriptor within the selected descriptor table specified by the T-bit
T-bit	Table indicator (global versus local address space)
RPL	Requested privilege level (used in the 80286's protection scheme)
Offset	Offset within the specified segment

80286 virtual address format

Figure A: *The placement of the T-bit and the permission bits within the address/segment word on the Intel 80286.*

multiple sector reads/writes, thereby letting the disk access the 128K-byte sector buffer through a local DMA channel or directly through an address port dedicated to the host processor. The RAM buffer also contains DRAM refresh circuitry.

The limitations placed on the RAM buffer are dictated by the software control module, which divides the RAM sector buffer into four blocks. Two of the blocks are designated read/write track size blocks, one for each PDP: This effectively prevents more than two PDPs from being used in the initial PAC 286 system. The third block is used by the verify track size command, while the fourth block is the control block. Each read/write track buffer contains storage for each sector on a track as well as track identification.

The analog board basically performs two functions: PDP receptacle control and actual drive control. All electronics are on the analog board, not inside the drive. This helps keep down the cost of individual PDPs. The analog board components include the receptacle motor drivers for loading and unloading the PDPs, an analog multiplexer for selecting RLL-encoded data, a pulse detector with filter and automatic gain control for converting PDP data to digital pulses, a drive position control processor, stepping and spindle motor drivers, and two gate arrays for controlling head movement (track placement and step and direction sequencing). The drive position control processor is interfaced to the system bus via a parallel port used to transfer status making programs compatible, address manipulation during context shifts could take hundreds of microseconds or more, compared to tens of microseconds or less for a Motorola 68000-type microprocessor. This factor would slow down the operating system drastically and degrade system performance.

In protected mode the 80286 protects segments of coresident processes by marking them as execute-only or read-only. The 80286 provides four levels of security (0 to 3), designated by the bits that make up the RPL field within the segment selector words. This system is normally secure, allowing programs to access any segment with a numerically higher (or less secure) privilege level. The real problem occurs when an application tries to execute subroutines that are part of the operating system (normally the highest level of protection). These code segments should be protected from possible damage, but less privileged applications should still be granted access to them.

The mechanism used for this purpose is the descriptor *gate*, a passageway to a more privileged level of code. The gate has a privilege level that is separate from the code segment to which it points. A descriptor gate with a privilege level of 3 can point to a code segment with a privilege level of 0, for example. Thus, a lower-level application can issue a call through the gate and the CPU will alter (raise) that application's privilege level temporarily, while it executes secure operating system code.

When the return instruction is executed, the application's privilege level is once again lowered to its original level. All in all, this is a complicated scheme, and it has not achieved great popularity among software developers.

and commands for drive position control and PDP loading and unloading. The signals from the controller are used by the RAM buffer controller and the data controller (both on the digital board) for translating the commands/status into signals to be sent to the disk drive interface for read/write chain, stepping motor, and spindle motor control. The drive position control processor also monitors the PDP seeking, recalibration, and loading in addition to interrupt sourcing.

When you receive a PDP, it is preformatted and configured with one partition that contains the operating system and utilities.

The Memory Mapper

PDPs are not the only unique hardware in the PAC 286. Tandon engineers also tackled the inability of the Intel 80286 to perform smooth context shifts between protected mode and real mode by developing a memory mapping device (see "The 80286 Problem" at left).

Tandon's engineers have not solved the 80286 protected mode problem, but they have found a way to work around it. In Tandon's scheme, the processor is not intended to run in protected mode at all. This machine can still run programs written for protected mode, but when it is in this mode, the same context-shift problems are still present as in any normal PC AT.

To avoid these problems, the processor is intended to run in real addressing mode all of the time, and the memory mapper/page register chip and the internal DMA registers control the remapping of memory for the three new operating modes—clone mode, mapped-clone mode, and extended mode. The on-chip DMA page registers were added to support DMA operations for the three addressing modes.

The memory mapper/page register chip serves three functions: mapping all addresses generated by the CPU into the physical address space, a DMA/page register mapping function that extends the addressing range of the DMA channels, and an interrupt redirection function for remapping system interrupts. Note that the memory mapper and DMA page register functions are separate and share only the silicon of the chip.

Clone Mode

In clone mode, the machine is like any other PC AT, with one exception. Memory between 640K bytes and 1 megabyte is not normally accessible on a PC AT. Tandon remaps this 384K-byte chunk of RAM, using hardware on the motherboard, so that it always appears above the highest address of any add-on memory present. (This function is not to be confused with the functions of the memory mapper/page register hardware.) The Setup menu checks the amount of RAM present when the machine is configured and reports where this chunk of bonus memory resides.

In clone mode the processor is capable of running protected mode programs, like any other PC AT, with all its attendant problems. All virtual memory address calculation is handled by the processor itself, and no memory mapping of any

continued

kind, other than the hardware relocation of the 384K bytes just mentioned, takes place. The DMA registers are configured exactly as they are in an IBM PC AT (see the clone-mode addressing scheme in figure 1).

Mapped-Clone Mode

The PAC 286 powers up in clone mode, with the memory mapper turned off, and then the mapper must be turned on by some software, such as Tandon's memory management software. In this configuration (referred to as mapped-clone mode), the processor is operating in real address mode and has access to a full 16 megabytes of memory through the use of the memory mapper's two groups of 64 mapping registers. The processor has the ability to select either 64-register set when executing a context shift, which greatly speeds up the process (see the mapped-clone addressing scheme in figure 2). One set of registers is dedicated to the operating system memory map, and the other set is used for the memory map of the current task.

All addresses presented to the DMA controller in this mode are below 1 megabyte and are considered virtual addresses. Processor address bits 14 through 23 are all seen by the mapper hardware. In this mode, if bits 20 through 23 are zero, virtual address translation is necessary. Bits 20 through 23 do not always have to be zero, but if they are not, the mapper is bypassed for that one bus cycle.

Bits 14 through 19 are used by the mapper to select a DMA register, and that DMA register supplies translated address bits 14 through 23. These bits make up the actual physical address derived from the virtual address.

This translation allows the processor, in Intel real address mode with the mapper turned on, to have access to any of 64 16K-byte pages within the full 16 megabytes of physical addresses rather than the 1 megabyte normally available to the PC AT in Intel real address mode.

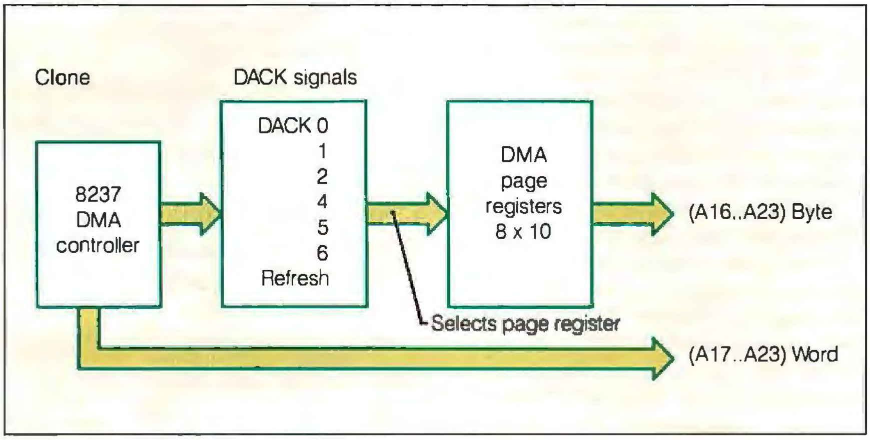


Figure 1: *The clone-mode addressing scheme used by the memory mapper circuit.*

DMA Page Registers

The memory mapper chip also contains the DMA page registers used in all three addressing modes. There is no hard logical connection between the memory mapper and the DMA page registers. Either can be enabled independently of the other, depending on the addressing mode desired.

IBM PC ATs employ seven DMA channels. Channels 0 through 3 are 8-bit data channels, channels 5 through 7 are 16-bit data channels, and channel 4 is used to cascade channels 0 through 3 to the microprocessor. These channels normally transfer data in 128K- byte blocks throughout the 16-megabyte address space, but transfers can be any size, limited by the channel's address space of 64K bytes for byte DMAs and 128K bytes for word DMAs.

Each DMA channel normally has a DMA page register associated with it. Clone mode uses one register per channel and decodes it into the I/O location that corresponds to the standard AT register for that particular channel.

In mapped-clone mode the address contained in the DMA page register is translated by the mapper the same way the processor addresses are translated by the mapper. In other words, in mapped-clone mode the page registers contain a virtual address that is translated by the mapper into a physical address, just as a CPU virtual address would be. DMA operations will view memory space the same way that the processor does, allowing DMA transfers to extended memory

continued

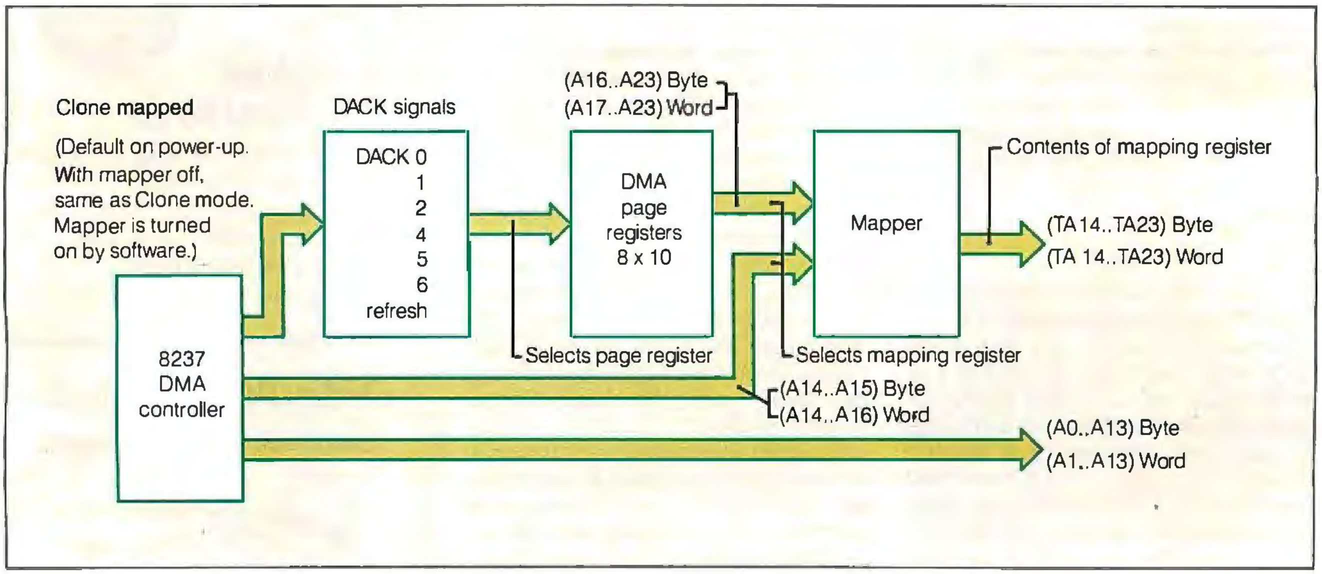


Figure 2: *The mapped-clone addressing scheme used by the memory mapper.*

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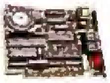

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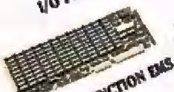

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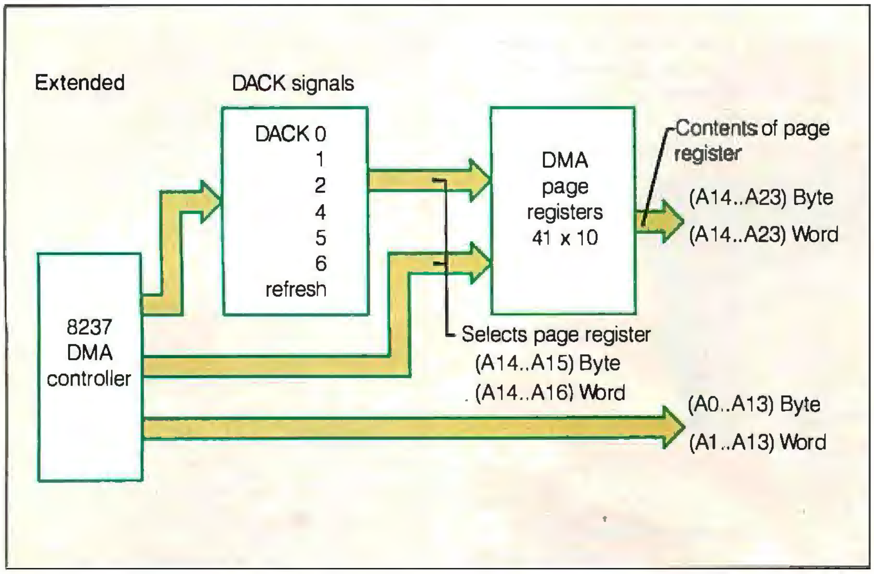

Figure 3: *The extended-mode addressing scheme used by the memory mapper.*

Table 1: *Benchmark results for the Tandon PAC 286.*

	Sieve	Calculation	Savage
IBM PC (BASICA)	191	69	891
IBM PC (QuickBASIC 2.0)	19.4	11.1	47.9
Tandy 3000 8 MHz (QB 2.0)	8.31	3.72	34.25
Tandon PAC 286 8 MHz (QB 2.0)	8.29	3.16	35.13

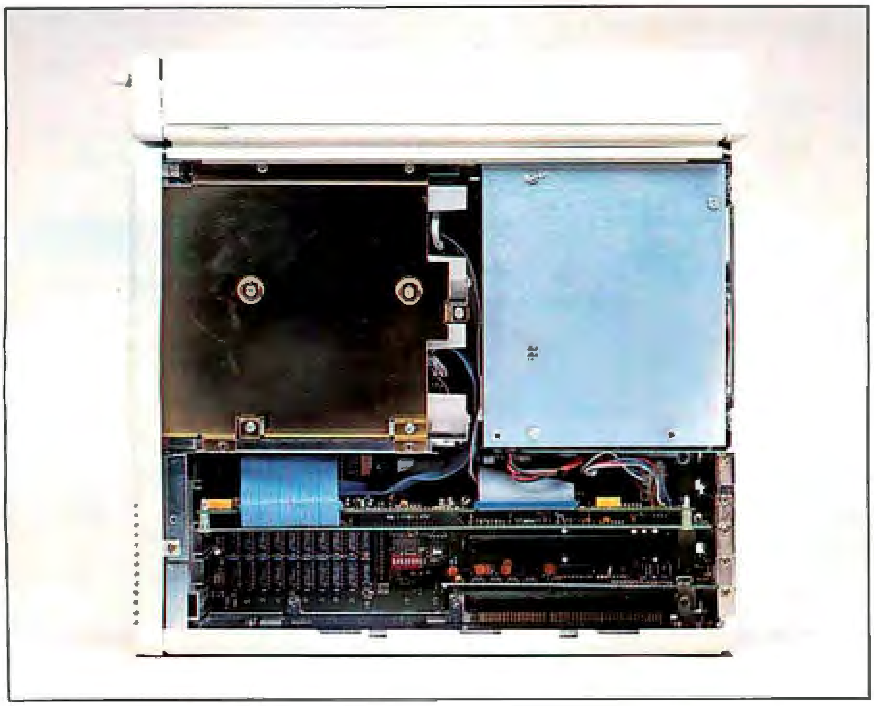

Photo 3: *The interior of the PAC 286 system unit.*

without having to change the values in the DMA page registers.

DMA Page Register Extended Mode

The DMA page registers can operate in an extended addressing mode. In this mode, 41 10-bit DMA page registers are used, one for each 16K-byte block of addressable memory per channel. Four registers are used for each of the 4-byte DMA channels, eight registers for each of the three Word DMA channels, and one register is dedicated to refresh cycles.

Eight-bit DMA channels (0 through 3) decode address bits 14 and 15 to select one 16K-byte block out of a 64K-byte block of addresses. Sixteen-bit DMA channels (5 through 7) decode address bits 14, 15, and 16 to select one of eight 16K-byte blocks from a 128K-byte block of addresses. Extended-mode addressing allows the DMA controllers to address any 16K-byte block within the total 16-megabyte physical address space (see the extended-mode addressing scheme in figure 3). These extra registers allow DMA operations to the noncontiguous memory space that results from memory mapping operations.

Interrupt Redirection

When the memory mapper is enabled, it watches for the 80286 to read an interrupt vector as a result of a hardware interrupt request. When the mapper detects a hardware interrupt, it disables itself temporarily during the interrupt vector fetch. This assures that all hardware interrupt vector fetches occur from physical page zero of the system rather than from the logical page zero.

Compatibility and Performance

We tested a prototype PAC 286 computer for compatibility and performance. The results of the standard BYTE Sieve and Calculation benchmarks, plus the Savage benchmark, are summarized in table 1.

The prototype machine shows obscured access to expansion slot J5 (see photo 3). Slot J2 contains the video adapter, and slot J4 holds the dual-board disk controller. Therefore, only slots J1 and J3 can be used for memory expansion or accessory boards. Cabling from the disk controller to the disks is not long enough to allow replacement of the disk controller to another slot.

Place in the Sun

The PAC 286's unique disk subsystem solves the data security and portability problems that some people experience in their work. When these disk subsystems become available for existing computers, they may make it possible to treat computers as appliances. ■

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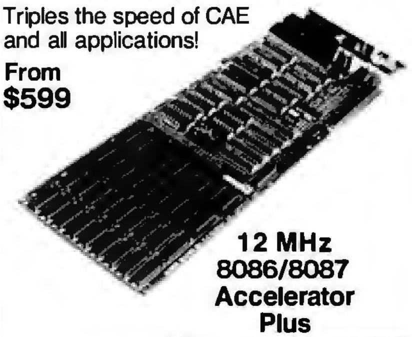

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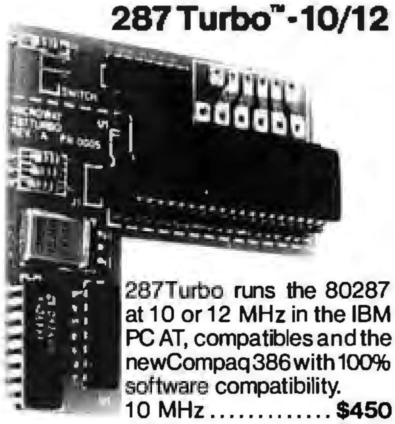

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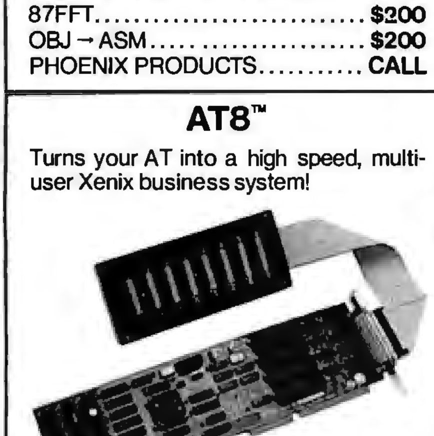

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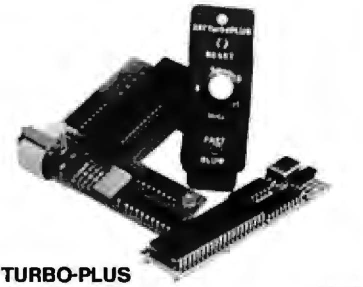

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Steve Ciarcia

Part 1: Display/Receiver

Build a Gray-Scale Video Digitizer

An imaging system with remarkable features for the price

Video technology has always interested me. One look at all the monitors, TVs, and displays around my house suggests that it goes deeper than interest. Freudian views aside, this is not the first time I have covered video technology in a Circuit Cellar project. In previous articles, I have described high- and low-resolution video display systems and even a low-cost digital camera. However, the one project I've always wanted to do has eluded me. Until now, I have had to hold off on the presentation of a cost-effective general-purpose high-performance gray-scale video-digitizing "frame grabber."

I'll explain all this later, but the key terms for the moment are "gray scale" and "frame grabber." Such terms usually indicate commercial units costing thousands of dollars.

While some video digitizers are designed as peripherals for specific computers, virtually all digitizers endent and involve significant trade-offs in performance to maintain low cost. Generally, their digitizing speed is significantly less than the rate necessary to capture a video image as it is transmitted in real time (1/30 to 1/60 second). Instead, they must repeatedly sample many sequential video frames. Digitizers like these—sequential field scanning digitizers—can deal only with stationary objects in front of a camera and can take as long as 30 seconds to scan and record an image. Such digitizers are useless if you are working with moving objects.

Another factor to consider is how a digitizer represents the intensity of each pixel. Most low-cost digitizers meet the minimum video display capabilities of their host computer and digitize each element only as black or white. Some allow a limited gray scale. Higher-performance digitizers offer 64 or more levels of gray scale as well as a high digitizing speed.

Fortunately, both static memory and video integrated circuit technology have progressed to the point where I can finally offer a project that attempts to meet the level of perfection I have outlined. For the next two months, I will describe a complete digital video system. You can use it independently as a video camera digitizer and display (to implement a video telephone, for example), or you can connect it to any personal computer for tasks like image processing, character recognition, and desktop publishing graphics.

ImageWise consists of two separate boards: a digitizer/transmitter and a display/receiver. Each board can be used independently, or they can be connected to form a complete digitizer/transmitter/receiver system (see photo 1).

In contrast to other digitizers, ImageWise is a true frame grabber that takes only 1/60 second to capture an image. It accepts the video signals from devices like a standard TV camera (either monochrome or color), VCR, laserdisc player, and camcorder, and it then stores the picture as 244 lines of 256 pixels with 64 levels of gray scale—256 by 244 by 6 bits (see photo 2). The ImageWise digitizer/transmitter board converts the stored video image to RS-232 serial data that can be transmitted to any computer or to the ImageWise display/receiver board. Transmission rates are selectable from 300 bits per second up to 57.6k bps.

The ImageWise display/receiver board has a serial RS-232 input and a composite video output. It receives serial data directly from the digitizer/transmitter board or transmitted from a file downloaded from your computer and converts this data back into a picture on a composite video input black-and-white monitor (adding a pair of modems lets you send the images over telephone lines). The displayed image is an interlaced 256 by 244 by 6-bit gray-scale picture. The following specifications for the display/receiver board sum it up better:

- Resolution: The three selectable resolutions are 256 by 244, 128 by 122, and 64 by 61. All resolutions support 64 levels of gray scale (each picture element is represented by 6 bits). Note that, regardless of resolution, the system displays all pictures as interlaced full-screen images. Lower-resolution images are composed of larger pixel blocks.
- Video output: 75-ohm, 1.5-volt peak-to-peak composite video.
- Serial input: RS-232, 8 bits, 1 stop bit, no parity. Transmission rate is selectable from 300 bps to 28.8k bps.
- Hardware: 8031 microprocessor, Telmos 1852 video D/A converter, 64K bytes of static video RAM.

The specifications of the digitizer/transmitter board are

- Resolution: Same as above.
- Video input: 1-V peak-to-peak, black and white or color, 75-ohm termination.
- Serial output: RS-232, 1 start bit, no parity. Transmission rate is selectable from 300 bps to 57.6k bps.
- Hardware: 8031 microprocessor, RCA CA3306 6-bit flash A/D converter, 64K bytes of static RAM.

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. The author of several books on electronics, he can be reached at P.O. Box 582, Glastonbury, CT 06033.

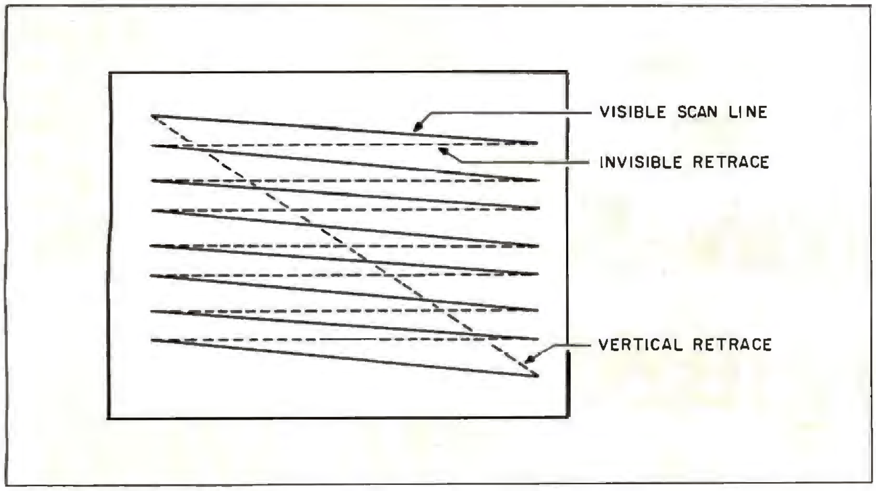


Figure 1: *The path of the electron beam during a video scan.*

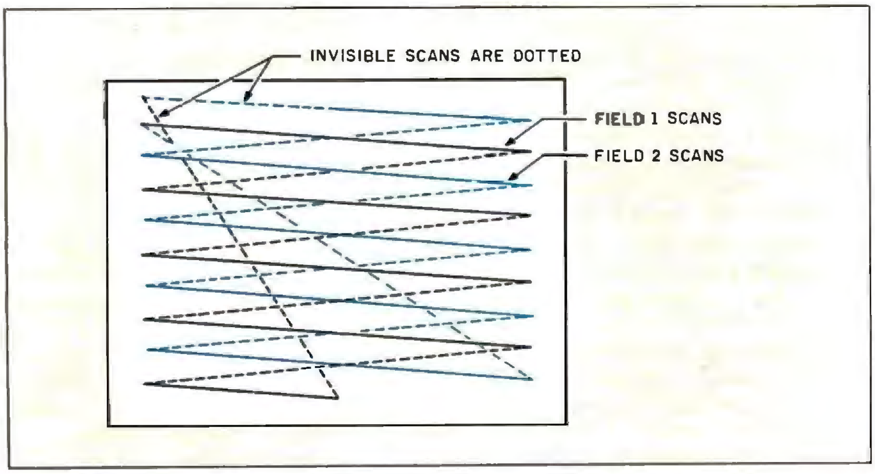


Figure 2: *The path of the electron beam for an interlaced video scan.*

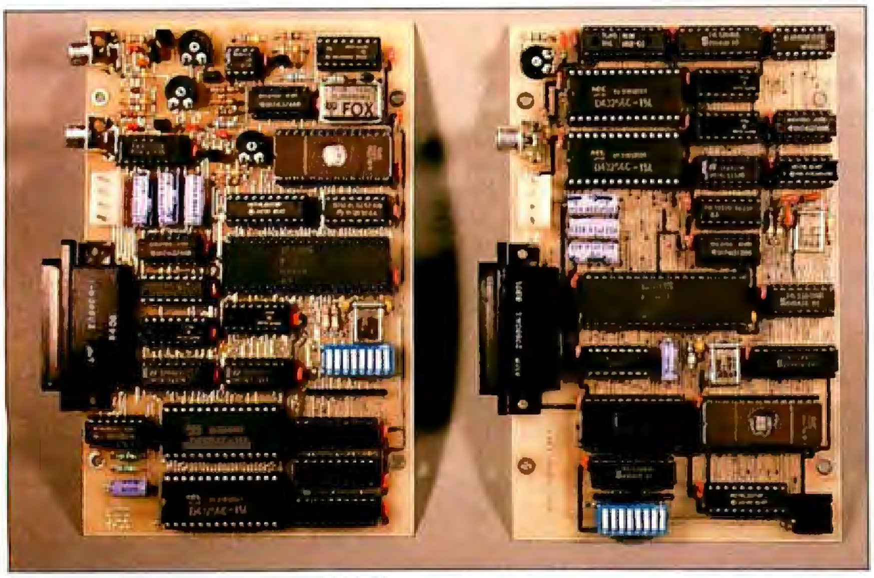


Photo 1: *The ImageWise video digitizer system consists of two boards that can be used together or independently. The display/receiver board, shown on the right, reassembles and displays images that are flash-digitized and serially transmitted by the digitizer/transmitter board on the left.*

The ImageWise video system is designed to be intelligent as well as functional. You can control many of its features—such as digitizer resolution and picture update—remotely from the receiver or another computer. In addition, the system incorporates various compression techniques, including run-length encoding, to considerably reduce image-transmission time (essential with slow modems).

ImageWise is no small project. Consequently, I will present it in two parts, beginning with the display/receiver section. (If you built the digitizer/transmitter section first, you would have no way of displaying a gray-scale picture other than converting it to a dot-dithered black-and-white-only image on your computer—and what would that prove?) You can check out the receiver using its internal test patterns and by downloading picture files from a computer or my bulletin-board system. It's much easier to verify that the transmitter is sending the correct data after you have a working receiver to show any problems.

Before I delve into the hardware and software, however, I think it's a good idea to review what goes into a "standard" TV signal. With that in mind, it will be easier to see how the ImageWise transmitter digitizes the video and the receiver reconstructs it. As you'll discover, there is a lot more to video than just another pretty picture.

Today's Class: TV Basics 101

Although there may be a few folks tucked away in odd corners of the country who don't have a TV set, I think it's safe to say that everyone who reads BYTE has at least seen a TV picture at one time or another. While most TV is color TV these days, I'll describe only monochrome (black-and-white) TV signals because that's what ImageWise uses. The circuitry required to digitize and reconstruct color TV signals is considerably more complex than seemed reasonable for this project. Fortunately, the color video standards include monochrome as a subset, so we can use color cameras and monitors as well.

Figure 1 shows a simplified diagram of the process used to build an image on a TV monitor. An electron beam is scanned horizontally across the screen, starting from the upper left corner. It is moved downward after each line, and the result is a set of lines scanned left to right and top to bottom filling the screen. After scanning the last line, the beam is returned to the upper left corner to begin scanning the next screen.

The faceplate of the screen is covered with a phosphor that glows when struck by the electron beam and continues to glow even after the beam passes on. Because the entire screen is scanned rapidly enough to get the beam back to each spot before the phosphor glow fades out, the entire screen seems to be illuminated at once.

One key difference between a TV display and most computer CRT displays is that the electron beam in a TV set can take on a wide variety of intensities, ranging from completely off (black) through shades of gray to completely on (white). A computer display may allow only black, one shade of gray, and white. We'll see what this difference means a little later on. Most composite video input amber or green monitors also have some gray-scale (or should I say green-scale?) capability.

As you might expect, the actual details are a bit more involved. A TV screen is scanned twice for each image, with the two sets of scan lines interlaced on the screen (computer displays are generally noninterlaced). This allows the whole screen to be scanned in half the time a noninterlaced scan would take, without reducing the number of lines in the image. Figure 2 shows how interlaced scanning paints lines on the screen. Each vertical scan is called a *field*, and two matched fields make up a *frame*.

One field is completed in 1/60 second. There are 262.5 lines in each field (see figure 2 to locate the half lines), so each line must be scanned in 63.5 microseconds (1/60 second divided by 262.5). Figure 3 illustrates the signal voltage sent to the display for a single scan line, along with the allowable times for each part of the waveform. (Note: By strict definition, ImageWise is a field rather than frame grabber, since it digitizes only the first 244-line field of an interlaced frame. However, since the term frame grabber has come to mean a digitizer with the speed to digitize within the time period of a video frame, I shall continue to use the term frame grabber.)

The horizontal sync pulse occurs every 63.5 μs and tells the monitor to end the current line, return to the left edge, and begin another line. Surrounding each sync pulse is a blanking voltage that ensures that the track of the retrace will not be displayed on the screen. After allowing time for retrace and blanking, about 52 μs are left for the actual video picture on the horizontal scan line.

A vertical sync signal tells the monitor when to end the current field, return to the top of the screen, and begin the next field. Because the two fields in each frame are offset by exactly half a line, the timings at the end of each field are slightly different. Figure 4 diagrams the analog voltage required to display a complete field. To keep the size of the diagram down, only the first and last lines of active video are shown. The horizontal scale is distorted so that you can see the details.

You should note that the horizontal

continued

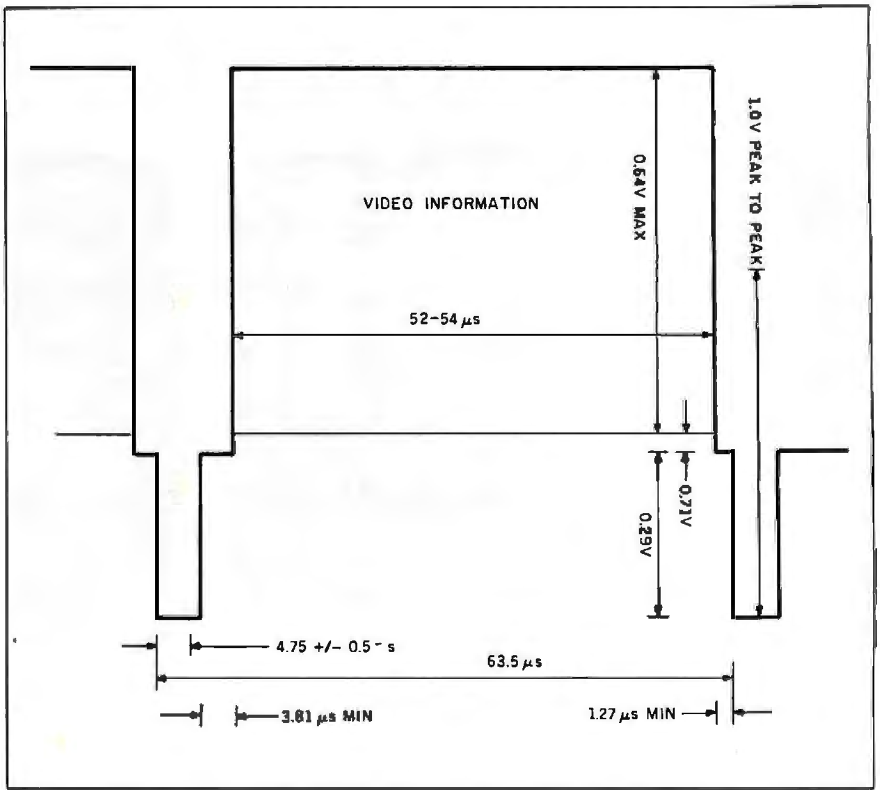


Figure 3: *A profile of the signal voltage sent to the display during a single scan line. Note the bracketing 63.5-microsecond horizontal sync pulses.*

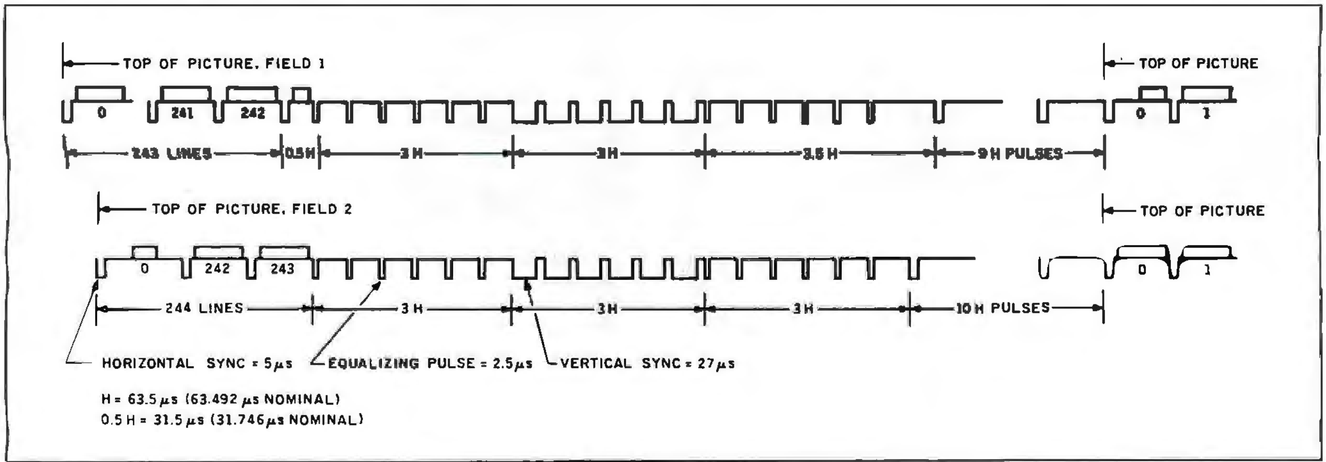


Figure 4: *Signal voltage timing diagram for a complete field.*

sync pulses do not stop during the vertical sync and retrace. In fact, to make sure that the monitor switches smoothly across the half line, sync pulses occur every 31.75 µs during most of the vertical sync period.

A blanking voltage surrounds the vertical sync pulse itself to ensure that the vertical retrace is not visible on the screen. Each field contains 244.5 visible lines, which you can verify by examining the timing diagram in figure 4.

Although video monitors can tolerate small variations in the number of displayed lines or the exact line timings, any errors will be immediately visible as jitter or distorted images. The sync voltages and timings must be exact to ensure a stable picture. The worst offense is to have timings that vary "just a little" from field to field; this will cause the picture to jitter annoyingly.

Variations on a Theme

Now that you're acquainted with standard video, I can explain some of the basic design criteria for ImageWise. As with any project, there are trade-offs between "the ultimate system" and "the one that got built." I will try to explain why I made the decisions I did.

The most basic question was one of resolution: How many picture elements (pixels) should appear on each line? A single pixel corresponds to the smallest unit of video information handled by the system. Computer monitors typically have 300 to 1000 pixels per line. With about 50 µs available in each line to display those pixels, a 1000-pixel line requires a new pixel every 50 nanoseconds. Since typical dynamic RAMs have a cycle time of 300 ns, allowing a few nanoseconds for the other circuitry would require about eight banks of RAM to ensure that a pixel was ready every 50 ns. Using 50-ns static RAMs, while feasible, would be very expensive.

I decided to look at it the other way: How many pixels will fit on a line with affordable hardware? We find that 32K-byte static RAMs are increasingly affordable, and they are considerably faster than DRAMs. Since even the "slow" ones have a cycle time of about 130 ns, one pixel every 200 ns is reasonable. That allows 256 pixels in 51.2 µs. Be-

Photo 2: *The ImageWise frame-grabber (or "freeze-frame digitizer") captures a video signal in 1/60 second; fast enough to digitize live TV broadcast signals as easily as those from a stationary camera.*

Photo 3: *The high-quality gray-scale images of the ImageWise digitizer can be used in security, pattern recognition, a video telephone, and image database applications. (Phone me sometime; I may be looking back at you through the camera.)*

Photo 4: *Teletransfer of pictures for purposes of identification or verification is a legitimate application for ImageWise. Simply hold the part in front of the camera and transmit the picture to everyone.*

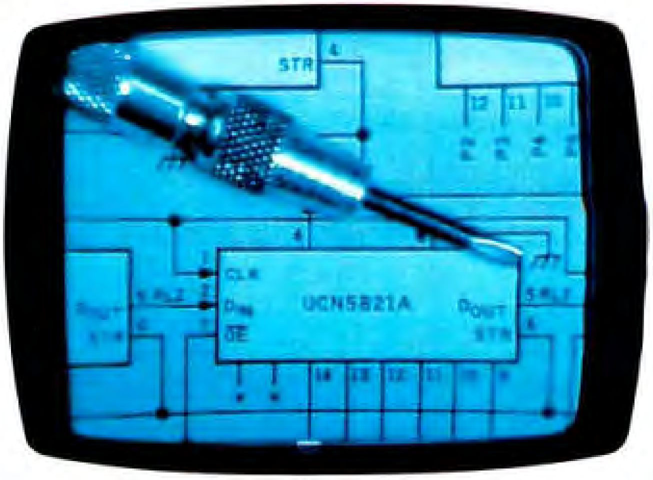


Photo 5: *The 6-bit gray scale of ImageWise adds significantly more to the perceptible resolution of an image, whether it be a black-and-white schematic or a silver screwdriver. (The schematic and the screwdriver could not be represented accurately without gray scale.)*

cause 256 is a "magic" number, I knew I was on the right track.

As I mentioned earlier, each field has about 244 visible lines. Therefore, a 64K-byte buffer could hold one field with some room left over. Two fields could be contained in 128K bytes. With two fields, however, the vertical resolution (488) is twice the horizontal resolution (256). This seemed excessive. Fortunately, because both fields often contain redundant information, I decided to keep the amount of RAM within reasonable bounds and digitize only a single field. But how would a 256- by 244-pixel picture look compared to the original?

All my experience with 320 by 200 computer displays suggested that I might not like the results and be forced to go back to expensive plan A. However, seeing is believing, so I figured I'd build it and decide then. (Often it is easier and faster to build a prototype and take a look at the results than to argue about what might be.)

Photo 3 shows the quality of the image I got with a 256 by 244 display. (So much for my prior experience with computer displays!) There's a good reason why I was wrong, and if you're as surprised as I was, here's the explanation.

You see jagged diagonal lines or "jaggies" on low-resolution computer displays because each pixel can have only a few levels of brightness. The jaggies can be reduced only by increasing the number of pixels on each line. Depending upon the subject material, resolutions of 640 pixels per line and 350 to 400 lines per screen are required to see noticeable improvement.

But there is another way to reduce the jaggies: If each pixel can take on many levels of brightness, the sharpness of the edges can be reduced. ImageWise uses 6 bits to represent each pixel, allowing 64 shades of gray. Real-world images don't have crisp, computer-generated edges, so each pixel tends to shade into the adjoining ones. The effect is a rather smooth picture that has more "effective" resolution than you'd expect (see photos 4, 5, and 6). This is why pictures shown on color displays that incorporate palette D/A converters often look better. Look closely at a line boundary and see if there is some gradual shading.

As an example, you're probably aware that a standard TV does not make a good computer monitor. Trying to fit more than 40 characters on a line results in an unreadable display. However, newspaper headlines displayed on a TV are easily readable even though the characters are very small, simply because each pixel can take on many brightness levels. Watch your TV carefully and see.

Finally, why does ImageWise use 6 bits per pixel and not more if gray scale is such a good idea? Again, it is a cost tradeoff. We have to digitize and determine the gray-scale value of 256 data points in 50 μs, or one every 200 ns. This requires a fast A/D converter called a flash A/D converter. The price of one is directly related to the number of bits it resolves. Eight-bit models are considerably more expensive than 4- or 6-bit chips. The device I ultimately chose was the RCA 3306 6-bit flash A/D converter, which can operate at 12 million to 16 million samples per second (our sample rate is 5 megahertz). I'll talk more about this next month.

Display/Receiver Hardware

The receiver has two main functions: It accepts data from the RS-232 serial port and displays the resulting picture on a monitor. Figure 5 shows the receiver hardware.

As in many recent Circuit Cellar projects, the receiver uses an Intel 8031 single-chip microprocessor to control the rest of the hardware. A 2764 EPROM stores the 8031's program. An Intel 8254 Programmable Interval Timer (PIT) produces the sync pulses. The video field data is held in a pair of 32K-byte static RAMs and is converted to an analog voltage by a specialized video D/A converter. The MC145406 converts RS-232 voltages into TTL levels for the 8031's serial port.

Often it is easier and faster to build a prototype and take a look at the results than to argue about what might be.

It was tempting to use the 8031 to produce the sync pulses directly, but a little study showed that there was no way to get the precise timings required for a stable picture. The 8254 is connected to produce repetitive pulses, so the 8031 need only program the appropriate values into the 8254's registers when a change is required. The 8254 uses a 500-ns (2-MHz) clock divided from the 10-MHz crystal oscillator. Figure 6 shows the 8254 pulses for a normal video line.

The Telmos 1852 is a specialized video D/A converter that accepts up to 8 video data bits, a blanking input, and a sync input. The analog output conforms to the standard video specifications. Using this D/A converter eliminates a lot of hardware that would otherwise be required to combine the video, blanking, and sync signals to produce the right output voltage with enough power to drive the monitor. The 8031 ensures that the 2 unused bits (the low-order ones) are always 0.

The 16-bit address required by the 64K-byte field buffer is divided into two parts: a high byte supplied by the 8031 and a low byte that can come from either the 8031 or an 8-bit counter. Normally, the counter steps through the 256 pixels on each line, and the 8031 counts out the lines in the high byte. Both bytes are supplied by the 8031 when it reads or writes buffer data.

A pair of LS244s isolate the field buffer's data bus from the 8031's data bus,

continued

Photo 6: *An in/out comparison. The camera is pointed at the magazine in the middle. The monitor on the left displays the image seen by the camera and the digitizer/transmitter. The monitor on the right shows the digitized image received by the display/receiver board.*

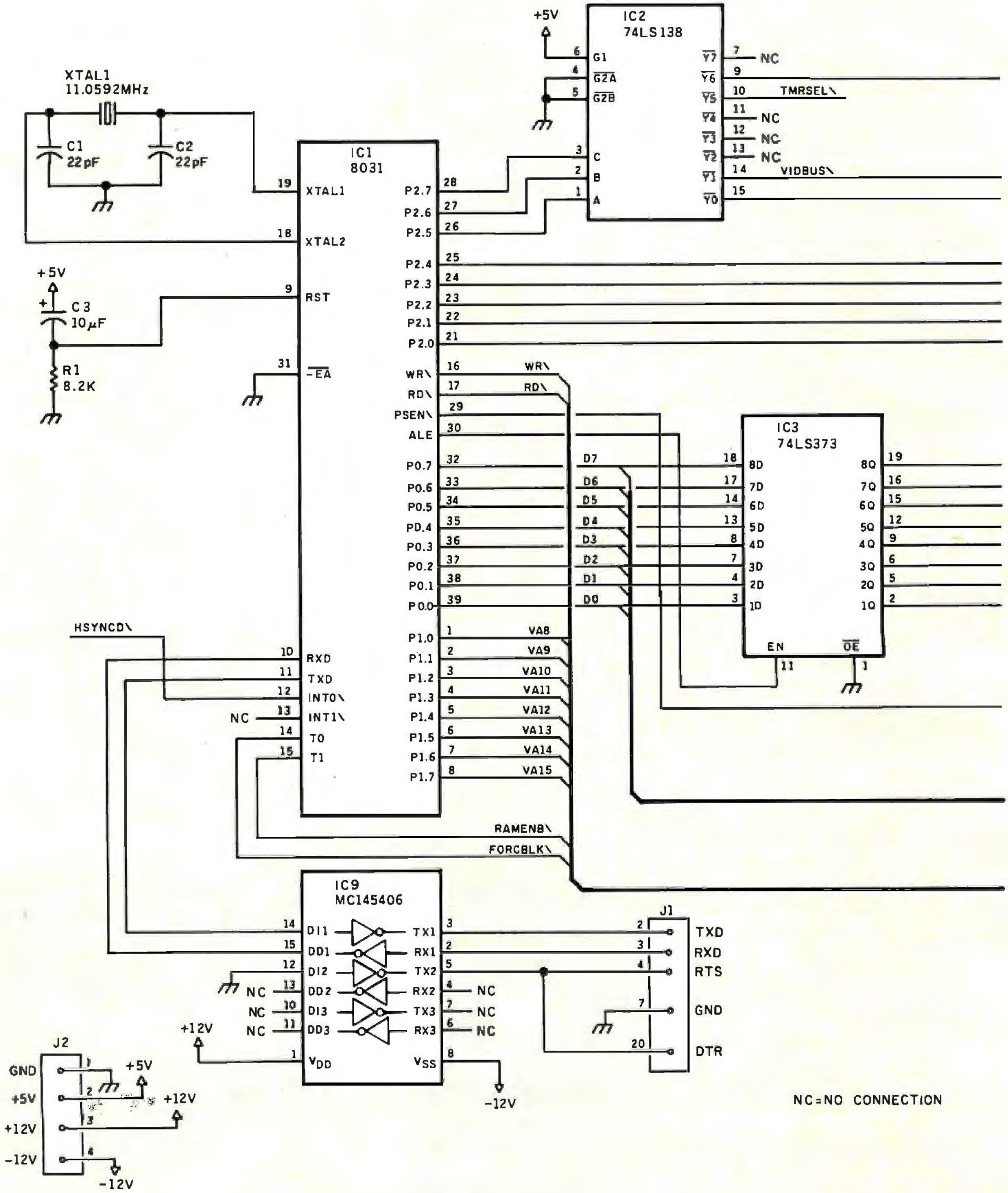
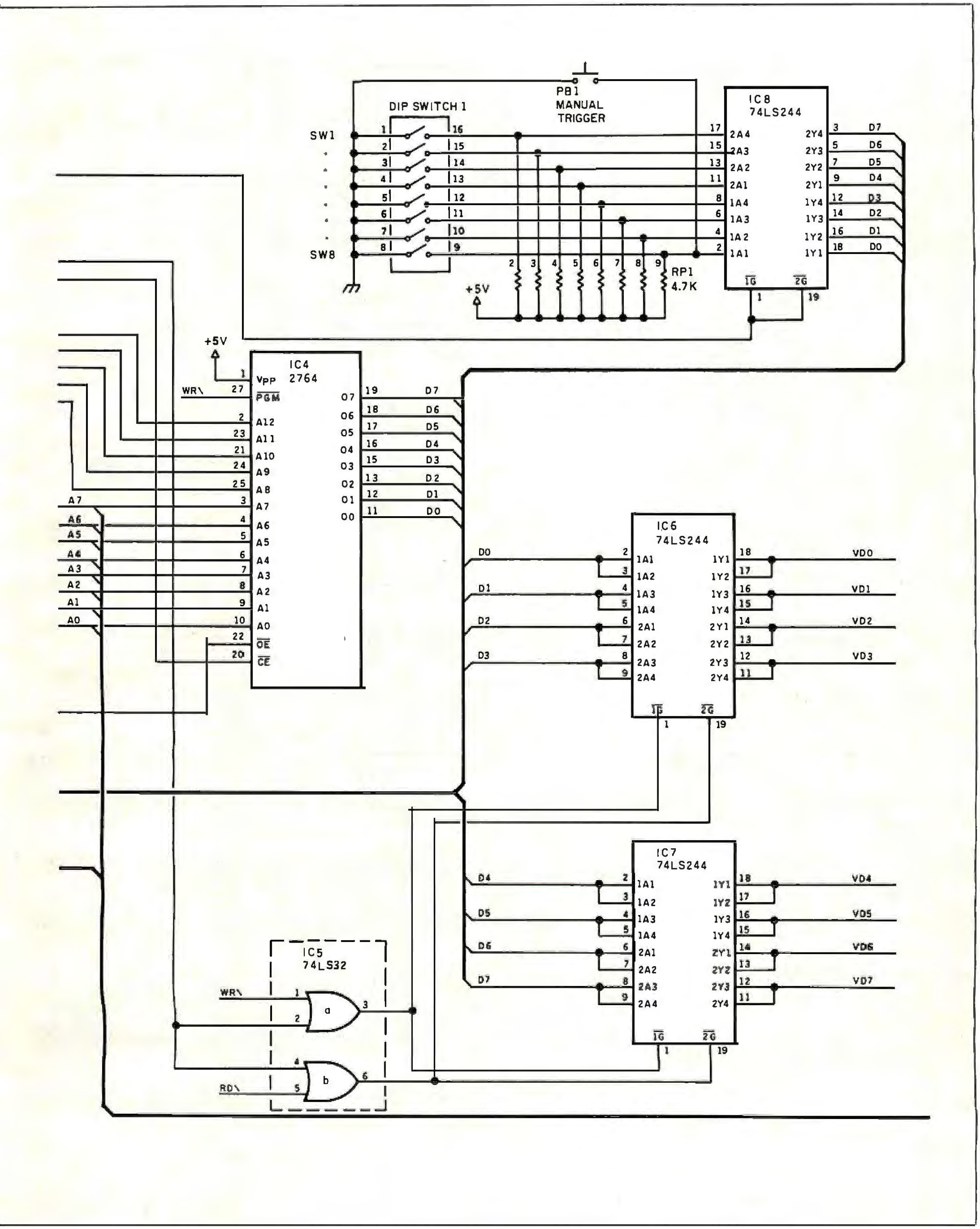


Figure 5: *Schematic diagram of the ImageWise display/receiver hardware.*


PB1
MANUAL
TRIGGER
DIP SWITCH 1
SW1
SW8
IC8
74LS244
2A4
2A3
2A2
2A1
1A4
1A3
1A2
1A1
2Y4
2Y3
2Y2
2Y1
1Y4
1Y3
1Y2
1Y1
1G
2G
D7
D6
D5
D4
D3
D2
D1
D0
RP1
4.7K
+5V
IC4
2764
VPP
PGM
WR\
A12
A11
A10
A9
A8
A7
A6
A5
A4
A3
A2
A1
A0
OE
CE
O7
O6
O5
O4
O3
O2
O1
O0
IC6
74LS244
VD0
VD1
VD2
VD3
IC7
74LS244
VD4
VD5
VD6
VD7
IC5
74LS32
a
b
RD\

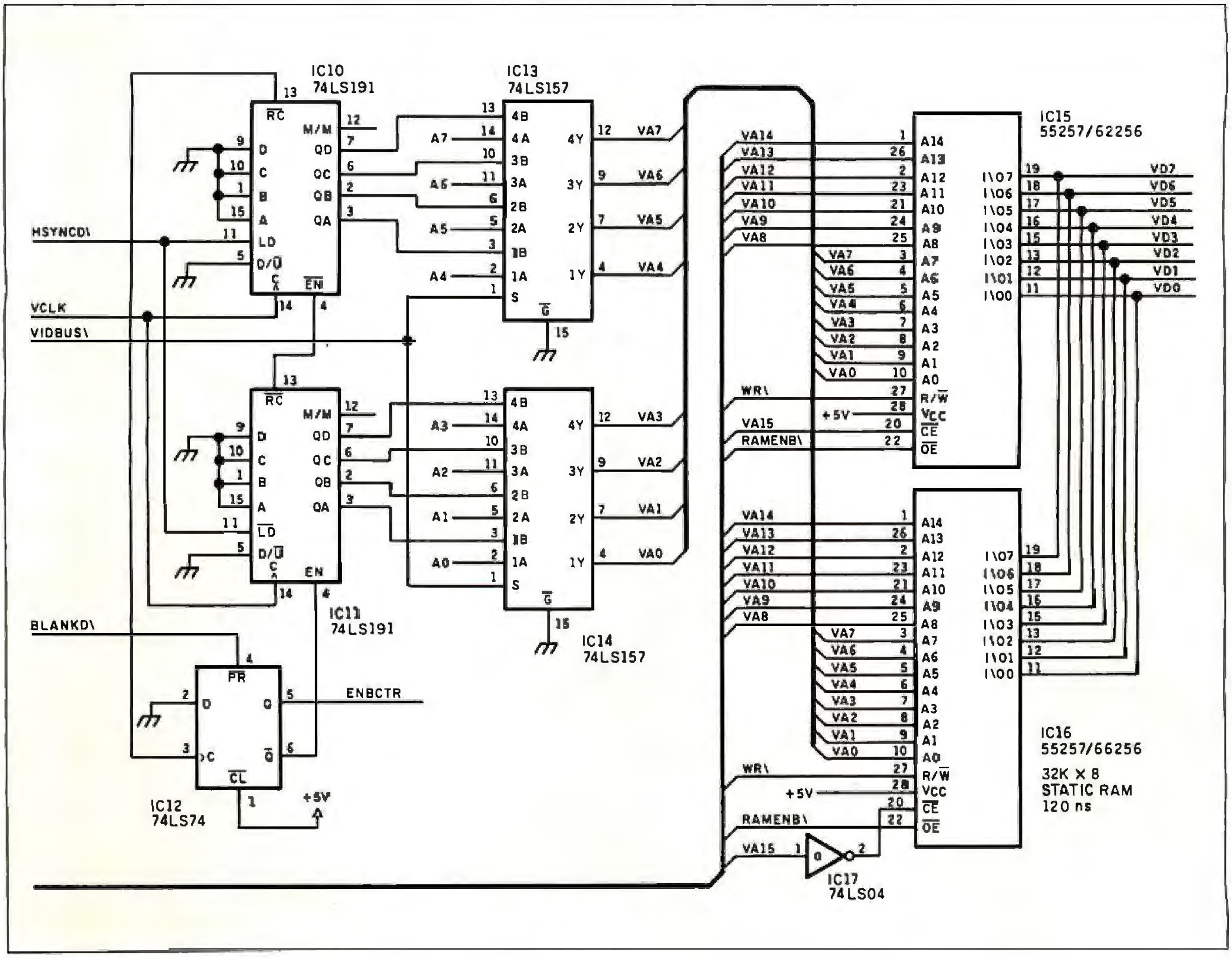


Figure 5: *Continued.*

except when the 8031 is reading or writing to the buffer. A third LS244 connects the DIP switches to the 8031's data bus. An 11.059-MHz crystal allows the 8031 to receive and generate standard RS-232 bit rates. The video data and sync timings are derived from a separate 10-MHz crystal oscillator circuit.

The divide-by-two counter that produces the video data clock is reset by the horizontal sync pulses from the 8254. This ensures that the pixel clock has the same phase in each line. Without the reset, the clock would alternate phases in successive lines because the length of each line is an odd multiple of the 500-ns clock. Worse, a given line would have a different phase in each frame because the frame length is also an odd multiple of the clock.

Serial Data

Each video field has 256 pixels on each line and 244 lines, for a total of 62,464 pixels (we round the half line up to a full

continued

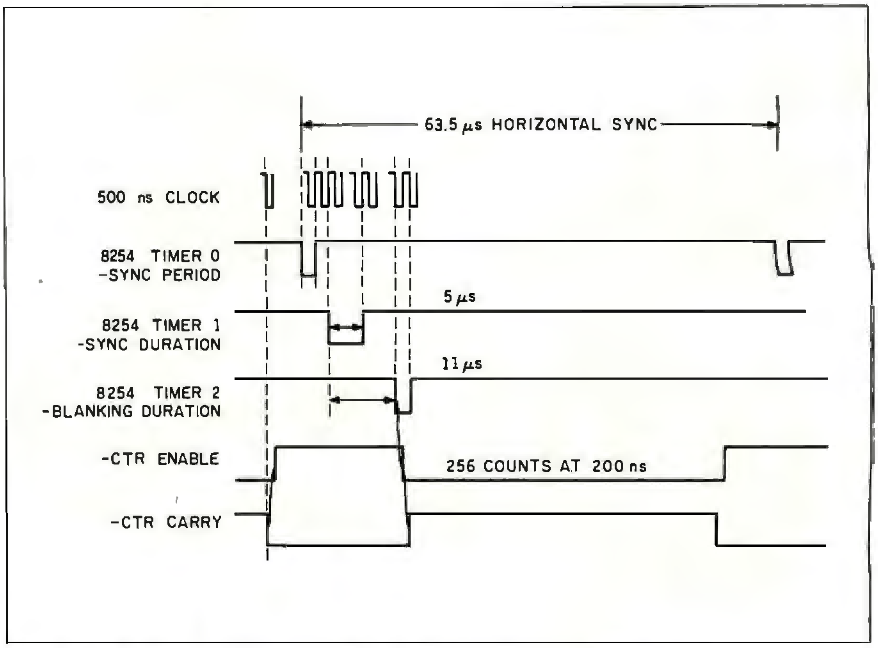


Figure 6: *Timing pulses generated by the display/receiver's 8254 PIT.*

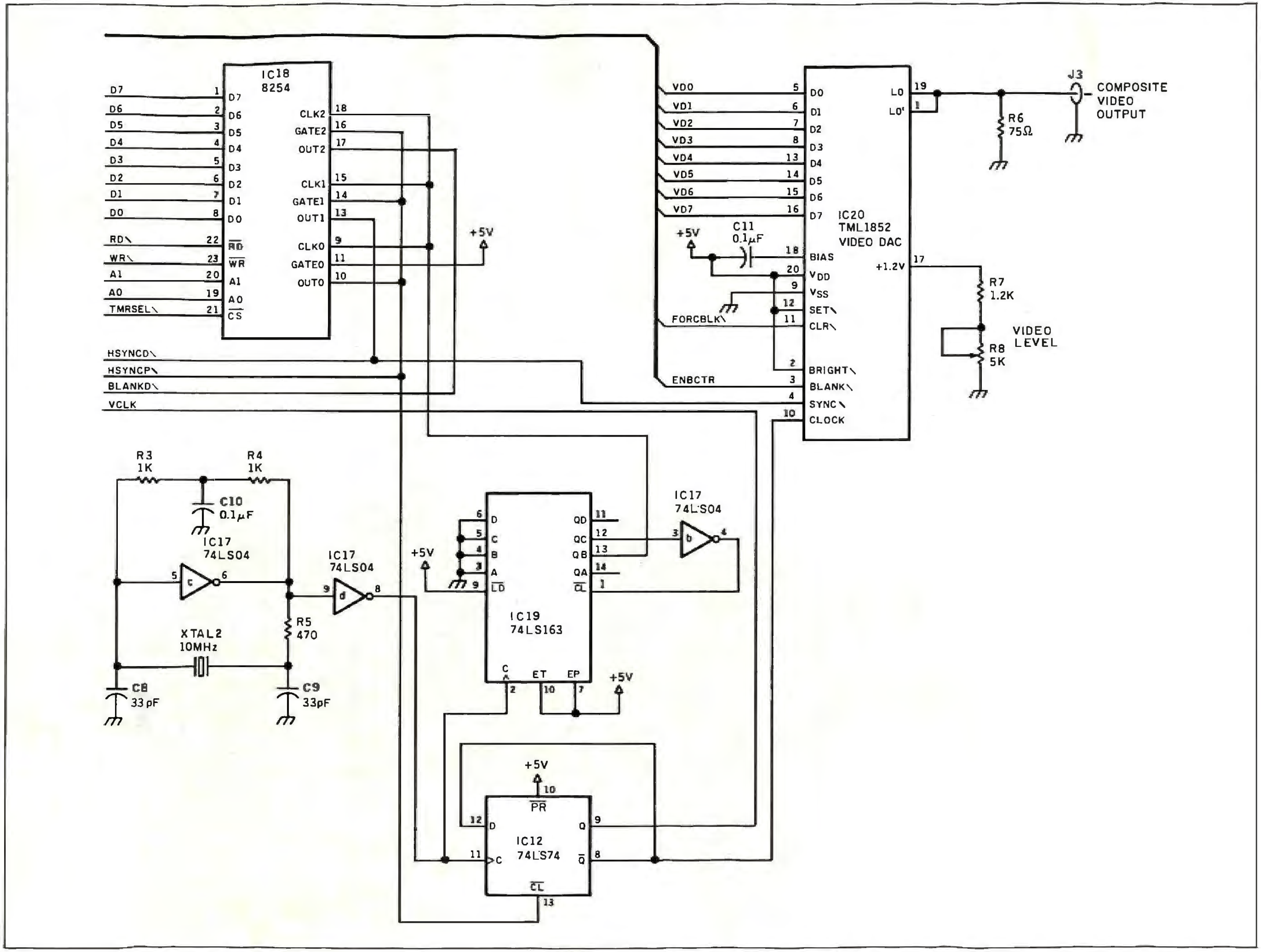


Figure 5: Continued.

line). Each pixel is contained in 1 byte, so there are 62,464 bytes in each field. If you use a serial rate of 3840 bytes per second (38.4k bps), a complete field will take about 16.2 seconds to transmit (it takes 10.8 seconds at 57.6k bps).

Fortunately, ImageWise takes advantage of the fact that most scenes have large areas of the same shade. The digitizer/transmitter (which I'll describe in detail next month) can compress each line of data by representing repeated bytes by a value and repetition count. In actual practice, the amount of data in a field can be reduced by a factor of two to four, with a corresponding reduction in transmission time.

The serial data format is 8 data bits, 1 start bit, no parity, and 1 stop bit. I did not build error checking into the system because it is intended for relatively short, robust connections. In any event, an error will generally be confined to a single line on the display. Because the video data itself has only 6 bits, 2 bits in each byte can be used for control information. Table 1 details the byte encoding used by ImageWise. The 8031 shifts the video data left so that it goes to the high-order 6 bits of the D/A converter.

The receiver puts the bytes into the field buffer as fast as it can, but at the faster rates it's possible for the transmitter to get ahead of the receiver. A circular buffer in the 8031's internal RAM holds up to 48 bytes until they can be processed. If this buffer begins to fill, the receiver sends an XOFF character to tell the transmitter to stop sending data. The receiver will continue transferring bytes from the circular buffer to the frame buffer until the former is nearly empty. Just before the circular buffer runs dry, the receiver sends an XON character to tell the transmitter to resume sending. If the circular buffer does empty completely, the receiver will simply wait for more bytes to show up.

As we'll see next month, the transmitter waits for an XON from the receiver before beginning to send data. The receiver will send the XON sometime after the circular buffer empties, even if it has sent one before. A DIP-switch setting determines the time between emptying the buffer and sending the XON. The choices are continuous pictures, every 4 seconds, every 8 seconds, or manually triggered (see table 2). A push button is used to trigger a new field from the transmitter in manual mode.

The Software

It's worthwhile to describe how the software pulls the receiver hardware together. The two main jobs are maintain-

Table 1: *ImageWise serial data encoding. (a) This data flows from the digitizer/transmitter to the display/receiver. (b) This data flows from the display/receiver to the digitizer/transmitter or is sent by a computer connected to the digitizer/transmitter. All other characters are ignored.*

(a)

Bit number								Bit Definition
7	6	5	4	3	2	1	0	
0	0	x	x	x	x	x	x	Video data byte
0	1	0	0	0	0	0	0	Start of video field
0	1	0	0	0	0	0	1	Start of video line
0	1	0	0	0	0	1	0	End of video field data
0	1	1	x	x	x	x	x	Reserved
1	0	0	0	x	x	x	x	Repeat previous byte *x* times (0 = 16 reps)
1	0	0	1	x	x	x	x	Repeat previous byte 16*x* times (0 = 256 reps)
1	1	x	x	x	x	x	x	Reserved

(b)

Bit number								Bit Definition
7	6	5	4	3	2	1	0	
0	0	0	1	0	0	0	1	XON, starts or restarts transmission
0	0	0	1	0	0	1	1	XOFF, halts transmission
1	0	0	0	0	0	0	0	Use 256 by 244 resolution (full)
1	0	0	0	0	0	0	1	Use 128 by 122 resolution (half)
1	0	0	0	0	0	1	0	Use 64 by 61 resolution (quarter)

Table 2: *Receiver DIP-switch settings. ON and OFF refer to switch positions. (a) SW1, SW2, and SW3 select the serial bit rate (must match transmitter rate). (b) SW4 and SW5 select the time-out interval. (c) SW6 and SW7 select the transmitter resolution. (Note: A manual push button is connected to the SW8 position, so SW8 must be OFF.)*

(a)

SW1	SW2	SW3	Serial transmission rate (bits/second)
OFF	OFF	OFF	300
OFF	OFF	ON	600
OFF	ON	OFF	1200
OFF	ON	ON	2400
ON	OFF	OFF	9600
ON	OFF	ON	19.2k
ON	ON	OFF	28.8k
ON	ON	ON	57.6k

(Note: 4800 bps intentionally omitted.)

(b)

SW4	SW5	Time-out interval
OFF	OFF	Continuous pictures, no delay
OFF	ON	4-second delay between pictures
ON	OFF	8-second delay between pictures
ON	ON	Send picture by manual push-button trigger

(c)

SW6	SW7	Transmitter resolution
OFF	OFF	Full: 256 by 244
OFF	ON	Half: 128 by 122
ON	OFF	Quarter: 64 by 61
ON	ON	Reserved

ing stable video sync and accepting bytes from the serial interface. The code is written in assembly language to maximize the performance of the 8031. Figure 7 is a flowchart of the software's major components.

The 8254 PIT generates the precise sync signals for each line, so the 8031 need only reprogram the PIT when a change is needed. Because changes to the 8254's settings take effect with the next 8254 sync output, the 8031 must make the changes one sync pulse before they're actually needed. All timings are determined by counting sync pulses, which are connected to the 8031's INT0 interrupt request pin.

The INT0 interrupt handler decrements a counter and checks to see if it's 0. If so, an 8254 change is required; otherwise, the handler simply returns to the mainline code. Each change to the 8254 involves writing a few bytes and reloading the counter to tell how many interrupts will pass before the next change.

Each 8031 instruction takes 1 or 2 µs. At most, only about 50 instructions can be executed per horizontal line. During the vertical retrace interval the sync pulses are only 31.5 µs apart, giving time for only 20 instructions per sync pulse. The interrupt routine must have enough

continued

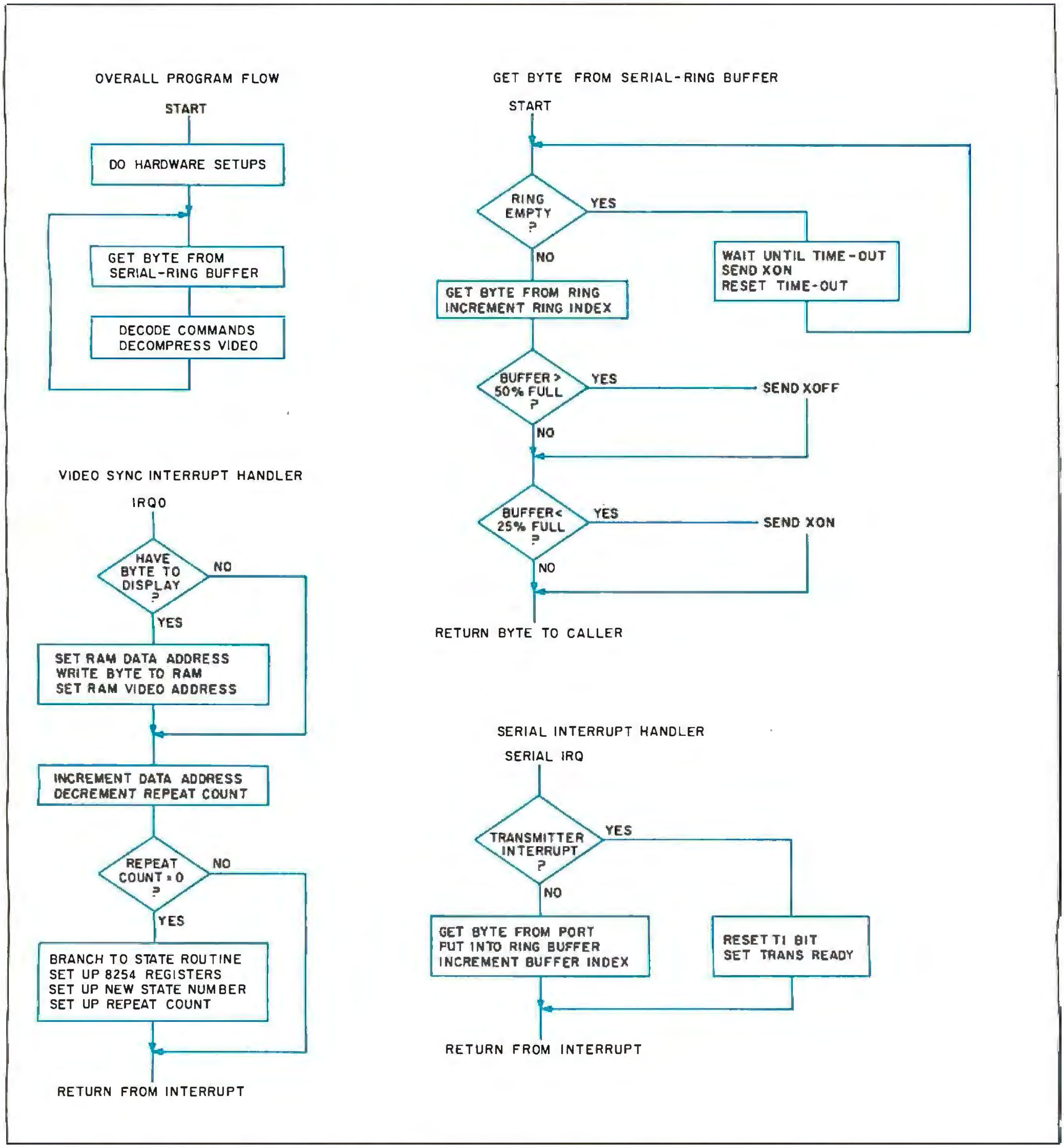


Figure 7: *Flowchart for the ImageWise display/receiver system's software.*

time to get ready for the 8254 loading during the short sync pulses in the vertical retrace interval, so control is passed to the routine two sync pulses before the change is needed. The interrupt routine then uses a polling loop to detect the last sync pulse.

Another interrupt is generated within the 8031 whenever a byte is received on the serial port. This interrupt awakens the serial interrupt handler routine, which reads the byte from the port and places it in the circular buffer in the 8031's internal RAM. The serial interrupt handler has a lower priority than the sync interrupt; consequently, the serial interrupt handler can be interrupted whenever a sync pulse occurs.

The sync and serial interrupt routines are linked by a background task that simply waits for bytes to show up in the circular buffer. Whenever a byte appears in the buffer, the background task takes it out and decides what to do with it. In most cases, the byte is either video data that should be put in the field buffer or a count that tells how many times the previous data byte should be repeated.

The ordinary way of putting a byte in the field buffer would be to have a subroutine that saves all the registers, sets up the buffer address, does the write, restores the registers, and returns to the caller. Unfortunately, this scheme doesn't work in our application because the writes to the frame buffer have to occur just after the video syncs to reduce sparkles in the display. Additionally, the sync interrupt routine must get control at the same time to reset the 8254. Something has to give!

The solution is to combine the two functions in the video sync interrupt handler. Whenever the background routine has a byte to be written in the buffer, it sets up the registers and turns on a flag bit. The sync routine checks the flag, does the write if it's on, then turns the flag off. The background routine sits in a loop until it sees that the flag has been reset, then continues on its way. Because the background routine has handled all the register setups, the interrupt routine can proceed at full speed and write the byte immediately without saving or restoring any registers.

The possibility arises that the serial interrupt handler will be interrupted by the video sync handler. Because the video sync handler assumes that the registers are set up for it, the serial interrupt handler has to take special precautions to make sure that the wrong byte doesn't get written at the wrong address.

The sync interrupt handler checks the switches once every frame (at the end of the second field) to see if anything's changed. If so, it drops what it's doing and runs through the power-on initialization routine again. If a picture is being received when you flip the switches, it will get garbled because the serial port will miss a few characters. The rule of thumb is to change switch settings only when nothing else is happening.

Experimenters

While printed circuit boards and kits are available for the ImageWise system, I encourage you to build your own. If you don't mind doing a little work, I will support your efforts as usual. A hexadecimal file of the executable code for the 8031 digitizer and display system EPROMs, sample picture files, and the Turbo Pascal code for storing images on an IBM PC or SB180 are available for downloading from my BBS at (203) 871-1988. Alternatively, you can send me a preformatted IBM PC or SB180 disk with return postage, and I'll put the files on it for you (the hexadecimal file could be used with my serial EPROM programmer, for example). Of course, this free software is limited to noncommercial personal use.

Circuit Cellar Feedback

This month's feedback begins on page 58.

Next Month

Having a gray-scale video display is one thing, but where do you get all the pictures? I'll describe the digitizer/transmitter hardware that captures images from a camera or TV and sends them to either the receiver for immediate display or a computer for storage. ■

Special thanks to Ed Nisley for his expert collaboration on this project.

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

Ciarcia's Circuit Cellar, Volume I covers articles 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. *Volume V* covers July 1983 through December 1984.

The following items are available from

CCI
P.O. Box 428
Tolland, CT 06084
(203) 875-2751

1. ImageWise digitizer/transmitter board experimenter's kit. Contains digitizer/transmitter printed circuit board, 11.05-MHz crystal, programmed 2764 EPROM with transmitter software, and CA3306 flash A/D converter and manual with complete parts list.
DT01-EXP $99

2. ImageWise display/receiver board experimenter's kit. Contains gray-scale display/receiver printed circuit board, 11.05-MHz crystal, programmed 2764 EPROM with receiver software, Telmos 1852 video D/A converter, manual with complete parts list, and an IBM PC 2.0 disk containing sample digitized images and test patterns.
DR01-EXP $99
DT01-EXP and DR01-EXP
together $179

3. ImageWise digitizer/transmitter full kit. Contains all digitizer/transmitter components, including printed circuit board, 64K bytes of static RAM, IC sockets, crystals, programmed 2764, CA3306 flash A/D converter, manual, and IBM PC 2.0 disk containing utility routines for storing and displaying (dot-dithered, not gray scale) and downloading image files using an IBM PC. Does not include power supply or case.
DT01-KIT $249

4. ImageWise display/receiver full kit. Contains all gray-scale display/receiver components, including printed circuit board, 64K bytes of static RAM, IC sockets, crystals, programmed 2764, Telmos 1852 video D/A converter, manual, and an IBM PC 2.0 disk containing sample digitized images and test patterns. Does not include case or power supply.
DR01-KIT $249
DT01-KIT and DR01-KIT
together $489

While only kits are described above, ImageWise has been licensed for assembly. Call CCI for source and availability of assembled boards and complete systems, black-and-white TV cameras, 32K-byte static RAM chips, and power supplies. Software utilities are also available in SB180 format.

All payments should be made in U.S. dollars by check, money order, MasterCard, or Visa. Surface delivery (U.S. and Canada only): add $3 for U.S., $6 for Canada. For delivery to Europe via U.S. airmail, add $10. Three-day air freight delivery: add $8 for U.S. (UPS Blue), $25 for Canada (Purolator overnight), $45 for Europe (Federal Express), or $60 for Asia and elsewhere in the world (Federal Express) . Shipping costs are the same for one or two units.

There is an on-line Circuit Cellar bulletin board system that supports past and present projects. You are invited to call and exchange ideas and comments with other Circuit Cellar supporters. The 300/1200/2400-bps BBS is on-line 24 hours a day at (203) 871-1988.

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Illustration by Diane Teske Harris

James L. Pinson

Pull-Down Menus in C

Add a user-friendly menu system to almost any IBM PC application

One aspect of commercial software that impresses me is the sharp-looking screen displays: the use of colors, the fast screen updates, and the easy-to-use, pull-down menus. Making a program look good is no substitute for making it perform well, but it certainly can make an impression on the user. With this in mind, when I began studying C, I decided to create a general-purpose, pull-down menu system in C for the IBM PC and its compatibles. I started by examining the pull-down systems I admired and trying to emulate their best features.

My idea of an excellent pull-down menu system is one that appears in a window at the top of the screen. In that window, you make selections by entering a letter that represents an option—the capitalized letter in the option name—or by highlighting options with the cursor-control keys.

If you use the cursor keys, the system will automatically pull down the appropriate menu when you highlight a main menu item to browse through its options. When a pull-down menu is present, you can select one of its options the same way. Pressing Escape puts away the current pull-down box and returns you to the previous highlighted menu level. It also takes you from the top level back to the DOS prompt. The pull-down menus are nondestructive of any text that they overlay; that is, any text underneath a pull-down box is restored when you withdraw the menu.

The BIOS Interface

The BIOS interrupts are one good way of controlling the video output and eliminating the need for external video drivers such as ANSI.SYS. Although the prospect of directly controlling the hardware is somewhat intimidating, the task itself isn't too difficult. The article "POKEing Around in the IBM PC" by Hugh R. Howson (BYTE, November and December 1983) provided much of the information I needed.

While BIOS interrupts are not part of the standard C language, most versions come with functions that provide the interface. The Lattice C compiler lets you initiate BIOS interrupts with int86( ). For example, to clear a rectangular area of the screen for a window, you load the registers as in table 1 and issue an int86( ) for interrupt 10 hexadecimal. Listing 1 contains the actual Lattice C code for the clear_window( ) function. Another function, cls( ), uses clear_window(1,1,80,25) to clear the screen.

The windows in my program, PULLDOWN, are constructed by a fairly standard technique. [Editor's note: *PULLDOWN.C is available for the IBM PC and compatibles in Lattice C source code on disk, in print, and on BIX. This program provides the window structure for a pull-down menu system; individual routines for the various functions called from the windows are not included. See the insert card following page 324 for details. Listings are also available on BYTEnet. See page 4.*] First, the program calls the function win_save('s') to save the screen image. Next, it calls make_window( ), which actually draws the window, calling box( ) to draw the box and clear_window( ) to clear the area within it. When the window is no longer needed, the program calls win_save('r') to restore the previously saved screen image, making the window appear to vanish.

To make these functions work efficiently with the various video cards available, you need to know what type of card you have. The function what_mon( ) returns a 0 if you have a monochrome card and a 1 if you have a color graphics card. Then PULLDOWN initializes two variables, nor_attr, the normal text attribute, and hi_attr, the attribute used to highlight menu selections.

Originally, I had used the function bios_prt, which uses DOS calls, for all screen writing. As a well-behaved function, it has the advantage of being compatible with future DOS versions and equipment. However, the display was too slow at pulling down menus. You could actually watch the pull-down box being drawn. So I wrote a function, fast_write, to write the characters directly to the screen buffer (see listing 2). Unfortunately, this sort of machine-specific code reduces program portability. The base address of the video text area may change with the introduction of new video cards. I believed, however, that the increase in performance justified the sacrifice.

PULLDOWN includes both the fast_write( ) and bios_prt( ) options for screen output. All of the text output to the screen is routed through the function print(column,row,string), which calls either fast_write( ), the default, or the slower bios_prt( ). If you include the optional s parameter, for example, pulldown s runs in slow mode.

The function fast_write( ) calculates the starting point of the text buffer for whichever type of video card is present, monochrome or color graphics. Once you know the base address of the buffer, it is simple to calculate the position of

continued

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each screen character. The base address for a color graphics adapter card is B800h; the character appearing in the upper left corner of the display, display(1,1), is located there.

To write directly to the display, you poke the value of a character into the proper address and then poke the appropriate text attribute into the adjacent memory position. In the video text buffer, each even-numbered byte represents a character position on the screen; the adjoining odd-numbered byte contains that character's attribute. If you are using a CGA card, the program must know which graphics page you are using. The global variables page, attribute, and mon_type provide the information needed for this and other functions.

To make PULLDOWN easy to modify, I used an array of structures to contain the main menu options, the pull-down options, and the pointers to the functions these options call. As an example of the method I used, if you had a maximum of three options in each pull-down menu, you could create a structure like this:

```
structure menu_str{
  char *head;
    char *body[3];
      void(*fun1)( );
      void(*fun2)( );
      void(*fun3)( );
};
```

The main menu option pointer is head; body[3] is an array of pointers to the pull-down options; and (*fun1)( ), (*fun2)( ), and (*fun3)( ) are pointers to the functions called. (I had to list them separately because Lattice C does not allow arrays of function pointers.)

Later in your program, you could assign the structure menu_str to the options[ ] array and initialize it (see listing 3). This structure represents the main menu option, File, which pulls down the options Path, Load, and Save. Selecting one of these options calls the appropriate function, setpath( ), loadfile( ), or savefile( ). Further array elements can contain other main menu choices.

A function such as setpath may be called with either of two statements: setpath( ); or (options[1].fun1)( );, which uses a pointer to the function's address rather than its name. Pointers to functions are particularly useful in creating multiple-choice menus.

Table 1: *Registers and the contents needed to clear a window on the screen.*

Register	Value
AH	6 (scroll page up)
AL	0 (clear specified area)
BH	Attribute used to clear the area (BL unused)
CH	Row of the upper left corner (starts at 0)
CL	Column of the upper left corner (starts at 0)
DH	Row of the lower right corner
DL	Column of the lower right corner

Listing 1: *The Lattice C code required to implement the* clear_window( ) *function defined in table 1. This function clears a rectangular area of the screen to make a window.*

```
/* x = column, y = row, width and height = window size */
void clear_window(x,y,width,height )
unsigned int x,y,width,height;
{
 extern unsigned int attribute;
 struct { unsigned int ax,bx,cx,dx,si,di,ds,es; } regist;
   y--;x--;              /* DOS treats upper left as 0,0 */
   regist.ax = 0x0600;
   regist.bx =(attribute<<8);
   regist.cx = (y<<8) | x ;
   regist.dx =(y+height-1) <<8 |x+width-1 ;
   int86(0x10, &regist,&regist);
}
```

Listing 2: *The* fast_write *function writes directly to the screen buffer.*

```
void fast_write(x,y,string)
int x,y;
char *string;
{
 extern unsigned int page;          /* graphic page used */
 extern unsigned int attribute;     /* text attribute    */
 extern unsigned int mon_type;      /* monitor type      */
 int position,offset,orig;
    if (page <=3 && page >=0) offset = 4096*page;
      orig = offset;
      offset=offset+((y-1)*160)+(2*(x-1));
      position =0xb800;
    if (mon_type ==0) position=0xb000;     /* monochrome */
   while(*string){
    poke(position,offset,string++,1);       /* character */
    poke(position,offset+1,&attribute,1);   /* attribute */
        offset=offset+2;
   }
}
```

The Program Flow

The main( ) routine makes calls to identify the type of video card present and sets up the proper text attributes. It defines the menu structure, calls win_save('s') to save the current text screen, then passes its address to the menu( ) function. Upon entering menu( ), PULLDOWN draws the menu window at the top of the screen and prints the options within it, highlighting the first one. The cur_opt index points to the first option on the menu. If you touch a letter key, the program scans all the main menu options (m_menu[i].head[j]) to see if any of the options contain the same letter in upper case. If one does, then that option is highlighted, and the program calls pull_down( ). Pressing a left or right arrow key adjusts the index and highlights a new selection. If you touch Enter, the program calls the pull_down( ) function that draws the pull-down menu, and interprets further selections. If you press either Enter or a cursor key, the program determines that you are using the highlighting option and sets the expert variable to 0. When ex-

continued

O/S ARCHITECTURE: sink with UNIX or soar with QNX.

If the sheer weight of UNIX brings the PC to its knees, all applications running under it will suffer. Conceived more than a decade and a half ago, UNIX is today the result of modifications, additions and patches by hundreds of programmers. It needs the resources of at least an AT.

Compare this to the QNX O/S, designed by a dedicated team with a common purpose and complete understanding of both the software and the environment in which it must run. Having elegantly solved the problem of inter-task communications, QNX is more than capable of both networking and real time performance – the superior choice for process control and office automation systems.

Quick and efficient on a PC, QNX soars on an AT. QNX occupies 70K (stand-alone version) to 104K (network version) of system memory and allows 40 tasks (programs) and up to 10terminals per computer.

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Communication among all tasks is via "message-passing." Tasks anywhere on a network of up to 255 computers communicate rapidly and transparently with each other.

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Over 25,000 systems have been installed worldwide since 1982.

Multi-User	10 serial terminals per PC, AT.	**C Compiler**	Standard Kernighan and Ritchie.
Multi-Tasking	40 (64) tasks per PC (AT).	**Flexibility**	Single PC, networked PC's, Single PC with terminals, Networked PC's with terminals. No central servers. Full sharing of disks, devices and CPU's.
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Message Passing	Fast intertask communication between tasks on any machine.	**Cost**	From US $450. Runtime pricing available.

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The only multi-user, multi-tasking, networking, real-time operating system for the IBM PC, AT, the HP Vectra PC, and compatibles.

By Quantum Software.

Quantum Software Systems Ltd., Moodie Drive High Tech Park, 215 Stafford Road, Ottawa, Ontario, Canada K2H 9C1 pert is 0, the program calls pull__down( ) automatically. Either way, the pointer to the main menu option, cur__opt, and the address of the menu structure, m__menu, are passed to pull__down( ).

The pull__down( ) routine must calculate where to draw the pull-down box, based on the index variable, cur__opt, and the length of the main menu options. You can't set the position ahead of time, because this menu system is flexible. All it has to work with is the structure passed to it, and this will vary according to the application. Once the program knows the box's starting position, it scans the list of pull-down options to find the longest one and sets the box width to that value. The function make__window( ) draws the pull-down menu box and prints the options within it. It is not a "true" window because text is not automatically confined within its borders, but it looks like one.

The program then waits for you to select a menu option and puts away the pull-down window with win__save('r') before calling the selected function. Touching Escape will also put away the pull-down window and return to the main menu, setting expert to 1. If you touch Escape when the main menu is active with no pull-down windows showing, the program removes the menu display window from the screen and exits.

Listing 3: *The structure for the main menu option, File, which provides the options Path, Load, and Save. These options call the functions* setpath( ), loadfile( ), *and* savefile( ), *respectively.*

```
int setpath();
int loadfile();
int savefile();
static structure menu_str options[N]= {
        "File",
           "Path",
           "Load",
           "Save",
   setpath,
   loadfile,
   savefile,
 /* repeat for each element in main menu */
}
```

Looking Through the Window

PULLDOWN allows you to add a user-friendly menu system to almost any IBM PC application. Due to the widespread use of pull-down menus, most users will find it easy to use and understand. If you like the menu system as it is, simply alter the structure statement to reflect your menu options and their interfaces and add the pull-down menus to your programs.

You can modify this system in many ways. You could add support for a mouse. Or you could have the pull-down box stay put when calling functions. This would be useful if you wanted to create another window for more options next to the current one. The PULLDOWN.C program listing may give you ideas for other functions and interfaces and can serve as a tutorial for implementing them. ■

Microsoft is pleased to announce that Microsoft QuickBASIC 2.0 is second best.

By any measure, Microsoft® QuickBASIC 2.0 was an outstanding success.

We'd taken all the things people loved in the BASICA interpreter, and added a ton of advanced features to make a compiler that was faster and more advanced than any BASIC ever.

A compiler that overwhelmed even the toughest judges:

"A snazzy new programming tool that bridges the gap between earlier BASICs and the high-performance languages like C." Peter H. Lewis, *The New York Times,* July 15, 1986.

"(Microsoft QuickBASIC) ...represents an outstanding contribution to the microcomputer world." Dennis Dykstra, *Byte,* February 1987.*

PC Magazine was so impressed, in fact, that they gave Microsoft QuickBASIC their Technical Excellence award. Before long, Microsoft QuickBASIC 2.0 was the most award-winning BASIC compiler ever.

But for us, excellence wasn't good enough. Introducing Microsoft QuickBASIC 3.0.

We looked for more ways to make BASIC better. Ways to make the programming easier and faster. And then we set to work on what became Microsoft QuickBASIC 3.0.

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Based on the technology of the famous CodeView™ debugger included with our C Compiler, it gives you complete control over your program and data. You can observe the contents of any variable. You have your choice of single-step, animate or trace modes.

You can even set dynamic breakpoints at runtime while still using the source for reference. Which lets you easily trace your program's operation without the bother of PRINT statements and recompiling.

This debugger is completely integrated into the compiler. So you can, for example, start debugging your program while it's running by simply pressing CTRL-Break. Instantly, the debugger is activated and you're in control again.

Faster math. And faster programming.

On PCs equipped with math coprocessors, Microsoft QuickBASIC 3.0 blazes through calculations. Our new in-line 8087 code is as fast as you can get. And that's just the start of the speed advantages.

"Microsoft QuickBASIC is phenomenally fast in compilation...(it) outstrips all other compilers." Marty Franz, *PC Tech Journal,* December 1986.

Fast compiling is nice, but it's not the most important consideration. Program development time is.

Microsoft QuickBASIC makes your programming substantially faster by integrating a sophisticated editor into the compiler itself.

Any errors found during compilation trigger the editor to take over, putting your cursor right on the trouble spot.

And if you have more than one error, the editor will keep track of them all, letting you fix your bugs one after another. No more hassles with the endless recompiling of other compilers.

Divide and conquer.

Microsoft QuickBASIC gives you the power of advanced languages without the headaches. A case in point: separate compilation.

Long used in languages like C, separate compilation simply means that you can compile your programs the same way you write them, a piece at a time. Once compiled, your individual modules can be combined into libraries and added to future programs without the bother of recompiling.

But that's just one way Microsoft QuickBASIC supports structured programming.

In addition to the previous Microsoft QuickBASIC extensions like block IF/THEN/ELSE statements, Version 3.0 adds a new set of control structures. Features like the new SELECT CASE, DO WHILE, and DO UNTIL make even the most complex programs amenable to reason.

Still the same. Only better.

After all this work on improvements, we didn't forget what made Microsoft QuickBASIC the success it is. This compiler is still the leader in BASICA compatibility. From graphics to sound, this BASIC commands the PC like no other.

For more Microsoft QuickBASIC advantages, just turn the page.

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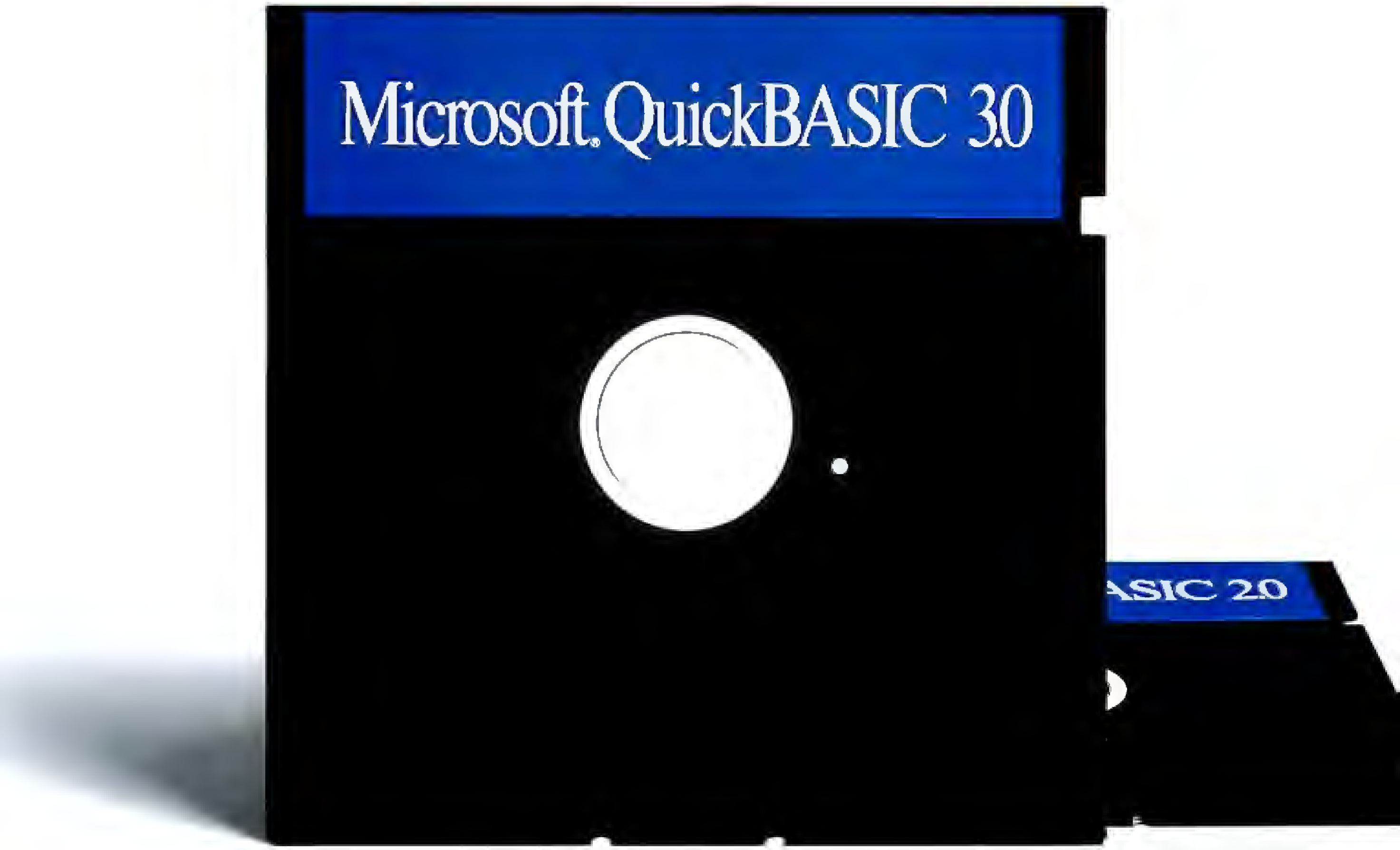
Introducing Microsoft QuickBASIC 3.0.



Integrated Program Debugging.

Microsoft QuickBASIC 3.0 includes the most advanced BASIC debugger available. This built-in debugger lets you track both program flow and the contents of variables with ease.

- ♦ Three debugging modes: single-step, trace, and animate.
- ♦ Set, clear, and examine breakpoints. NEW!
- ♦ Adjustable windows let you view source code, variable contents, and program output—all at the same time. NEW!
- ♦ Display and search through source code while debugging. NEW!

Advanced Integrated Editor.

The Microsoft QuickBASIC Editor is integrated with the compiler to make all your programming as fast and efficient as possible.

- ♦ Built-in editor places cursor on problem in source when error occurs in compilation.
- ♦ In contrast to other compilers that give up after finding a single error, Microsoft QuickBASIC's editor keeps track of all errors found during compilation. No more hassles with recompiling over and over.
- ♦ Editor supports both Insert and Overtype modes. NEW!
- ♦ Fully compatible with SuperKey,® ProKey,™ and SideKick.® NEW!

8087 Math Coprocessor Support.

The standard Microsoft QuickBASIC math package has been enhanced to take advantage of numeric coprocessors in machines that have them. Now you have several ways to optimize your program's performance.

- ♦ Microsoft QuickBASIC 3.0 generates fast in-line code for machines equipped with 8087 or 80287 coprocessors. Now your programs can be as fast as the hardware allows. NEW!
- ♦ Microsoft QuickBASIC includes full 80-bit IEEE Math support for programs that demand the most precise calculations possible. NEW!
- ♦ Choose from the Microsoft Binary Math routines for faster math or the new 8087 software emulation routines for more accuracy when you don't have a coprocessor.

Structured Programming Support.

In addition to the standard BASICA commands, Microsoft QuickBASIC Version 3.0 has a variety of advanced statements and features similar to those found in C and Pascal. By making structured programming easy, Microsoft QuickBASIC makes programs both easier to write and easier to maintain. Older BASIC features like line numbers and GOTO statements are strictly optional.

- ♦ New statements include SELECT CASE, DO WHILE and DO UNTIL, LOOP WHILE and LOOP UNTIL, and EXIT. NEW!
- ♦ Block IF/THEN/ELSE/END IF statements virtually eliminate any need for GOTOs.
- ♦ Subprograms may be called by name and passed parameters.
- ♦ Microsoft QuickBASIC now supports user-defined CONSTANTS. NEW!
- ♦ Both true local and global variables are supported.
- ♦ Microsoft QuickBASIC supports alphanumeric labels as well as line numbers.

Modular Programming Support.

Microsoft QuickBASIC's separate compilation lets you create stand-alone programs a piece at a time. You just compile your routines and add them to a library. Future programs can use those routines by simply linking in your libraries.

- ♦ Create stand-alone programs, with or without a separate run-time package.
- ♦ Link support routines once at beginning of a programming session, then forget about linking.
- ♦ Includes library for access to DOS and BIOS interrupts.
- ♦ Microsoft QuickBASIC makes it easy to use professional support libraries such as Softcraft's Btrieve package.

A compiler with both speed and power.

Microsoft QuickBASIC gives you the most advanced compiler features and debugging possible, without any speed handicaps. Microsoft QuickBASIC 3.0 compiles code up to an astonishing 12,000 lines per minute on an IBM® PC/AT.

Microsoft QuickBASIC also supports extra-large programs. Your programs can use all available memory for any mix of code and data. Individual arrays may use up to 64K bytes each (to the PC's limit of 640K).

BASICA Compatibility.

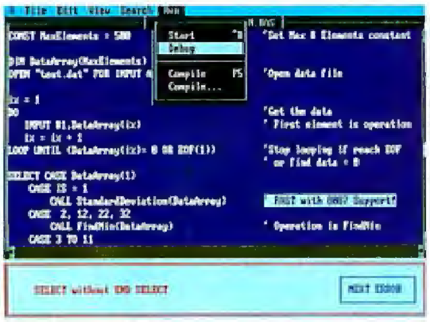
It's not hard to see why Microsoft's QuickBASIC is more compatible with IBM's BASICA than any other compiler. After all, we wrote it for IBM. And we've kept the same features in Version 3.0.

- ♦ Graphics statements include WINDOW, VIEW, DRAW, GET, PUT, LINE, CIRCLE, LOCATE, and SCREEN.
- ♦ Sound statements include SOUND and PLAY.
- ♦ Support for EGA extended graphics modes including the new 43 line mode.
- ♦ Supports standard BASICA structures such as GOSUB/RETURN, WHILE/WEND, and event handling.

Dramatic execution speed enhancements.

Benchmark	Microsoft QuickBASIC 2.0	Microsoft QuickBASIC 3.0
Graphics (500 Circles)	21.42	9.83
Floating Point Math	16.92	6.48
Quick Sort	5.27	3.02

All test results in seconds. Tests were performed on an IBM PC/AT equipped with an 80287 coprocessor and an 8 MHz clock.



```
CONST MaxElements = 500                'Set Max # Elements constant

DIM DataArray(MaxElements)
OPEN "test.dat" FOR INPUT #            'Open data file

ix = 1
DO                                     'Get the data
   INPUT #1,DataArray(ix)              ' First element is operation
   ix = ix + 1
LOOP UNTIL (DataArray(ix)= 0 OR EOF(1))  'Stop looping if reach EOF
                                       ' or find data = 0
SELECT CASE DataArray(1)
   CASE IS = 1
      CALL StandardDeviation(DataArray)  ' FAST with 8087 Support!
   CASE 2, 12, 22, 32
      CALL FindMin(DataArray)          ' Operation is FindMin
   CASE 3 TO 11
```

SELECT without END SELECT

Programming is easier with the built-in editor that searches for all errors, letting you correct them and recompile without leaving the programming environment.

```
Help:F1 Edit:F4 Go:F5
LASTYEAR% = 1987

      DO
         CALL SetUpGraph
         CALL DrawAxis
         CALL DrawData
         CALL ComputeTrend
         INPUT "Another Graph";Response$
      LOOP UNTIL Response$ = "N"
```

Pinpoint errors by tracing through your source code with the integrated debugger. You can set breakpoints and observe the contents of variables.

Microsoft® QuickBASIC

For more information or the name of your nearest Microsoft dealer, call (800) 426-9400. In Washington State and Alaska, call (206) 882-8080. In Canada, call (416) 673-7638.

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Karl Brown

Build BERT, the Basic Educational Robot Trainer, Part 2

This month we show how to troubleshoot and program your robot

Last month I introduced you to BERT, a simple, programmable robot made from inexpensive parts (see photo 1). I described how his circuits worked and how to build his circuit boards. Now I'll discuss how to troubleshoot and program your assembled BERT.

After the four main components—base, motor driver board, on-board computer, and speech board—have been built and connected (see photo 2 in part 1), you should have a working BERT. Well, he *should* work. To see if he is fully functional, put him on the floor and press the self-test button. He should perform the routine shown in table 1. If he doesn't perform as expected, you must determine the problem by first isolating it to one of the main components, then referring to that component's schematic and its troubleshooting section.

Motor Check

Testing of the motor driver circuitry is accomplished with some wires and a resistor. These will temporarily substitute for the on-board computer (OBC). First, secure the board to the robot base. Make sure all electrical connections to the motors, both batteries, speaker, sensors, and LED are secure. After this is done, we are ready to begin testing.

Caution! Do not stuff any wire into the connector socket while performing these tests. Doing so will cause the socket's

continued

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Photo 1: *BERT has "skin" constructed of acrylic salad bowls.*

connector pin spacing to enlarge, making the connector's pins unable to correctly grip the DIP connector.

To check for motor operation, you will need three pieces of wire (approximately 10 centimeters long) and a 510-ohm resistor. Solder one end of the resistor to +5 volts. Then, strip 1 millimeter of insulation off each end of each wire. Now solder one end of each wire to the following points on the solder side of the motor driver board: wire 1 to IC2, pin 12; wire 2 to IC1, pin 11; and wire 3 to IC1, pin 3.

With the above connections made and power from both batteries being fed to the board, temporarily connect the free ends of wires 2 and 3 to ground. Then, connect the free end of wire 1 to the free end of the 510-ohm resistor. Both motors should spin in the reverse direction. If either one turns forward instead of backward, just reverse the connections to that motor's terminals.

When this test is completed, leave the connection between wire 1 and the resistor intact. Now, connect the free ends of wires 2 and 3 to the resistor as well. Both motors should spin in the direction required to move the robot forward. This concludes the motor driver circuitry test. Remove all three wires.

Beeper Test

To test the beeper speaker, simply solder one of the aforementioned wires to the free end of the 510-ohm resistor. Solder the other end of that wire to IC3, pin 9. Now, solder one end of another piece of wire to ground. With your ear right up against the beeper speaker, brush the free end of that wire against IC3, pin 9. You should hear some noise. When you've completed your testing of this circuit, remove the resistor as well as all wires.

Sensor Testing

Sensor testing requires a voltmeter. Connect the negative end of the voltmeter to ground. Connect the other end to the OBC socket (S1), pin 7. You should measure +5 V. Depress the right whisker sensor. You should measure 0.0 V. Perform the same test for the nose and left whisker sensors on pins 6 and 8, respectively, of the same connector (S1).

LED Test

Testing the LED (eye) circuitry is simple. All you do is temporarily ground IC3, pin 11. The LED should illuminate. The circuits involving the sensors, speaker, and eye are very simple. If any of these circuits fail to check out, first check the connections to the batteries, then their voltage level. After that, merely start at the beginning of the circuit (where the test wires are attached) and follow the levels through the circuit until the break is found.

The motor driver circuits are a bit more complex, but not much. There are actually two circuits, one for each motor. Remember to troubleshoot only one at a time.

Again, check the power connections first. Next, check the inputs to the gates. Find out what logic levels are on the inputs; then, using the truth table for AND gates, figure out what levels should be on the outputs of the gates. With this information, and following the outputs to the bases of all four transistors, write down on the schematic what level should be on the base of each transistor.

At this point you will need a voltmeter. Attach its negative lead to ground. Check the TIP31's emitters. They must measure 0.0 V. Each base that should be high will measure approximately 0.7 V. Each base that should be low will measure less than 0.3 V. If they do not, trace the connections from the base back to its driving gate and check the value of its series resistor.

Some Helpful Hints

When BERT is powered up, the OBC is in a reset state. A power-on reset lasts only $\frac{1}{10}$ second. If the reset button is pressed, the reset state will last as long as the button is held down, plus $\frac{1}{10}$ second. In either case, as long as the reset state lasts, the motor driver board will cause both motors to turn in the forward direction. In fact, if the motor driver board does not receive signals from the OBC (as is the case during the OBC's reset state), it will always cause both motors to turn in the forward direction. Therefore, if at this stage BERT goes forward and keeps going forward, it is likely that the problem lies with the OBC or the connections between the motor driver board and the OBC.

The beep produced by the speaker is the result of the 6802 microprocessor causing the peripheral interface adapter to toggle one of its outputs (pin 14). If the beep is not heard, use a logic probe or oscilloscope to check the PIA's pin for a ¼-second train of pulses. If the train is there, follow the signal along its path to the speaker to find where the circuit is broken. If the pulses are not found at the PIA's pin, there is either a problem on the motor driver board that is holding the pin at a constant level (short to ground or +5 V) or you have a problem with the OBC and must troubleshoot it.

Table 1: *BERT's self-test routine.*

Move forward,
Turn eyes on,
Speak the word "cookie,"
Turn left,
Turn right,
Left to center,
Beep once,
Move backward (to original position),
Beep once,
Turn eyes off,
Perform system initialization (reset).

Feedback Problems

When the test button is pressed, pin 6 of the 6802 should go low and the OBC should enter its nonmaskable-interrupt routine. The first thing this routine does is output signals to the motor driver board that cause the motors to spin in a forward direction. These signals are output from the PIA's pins 10, 11, and 12.

Immediately after the test button is pressed, these pins should go high and remain in that state until the robot has gone a distance equal to 50 (decimal) holes from the hole sensor. The actual distance traveled will depend on the size of the wheels. Should these pins not respond as above, there is either a problem on the motor driver board that is holding the pins at a constant level (short to ground or +5 V) or you have a problem with the OBC and must troubleshoot it.

If the signals at these pins do transition, but only briefly, here is the most probable reason: BERT uses feedback from the drivetrain to determine how far he has gone. If he does not have this feedback, he has no way of knowing the distance he has traveled. This feedback comes from the hole-sensor circuit. If BERT fails to stop, look at the output of this circuit.

BERT counts these pulses at PIA pin 18. This input pin is a negative-going, edge-sensitive input. In the self-test mode, BERT will turn the motors on in the forward direction and leave them on until he has counted 50 negative edges (or holes) at PIA pin 18. Should the output of the hole-sensor circuit be faulty, or not arrive at the PIA, BERT will simply keep going.

Noise

There is a very subtle problem which can arise with BERT that relates to the hole-sensor circuit described above. Small DC motors are electrically noisy. This noise manifests itself as large (up to 100 V in amplitude) and narrow (100 nanoseconds to 20 microseconds) voltage transients, or spikes.

These spikes may be large enough to propagate through not only the power leads (from battery to boards), but also

continued

Programming in BERTL

BERTL is BERT's control language. It is an interpretive language that does syntax checking at program entry time. Table A lists the BERTL commands and their functions.

Each of the commands (except E) requires a parameter. If you command BERT to go forward, for example, he needs to know how far. The entire command would be Fnn, where nn can be any hexadecimal number from 01 to FF (FF hexadecimal equals 255 decimal).

BERTL commands can be downloaded from any serial device with the following characteristics: 300 bps, 7 data bits, 2 stop bits, and no parity. One way to enter BERTL programs into your robot is to write a short program that receives characters from your computer's keyboard and then sends them via the serial port to the robot.

The only drawback to this method is that it is impossible to store the program for future use or to change the robot's program without reentering it entirely. I suggest that the program be edited on a computer using a word processor or text editor and then sent to the robot. This allows you to conveniently edit and store many different BERTL programs.

The Commands in Detail

Here is a description of the BERTL commands:

- Bnn (Backward): This command causes BERT to reverse both wheels. They will continue in reverse until the number of pulses from the feedback circuit equals the parameter. In BERT's case, a value of 32 (hexadecimal) equals approximately 32 centimeters.

- Ccn (Call subroutine): This command causes the conditional execution of a subroutine, depending upon the condition of the on-board sensors. The parameter determines both the condition upon which the subroutine is called and which particular subroutine (out of a possible four) is to be called.

The first digit in the parameter is the condition. If it is 0, the call is unconditional and will be done regardless of the status of the on-board sensors. If it is a hexadecimal number other than 0, the condition of the on-board sensors will be tested to see if they match c. The conditions specified by c are shown in table B. (Note the logical conditions AND and OR.)

The second digit in the parameter specifies which subroutine will be called. The subroutines are 0, 1, 2, and 3 (see the command N). For the command B12 C00, the robot would go backward 12 cm, then call subroutine 0 regardless of the state of the on-board sensors. For the command F09 C51, the robot will first go forward 9 cm and then, if the nose button is low and both whiskers high, call subroutine 1.

- E (End): This command has no parameter. Upon receiving it, the robot "honks" to indicate that it has received the downloaded program. It waits for you to activate its nose sensor, after which it executes the program. It then waits for its nose sensor to be activated again. This procedure can be repeated indefinitely.

- Fnn (Forward): Turn both motors on in the forward direction. Otherwise, this

continued

Table A: *The BERTL command set.*

Command	Function
B =	Backward
C =	Call (subroutine, conditional or unconditional)
E =	End program
F =	Forward
G =	Goback (to main routine, unconditional)
H =	Honk
I =	Eye
L =	Left
N =	Name (of subroutine)
O =	Output
P =	Pause
R =	Right
S =	Shoot
T =	Talk (allophone or word)

Table B: *Conditions for sensor parameter* c. *The symbol "&" represents the logical AND, and "+" is the logical OR condition.*

Value of c	Logical condition of sensors
0	Don't care (disregard state of sensors)
1	Left low & Nose low & Right high
2	Left low & Nose high & Right low
3	Left low & Nose high & Right high
4	Left high & Nose low & Right low
5	Left high & Nose low & Right high
6	Left high & Nose high & Right low
7	Left high & Nose high & Right high
8	Left low & Nose low & Right low
9	Left low + Nose low + Right low
A	Left low + Nose low + Right high
B	Left low + Nose high + Right high
C	Left high + Nose low + Right low
D	Left high + Nose low + Right high
E	Left high + Nose high + Right low
F	Left high + Nose high + Right high

Table C: *Allophones used by the SPO256 chip on the speech board.*

00	Delay	10 ms	10	mm	milk	20	aw	out	30	wh	when
01	Delay	30 ms	11	tt1	part	21	dd2	do	31	yy1	yes
02	Delay	50 ms	12	dh1	they	22	gg3	wig	32	ch	church
03	Delay	100 ms	13	iy	see	23	vv	vest	33	er1	letter
04	Delay	200 ms	14	ey	beige	24	gg1	guest	34	er2	bird
05	oy	boy	15	dd1	could	25	sh	ship	35	ow	sew
06	I	sky	16	uw1	to	26	zh	azure	36	dh2	they
07	eh	end	17	ao	aught	27	rr2	brain	37	ss	vest
08	kk3	comb	18	aa.	hot	28	ff	food	38	nn2	no
09	pp	pal	19	yy2	yolk	29	kk2	sky	39	hh2	hoe
0A	jh	dodge	1A	ae	hat	2A	kk1	can't	3A	or	store
0B	nn1	thin	1B	hh1	he	2B	zz	zoo	3B	ar	alarm
0C	ih	sit	1C	bb1	rib	2C	ng	anchor	3C	yr	clear
0D	tt2	two	1D	th	thin	2D	ll	lake	3D	gg2	got
0E	rr1	rural	1E	uh	book	2E	ww	wool	3E	el	saddle
0F	ax	succeed	1F	uw2	food	2F	xr	repair	3F	bb2	business

command is identical to B.

- G00 (Goback): Go back to main routine. This command must be placed at the end of each subroutine. Its parameter is always 00.

- Hnn (Honk): Cause the robot's speaker to honk (beep) *nn* times, where *nn* is a hexadecimal number from 00 to FF. Note that all other robot activity will cease during the honk. The honk duration is 0.52 second.

- Inn (Eye): Turn the robot's lights on or off. If the parameter is 00, the lights will turn off. Any other value turns the lights on.

- Lnn (Left): This command causes the robot to pivot on its axis (the imaginary point between the drive wheels) in a counterclockwise (when viewed from above) direction. This is done by moving the left wheel in a forward direction while moving the right wheel in reverse. This motion continues until the feedback circuit outputs enough pulses to equal the parameter.

- N00, N01, N02, N03 (Name of subroutine): BERTL allows four subroutines. Each may be called unconditionally or only when the on-board sensors match a specific condition (see the command C). The format of a subroutine is as follows: name, commands, goback. For the subroutine N00 F60 H02 B60 G00, the robot will go forward 60 cm, honk twice, go backward 60 cm, and then return to the main program.

- Onn (Output): If the parameter is 00, the output of the 1-bit OBC port will switch to a logic low. If the parameter is any other value, the output level of the port will be a logic high. The port will support two TTL logic loads and therefore may need buffering if it is used to switch higher-current loads.

- Pnn (Pause): This command causes the robot to pause (do nothing) for the decimal equivalent of the number of seconds specified in hexadecimal in the parameter. For example, the command P3C would cause the robot to pause for 60 seconds.

- Rnn (Right): Turn right (or, to be more specific, cause the robot to pivot in a clockwise direction). Otherwise, the command is identical to Lnn.

- Snn (Shoot): This is a light and sound effect. It causes the LED to light up and the speaker to produce a "phaser" sound. Otherwise, it is the same as Hnn.

- Tnn (Talk): This command is used to control the optional speech board. If the speech board is not used on the robot, the OBC's CA2 output must be connected to the CA1 line. If this is not done, the robot will "hang" whenever this command is used.

BERT's speech chip is the General Instrument SPO256-AL2. This chip has specific sounds (allophones) stored in it. When strung together, these sounds simulate human speech. The parameter for this command is any hexadecimal number from 00 to 7B.

There are a total of 63 allophones and 63 words available to the BERTL programmer. Note that the speech chip continues to make the last portion of the last allophone it was commanded to emit. You can clear its throat by using 00 (silence) as the last sound emitted.

The command string T09 T2D T13 T2B T00 uses allophones to make the robot say the word "please." This can also be accomplished with the command T67, a command that uses BERT's preprogrammed 63-word vocabulary. Each word is represented by a number in the range of 40 to 7B hexadecimal. (See table C for the allophones and table D for BERT's vocabulary.)

Syntax Checking

When BERT receives commands via his serial port, he checks each one for syntax and validity. If bad syntax or an invalid command is detected, BERT will honk and light up his eye. If this happens, reset the robot and check your program for errors (a favorite error is typing o instead of 0).

Table D: *BERT's preprogrammed vocabulary. Each word is automatically terminated by the allophone "PA5" (04).*

40	; ZERO	4F	; CAN	5E	; LIKE	6D	; START
41	; ONE	50	; CHECK	5F	; LITTLE	6E	; STOP
42	; TWO	51	; COMPUTER	60	; ME	6F	; SORRY
43	; THREE	52	; COOKIE	61	; MEMORY	70	; SWITCH
44	; FOUR	53	; CORRECT	62	; MOMMY	71	; TALK
45	; FIVE	54	; DATE	63	; NO	72	; TEA
46	; SIX	55	; DO	64	; NOT	73	; THANK
47	; SEVEN	56	; EDUCATIONAL	65	; OFF	74	; TRAINER
48	; EIGHT	57	; EMERGENCY	66	; ON	75	; YES
49	; NINE	58	; ENTER	67	; PLEASE	76	; YOU (U)
4A	; ALARM	59	; ERROR	68	; READY	77	; ALERT
4B	; ARE	5A	; ESCAPE	69	; ROBOT	78	; LEFT
4C	; BASIC	5B	; EYE (I)	6A	; ROBOTS	79	; RIGHT
4D	; BE	5C	; HELLO	6B	; SEE (C)	7A	; WANT
4E	; BERT	5D	; IS	6C	; SPEAK	7B	; SILENCE

The BERTL language is also tolerant of the following characters: space, carriage return, and linefeed. While an error beep will not result from the preceding ASCII characters, nothing else will happen either. However, these characters must not come between the hexadecimal digits. For example, F44 L22H01 B 17 E would be acceptable, whereas, F44 L22H01 B1 7 E would not. (In this example, the robot would go forward, turn left, honk once, and go backward.)

I recommend that you make judicious use of subroutines to reduce your program's memory requirements. If something has to be done two or more times, use a subroutine. But bear in mind that no subroutine can call another subroutine. This is impossible due to the severely limited stack space of the OBC.

Should you decide to use a word processing program to enter, edit, and transmit a BERTL program, be careful. A lot of word processors embed nonprinting characters (ASCII codes above 127 hexadecimal) in the text for their own purposes. If you are using WordStar, for example, always create and edit BERTL programs using the nondocument command. When "printing" your program to the robot, suppress page formatting.

Listing A: *A sample BERTL program. Note: Do not try to enter the comments into BERT.*

```
H01 T5C     ; HONK ONCE & SAY "HELLO".
F0F         ; GO FORWARD 15 UNITS, THEN
C30         ; IF SENSOR CONDITION "3" IS MET,
            ; CALL SUBROUTINE NAME0.
C51         ; IF SENSOR CONDITION "5" IS MET,
            ; CALL SUBROUTINE NAME "1".
C62         ; IF SENSOR CONDITION "6" IS MET,
            ; CALL SUBROUTINE NAME "2".
F0F C30 C51 C62        ; DO THE SAME THING AGAIN
F0F C30 C51 C62        ; AND AGAIN
F0F C30 C51 C62        ; AND AGAIN
N00         ; SUBROUTINE NAME "0" STARTS HERE.
T79         ; SAY "RIGHT", THEN
R09 G00     ; TURN RIGHT AND GOBACK TO MAIN
            ; PROGRAM.
N01         ; SUBROUTINE NAME "1" STARTS HERE.
T4A         ; SAY "ALARM", THEN
B10 R06 G00       ; BACKUP 16 UNITS, TURN RIGHT AND
            ; GOBACK TO MAIN PROGRAM.
02          ; SUBROUTINE NAME "2" STARTS HERE.
T78         ; SAY "LEFT", THEN
L06 G00        ; TURN LEFT AND GOBACK TO MAIN
            ; PROGRAM.
E           ; END OF PROGRAM.
```

The program shown in listing A will cause BERT to beep and say "hello." Following that, he will jog forward, stop and check his sensors, and then take appropriate action if any one of the sensors is activated (low). If no sensor is activated (by bumping into some object), BERT will again go forward, stop, and check his sensors. If no sensors are activated throughout his journey, BERT will jog forward a total of four times, then finally stop and wait for either his nose or reset button to be pressed.

The appropriate action to be taken if a sensor is low depends upon which sensor is low. If the nose sensor is activated (by bumping into a wall, for example), then the subroutine N01 will be called. This subroutine will cause BERT to say "sorry," then back up, turn to the right, and return to the main program.

through the air, as radio frequency energy. This RF interference can be picked up by any antenna in the vicinity, even the piece of wire connecting the hole sensor to the PIA. The PIA interprets these spikes as hole transitions and soon counts enough of them to satisfy the command parameter. BERT thinks he has traveled the required distance when, in reality, he has moved a short distance, or not at all.

If this noise causes problems for your robot, you might consider using shielded cable from the hole-sensor circuit to the connector on the motor driver board. If the problem persists, try increasing the size of filter capacitor C3 on the motor driver board.

If the LED does not illuminate at this point, check for pin 13 of the PIA going low. If it does not, your problem is likely the OBC. If it does go low and the LED refuses to illuminate, follow the signal from the PIA to the LED to find the circuit break.

If BERT has operated well up to this point, but has failed to turn, it is not likely that the problem is with the OBC. The guilty party is probably the motor driver board. To prove this, check the PIA's pin 12 at the precise time in the self-test when BERT is supposed to be turning left. Pin 12 should be low. Follow this signal through to the motor driver board. If it arrives there, you have isolated the trouble to the motor driver board.

If BERT fails to turn right, the PIA pin to look for is pin 11. It should be low. To cause the motors to spin in a reverse direction, PIA pins 11 and 12 should be low, while pin 10 is high. If this is the case, but the motors do not reverse, follow these signals to the motor driver board. If they arrive there, the problem is in the board. If BERT successfully completes all the above movements but fails at one of the self-test points, you probably have an intermittent connection. Check your wiring and soldering.

Photo 2: *The results of a BERT construction class at Vancouver Community College.*

Communicating with BERT

After a reset (either power-on or manual), BERT enters his "get commands" state. In this state he sits quietly, receiving and storing ASCII data arriving at his S.IN (serial input) connector. He will stay in this state until one of three events occurs:

1. An E ("End") instruction arrives.
2. His memory fills up with the received data.
3. Improper data is received.

Events 1 and 2 are normal. When they occur, BERT will beep, then enter his "nose?" state. While in this state, BERT constantly monitors his nose button. The only way out of this state is to punch his nose (press the sensor). He will then enter his "interpret" state.

In this state BERT acts like a robot, toddling around executing whatever commands you gave him during his "get commands" state. When he finishes doing all the things you told him to do, he reverts back to his "nose?" state and awaits his chance to do it all over again.

Event 3, however, is an abnormal event, and BERT does not like it. Improper data is defined as either "any data which represents a nonexistent command" or "any non-ASCII data."

Upon receipt of either of these types of garbage, BERT will make a rude noise and glare at you (make a beep and turn on his eye). To put him back in a good mood, press his reset button, then examine your code for the bad instruction, correct the error, and prepare to download the corrected code.

Speech Board

Attempting the self-test without the speech board could get you into trouble as well. Since the OBC waits for the SBY signal from the speech board, it could wait forever (doing nothing else but waiting). To allow BERT to do the self-test without the speech board, short pins 39 and 40 of the PIA together.

If the speech board said "ready" when BERT was first powered up, but did not say "cookie" at this point, the most likely problem is an intermittent connection between the OBC and the speech board. Check all wiring.

The speech board produces sound in response to numbers sent by the OBC. These numbers are loaded into the speech board via a low-going pulse output at the PIA's pin 39. Using a logic probe or oscilloscope, check for this pulse at the PIA, then follow it to see if it actually gets to pin 20 of the SPO256 speech chip.

To tell the OBC that it is ready to receive another number, the SPO256 outputs a low-going pulse on its pin 8. If this pulse is not output by the SPO256, check the power on the speech board (it should be +5 V). If power is okay, check all solder connections and look for bent IC pins. If this pulse is output by the SPO256, you must make sure that it gets to the PIA's pin 40.

If all these handshaking signals come from and go to where they are supposed to, odds are that the SPO256 is working and the problem is in the LM386 audio-amplifier circuit.

Customizing

If you wish to modify BERT, please do. Any robot is only a beginning. Having built it yourself, you are the person best qualified to handle any modifications. My own personal BERT is an awful mess of add-ons and kludges. Perhaps someday I'll clean him up and make those temporary modifications more permanent—maybe just after I add a little more RAM, or perhaps after I modify the nose sensor. . .

Finally, should you start to feel limited by the BERTL language, or should you even wish to write your own robot control language, you may be interested in obtaining an optional ROM for BERT. After you've installed this ROM and added an RS-232C driver (to allow the OBC to talk back to the host computer), BERT will be transformed into a 6800 machine language development device. This will open the door to unlimited control over the hardware. It will allow you to enter, edit, and debug machine language code in the OBC. This ROM, complete with instructions and commented source code listing, is called KRMIN and is available through Amarobot.

[Editor's note: *Since this article was written, the author has added design enhancements to BERT, such as increased motor drive capability, more RAM, and an additional output port. The BERTL language has been revised to accommodate instantaneous response to on-board sensors (allowing BERT to play a version of robot laser tag) as well as increased vocabulary. The circuit boards and the EPROM required for these modifications, in addition to the ones described here, are available from Amarobot. See the address at the end of this article.*]

Pulling the Plug

Well, that's about all there is to it. If you follow all the steps in both parts of this article, you should have your very own robot—probably not the most elaborate robot ever featured as a construction article, but the most complete.

Everything, from hardware to software, is defined, debugged, and obtainable right now. Many configurations of BERTs are roaming around classrooms and basements (see photo 2). The first BERT users group has started here in Vancouver. You can correspond with them by writing the Vancouver Robot Club, c/o Seaport Pacific Services Ltd., Suite 611, 470 Granville St., Vancouver, British Columbia, Canada V6C 1V5.

If you wish to receive a copy of their latest newsletter, send your address and $1 (don't send a stamped envelope unless the postage is Canadian). I wish you good luck with your BERT, and I hope that building and programming him provides you with the opportunity to enter the fascinating domain of robotics and artificial intelligence. ■

All parts for BERT are available from Amarobot, 2913 Ohio St., Richmond, CA 94804, (415) 451-6780.

INTEGRATED SOFTWARE

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"...finishes a winner."

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"...Jack2 is a likely choice."

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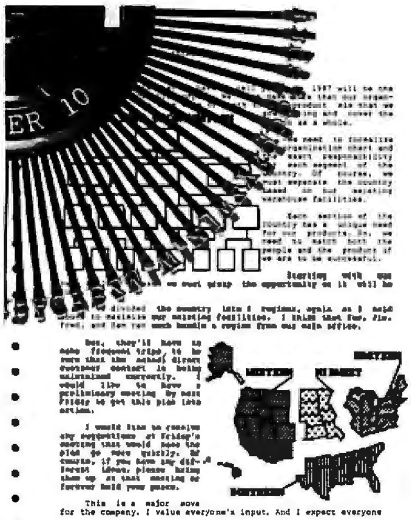


This is a major move for the company. I value everyone's input. And I expect everyone

DAK
INDUSTRIES INCORPORATED

Dear Customer,

Now you can have text and graphics together on one page with your own logo and even a border at the top, to the side or at the bottom. Now you won't have any more problems when you want to print out letters. And, what's best of all is that there won't be any bugs to worry about in the program either.

You're sure to be amazed at how easy it is to add pictures to your letters or reports. And you can add drawings and charts to your business letters or proposals.

This program is so easy to use that you will use it from now on. And what's really great is that if you already use a word processing program, you can pick up files that you've written in your other program and use them in this one in minutes.

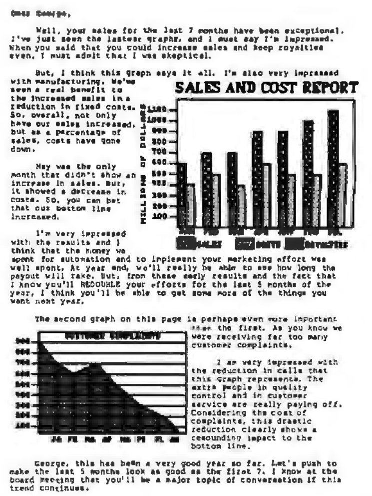
So no matter where you live in the United States, you'll find that this program will let you really use your mind.

So, if you do use your brain, you can really get into the swing of using this great new program.

There is simply no limit to the impact that drawings can provide for your work. It doesn't matter if it's a chart, a graph or a picture of a brain. You can do it all with this exciting new program.

So, don't let the brick wall of disbelief stand in your way. You don't need many graphs or drawings to make a really first class impression. After all, they say that a picture is worth 1,000 words. Just think of how many ideas are represented on this single page of copy.

For formal proposals, for marketing reports or for impressive letters, you can do it all with this powerful new program.



Dear George,

Well, your sales for the last 7 months have been exceptional. I've just seen the lastest graphs, and I must say I'm impressed. When you said that you could increase sales and keep royalties even, I must admit that I was skeptical.

But, I think this graph says it all. I'm also very impressed with manufacturing. We've seen a real benefit to the increased sales in a reduction in fixed costs. So, overall, not only have our sales increased, but as a percentage of sales, costs have gone down.

May was the only month that didn't show an increase in sales. But, it showed a decrease in costs. So, you can bet that our bottom line increased.

I'm very impressed with the results and I think that the money we spent for automation and to implement your marketing effort was well spent. At year end, we'll really be able to see how long the payout will take. But, from these early results and the fact that I know you'll REDOUBLE your efforts for the last 5 months of the year, I think you'll be able to get some more of the things you want next year.

The second graph on this page is perhaps even more important than the first. As you know we were receiving far too many customer complaints.

I am very impressed with the reduction in calls that this graph represents. The extra people in quality control and in customer service are really paying off. Considering the cost of complaints, this drastic reduction clearly shows a resounding impact to the bottom line.

George, this has been a very good year so far. Let's push to make the last 5 months look as good as the first 7. I know at the board meeting that you'll be a major topic of conversation if this trend continues.

For Daisy Wheel, Dot Matrix & Ink Jet Printers

$89⁹⁰ Desktop Publishing Breakthrough

Imagine using a word processing and drawing program that lets you integrate charts and pictures that you 'paint' or 'clip' into your text. Well, if you use an IBM PC or Clone, now you can have graphically dramatic documents, from business or personal letters, to proposals; to organization charts, even with a daisy wheel printer.

By Drew Kaplan

It's easy. It's impressive. And, now your thoughts can be powerfully illustrated in both words and graphics.

After all, for illustrating abstract data and thoughts, nothing beats a dramatic chart or drawing. So, let your ideas leap off the page by using integrated text and graphics. Your thoughts are sure to make an impressive impact.

Whether you write letters, bank proposals, term papers, company manuals or news letters, you can forget complicated and expensive laser printing. And, you can forget complicated expensive desktop publishing programs.

Now for just $89⁹⁰, you can use your daisy wheel, dot matrix or ink jet printer to print normal text. Plus, you can integrate simply fabulous graphs and drawings into your creations.

INCREDIBLY EASY

Savtek, a brain trust group, has developed an easy to use yet incredibly sophisticated integrated word processing and graphics program.

Just create your letters, proposals, or reports as you would with any other word processor. In fact, if you **already** have a document created in virtually any other word processor, you can 'grab' it into Savtek's instantly.

You'll produce visually powerful technical papers and manuals with drawings and charts, and dramatic marketing reports with graphs. You'll produce sales proposals with panache.

And since there's no complicated training needed (if you can run a word processor, you can run Savtek), you'll make great impressions, fast.

Anyway, once you've created the written part of your report, using Savtek's sophisticated automatic word processing features, you're ready to add pictures, charts and graphs.

Just select from the over 100 supplied changeable pictures or draw your own, using the automated ICON based drawing program.

Later, you'll learn much more about the sophisticated drawing program that lets you draw, paint, fill, expand, reduce, copy, and move your pictures.

And, you'll form squares, circles and triangles automatically. Anyone can draw with it because it's totally automated and uses arrow keys and doesn't require a mouse. But, read on.

Once you've selected a picture, the computer will produce an automatically sized box representing it. Just position the box wherever you want the picture to be in the text.

Like magic, the actual picture will appear and the text will automatically reformat itself around it.

And, speaking of reformatting, this program will automatically make page-breaks and recalculate each page as you write or edit. If you make an addition to page 1 of a 10 page report, the effect will ripple through all 10 pages.

So, whatever length you've chosen for each page (including headers, footers and automatic page numbering), will automatically be preserved.

You'll particularly like the cut and paste features of this word processing program which allow you to copy, move or delete sections of your text.

Of course, you'll have automatic Word-wrap, Hidden Hyphenation, Justified Smooth Right or Ragged Right text. Plus, you'll have Find, Replace and Search.

And look how you can format your document. There are 5 page templates called rulers which allow you to automatically set up your page.

You can select any right and/or left margins, your tabs, one, two or three line spacing, and the number of blank lines at the top and bottom of your page.

Each of the 5 rulers comes with different default settings. But, you can adjust and save them or change them and even use several at one time on a page.

HOW DO THE PRINTERS WORK?

I use a daisy wheel printer because I like my letters to look personal. I've always had to switch to a dot matrix printer for graphs and illustrations. Unfortunately, I couldn't have my graphics on the same page as my text.

Now, because this program can use the period on the daisy wheel to create all the charts and graphic symbols you see within this ad, I don't need to switch printers any more.

And while it doesn't create the graphics as fast as a dot matrix, the quality is superb. Now my graphics can be impressively integrated into my text.

Note: Every single sample page shown in this ad, was printed out on my EXP 400 Silver Reed daisy wheel printer.

Note: This program does not produce two column news letters in a single action. Simply create a double length column and cut it when you have it printed.

No matter what printer you use, daisy wheel, dot matrix (with or without near letter quality printing) or ink jet (color or single color), you'll have powerful looking documents to really present your ideas in the most professional manner.

DESKTOP PUBLISHING

Desktop publishing is about the hottest category of computer programming. It seems that everyone has discovered the impact of combining text and graphics.

And **very** impressive presentations are just what Savtek's ETG Desktop publishing system provides for you.

Imagine leveraging the capabilities of your own IBM or Clone, your own printer and your own keyboard to produce the documents you see on these pages, with nothing else to buy.

THE 1000 WORD PICTURE

First a confession. I can't draw. That's why you don't see drawings in DAK's catalogs. But I've been amazed at how creative I can be with this paint program.

It's easy. You do everything with the arrow keys and the return key. By using the arrow keys you can draw in any direction with a choice of 12 brush shapes.

There's an erase function to eliminate anything you don't like. And here's my favorite function. UNDO is a function that works throughout this program.

. . .Next Page Please

. . .Publishing Continued

It simply removes the last thing you did. So, no matter what you do wrong, you're a button away from removing it.

If you don't want a solid line, just spray an area. It's like using a spray can.

Let's say you want to connect two points with a straight line. Use the Angle Line. It produces a computer generated straight line between any two points.

What if you want a circle? Just touch the return key. Then use the diagonal arrow key to enlarge or reduce the circle. If you use the up/down or right/left arrows, you'll get an ellipse.

In the same way you can create squares, rectangles or triangles. And you'll be amazed how many things, from houses to technical drawings, are made up of squares, rectangles, circles and triangles.

But, that's not all. You can choose any of 32 background patterns to fill in enclosed areas or broad lines. And if 32 isn't enough, you can design your own.

There's so much more. You can juggle a picture. Imagine, turning it over or sideways with the touch of a button.

You can copy or move a picture or even part of a picture right on the screen. So, draw it once and copy it or move it.

But, here's my favorite. You can enlarge or reduce any picture or part of a picture right on the screen. So you can change its size equally, or you can stretch it out or make it tall and thin. Wow!

There are 12 included font/sizes. So you can have large or small type in your choice of styles within a picture or integrated with your text.

And, each of the 12 font/sizes can be shown on the screen and printed normally, in bold, in italic, in outline, or in shadow. Plus, you can write normally across the page, up the page, down the page or upside down.

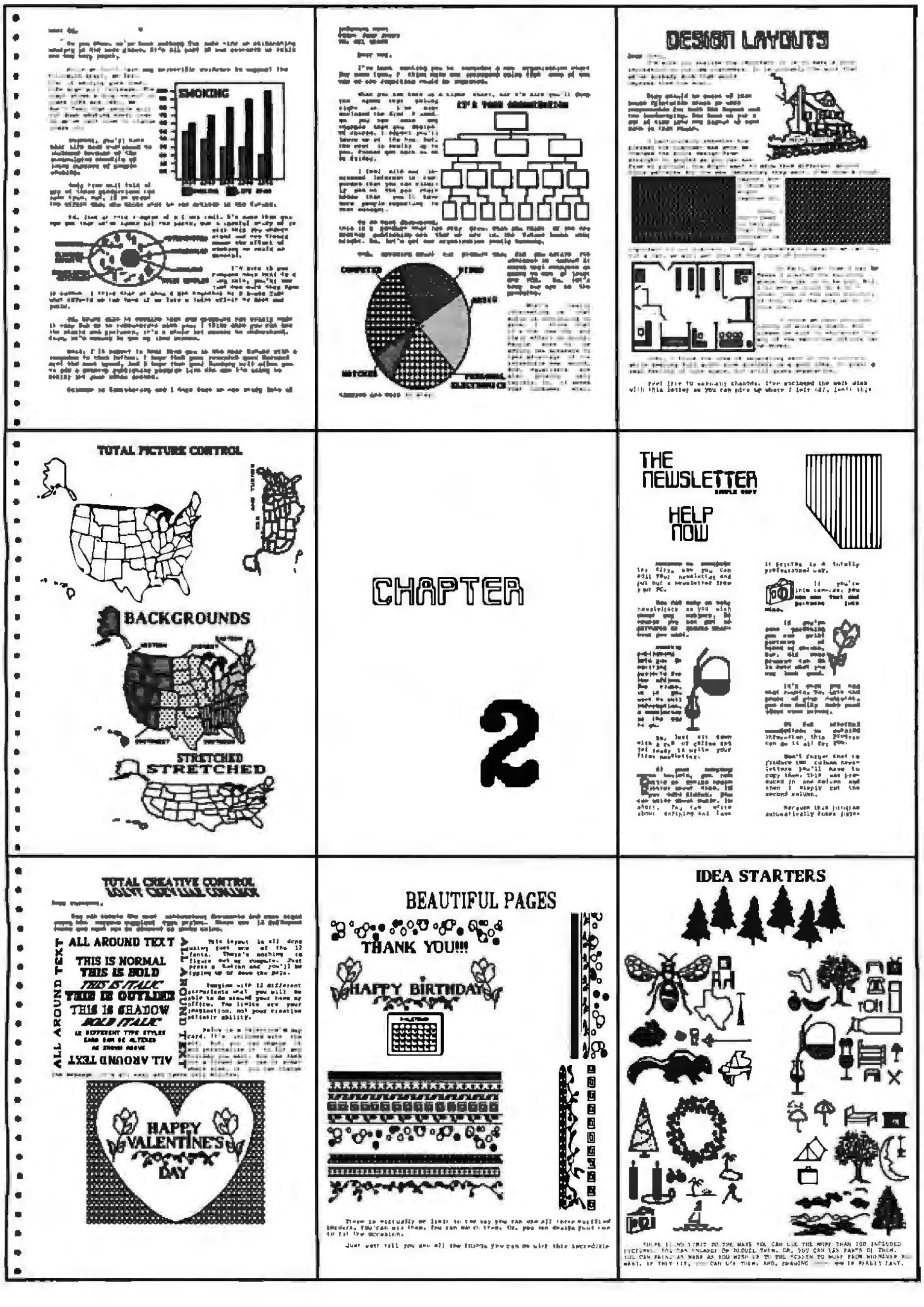
Finally, you can zoom into any small section of the screen and edit your pictures, pixel by pixel. With this kind of power, you don't need to be an artist, just have the ability to push a button.

You can operate this Paint program independently. Or, you can access any picture from within word processing.

So, for banners and pictures, you can print directly from the Paint Program. Or, for everything previously described, simply access your pictures, captions, graphs or charts through the desktop publishing section.

This program is incredibly powerful, yet you'll be comfortable using it within just a few hours.

Every picture in this ad was created with this program. And, you haven't even seen the tip of the iceberg of its capabilities. For example, if you have a picture on the screen, you can bring a second picture up and join them together.



WHO CAN USE THE SYSTEM

All you need is an IBM PC, AT, XT or 100% compatible with standard IBM CGA or EGA graphics capability. It must have at least 256K, and either two floppy disk drives or one floppy and a hard disk.

Below is a list of some of the dot matrix, ink jet and daisy wheel printers that have been tested with this program. If your printer is compatible with any of these printers, it should work too.

Special Note: Most daisy wheel printers are Diablo 620/630 compatible, so they will work with this program.

Special Note: With a color printer you can print 3 colors plus black text.

C.Itoh 8510, **Epson** Fx-80, FX-85, FX-185, JX-80 (color), LQ-800, LQ1500, LX80, MX80with Graftrex Plus or Graftrax, RX-80, **Hewlett Packard** 2225C Think Jet or QuietJet, LaserJet, or Laser Jet Plus, **IBM** BOCPS Graphics Printer, **IBM** Proprinter, IBM 3852 Jetprinter (color), **Juki** 6100, **Mannesmann** Tally Spirit 80, **NEC** 3500, 3510, 3520, 3530, 3550, 5500 series, 8023A, NEC Pinwriter P5XL, P6, P7, (single or color), **OKIDATA** Microline 92, ML92, w/IBM Plug & Play, Microline 193, 20 (color), **Panasonic** KX-P1091, KX-P1091i, **Quadram** Quadjet (color), **Radio Shack** DMP-200, **Silver Reed** EXP400, 600, 800 and all EXP series, **Star Micronics** SG-10, **Texas Instruments** 855, 865, **Xerox** (Diablo) 620, 630.

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Bad News For Escort

3RD IN A SERIES

Dear Customer, *From Drew Kaplan*

Escort has ignored DAK's **second**, one-on-one Maxon versus Escort radar challenge. And frankly, I'm fighting mad. I suppose they have a right to ignore me. But after referring to my challenge as only an "advertising gambit" and calling Maxon's radar detector an off-shore, primitive, and bottom-end unit, I'd think they'd be glad to wipe us out in a head to head duel to the death. But, I'm really mad for two other reasons and I think that you may be as fascinated by them as I am.

Mad Reason 1. Road and Track Magazine held an independent general radar detector test in their September 86 issue.

As far as I can see, Maxon beat Passport in Uninterrupted Alert, and Passport beat Maxon in Initial alert. Now to be fair, neither of us seem to have beaten the other by even 2 seconds at 55 miles per hour. So, we didn't win or lose by much.

And, Maxon's \$99^{90} detector was tested against the $295 Passport, not the $245 Escort we challenged. What's interesting is that Road and Track had nice things to say about Passport and even about Escort, which **wasn't even included** in the tests any more.

Now, if you've been following DAK's challenge, you know we've only been challenging Escort. If you've read Road and Track's tests, you'll be amazed when you read Boardroom Reports, which I've reprinted for you to the right. What's really interesting is that **it's the exact same person** in both publications.

Actually, Maxon did extremely well. Road and Track only used 'over hill' and 'around curve' tests because on straightaways the differences weren't worth describing. (Imagine that!)

It's just as I've said in my challenge. I don't think there's much difference between Maxon's and Cincinnati's Radar detectors when it comes to sensing radar.

THE CHALLENGE GROWS

In view of the opinions stated in the article in Boardroom Reports about the $245 Escort, DAK hereby adds the $295 Passport to our challenge.

Mad Reason 2. Did you ever hear about the cure for dandruff that was developed in the middle-ages? It was the guillotine. And frankly, I think you should be aware of Cincinnati Microwave's advertising cure for the Rashid VRSS Collision Avoidance System.

The Rashid VRSS system, as described in Popular Science magazine, January 1986, sends out a radar signal on the K band ahead of your car. The good part is that it can help you avoid running into things higher than your front bumper. The bad news is that since it operates on K band, it sets off radar detectors.

Well, hats off to Cincinnati Microwave. I've tested the Passport against the Rashid unit and, as usual, they have done a splendid job. While every other detector I tested, including Maxon's, was driven crazy, theirs didn't utter a peep.

But then, my Maxon hasn't uttered any peeps lately either and let me tell you why. I was on my way to the Far East to visit Maxon, so I asked Tom, a manager at DAK, to purchase and test the Rashid.

Well, did I ever hear from him. First the unit cost $558 plus about $100 to install. Then buying it and finding someone to install it took almost a month.

But the real reason he was unhappy was that the recommended method of installation involved **cutting a 6½" hole** in the front grill of his neat new car.

Well, much to my wife's chagrin, it's now installed in her station wagon.

After installation, it has to be set by an installer. He drives between 15 and 30 miles per hour toward a solid object. When the installer **thinks** he's reached a safe stopping distance, he adjusts the warning alarms to sound. Then in the future, when a similar distance is reached, lights will flash and an alarm will sound.

Of course, if you accelerate too quickly into a lane behind another car the same alarms can go off.

And, I haven't figured out what to do if there's a dog in the road, dirt on the radar sensor, or how to compensate for the different stopping distances encountered on dry, wet, icy or snowy roads.

MOST IMPORTANT PART

Speaking of advertising gambits, in **virtually every magazine I pick up**, I've been seeing Cincinnati's Bad News for Radar Detector ads spelling out the obsolescence of all other detectors.

If it's such an important feature that distinguishes them from us, there had better be some of these devices on the road, or Cincinnati Microwave's credibility may just be on the road as well.

I will add $10,000 to my Escort/ Passport challenge if Cincinnati Microwave can prove that there are even 1000 Rashid units on the road **anywhere** in the U.S. Oh heck, I'll add $5000 if they can even find 500. **(And, look at this.)**

NOTE: There are several other potential collision avoidance systems on the drawing boards and each may have a DIFFERENT FINGERPRINT.

So, If you're a current Escort or Passport owner, I suggest that you find out how many Rashid units there are and what Cincinnati Microwave will do about the 'other' units **before** you pay $$$ to have your current detector upgraded.

Besides, with over 3,000,000 square miles in the U.S., even 1,000 units would work out to less than one unit for every 3,000 square miles.

If a major car company successfully sells a collision avoidance system, then Maxon will be ready. But, the car companies currently can't even get consumers to pay $200 for air bags. So, you decide. Is it significant, or an advertising gambit?

Below is the **NEW** version of the challenge. Escort, a reply please!

A $20,000 Challenge To Escort

Let's cut through the Radar Detector Glut. We challenge Escort & Passport to a one on one Distance and Falsing 'duel to the death' on the highway of their choice. If they win, the $20,000 check pictured below is theirs.

By Drew Kaplan

We've put up our $20,000. We challenge Escort to take on Maxon's new Dual Superheterodyne RD-1 \$99^{90} radar detector on the road of their choice in a one on one conflict.

Even Escort says that everyone compares themselves to Escort, and they're right. They were the first in 1978 to use superheterodyne circuits and they've got a virtual stranglehold on the magazine test reports.

But, the real question today is: 1) How many feet of sensing difference, if any, is there between this top of the line Maxon Detector and Escort's or Passport's? And 2) Which unit is more accurate at interpreting real radar versus false signals?

So Escort, you pick the road (continental U.S. please). You pick the equipment to create the false signals. (Don't forget our $10,000 Rashid challenge). And finally, you pick the radar gun.

Maxon and DAK will come to your

. . .Next Page Please

. . .Challenge Continued

highway with engineers and equipment to verify the results.

And oh yes, we'll have the $20,000 check (pictured) to hand over if you beat us by more than 10 feet in either X or K band detection with the Escort, or by 2 seconds at 55mph with the Passport.

BOB SAYS MAXON IS BETTER

Here's how it started. Maxon is a mammoth electronics prime manufacturer. They actually make all types of sophisticated electronic products for some of the biggest U.S. Electronics Companies. (No, they don't make Escort's).

Bob Thetford, the president of Maxon Systems Inc., and a friend of mine, was explaining their new RD-1 anti-falsing **Dual** Superheterodyne Radar detector to me. I said "You know Bob, I think Escort really has the market locked up." He said, "Our new design can beat theirs".

So, since I've never been one to be in second place, I said, "Would you bet $20,000 that you can beat Escort?" And, as they say, the rest is history.

By the way, Bob is about 6'9" tall, so if we can't beat Escort, we can sure scare the you know what out of them. But, Bob and his engineers are deadly serious about this 'duel'. And you can bet that our $20,000 is serious.

We ask only the following. 1) The public be invited to watch. 2) Maxon's Engineers as well as Escort's check the radar gun and monitor the test and the results. 3) The same car be used in both tests. 4) We'd like an answer from Escort no later than July 31, 1987 and 60 days notice of the time and place of the conflict. 5) If Escort can prove that there are 1,000, or even 500 Rashid units in operation, we will present them with the appropriate $10,000 or $5,000 check at the beginning of the conflict. And, 6) We'd like them to come with a $20,000 check made out to DAK if we win.

HOW'S THIS FOR FAIR

Cincinnati Microwave will be deemed the winner and given the check if **either** Escort beats Maxon by 10 feet in both uninterrupted and initial alerts, **OR** if Passport beats Maxon by 2 seconds at 55mph in both uninterrupted and initial alerts. So, DAK wins **only** if we beat both Escort and Passport.

A tie will exist only if **both** the $295 Passport and $245 Escort fail to beat Maxon's $99^90 Dual Superheterodyne RD-1 Radar Detector.

SO, WHAT'S DUAL SUPERHETERODYNE?

Ok, so far we've set up the conflict. Now let me tell you about the new dual superheterodyne technology that lets Maxon leap ahead of the pack.

It's a technology that tests each suspected radar signal 4 separate times before it notifies you, and yet it explodes into action in just 1/4 of one second.

Just imagine the sophistication of a device that can test a signal 4 times in less than 1/4 of one second. Maxon's technology is mind boggling.

But, using it isn't. This long range detector has all the bells and whistles. It has **separate** audible sounds for X and K radar signals because you've only got about 1/3 the time to react with K band.

There's a 10 step LED Bar Graph Meter to accurately **show the radar signal's strength**. And, you won't have to look at a needle in a meter. You can see the Bar Graph Meter with your peripheral vision and keep your eyes on the road and put your foot on the brake.

So, just turn on the Power/Volume knob, clip it to your visor or put it on your dash. Then plug in its cigarette lighter cord and you're protected.

Radar detectors

John Tomerlin, Road & Track

Radar detectors

Today's best radar detectors aren't much bigger than a pack of cigarettes. They weigh less than eight ounces and have exciting new circuitry. *What to look for:*

☐ **X-band and K-band sensitivity.** Both are used by the police.

☐ **Different alarm sounds** for the different types of speed radar. K-band radar is used in the newer instant-on radar units that are used for short-range ambushes where police locate themselves out of sight. Listen for intermittent bursts of radiation to warn of this type of radar. Since X-band radar can be detected from as far away as three miles, a warning buzz doesn't call for an instant reaction. The driver can gradually slow down as the intensity of the alarm increases. X-band is also used in many automatic garage door openers and home burglar alarms, which makes it much more likely to generate false alarms.

☐ **False-alarm filtering.** Most newer models have specialized circuits that filter out many false alarms. Since many older models don't have good filtering capability, in built-up areas it's almost impossible to determine whether the near-constant buzzing means that speed radar is being used.

☐ **A proximity indicator.** Good detectors change the warning sound as the radar device gets closer.

☐ **Easy mounting method.** Radar detectors have become almost as popular with thieves as car stereos. It helps if a unit is simple for the owner to remove whenever he leaves the car.

☐ **Bright visual display.** The best detectors have light-emitting diodes (LEDs) that glow brightly during daylight. *Caution:* Analog meters that use needles on a numeric scale are less useful—and they can be dangerous, because the driver has to focus on the meter to see exactly where the needle is.

The best at any price: Cincinnati Microwave's *Passport.* The price is a steep $295 for this 6½-ounce unit that measures ¾" high x 4¼" deep x 2¾" wide. *Features:* Dual-tone alarm, automatic brightness adjustment of the LED proximity meter, a very sophisticated false-alarm filter and an audible alarm switch that allows the driver to turn the buzzer off during one radar contact and have it reset automatically for the next encounter. *Caution:* Don't mistake Cincinnati Microwave's *Escort* for the *Passport.* The older *Escort* is still sold (for $245). It was once the best available but is less technologically sophisticated. Since both units are available only directly from the factory, there's no price discounting.

Good protection for half the price: The Cobra *Trapshooter* offers many of the same features as the *Passport* for a suggested retail price of $230. *Major drawback:* In bright sunlight it's difficult to tell if the LED lights are on. *Others worth considering:* B.E.L.-Tronics Limited's *Micro Eye XKR-LR,* $299.95 and Whistler *Spectrum 2,* $140. ☐☐

Boardroom interviewed John Tomerlin, highway safety analyst, *Road & Track,* 1499 Monrovia Ave., Newport Beach, CA 92663, monthly, $17.95/yr.

Boardroom Reports ☐ September 15, 1986

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And you'll have a very high level of protection. Maxon's Dual Conversion Scanning Superheterodyne circuitry combined with its ridge guide wideband horn internal antenna, really ferrets out radar signals.

By the way, Escort, we'll be happy to have our test around a bend in the road or over a hill. Maxon's detector really picks up 'ambush type' radar signals.

And the key word is 'radar', not trash signals. The 4 test check system that operates in 1/4 second gives you extremely high protection from signals from other detectors, intrusion systems and garage door openers.

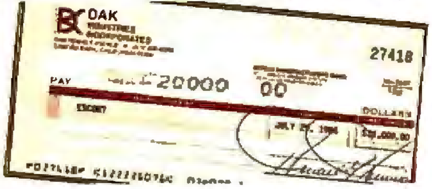
So, when the lights and X or K band sounds explode into action, take care, there's very likely police radar nearby. You'll have full volume control, and a City/Highway button reduces the less important X band reception in the city.

Maxon's long range detector comes complete with a visor clip, hook and loop dash board mounting, and the power cord cigarette adaptor.

It's much smaller than Escort at just 3½" Wide, 4¾" deep and 1½" high. But, it is larger than Passport. It's backed by Maxon's standard limited warranty.

Note from Drew: 1) Use of radar detectors is illegal in some states.

2) Speeding is dangerous. Use this detector to help keep you safe when you forget, not to get away with speeding.



CHECK OUT RADAR YOURSELF RISK FREE

Put this detector on your visor. When it sounds, look around for the police. There's a good chance you'll be saving money in fines and higher insurance rates. And, if you slow down, you may even save lives.

If you aren't 100% satisfied, simply return it in its original box within 30 days for a courteous refund.

To get your Maxon, Dual Superheterodyne, Anti-Falsing Radar Detector risk free with your credit card, call toll free or send your check for just **$99^90** ($4 P&H). Order No. 4407. CA res add tax.

Special Note: Now that we're challenging Passport, we've added an optional suction cup windshield mount and extra coiled power cord. (Sorry we can't afford to throw them in for free.) They're just **$5^90** ($1 P&H) Or. No. 4800.

OK Escort, it's up to you. We've got $20,000 that says you can't beat Maxon on the road. Your answer, please?

Escort and Passport are registered trademarks of Cincinnati Microwave. Rashid VRSS, and Rashid Radar Safety Brake are registered trademarks of Vehicle Radar Safety Systems, Inc.

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David Betz

An Adventure Authoring System

A tour of AdvSys, a tool for writing text adventure games

[Editor's note: *"Interactive Fiction as Literature," a companion piece to this article, begins on page 135.*]

AdvSys is a system I designed for writing text adventure games. In adventure games, the player acts as an adventurer in a simulated world (real or imaginary). Players determine their own course of action by typing commands that trigger events in the simulated world.

You can approach the writing of an adventure game in many ways, and a number of books describe how to use traditional programming languages to write adventures. The most commonly used language is BASIC. But while you can certainly build very complex and interesting adventures using BASIC, it was not designed specifically for that purpose.

Much of the task of building an adventure game program consists of constructing complex data structures that model the game universe. BASIC has no convenient means for describing these data structures. Even Pascal, which is rich in data structuring facilities, has no easy means of constructing complex initialized data structures.

Another approach to writing adventures is to use a special language specifically designed for the purpose. This article describes such a language.

A language for writing adventures must have three essential features: a parser to handle commands typed by the player, an object-description facility, and a language for specifying the events that take place in response to the players' commands.

continued

David Betz is a BIX senior editor. He can be reached at BIX, One Phoenix Mill Lane, Peterborough, NH 03458.

Illustration by Nancy Doniger

Adventure games generally take place in a world made up of a network of interconnected 'locations.'

The Parser

The parser is responsible for prompting the player to enter a command. It must read the command from the keyboard and break it into pieces that can be digested by the action code. All commands are broken into one of five different types of phrases:

1. an actor phrase
2. a verb phrase
3. a list of direct-object noun phrases
4. a preposition
5. an indirect-object noun phrase

Not all of these phrases are present in every command, and the parser recognizes only a limited set of command forms. AdvSys recognizes these forms:

1. [actor,] verb
2. [actor,] verb direct-objects
3. [actor,] verb direct-objects preposition indirect-object
4. [actor,] verb indirect-object direct objects

where "direct-objects" is defined as:

direct-object [conjunction direct-object]*

(In this article, phrases within square brackets are optional. Phrases followed by an asterisk may be repeated zero or more times.)

The terms "actor," "direct-object," and "indirect-object" all represent noun phrases. Each noun phrase is of the form

[article] adjective* noun

In other words, a noun phrase consists of an optional article followed by zero or more adjectives followed by a noun. Here are some examples of noun phrases recognized by the AdvSys parser:

sword
the angry man
the thick red book

Now that we have defined the command forms that are handled by the parser, let's look at some complete commands. I will precede each example with a number indicating the form on which it is based:

1. Look
1. Fred, wake up
2. Drop the book
2. Take the sword and the orange vial
3. Give the book to the librarian
4. Librarian, give me the book
4. Show the librarian the book

The second example illustrates another feature of the parser. Verb phrases can consist of either a single word like "take" or a pair of words like "pick up" or "wake up." If a verb phrase consists of two words, the words do not have to be immediately adjacent to each other in the command. Either "Pick up the book" or "Pick the book up" will produce the intended result.

After breaking the command into phrases, the parser sets a small number of global variables to communicate the results of its work to the rest of the adventure system. The parser stores each noun phrase in an internal array, indexed by the noun phrase number. The index associated with the actor noun phrase is stored in the global variable $actor, the index associated with the first direct-object noun phrase is stored in the variable $dobject, and the index of the indirect-object noun phrase is stored in the variable $iobject. If a noun phrase is missing from the command, its corresponding variable is set to nil (which is the same as zero in this system). These noun phrase numbers will be used later to determine which objects the noun phrases refer to.

The parser uses the verb phrase and the preposition to select an action to handle the command. It stores the selected action in the global variable $action. (More details about actions later.) The adventure language statements you use to define the vocabulary used by the parser are

```
(adjective word*)
(preposition word*)
(conjunction word*)
(article word*)
```

In addition, it is useful to define synonyms of some words. This is accomplished by the statement

```
(synonym word synonym*)
```

Objects

Adventure games generally take place in a world made up of a network of interconnected "locations." Each location has a set of exits that connect it with adjacent locations. The player explores the game world by moving an actor from location to location through these exits.

In the course of exploring these locations, the player encounters "things" and other "actors." In a fantasy adventure, for example, the player might encounter a magic sword or an angry dwarf.

AdvSys groups locations, actors, and things in the general category of *objects*. Each object in the adventure has an associated set of *properties*. Each property has an associated *value*.

A location object, for example, has a property for each of its exits. The values of these exit properties are the locations a player will reach by passing through the corresponding exits. Location objects also have *description* properties whose values are text strings describing the location under different circumstances. The concept of objects with properties is very general in this system, leaving you, as you write your game, free to invent new properties appropriate to a particular type of game and to define new classes of objects that share common properties, structure, and behavior.

For instance, a location object might be defined as

```
(location living-room
  (property
  description "You are in the living
    room. \ n"
  north library
  south entrance
  east dining-room))
```

This is a definition of living-room, a location object with the properties description, north, south, and east. The description property has the string "You are in the living room. \ n" as its value. (A back slash followed by the letter n instructs the program to start a new line). The property north has the value library (the location the player reaches when traveling north from the living room), the property south has the value entrance, and the property east has the value dining-room.

Things are objects that the player can manipulate. A thing must have a noun associated with it. And since the same noun can refer to different objects, you can associate adjectives with the objects to make references to the objects unambiguous. Here is an example of an object description:

```
(thing sword
(noun sword weapon)
(adjective red)
(property
  description "a red sword"
  weight 20
  value 10
  initial-location entrance))
```

continued

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This definition describes the object sword, which has the nouns sword and weapon and the adjective red. Thus, a player could refer to this object as "the sword," "the weapon," "the red sword," or "the red weapon."

The sword object also has four properties: description has the value a red sword, weight has the value 20, value has the value 10, and initial-location has the value entrance.

The weight property might be used to provide the player with a limited carrying capacity. If each object has a weight, you can prevent the player from carrying a set of objects whose combined weight exceeds the player's load capacity. Similarly, the value property could be used for scoring. Each object has an associated value that the game will add to the player's score when the object is carried to some specified location. The meaning of these properties is up to you, the game author.

Defining Objects

Actors are objects that represent characters in the adventure. The player controls a special actor that is the "player character." The player "sees" through this actor's eyes and takes part in the action by controlling this actor's movements. In AdvSys, the player character is called the "adventurer." Other actor objects represent nonplayer characters. These nonplayer characters are controlled by the adventure program (the code that you have written) rather than by the player, and they may include both friendly and hostile characters with whom the adventurer must interact to solve the adventure. An example of a nonplayer character might be

```
(actor troll
  (noun troll dwarf)
  (adjective angry)
  (property
    description "There is an angry troll
      here."
    short-description "an angry troll"
    initial-location "dungeon"))
```

This defines a troll that the player can refer to as "the angry troll," "the dwarf," and so on, and is initially found in the dungeon, where the adventure will see the words "There is an angry troll here" upon entering.

So far we have seen how to describe the static portions of an adventure game. Location objects allow us to build the adventure universe, things allow us to place interesting objects in this universe, and actors allow us to populate the universe with other characters.

I have defined locations, things, and actors as part of a run-time package that

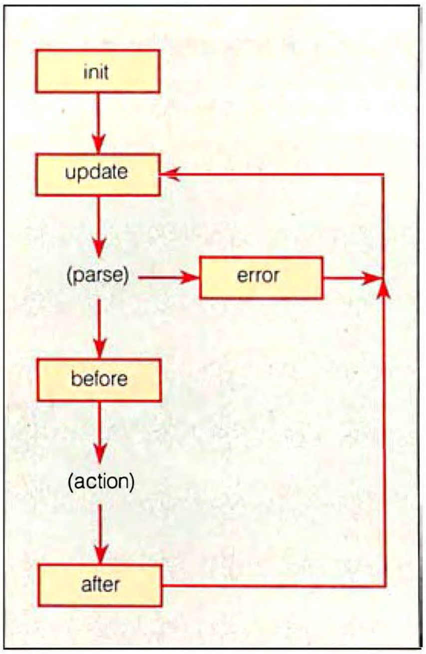

Figure 1: *The action in an AdvSys game is controlled by "handlers," described below.*

comes with AdvSys, but you can define your own objects if you wish. The statements used to define these objects, as shown in the previous examples, are

```
(object object-type
  object-statement*)

(object-type name
  object-statement*)
```

where the object-statement may be defined using one of the following:

```
(noun word*)
(adjective word*)
(property [property-name initial-value]*)
(class-property [property-name
  initial-value]*)
(method (selector arg-name* [&aux
  tmp-name*]) expression*)
```

Now we will explore how things happen in the adventure universe.

Handlers

All action within an AdvSys adventure is controlled by a set of "handler" and "action" procedures. There are five different handlers that are part of the main control loop. Each of these handlers contains user-defined code written in the adventure language. Figure 1 illustrates the control flow of the adventure system.

At the beginning of the game, the AdvSys interpreter calls the "init" handler. The init handler is responsible for printing any introductory text explaining the initial situation and for performing any initialization. Here is an example of an init handler definition:

```
(init
  (print "Welcome to the sample
    adventure! \ n")
  (setq curloc nil))
```

This example handler prints a welcome message and sets the variable curloc (the current location of the adventurer) to nil.

The first handler in the main loop is the "update" handler, which is responsible for handling changes in the game state. If the player has moved a new location, the update handler should print a description of the new location. Here is an example:

```
(update
  (if (not (= (getp adventurer parent)
    curloc))
    (progn
      (setq curloc (getp adventurer
        parent))
      (send curloc describe)))
```

This handler checks to see if the adventurer's new location is different from the current one. If it is, the handler updates the current location and prints a description of the new location by sending the message describe to the new location object. (Note that on the first pass through the control loop, the update handler sees the location of the adventurer as being different from that stored in curloc and prints a description of the initial location.)

After the update handler has finished, the AdvSys interpreter calls the parser. The parser prompts the player for a new command, allows the player to enter the command, and parses the command according to the description above. The parser communicates its results to the remaining handlers by setting the global variables $actor, $action, $dobject, $ndobjects, and $iobject. If an error occurs during the parsing of the command, the system prints an error message, calls the error handler, and goes back to the start of the main loop (the update handler).

Assuming that the parser succeeds in parsing a syntactically valid command, the AdvSys interpreter calls the "before" handler, which handles any general preprocessing that needs to be done before the command-specific code is performed.

Next, the action associated with the player's command is performed. This is the action that was stored in the global variable $action by the parser. This code is responsible for actually carrying out the player's request (if it is allowed in the current situation).

The last handler in the main loop is the

continued

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"after" handler, which handles any processing that must happen after the action is complete, such as updating the game clock or the player's score, or anything that should happen only at the end of a successful turn.

The adventure language statements that are used to define handlers are:

```
(init expression*)
(update expression*)
(before expression*)
(after expression*)
(error expression*)
```

Actions

The only part of the adventure system left to describe is the method for defining actions. Each action definition handles a specific command form and verb/preposition combination. Let's look at an example:

```
(action a-take
  (verb take get (pick up))
  (direct-object)
  (code
      (setq %dobject (in-location
      $dobject))
    (if (getp %dobject takeable)
      (progn
        (if (send %actor carrying?
            %dobject))
          (complain "You are already
            carrying the "
            $dobject "! \ n"))
          (send %actor take
            %dobject)
          (print-noun $dobject)
          (print " taken. \ n"))
      (complain "You can't take the "
        $dobject "! \ n"))))
```

This action definition handles commands like "take the lamp" or "pick up the sword." It handles any command with the verbs "take," "get," or "pick up" and at least one direct object. The code begins by determining to which object the direct-object noun phrase refers. The function in-location looks for an object in the current location (curloc) that matches the noun phrase it receives as its argument. The function returns the matching object or signals an error if no object in the current location matches the noun phrase.

Assuming that in-location finds a matching object, the action code assigns that object to the variable %dobject and then checks to see if it is possible to pick up the object. This is done by checking the value of the property takeable. If the result is true, the object may be taken. If not, the program prints an error message and the turn ends.

If the object is takeable, the code then checks to see if the player is already carrying it. It does this by sending the message carrying? to the actor object. This message checks to see if the object is currently being carried by the actor receiving the message. Both actor and location objects support the concept of containment. If the adventurer is already carrying the object, the program prints a message saying so and the action is complete. If not, the program adds the object to the adventurer's inventory by sending the actor object the take message and the program prints a message indicating the successful completion of the command.

This example illustrates the use of object-oriented programming techniques in the specification of action code. AdvSys lets you define "methods" to handle messages sent to objects. Each message requests that the object perform some operation. The specific operation that is performed in response to a message is determined by a method definition associated with the object that receives the message. AdvSys supports hierarchical in-

continued

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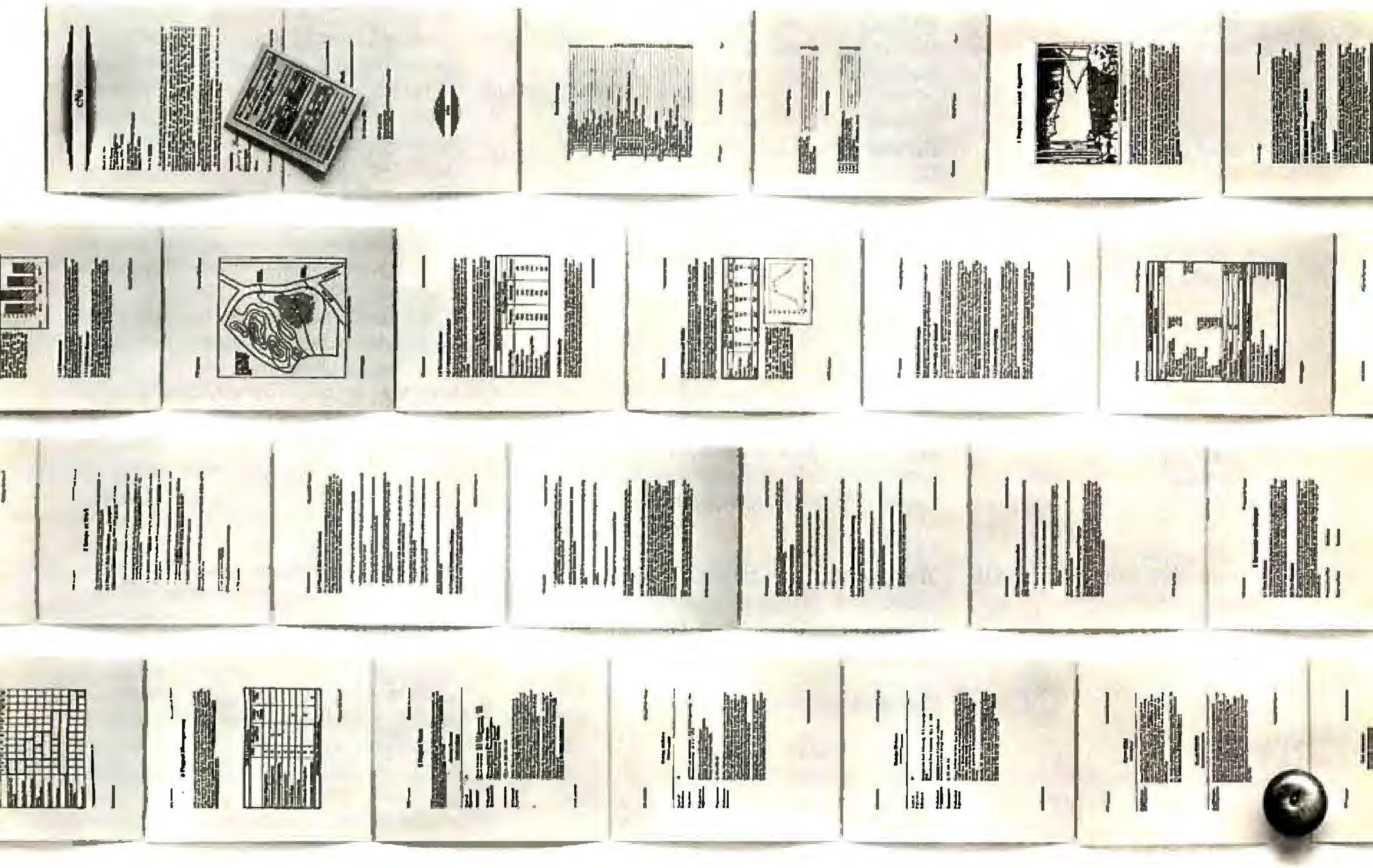

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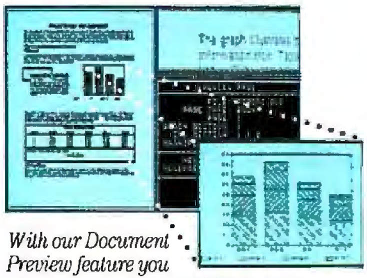

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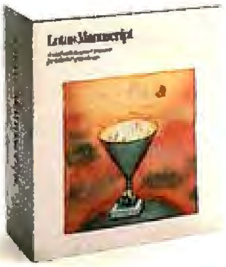

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Table 1: *The executable statements used in actions and handlers to control an adventure game written with AdvSys.*

(+ exprl expr2)	Add two numbers
(− exprl expr2)	Subtract two numbers
(* exprl expr2)	Multiply two numbers
(/ exprl expr2)	Divide two numbers
(% exprl expr2)	Remainder after dividing two numbers
(& exprl expr2)	Bit-wise AND of two numbers
(: exprl expr2)	Bit-wise OR of two numbers
(expr)	Bit-wise complement of a number
(< exprl expr2)	Is exprl less than expr2?
(= exprl expr2)	Is exprl equal to expr2?
(> exprl expr2)	Is exprl greater than expr2?
(setq sym value)	Set the value of a variable
(getp obj prop)	Get the value of a property
(setp obj prop val)	Set the value of a property
(and [expr]*)	Logical AND of a set of expressions
(or [expr]*)	Logical OR of a set of expressions
(not expr)	Logical NOT of an expression
(cond [clause]*)	LISP style conditional
(if expr then-expr [else-expr])	Traditional "IF" statement
(while expr [expr]*)	Traditional "WHILE" statement
(progn [expr]*)	Group expressions into a block
(return [expr])	Return from a function
(expr [expr]*)	Call a user-defined function
(class obj)	Get the class of an object
(send obj sel [expr]*)	Send a message to an object
(send-super sel [expr]*)	Send a message to the superclass of an object
(randomize)	Initialize the random-number generator
(rand expr)	Generate a random number between 0 and n-1
(yes-or-no)	Prompt the user and accept YES or NO
(print expr)	Print a string
(print-number expr)	Print a number
(print-noun expr)	Print a noun phrase
(terpri)	Start a new print line
(match np obj)	Does this noun phrase match this object?
(finish)	Finish this turn (go to the AFTER handler)
(chain)	Exit this handler and go to the next
(abort)	Abort this turn (go to the UPDATE handler)
(exit)	Exit the adventure (back to DOS)
(save)	Save the current game state to a file
(restore)	Restore the game state from a file

heritance of both properties and methods so you can define classes of objects that share the same property structure and behavior.

The default run-time environment for AdvSys adventures (contained in the file OBJECTS.ADI) defines methods that implement the default behavior for the built-in object classes. But the power of the system is that it lets you define subclasses of these default classes that implement either objects or classes of objects whose behavior and properties are unique to a particular adventure. This allows you to build on the existing classes rather than "reinventing the wheel." The default run-time environment is thus a framework for building an adventure rather than merely a sample program.

If a command contains multiple direct objects, the parser will store the first direct object noun phrase number in `$dobject` and the number of direct objects in `$ndobjects`. If your action code doesn't touch the value of `$ndobjects`, at the end of the after handler, the system will assign the next direct object to the variable `$dobject`, decrement the count stored in `$ndobjects`, and loop back to the before handler again. This means that you don't need to do anything special to handle commands with multiple direct objects. However, if you have a reason to want to handle all of the objects yourself, you can do so on the first pass through the action code and then set the variable `$ndobjects` to nil to prevent the system from looping back to handle the additional direct objects.

The adventure language statements used to define actions are:

```
(action name
   action-statement*)
```

with `action-statement` defined as one of the following:

```
(actor [flag])
(verb [word | (word1 word2)]*)
(direct-object [flag])
(preposition word*)
(indirect-object [flag])
(code expression*)
```

and where `flag` is one of the following:

```
required
optional
forbidden
```

Expressions

Handlers, actions, and methods all contain executable statements called expressions. The complete list of expression types allowed in AdvSys is shown in table

continued

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1. Each of the forms shown computes a result, which is returned as the value of the expression.

Here is an example of an expression derived from table 1:

```
(setq x (+ (* a b) (* c d)))
```

This executable statement is an arithmetic expression that multiplies `a` times `b` and `c` times `d`, adds the two products, and stores the result in the variable `x`. Even the `setq` form returns a value. Its value is the new value of the variable after the assignment is done.

Run-Time Functions

Not all of the functions that I have used in the examples are listed in table 1. The missing functions are part of the run-time package OBJECTS.ADI (see table 2) and are not built into the language. These functions are defined in adventure code and can be changed by the adventure author to suit a variety of tasks.

I wrote the run-time package so that you would not have to start from scratch when writing adventures. The run-time package defines commonly used object types such as locations, actors, and things; common actions such as look and take; game control commands like save and restore; and methods for handling common messages. These methods define the default behavior of objects, but can be easily supplemented or overridden by methods defined in ob-

Table 2: *The functions included in the basic run-time package for the AdvSys adventure writing system, OBJECTS.ADI.*

BASIC-THING	
superclass: object	
properties:	
initial-location	Initial location of the object.
parent	Current location of the object.
sibling	Next object in the location.
methods: (none)	

THING	Things that can be taken.
superclass: basic-thing	
properties:	
takeable	Can the thing be taken? (defaults to T)
methods: (none)	

ACTOR	The adventurer or non-player characters.
superclass: basic-thing	
properties:	
child	First object carried by the actor.
methods:	
(move dir)	Move in the specified direction.
(take obj)	Take an object.
(drop obj)	Drop an object.
(carrying? obj)	Is actor carrying the specifed object?
(inventory)	Show the actor's inventory.

STATIONARY - THING	Things that cannot be taken.
superclass: basic-thing	
properties:	
(takeable)	Can the thing be taken? (Because this property is missing, GETP will return NIL as its value.)
methods: (none)	

PORTAL	Connections between locations.
superclass: basic-thing	
properties:	
other-side	Counterpart in the other location.
closed	Is it closed?
locked	Is it locked?
key	Key to lock and unlock.
methods:	
(knock? obj)	Can this object enter?
(enter obj)	Cause this object to enter the location.
(open)	Open the portal.
(close)	Close the portal.
(lock key)	Lock the portal.
(unlock key)	Unlock the portal.

LOCATION	Locations in the adventure.
superclass: object	
properties:	
description	Long description.
short-description	Short description.
visited	Has the player been here?
child	First object in this location.
(exit directions)	Exits.
methods:	
(knock? obj)	Can this object enter?
(enter obj)	Cause this object to enter the location.
(leave obj dir)	Leave in the specified direction.
(describe)	Describe the location.

jects or subclasses defined by the adventure author. In this way, you can build your adventure game on the basic framework provided by the run-time package. For example, the run-time package supplies a method for the message leave, which allows an actor to leave a location.

Associated Definitions

The following method definition could be associated with a particular location and would require the actor to be carrying the "rusty key" in order to leave the location:

```
(method (leave obj dir)
  (if (send obj carrying? rusty-key)
    (send-super leave obj dir)
    (print "You seem to be missing
      something! \ n")))
```

This example also illustrates the use of the send-super form. Send-super passes a message to the parent (or super) class of the current object. This definition says that if the actor (the value of obj) is carrying the rusty key, the leave message should be handled normally. If not, the program prints a message and the action is aborted.

The adventure language statements used to define constants, functions, variables, and property-names are:

```
(define symbol value)
(define (function-name symbol*)
  expression*)
(variable symbol*)
(property symbol*)
```

Summary

AdvSys is a tool for writing adventure games, much as a word processor is a tool for writing novels. It is not a substitute for good creative writing, but a tool for the writer. I hope the availability of this system will inspire potential adventure authors to write adventure games and share them with the rest of us. (See the article "Interactive Fiction as Literature," which begins on this page.) ■

Editor's note: *The source code for AdvSys, the adventure game writing system, was written in C and includes the following files: ADVCOM, the adventure game compiler; ADVINT, the adventure game interpreter; OBJECTS.ADI, a run-time package containing the basic definitions needed for a game; and the AdvSys documentation.*

The files are available on disk, in print, and on BIX. See the insert card following page 324 for details. Listings are also available on BYTEnet. See page 4. In order to run the programs, you will need a C compiler appropriate for your computer system.

Mary Ann Buckles

Interactive Fiction as Literature

Adventure games have a literary lineage

When Willie Crowther and Don Woods wrote the narrative-based game Adventure, they most likely did not foresee that they were creating a new way of telling a story or that Adventure might some day be considered a work of literature.

The adventure game genre is now called interactive fiction (IF). In some ways, IF closely resembles the traditional literary genres of mysteries, science fiction, fantasy, and adventure tales. These types of popular literature are based on rules, games, and the creation of fantasy worlds. They all emphasize a step-by-step, action-consequence type of thinking and imagination.

Mystery Literature: Detection as a Game

Edgar Allen Poe would have loved IF; he was a master at solving cryptograms and thought problems, and he wrote the first detective story, "Murder in the Rue Morgue." Ever since then, mystery literature has been compared to games. The Sherlock Holmes stories, for example, have been called "crossword puzzles." Mystery novels like those of Agatha Christie and Dashiell Hammett are more like jigsaw puzzles, while James Bond novels and spy stories can be compared to games of chess.

Mysteries challenge the reader's powers of deduction; they are games in the form of stories, in which the reader competes with the author, matching wits in the game of "who done it" and how.

Some writers have even established mystery literature "rules" to make sure the competition between the reader and the characters, or the reader and the author, is fair. One set of rules that was set forth to give the reader a sporting chance requires that the author at least mention the criminal early on in the story, that there be no more than one secret passage per story, and that no secret twin brothers or sisters may suddenly appear to explain the crime. To promote such fair play with the reader, the famous Detection Club (founded by G. K. Chesterton, Agatha Christie, Dorothy Sayers, and others) requires new members to swear to the following initiation oath (see reference 1):

> *Ruler: Do you solemnly swear never to conceal a vital clue from the reader?*
>
> *Candidate: I do.*
>
> *Ruler: Do you promise to observe a seemly moderation in the use of Trap-Doors, Chinamen . . . and utterly and forever to forswear Mysterious Poisons unknown to science?*
>
> *Candidate: I do.*

Of course, fair play in no way hinders an author from trying to fool the reader; trickery and the ability to manipulate the rules to one's own advantage are admired qualities in gamesmanship.

As in mystery literature, the fascination of the intellectual challenge in IF may make up for weaknesses in characterization and style, which often suffer from the all-consuming goal of making the plot as thick as possible. In both IF and in detective literature, events and characters' choices are often not explained psychologically. In many mystery stories, the author simply establishes that the crime is puzzling, without providing any plausible motivation for it.

However, the suspense in mysteries can evoke total involvement and escape from our real-world problems. Because the reader is the detective and unraveller of puzzles in IF, and therefore more actively and intensely involved in solving the problems, IF can become a more powerful type of suspense and escape literature than current mystery literature.

IF and Adventure Literature

Crowther and Woods' Adventure is a story of exploration, like Jules Verne's *Journey to the Center of the Earth*. Both take place in caves, and many of the descriptions are similar. Perhaps surprisingly, the cave

continued

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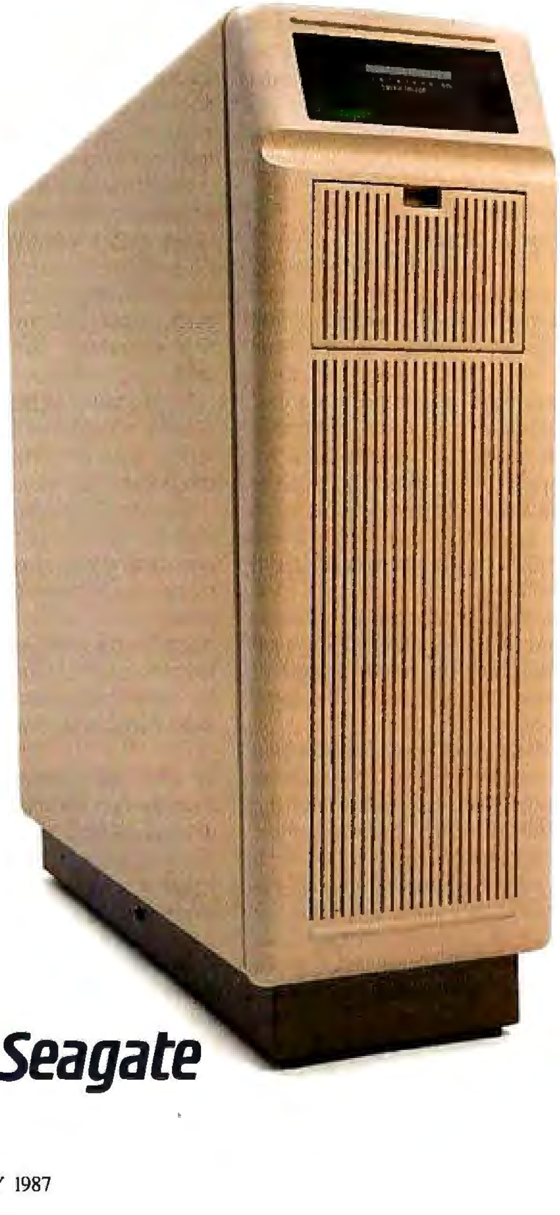

descriptions in Adventure are often more realistic and vivid than in Verne's story. Whereas Jules Verne explored only in his imagination, Willie Crowther is a real-life spelunker. Adventure began as a map, a computer model of an actual Colossal Cave in Kentucky, which Crowther explored and then accurately duplicated in the first few levels of Adventure's cave.

Similarly, Adventure is related to Robert Louis Stevenson's *Treasure Island*. The desire for treasure motivates both stories, and both were inspired by maps. Location and physical setting dictate the process of action. Stevenson once explained how he got the idea for his famous story:

> *I made the map of an island; it was elaborately and (I thought) beautifully coloured; the shape of it took my fancy beyond expression; it contained harbours that pleased me like sonnets; and with the unconsciousness of the predestined, I ticketed my performance 'Treasure Island'... as I paused upon my map of 'Treasure Island,' the future character [sic] of the book began to appear there visibly among imaginary woods; and their brown faces and bright weapons peeped out upon me from unexpected quarters as they passed to and fro, fighting and hunting treasure, on these few square inches of a flat projection. The next thing I knew I had some papers before me and was writing out a list of chapters . . . the map was most of the plot.* (See reference 2.)

Chivalry is Alive

Adventure, which was made possible by technological advancements in computers, is similar to the first "novels," which were also dependent upon a new technology, the printing press. These novels of chivalry were prose versions of medieval knightly verse epics that, with the introduction of the printing press, could be mass-produced for a wide audience.

Compare Irving Leonard's comments on the romances of chivalry to the reactions of Adventure lovers:

> *These tremendously popular works of fiction . . . stimulated the emotions and won the passionate devotion of all literate classes of Spain, from the great Emperor Charles V himself to the lowliest clerk in his service. . . . The pages of this chivalric fiction were thumbed with an enthusiasm amounting to a passion. . . . The aristocracy of every shade and degree, including its womenkind, and even the clergy, devoted much of their ample leisure to this diverting pastime."* (See reference 3.)

The prose novels of chivalry, which Cervantes satirized in *Don Quixote*, delight in childlike fantasies of overcoming all difficulties, vanquishing all foes, and being rewarded with treasure and success in the process. The hero and characters in the chivalry stories are basically cardboard figures without internal conflicts and can be said to have no psychology at all. The pop-up characters in Adventure are limited in the same way.

Adventure and the novels of chivalry are based on a story structure of more or less independent units that are strung together and can be expanded infinitely. Today, we do not usually consider plot profusion and complexity as positive literary attributes, but this was not always the case. In the Renaissance, entangledness and complexity of plot were regarded as admirable qualities; the novels of chivalry have been considered "vast, almost unreadable jumble(s) of episodes that stand as a fitting monument to sixteenth-century taste for the fantastic." (See reference 4.)

Similarly, complexity in Adventure is achieved through the difficulty of remembering the layout of the cave and through the intricacies of the brainteasers you encounter. Such complexity seems to appeal to the computer enthusiast mentality. In *The Second Self* (see reference 5), Sherry Turkle comments on the worship in the computer subculture of the fantastic, the bizarre, and the intricate. This applies not only to a style of programming but also to tastes in literature (science fiction and fantasy) and music (baroque and jazz).

The loose structure in the prose novels of chivalry promoted joint or multiple authorship, another characteristic of text adventures. John O'Conner writes: "In general, the longer a chivalric prose narrative, the better and more influential it was. This kind of tale was written in such a way that, if popular response warranted, succeeding books could easily be added. Hence, the number of volumes a romance finally attained is an approximate gauge of its popularity." (See reference 4.)

The same can be said for text adventures as they get passed around on computer networks, modified, and expanded: the longer, the better.

IF and Fantasy/Science Fiction

In fantasy and science fiction, the author makes up an imaginary world and plays with the probable consequences of a set of rules that may be different from those governing our real lives. The author can set up the rules for the imaginary world in any way desired, but he or she must abide strictly by them.

This attitude toward rules is similar to that in computer programming, where the rules are arbitrary but absolutely binding. It is also an age-old literary technique.

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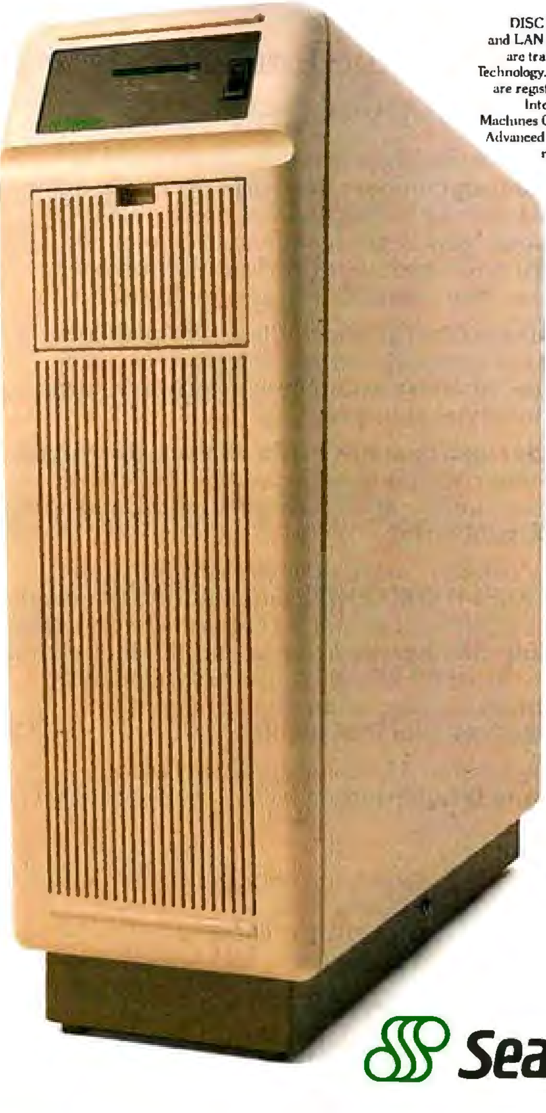

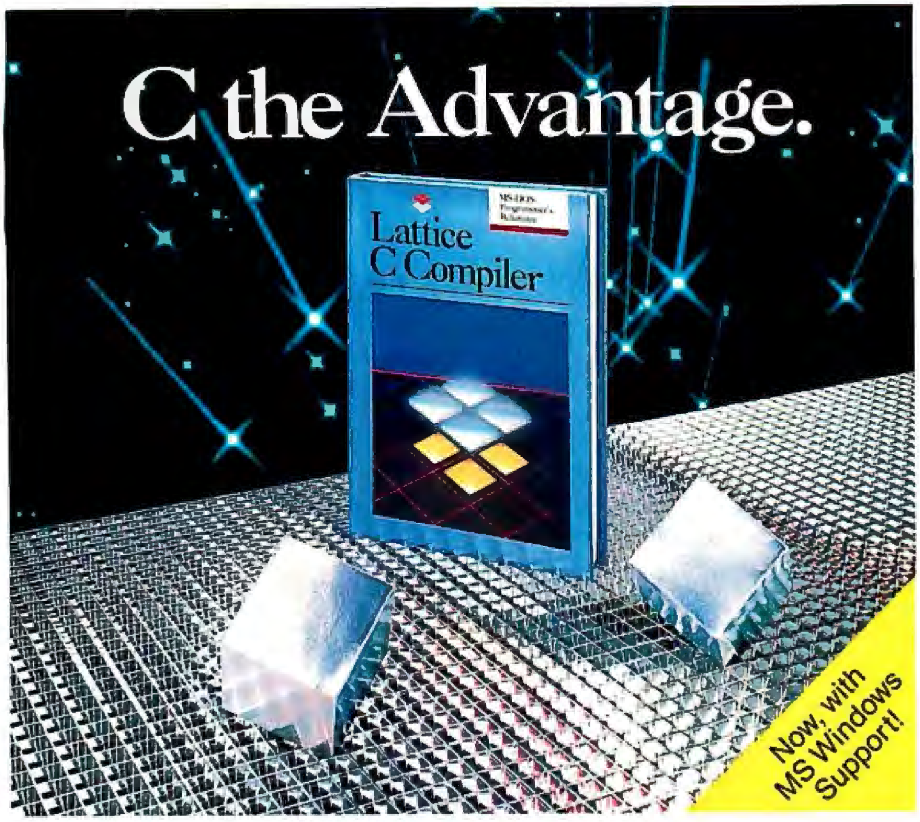

Around 330 B.C. Aristotle wrote

The poet should choose probable impossibilities rather than incredible possibilities . . . if a poet does take such a[n impossible] plot and appears to have handled it with some appearance of probability, the absurdity may be pardoned. Even the improbabilities about putting Odysseus on shore in the Odyssey would clearly not be tolerable if treated by an inferior poet. As it is, the skill of Homer conceals the absurdity and makes it pleasing.'' (See reference 6.)

Adventure's authors drew some of the content, characters, and motifs from science fiction and fantasy literature, especially from Tolkien's *The Lord of the Rings.* Don Woods says that he had glanced at Tolkien's description of Orodruin (Mount Doom, the volcano in the Land of Mordor where the evil Sauron forged the One Ring of Power) before he wrote the "Breathtaking View" scene in Adventure. Tolkien says of Mount Doom,

. . . its ashen cone would grow hot and with a great surging and throbbing pour forth rivers of molten rock from chasms in its sides. . . some would wind their way into the stone plain, until they cooled and lay like twisted dragon-shapes vomited from the tormented earth. Sam beheld Mount Doom, and the light of it. . . now glared against the stark rock faces, so that they seemed to be drenched with blood.'' (See reference 7.)

Compare this to the beginning of Wood's "Breathtaking View":

Far below you is an active volcano, from which great gouts of molten lava come surging out, cascading back down into the depths. The glowing rock fills the farthest reaches of the cavern with a blood-red glare, giving everything an eerie, macabre appearance.

How is Interactive Fiction New?

Although the story content of Adventure and other interactive works is related to established forms of literature, IF also differs from them on a very basic level—the reader's participation in creating the story and text makes the reader both a character and, in some sense, the coauthor of the story.

In IF, the nature of the text is also changed. The fluid computerized text allows a personalization and individualization of a literary work. The reader can talk to the text, and the text, in the form of the story's narrator, can talk back to the reader.

continued

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An acquaintance has calculated that the 'battery maze' in Adventure can be experienced in 187 billion trillion unique ways.

In conventional literature, a "gap" occurs when readers must interpret for themselves what the text means; the story is told, but its meaning is not. IF, however, contains not only gaps in meaning, but physical gaps in the text that the reader must fill in. These physical gaps in the interactive text allow such a wide range of explanations or interpretations of the fictional events taking place in Colossal Cave that it often seems as if different readers are not reading the same story. Some people play Adventure strictly as a game, while others read it as a straight story about exploring a cave and discovering the treasures.

Many, however, see Adventure as a story with deeper meanings. One player/reader believed the treasures in the cave were left by the good wizard of a long-vanished civilization, whose long-lost secrets would be revealed only when all of the puzzles in the cave were solved completely.

Another reader, a camper-backpacker, imagined that careless spelunkers had left the treasures in the cave. Yet another reader interpreted taking the treasures in the cave as stealing them.

The texts these three readers created were completely different because they read different stories into Adventure. This apparent drive to make context is a reflection in some ways of readers' psychological needs.

Some attempts have been made in more conventional literature to allow the reader choices about how a story unfolds, such as the "Choose Your Own Adventure" series. These books contain many story units; each lasts only a few pages and is complete in itself. At the end of a unit, either the story ends or you are given a choice and the story continues.

The artistic effects of these techniques fall far short of those in IF, due to the linear nature of text printed on paper. In IF, you make choices about each individual step and construct the story units for yourself; the choices are not predefined.

The quantitative difference between the number of possible stories in computer-based fluid text and the printed texts is also great. In one printed book, *The Cave of Time* (see reference 8), for example, there are 56 possible stories. In Adventure, the number of different stories must be, strictly speaking, infinite, since you can travel in repetitive loops within the cave and type in any comment and elicit at least some response. Even without resorting to loops and nonsense commands, though, the number of distinct possible texts is astronomical. A scientist acquaintance has calculated that the "battery maze" in Adventure alone (which has 12 different locations, 11 of them connected to 9 or 10 of the others) can be experienced in 187 billion trillion unique ways.

The fluid nature of interactive text and its computer medium explodes the traditional literary concept of the individual authorships of a printed text. In some ways, the authorship and transmission of the interactive text is similar to those of oral literature. With a printed text, we generally have the idea that there is a single author who "owns" the text; copyrighting reflects our views about this. But in oral literature and IF, single, joint, multiple, communal, unknown, and anonymous authorships are common. Adventure, for example, was first written and released by William Crowther, enlarged and improved by Don Woods, and released again. There are now many versions of Adventure, and programmers often personalize the programs so that the dwarves have the names of their friends, enemies, or despised professors, for example.

Bringing Beauty to the Beast

For those who would like to write interactive fiction, a few suggestions and observations follow. I have based them on the scripts of the texts readers created while playing Adventure and on the varying degrees of enthusiasm the readers expressed in interviews when they discussed Adventure's literary qualities.

1. Provide a unified but open text. In traditional literature, almost everything of importance to the story itself is explained to the reader. If a cave bear were locked up in golden chains in a conventional story, the author would probably explain somewhere who locked it up and why. This doesn't happen in Adventure. You not only stumble in surprise upon the events; you never really find out what they mean. Unfortunately, in Adventure, they usually don't mean anything.

I would suggest that any text adventure writer make up a supra-story, that is, a story that explains every object and the behavior of every creature, even though you don't reveal this supra-story to the reader directly. The events will then have an inner coherence, but readers can project their own supra-story onto them, just as each person arrives at a personal meaning for a poem.

2. Take advantage of step-by-step buildups. "Breathtaking View" was the aesthetic highpoint of Adventure for many readers. From the first hint of rumbling in the distance, through the stifling passages with their trembling walls, to the stunning vision of the volcano, most readers were gripped with emotion. Not surprisingly, many readers felt let down when they found out that nothing happens at the viewpoint. This letdown was one of the aesthetic low points of the game. The lesson to be learned is, if you build up story tension, make sure something exciting happens!

3. Give the puzzles a moral quality. For many people, merely winning points for gathering treasures is not as emotionally satisfying as doing good and overthrowing evil to win the points or treasures. Most readers preferred using the treasures and doing something with them later on, not dragging them back to the surface to win points. For example, several people told me they thought the hungry bear bound with the golden chains was the most enticing problem because they were emotionally involved with it. They didn't want to hurt the bear, yet they were mildly afraid of it. When the puzzles have a moral dimension, it gives them emotional depth.

Although there is no moral basis to the text in Adventure or to the solutions of the narrative puzzles themselves, the reader practices reality testing as a principle of action, which can be useful when carried over into the real world. While playing Adventure, readers test their interpretation of the story and events many times over. If you can't solve a puzzle, you must face the fact that you don't have enough information, that you overlooked or misjudged the information you do have, or that your general view of the story might be wrong. You have to maintain a critical attitude toward yourself and the fictional situations you confront, even as you are making choices. Needless to say, this can be a useful philosophy of life.

4. Create a narrator with a unified personality and vision. The narrator of a story is the one who tells the story in the text. Readers know that whoever or whatever they are talking to has a personality. Sometimes it is peevish, petulant, or whining; sometimes it seems to laugh at the reader. Make sure that your game has a personality that is consistent

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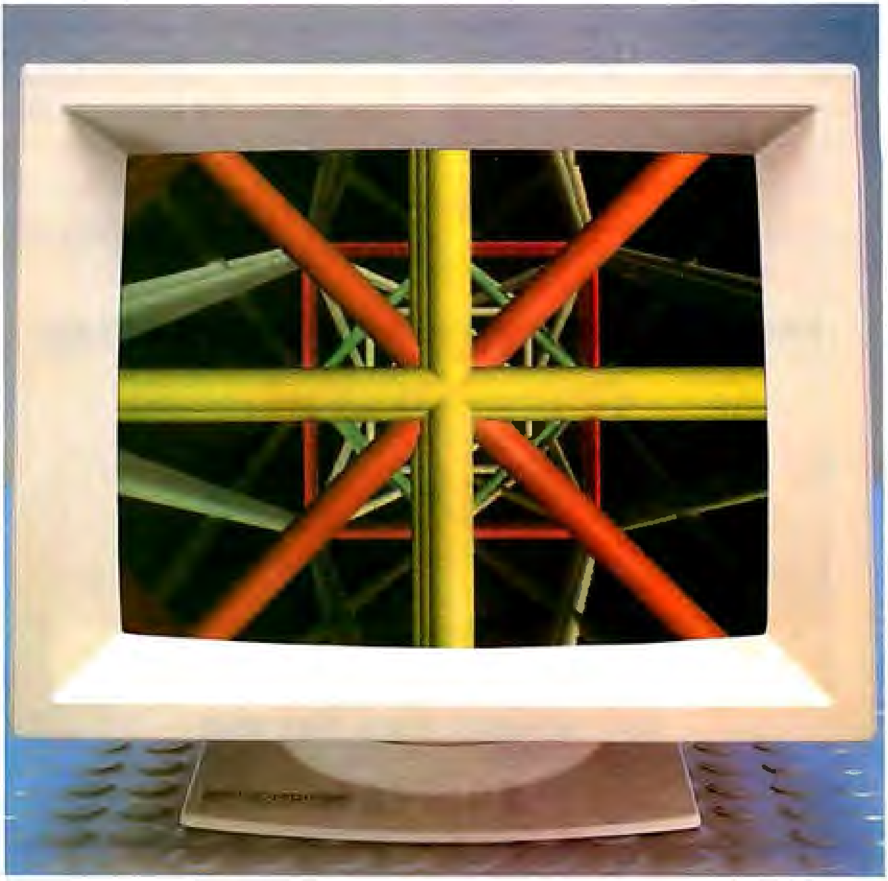

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from the reader's point of view.

You should also watch the narrator for consistency in what it does or doesn't know. For example, in Adventure, some readers seem confused as to whether the narrator knows the entire layout of the cave and is simply hiding it from them, or whether the narrator only knows about what it sees directly in front of it. They also are not quite clear about what the narrator is: a robot like R2D2, a computer like "HAL" in *2001, A Space Odyssey* or some entity with feelings of its own. You don't need to explain the narrator to the readers directly, just make sure you've got a clear image of it in your own mind.

5. Test your interactive story on other people. Get as many people as you can, in as many combinations as possible to play or read your story for you. Then watch them and ask them questions, during or after the game. (Some people are not able to explain what they are thinking or get frustrated if they get interrupted while they're playing.) The most revealing interviews or readings are often made by two or three people playing together at once. Group players often discuss and argue about whose interpretation of the fictional events is correct. This is an excellent way of finding out the various ways people interpret the events.

Have the computer make a script of the game as it is being played, which includes both the game prompts and the reader's responses. After studying the scripts, you can modify your program to deal with players' commands and vocabulary that you hadn't considered before. For example, one Adventure player assumed that "lamp" meant "flashlight," while others thought of it as Aladdin's lamp. The authors were clever enough to prepare responses consistent with either meaning.

The Future of Interactive Fiction

The first interactive texts were written by programmers who thought of them mostly as games, and the literature they created is unsophisticated. The computer itself, however, does not limit IF to frivolous works. Consider the development of film. Early film was an unsophisticated medium, "so crude in its initial stages that it was considered to be beneath contempt" (see reference 9). Only with D. W. Griffith's "Birth of a Nation" and, later, Charlie Chaplin's films, did audiences become aware that film could transmit and aesthetically mature experiences.

Now interactive stories are being written by traditional authors with technical assistance from programmers. Perhaps it will take someone who is both a programmer and an author to explore the artistic promise of IF and create works of literature that rank with the classics of traditional literature. ■

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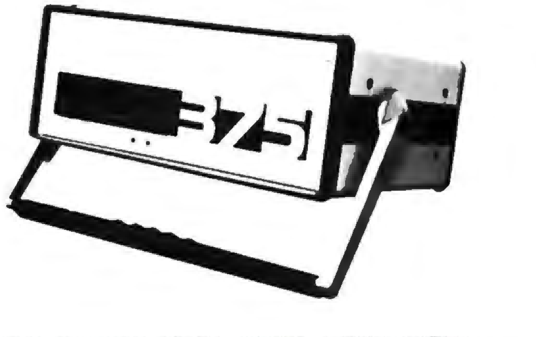

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Desktop Publishing

Introduction

Desktop Publishing

Very few developments in microcomputers have grabbed the attention of computer users quite like desktop publishing. In essence, desktop publishing gives you total control over the creation of the printed word. It provides a method for producing professional-looking documents without the need for outside typesetters and graphic artists. You can now write text, edit text, draw illustrations, incorporate photographs, design page layouts, and print a finished document with a relatively inexpensive computer and laser printer. Desktop-publishing systems can decrease the cost of producing documents and increase the flexibility for producing timely results.

But "desktop publishing" is a deceptively simple description for an extremely complex group of hardware and software tools. This new technology came about through a unique combination of existing technologies: faster personal computers, sophisticated word-processing programs, and laser printers based on photocopier technology. Practically every functional use of a microcomputer, from text processing to graphics manipulation to communications, is involved in the average desktop-publishing program.

John W. Seybold, a pioneer in the field of computer-aided typesetting and publishing, examines how desktop publishing has developed. His article "The Desktop-Publishing Phenomenon" describes how the development of the multifunction Altos workstation at the Xerox Palo Alto Research Center, the Xerox Star computer, and the Apple Lisa led to today's crop of sophisticated computers and graphics environments. He also establishes the criteria for what he considers a useful "platform" for a desktop-publishing system.

Choosing the correct software is a critical step in building a desktop-publishing system. There is a bewildering hierarchy of programs, from sophisticated word processors to typesetting programs, page layout programs, and dedicated publishing systems. Some are designed for novice users or simple applications such as pamphlets or small newsletters. Other packages are designed for more technical uses, such as page composition for book publishing. Thom Holmes, in his article "Make My Page!," takes you through this jungle and gives you a specific set of guidelines for the selection of software. He describes the composition features to look for, examines the strengths and weaknesses of several page-composition packages, helps you decide between the Apple Macintosh and the IBM PC computers, and lists all available desktop-publishing packages.

Jon Barrett and Kirk Reistroffer give a behind-the-screen look at how the image you see on the screen eventually appears on paper. In their article "Designing a Raster-Image Processor," they take us through a generic electronic-publishing system. Starting with a screen display of characters, the authors explain how a bit map of the text is manipulated and how proportional spacing, kerning, and ligatures are handled by software and hardware. They describe several page-description languages and explain how a PDL can take a 75 dot-per-inch screen display and transform that into data for a 300-dpi laser printer. Finally, they explain how the raster-image processor takes this data stream and transforms it into pulses of laser light in the laser printer.

Some desktop-publishing products are being used in ways their developers never imagined. Denis G. Pelli, a visual psychophysicist, has developed a different way of using the page-description language PostScript. In "Programming in PostScript," Pelli describes how he realized that Postscript-based output devices, such as laser printers or typesetting machines, could be programmed directly and used to create graphic images from mathematical descriptions. Writing his own PostScript programs, Pelli has developed subtle graphics patterns that help him study how people interpret visual information. He shares his knowledge and PostScript code and shows how you can program PostScript-based output devices to produce your own graphics.

Jerry Pournelle once said that microcomputers are a hardware implementation of the First Amendment. Desktop publishing is certainly a new form of freedom of speech. It enables us to manipulate and distribute information more easily than ever before. Yet there is a price to be paid for this freedom. With total control comes total responsibility.

—Stanley J. Wszola, Technical Editor

The Desktop-Publishing Phenomenon

Personal printing has come a long way in a short time

John W. Seybold

EVERYBODY UNDERSTANDS WHAT you mean when you say "desktop publishing," even those who have never used a computer. As a concept, it's compelling. As a product offering, it's the best thing that ever happened to personal computers. As a fillip for a market that—at least temporarily—had lost its momentum, it has been a godsend. As a harbinger of personal-productivity tools, it has been and will continue to be a prime example. Yet, in a sense, desktop publishing is a slippery product without a clear-cut definition.

The term is not old, and its origins are readily traceable. Paul Brainerd of Aldus, father of PageMaker, gets credit for coining the phrase. Apple Computer, looking for a vehicle to dramatize the Macintosh's capabilities, had the perspicacity to go all out on a promotional campaign. Without the Apple LaserWriter, desktop publishing would never have existed—desktop publishing didn't really make its debut until Apple announced the LaserWriter in January 1985. That was a short time ago, and a lot has happened since.

But the concept didn't just come out of the blue; an interesting history lies behind it. It originated in 1973, when an experimental multifunction workstation was developed at the Xerox Palo Alto Research Center (PARC). That workstation, the Alto, was the most important unannounced computer product of the 1970s. It was conceived as a completely self-contained, single-user computer, although its principal mission was to communicate with other similar devices over the original 3-megabit Ethernet local network. Because its designers had graphics applications in mind, the Alto had a high-resolution bit-mapped display screen and a mouse-pointing device.

No one intended the Alto to be a widely used system. Each run of Altos was supposed to be the last, but by 1981 over 1200 had been installed on 46 Ethernet networks in seven geographic areas. Outside of Xerox, Altos were assigned to a few selected sites, including the White House, the House of Representatives, the Senate, a few universities (especially Stanford), and several undisclosed locations in the U.S. and Europe. The large base of users provided input as to what was right and what was wrong with the Alto and the various software packages that had been developed for it. These included Bravo, Gypsy, Markup, Draw, SIL, and Laurel—for text editing and formatting, creating pictures and diagrams, and providing electronic mail by means of a central file server.

Even more important, PARC alumni disseminated their fascination with this product, and the ideas it generated, throughout the computer industry—especially on the West Coast—wherever they took on new roles as key members of advanced development teams.

From the Alto came the Star, developed under the aegis of Dave Liddle, vice president of office systems within Xerox's Office Products Division, and announced on April 27, 1981. The Star perpetuated four key concepts. The first was "seeing and pointing" rather than "remembering and typing." "Progressive disclosure" reduced the apparent complexity of the system by presenting you with only the information relevant at that moment. "Uniformity of commands across domains" made system procedures consistent. Once you understood the basic logic of the machine, you could deduce what to do next without recourse to manuals. Last was WYSIWYG (what you see is what you get). The display on the screen should always be a close facsimile of the final printed document.

The Descending Star

The Star never reached any kind of ascendancy. It was poorly marketed, was too expensive, and lacked a reasonable output device. The 8044 Print Server, offered as an Ethernet peripheral, cost $30,000.

But Steve Jobs had visited PARC and saw it all happen. He enlisted the support of some of the Star's major developers and brought out the Lisa, a $10,000 desktop unit with a high-resolution bit-mapped display screen, a Motorola 68000 processor with a million bytes of memory, two high-capacity floppy disk drives, a 5-megabyte hard disk drive, a

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The publishing process has suddenly become democratized and affordable beyond the fondest dreams of only a few years ago.

mouse, a user interface inspired by the Xerox Smalltalk system, and an impressively complete set of office application programs (LisaCalc, LisaGraph, LisaDraw, LisaProject, LisaList, and LisaWrite).

But the Lisa didn't have anything to write with that wasn't anticlimactic, even though its dot-matrix printer (with a standard resolution of 96 by 72 dots per inch) could move into a double-write mode of 160 by 144 dpi. The Lisa, too, was overpriced, ahead of its time, and not quite all there.

Still, the Lisa perpetuated the desktop metaphor of the Star and Alto. This metaphor is the origin of the "desktop" in desktop publishing.

The concept used almost all the screen to portray a desktop environment on which icons represented various familiar objects, images that you could point to and move about to make things happen. *The Seybold Report on Publishing Systems*, in describing this product in its January 31, 1983, issue, included a footnote that argued that, while some believe that the physical environment of an office needs significant change and shouldn't be emulated and "while we recognize many of the failings of the existing office, we also object to the arcane user interfaces typical of most computer systems . . . There can be no doubt that Lisa is different from many systems, and we are convinced that it is better than many systems because it uses icons."

Still, there was no desktop-publishing phenomenon. Nor did the phenomenon begin when Apple moved away from the Lisa and introduced the Macintosh in January 1984. It began in January 1985, when the LaserWriter made its debut. This $7000 plain-paper "typesetter" incorporated Adobe's RIP (raster-image processor) and Adobe's professionally designed fonts licensed from the International Type Face Corporation. Moreover, the event received the blessing of the most famous professional typesetting manufacturer: Allied Linotype (formerly Mergenthaler) threw tradition to the winds and embraced the technology, offering an interface, via Adobe's PostScript, to drive its Linotronic 101 and Linotronic 300 typesetters to produce truly professional output quality.

Aldus president Paul Brainerd had been in on the ground floor and played a role in persuading Apple that a typesetting application would be popular. The word "typesetting" is used in this context only because desktop publishing hadn't yet been invented, although with Aldus's PageMaker, and the hype that surrounded it, the term quickly emerged and conquered.

What Is Publishing?

As you can see from its history, the "desktop" part of desktop publishing was a product of the Xerox desktop metaphor, implying icons, bit-mapped screens, and the other features described above. The "publishing" part suggests that the LaserWriter would be more than a typesetter, since it could also serve as a final output device.

A typesetter produces only camera-ready copy from which printing plates are made, but you could use the LaserWriter to print multiple copies for distribution. This isn't very practical, however, because you'd want to print on both sides of the sheet (which is awkward), and the duty cycle of the LaserWriter won't support extensive emulation of a printing press.

"Publishing" also implies going beyond typesetting to produce graphics. While typesetting devices (now of the raster-image variety) have become increasingly capable of producing illustrative matter, this (with a few exceptions) was and is not commonly the way that graphics are reproduced. Generally, the platemaker or the camera operator combines graphics with text by stripping film onto the indicated page positions or double-burning illustrations onto printing plates that already contain the text.

Finally, "publishing" implies distribution to a readership. In its broadest sense, the word means to make known, presumably in a general way, to differentiate the activity from mere communications. Traditionally, publishing has implied the use of printing presses and paper, although today many publishers have ventured into nontraditional activities that make use of alternative media.

Thus, just as "desktop" is either too specific or too vague a term to provide a definitive description of the activity in question, so "publishing" is probably too ambitious or presumptuous. But the fact remains that the new technology has spawned a whole host of desktop publishers who are publishing—writing, producing, and distributing—to a readership, and the publishing process has suddenly become democratized and affordable beyond the dreams of only a few years ago.

Not Just the Mac

So far, I have focused on Apple's Macintosh. This has been intentional because, without the Mac, I doubt if desktop publishing as we know it today would ever have happened. But nowadays desktop publishing isn't limited to the Mac, and it may not be principally pursued on the Mac in the future. However, desktop publishing does not necessarily include any and all efforts to apply personal computers to text processing (or even typesetting). No product deserves inclusion in the category unless it meets all or, at least, most of the following criteria (although many people might be inclined to argue with me).

First, the system should let you compose text in a manner that comes close to the requirements of typesetting—that is, well-designed and proportionally spaced characters—along with the ability to produce justified lines if desired, including automatic hyphenation. The latter is what the graphic arts industry calls h&j (hyphenation and justification). The process of composition also generally implies other typographical considerations, including the use of more than one type font or size, and a character repertoire more extensive than that available on a typewriter. It also embraces the setting of tabular matter, indents of all kinds, and perhaps aesthetic character kerning.

Second, the system should let you perform the composition tasks I've alluded to in a manner that is considerably less code-intensive than that which characterizes traditional computer typesetting. This strongly supports the WYSIWYG bit-mapped screen and an interface that lets you point to the effects desired rather than requiring that you describe them by some sort of command language. Command codes might inevitably be embedded in the text stream or in some sort of pointer file, but in either case they are transparent to the user.

Already I have excluded from my definition a good many typesetting programs written to perform professional typesetting, or which emulated them. These were code-intensive and required considerable user experience in markup and composition programming. There are a good many programs of this sort. In fact, they antedate desktop publishing. Some of them are powerful and go well beyond the capabilities of desktop publishing, but they are something else again.

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Third, the system should let you include graphics and output illustrative matter along with the text. This implies, for example, the existence of some sort of pagination or area composition program—not just what the industry calls "galley composition." This feature also implies that you can create graphics on your system, import graphics into the system, or both. Graphics features created within the system do not necessarily need to be produced by the same software that handles composition, but the relationship between the handling of text and graphics must be as seamless as possible.

Illustrations can be generated by business graphics programs that pull figures from a spreadsheet and convert them into bar or pie charts. They can be created by painting, drawing, or CAD programs, or be scanned in from a peripheral device such as a scanner. They can even be captured by means of a video camera. Or perhaps the pictures can be moved over from a digitized clip-art collection. The pictures need not be derived from photographs (continuous-tone images) and screened to become halftones for purposes of reproduction, but they might well be. The system should also provide some means, within itself, to perform a variety of manipulative tasks, such as sizing, cropping, image rotation, or enhancement.

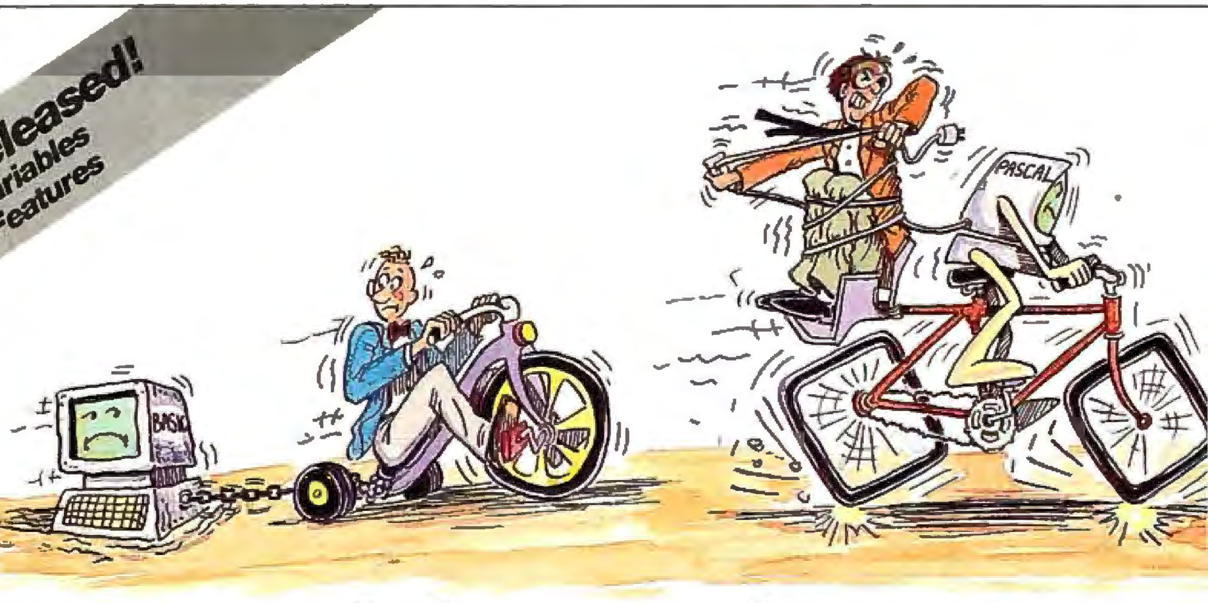
Fourth, the system should offer some reasonably good editing capabilities. Ideally, you should be able to use the same kinds of editing tools offered by the best word processors and to make changes interactively, not merely to uncomposed text, but to text in the process of interactive composition. In other words, you want a system sophisticated enough to let you look at a composed page on the screen, identify a paragraph that needs rewriting, and make that change then and there, without reverting to some sort of input file. Whatever the system's capabilities are, desktop publishing clearly demands an effective editor as part of the package.

Finally, the system must be able to produce output on at least one device that offers a resolution of 200 or more (I would prefer to say 300 or more) dpi. Without this, you can't handle graphics, except a few bar charts and the like, and the quality of type doesn't deserve to be considered publishable. Beyond that, the system should interface to (or contain) one or more RIPs that work with PDLs (page-description languages) capable of producing a variety of outputs, including output to a high-resolution typesetter. This is the beauty of PostScript, Interpress, and Document Description Language as page-description languages. And this is what RIPs are for—the hardware and software necessary to interpret and translate that language into commands to drive the desired device.

Not all so-called desktop-publishing systems meet all the criteria outlined above. Some of them fall quite short. Even PageMaker was unable to perform automatic hyphenation until recently. Many program developers have never heard of kerning. Some programs use type-width values that are simply too gross to produce good-quality output. I believe that type-width increments as tiny as 1/216 inch are essential, and I would prefer much finer increments. This figure is based on the reasoning that an increment should not be less than 1/18 of a printer's em (a unit of measure based on a piece of type that is as wide as it is tall), and an em needs to be at least as small as six points (1/72 inch).

Putting It All Together

A happy coincidence of events has been engendered or accelerated by powerful,



low-cost computer chips: the advent of scanning and graphics packages, for example, and the ability to store a hyphenation dictionary in memory along with tables of width values and typesetting macros.

Another important technology was pioneered by Bitstream. It was able to transfer the art of type design into a computer science, and develop the contacts and initiative to get the rights to a library of classical type fonts and transform them into a database. The authority and persuasiveness of true type makes a significant difference between publishing and mere communications.

For many users, desktop publishing will end with laser-printer output. For others, such 300 dpi output, while a significant improvement over letter-quality daisy wheels, is the first step. The laser printer often furnishes merely the proofing copy, and then the output can be redirected to a true typesetting system, either convenient to the desktop of the user or by arrangement with a neighborhood trade typesetter.

Again I come back to the desktop. The implication is clear that the devices must be inexpensive, small, easily installed without the need for professional assistance, and easily maintained. One person should be able to easily take control of the entire process. He or she can learn and practice all phases of it, more or less intuitively, keep track of all the components within the system, and function effectively in a creative and a production environment to produce publication-worthy products.

Publishing Platforms

Although the Macintosh and the LaserWriter started it all, others soon got into the desktop-publishing act. The IBM PC was, in some respects, an ideal platform for the development of a desktop-publishing system because it is ubiquitous, powerful, and open. In other respects, the PC has been awkward and frustrating. Graphics capability does not come easily to it, and no intuitive and seamless way exists for the user to flow copy and graphics into and through the system.

When applied to the Macintosh, the term "platform" is easy to understand. It consists of a certain amount of hardware and a clearly understood set of operating conventions sufficient (with the aid of an RIP in the output device) to provide a platform for the development of application software.

But the PC has no comparable platform. You must specify what kind of graphics board is available, and, to get an appropriate environment, you need Windows under MS-DOS or GEM under its own set of conventions.

Nevertheless, in describing available systems, you will often hear of a PC platform as if it did exist. I would caution you to make sure that some degree of seamlessness is possible with the aid of the particular planks used to build the platform you choose.

In a sense, the IBM platform, despite its ambiguities, is more congenial for the development of future desktop-publishing applications than the Macintosh, simply because it's more "naked" and can be clothed or ornamented more easily by clever designers. Some of the desktop systems for the PC platform are so powerful that it becomes impossible to draw a clear-cut distinction between desktop and professional publishing.

To draw such a distinction, once you are satisfied that all the typographical niceties are provided for, you have to look closely to determine whether you can "grow" a given desktop system for simultaneous use, in some sort of sharing and

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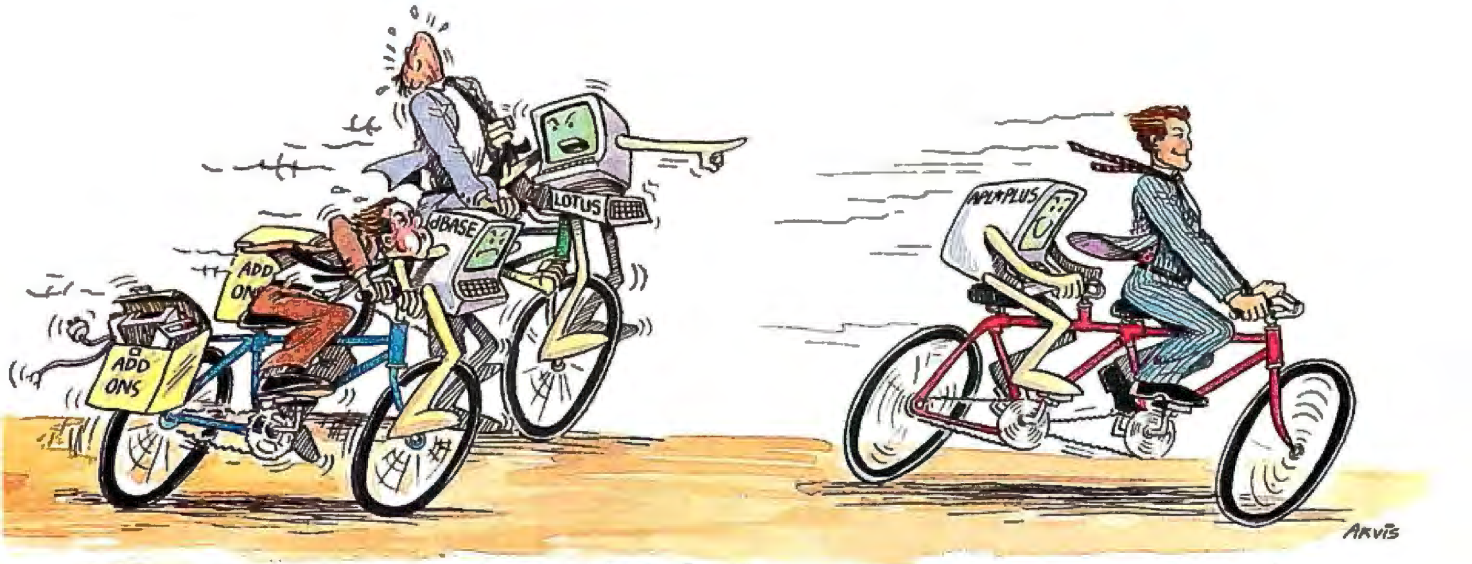

networking mode, with a fairly large number of users.

In my opinion, the primary difference between a professional front-end system and a desktop-publishing system lies not so much in the system's composition and graphics capabilities as in supporting a fairly large number of users. In other words, the file-handling capabilities of, say, a newspaper or magazine editorial system must be powerful and sophisticated. I haven't seen anything in the low-end, desktop market that offers the queue and directory structures essential to the copy-flow requirements of a major publishing venture. These will no doubt come in time, and when they do, the distinction between desktop and other publishing systems will probably fade away.

This is not to suggest that all systems will offer the same capabilities. Significant differences exist between desktop offerings, not only in terms of typographical niceties, the ways in which illustrative matter is handled, and throughput speeds, but more specifically in terms of the type of work the system can best handle.

For example, some systems are built around yet a third platform: workstations that support UNIX, which are patterned after Donald Knuth's $\TeX$ and which handle multilevel mathematics, scientific notation, and book pagination in an environment that is primarily batch-oriented, rather than interactive in nature.

Some systems, built on either a Mac or PC platform, are superb at area composition (making up blocks of copy—like newspaper display ads) but can't cope with running the pages of text necessary for book composition. Still other systems intended primarily for short pieces—brochures and newsletters—try to offer something a bit more appealing than word-processing output. However, they don't come to grips with what makes for good-quality composition, such as control over interword spacing; letter spacing; frequency of hyphenation; handling of hangers, widows, and orphans (lines or portions of lines that stand by themselves when they should join to larger text blocks); and all of the other features that contribute to the artistry of composition.

Opportunities at Hand

Desktop publishing has come a long way in a short period of time. Now on the desktop are tools that take advantage of the knowledge and experience of generations of artisans and designers. Without serving a long term of apprenticeship in a specialty such as photoengraving or hand or machine composition, you can quickly and pleasurably become a desktop publisher. ■

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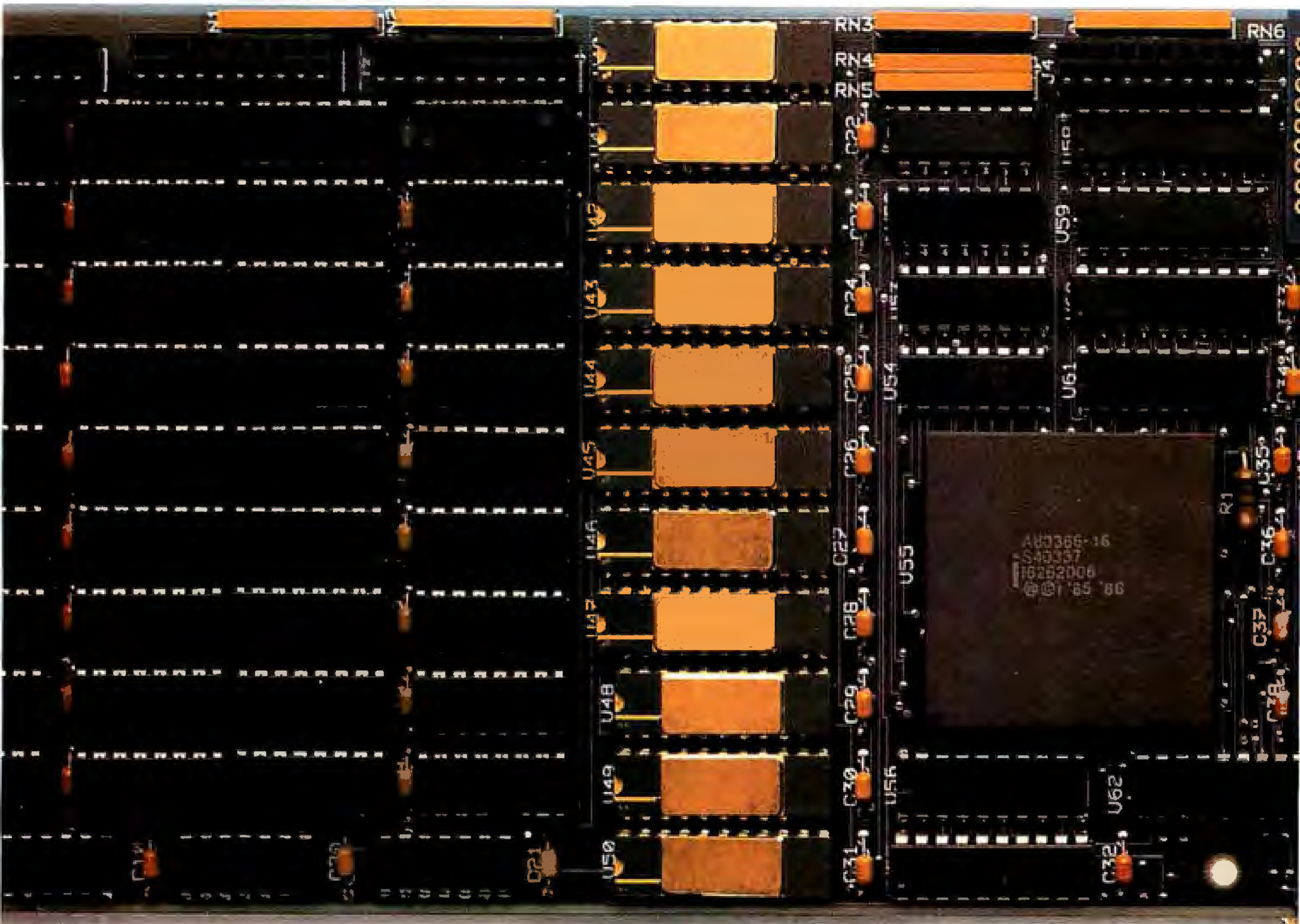

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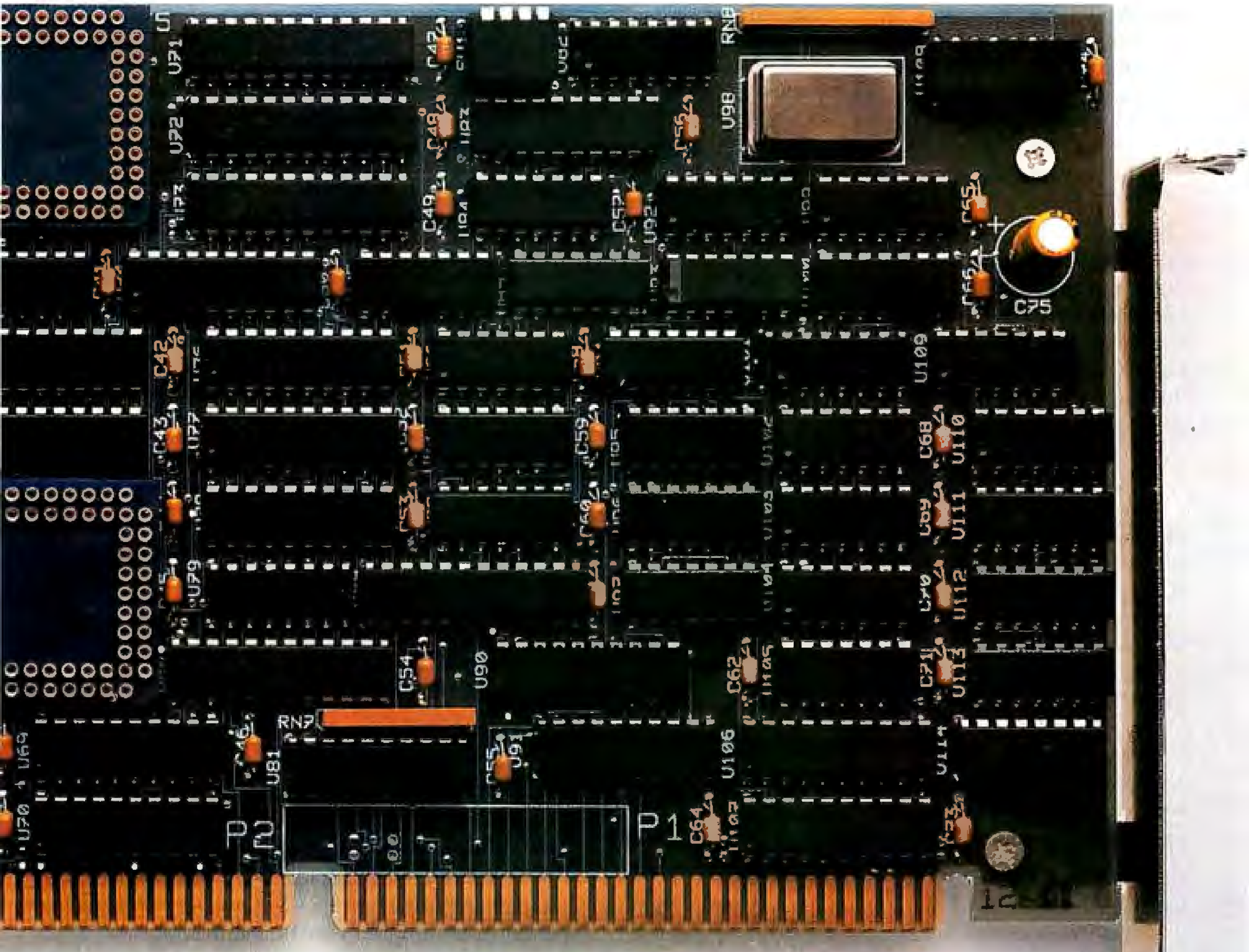

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Make My Page!

Here's how to choose the best desktop-publishing program for your needs

Thom Holmes

RECENT ADVANCES IN microcomputer technology and the development of relatively low-cost laser printers have made it possible to use desktop computers in place of traditional composition systems for many publishing applications. Assembling a desktop-publishing system involves little more than buying a microcomputer, laser printer, and publishing software.

The most critical of these choices is software. It is also the most difficult choice to make because of the bewildering variety of publishing software available for microcomputers. The programs are designed for many different levels of users. Some are meant for novices and provide easy-to-use, although simplistic, WYSIWYG (what you see is what you get) functionality; others are intended for technical people already familiar with composition coding and the extensive use of key commands.

In desktop publishing you use off-the-shelf hardware and software components, as opposed to turnkey systems that use proprietary software and special workstations. The basic components making up a desktop-publishing system include a personal computer, hard disk, high-resolution monitor, mouse or other control device, laser printer, and composition software. In addition, the system will probably include a word-processing program and any number of graphics programs for paint or draw functions. A final option, for incorporating existing images into documents, is a digital scanner.

Whether you choose an IBM PC, Apple Macintosh, or other hardware base for your system, the cost of a basic setup can run between $10,000 and $15,000. Publishing or composition software itself, which is the focus of this article, ranges anywhere from $200 to $8000, a range that is likely to close during the coming months as competitive packages begin to be more comparable. Tables 1 and 2 list IBM PC–based and Macintosh-based publishing packages and their distinguishing features.

Software Basics

All publishing software packages are not created equal. Some are designed to focus on one or two specific functions, while others are broad-based and provide a little bit of everything. Not many of the programs for microcomputers are strong in all areas. Among the features of these programs are text creation and editing; graphics creation and editing; interactive page layout using a mouse and a graphics display of the page; batch composition in which all pages are automatically composed according to preset page and typographic specifications; importing of text and graphics from other programs; true typographic control over hyphenation, justification, leading, kerning, and other features; automatic page numbering; and automatic repagination (renumbering of pages) once a document has been edited.

The heart and soul of desktop-publishing programs are the composition features—those elements that let you design a page format, control typographic specifications, and perform pagination prior to output. For this reason, most microcomputer publishing programs focus on composition features, rather than text and graphics features. The text and graphics elements of a publication are commonly created using programs other than the desktop-publishing package, and are imported into the publishing program at the time when pages are being composed. Keep in mind that, in addition to the publishing program itself, you will probably need to find compatible word-processing and graphics-illustration programs.

Publishing software for microcomputers is relatively expensive compared to the cost of software to which most users have become accustomed. Compared to the cost of using outside text compositors and typesetters, however, the software can pay for itself in less than a year. The programs make no particular demands on personal computers; they often require some extra memory and a hard disk drive, but these are features that many users already have.

Menu-Driven vs. Command-Driven

The two basic approaches to the design of publishing software for microcomputers are based on the two leading hardware products: the IBM PC and the Apple

continued

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Table 1: *IBM PC–based desktop publishing packages and their features.*

Vendor	Product	Hardware requirements	Imports from word processing programs	Import ASCII files	Command-driven	Menu-driven	Icon/mouse-driven	Spelling verification	Size(words)
Addison-Wesley Publishing Company	MicroTEX 1.5at	IBM PC, XT, AT 512K RAM		●	●				
Aldus Corporation	PageMaker 1.0 for the PC	IBM PC AT or compatible, EGA or other windows-compatible card, 512K RAM, hard disk	Microsoft Word, WordStar 3.3, MultiMate, XyWrite, WordPerfect, DCA files, Volkswriter	●	●	●	●		
Alphatype Corporation	Work Station III-PC 4.1	IBM PC, XT, AT, 640K RAM, hard disk, Hercules graphics card		●	●	●		●	160,000
Amgraf	Mecca III 2.00	IBM PC AT or compatible, 1.5-megabyte expansion memory, math coprocessor, 30-megabyte hard drive, high resolution, color monitor	WordStar; VI Text Editor	●	●	●		●	90,000
Award Software	Laser-Press 52.04	IBM PC or compatible	WordStar, MultiMate	●	●	●			64K bytes
Bestinfo	Superpage 2.0	IBM XT, AT or compatible, 640K RAM, Hercules card, hard disk		●		●	●		
Compugraphic Corporation	PTS Composer 1.0	IBM PC, XT, AT or compatible, two drives (one must be 360K disk)		●	●	●			
CyberResearch	CyberType, CyberMerge 1.3	IBM PC, XT, AT or compatible, Hercules adapter, 384K RAM	MicroSoft Word	●	●			●	
Data Transforms	^{1}Printrix 2.4/^{2}Fontrix 2.8	IBM PC or compatible, 256K; 512K, CGA, supported printer (Fontrix)	Microsoft Word, WordPerfect, WordStar 2000, PFS:Write	●	●	●			
G.O. Graphics	DeskSet 1.0	IBM PC, XT, AT or compatible, dual disk drives or hard disk, 512K RAM, Hercules card	WordStar, MultiMate, WordPerfect, PC Write, DisplayWrite	●	●				
Itek Graphix Corporation	PTW 2.0	IBM PC, XT, AT or compatible, hard disk, Hercules graphics card		●		●		●	
Lexisoft	Spellbinder Desktop Publisher 6.2	IBM PC or compatible w/ 256K RAM, and CGA, EGA, Hercules Vectra Multimode, or AT&T 6300, graphics card		●	●			●	50,000
Magna Computer Systems	Magnatype 1.5	IBM XT, AT or compatible, 640K w/ hard disk		●	●			●	25,000
Megahaus Corporation	First Impression	IBM XT, AT or compatible, hard disk, 512K RAM, Hercules, CGA, EGA, or MDS Genius Graphic	DisplayWrite (DCA), WordStar, MultiMate, WordPerfect	●			●		
Microsoft Corporation	Word 3.1	IBM PC or compatible, 256K RAM, MS-DOS 2.0, two disk drives or hard disk		●		●		●	
Network Technology Corporation	The Gutenberg Laser Composition System 2.0	IBM PC, XT, AT or compatible, 512K RAM, hard disk		●	●	●			
New American PagePlanner	PagePlanner-PRO 3.0	IBM PC, XT, AT or compatible, 256K RAM, Hercules or CGA	WordStar	●		●			
Personal TeX	PC TEX 2.0	IBM PC or compatible, 10-megabyte hard disk		●	●				
ProSoft	Fontasy 2	IBM PC or compatible, 512K RAM, CGA or Hercules graphics adapter		●	●	●			
The 'Puter Group	PageWriter 2.1a	IBM PC or compatible, 640K RAM, color graphics card		●	●	●			
The 'Puter Group	PC-Preview 2.1a	IBM PC or compatible, 640K RAM, color graphics card		●	●	●			
The 'Puter Group	PC-Transfer 1.0	IBM PC or compatible, 256K RAM		●		●			
ScenicSoft	ScenicWriter 4.0	IBM PC, XT, AT or compatible, 256K RAM, hard disk		●	●				
Software Channels	scLASERplus 1.2	IBM PC, XT, AT or compatible, 256K RAM, graphics card	WordPerfect, WordStar 2000	●	●			●	50,000
Software Publishing Corporation	Harvard Professional Publisher 1.0	IBM PC, XT, AT or compatible, 640K RAM, Hercules graphics card or IBM EGA	DCA-compatible	●		●	●		
Studio Software Corporation	FrontPage 1.1	IBM PC, XT, AT or compatible, 512K RAM, math coprocessor, and graphics card	DisplayWrite 2/3, EasyWriter, PFS:Write, MultiMate, WordPerfect	●			●		
TYX Corporation	TYXSET 3.1	IBM PC, XT, AT or compatible, 512K, Venix 5	WordPerfect, WordStar, MultiMate, Perfect Writer	●	●	●		●	20,000
West End Film	Pagework	IBM PC, XT, AT or compatible, 512K RAM		●		●			
White Sciences	Pagebuilder	IBM PC, XT, AT or compatible, 512K RAM, JLaser or JLaser Plus card; EGA, Hercules, or Genius Display System		●	●	●	●		
WordPerfect Corporation	WordPerfect 4.2	IBM PC or compatible, 256K RAM, hard disk or two disk drives	MultiMate, WordStar	●	●	●		●	
Xerox Corporation	Xerox Ventura Publisher 1.0	IBM PC, XT, AT or compatible, hard disk, 512K, EGA, CGA, Hercules, Genius, or Xerox Full Page	WordStar, MultiMate, Microsoft Word, WordPerfect, Xerox Writer	●			●		
Xyquest	XyWrite III 3.1	IBM PC, XT, AT, Jr-compatible, single disk drive, 256K RAM		●	●				

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•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	Programs, scanner	•	•					HP LaserWriter, HP LaserJet Plus, QMS PostScript 800, Imagen	$295-$750
•						•	•						•	•	•	Programs, Scanner	•	•				Linotronic 100, 300	HP LaserJet Plus, IBM Pageprinter 3812, PostScript-compatible	$695
•			•			•	•	•	•	•	•	•						•				Alphatype CRS Typesetter	Apple LaserWriter	$2700
•	•	8	•		•	•	•	•	•	•	•	•	•	•	•	Programs, scanner	•	•	•	•		Autologic, Linotronic 100, 300	Apple LaserWriter, PostScript printers	$3500
•			•		•	•	•	•	•	•	•	•	•	•	•	Programs, scanner	•	•	•	•	•		HP, Ricoh, PCPI, AST, C. Itoh, Canon, Kyocera, QMS, Hanzon, Cordata	$495
•	•	Unlimited	•			•	•	•		•	•	•	•	•	•	Programs, scanner	•	•	•	•	•	Allied, A, Compugraphic, Itek, Varityper	Apple, Hewlett-Packard, QMS, Xerox	$7000
•			•			•	•	•	•		•	•										Compugraphic 8000, 8200, 8400, 8600	Compugraphic EP 308	$3495
•	•	9	•	•	•	•	•	•	•	•	•	•		•	•		•	•	•	•	•	Linotronic 100, 300	PostScript-compatible	$495
•[2]	•	3	•								•	•	•[2]	•	•	Programs	•[1]		•[1]	•[2]			HP, Quadlaser, Kyocera, Jlaser	[1]$165; [2]$155
•	•	20	•			•	•	•		•	•	•	•	•	•	Programs, scanner			•	•		Linotronic 100, 300	PostScript-compatible	$995
•	•		•			•	•	•	•		•	•	•	•	•	Programs	•	•				Digitek 5000 typesetter	PTW laser printer	$1495-$4995
•	•	Unlimited	•	•	•	•	•	•	•	•	•	•	•	•	•	Programs, scanners	•	•	•	•		Linotronic 100, 300, PostScript-compatible	HP LaserJet Plus; LaserJet; Cordata 300x LaserMaster; QASYS	$695
•	•	Unlimited	•		•	•	•	•	•	•	•	•		•	•	Scanner	•		•			Linotype-VIP, 202, 100, 300, 100P Compugraphic 8000, 8400	Al PostScript, Tegra Genesis	$8500
•	•				•	•		•	•			•	•	•	•	Programs, scanner				•		Linotronic 100, 300	PostScript, HP LaserJet, Interpress, DDL, IBM Pageprinter, Canon LBP2	$695
•	•	Unlimited	•	•	•	•	•	•		•		•					•		•			Linotronic 101 and 301	Apple LaserWriter and LaserWriter Plus; AST TurboLaser	$450
•	•	Unlimited	•	•	•	•	•	•		•	•	•		•	•	Programs, scanner	•		•		•		HP LaserJet Plus, Canon A2	$695
•	•		•			•	•	•		•	•	•	•	•	•	Scanner		•		•	•	AM Comp/Set; Compugraphic 8400, 8600; Linotronic 100, 101	HP LaserJet Plus, Cordata 300, Apple LaserWriter, IPL	$3995
•	•	Unlimited	•	•	•	•	•	•	•	•	•	•	•	•	•	Programs, scanners	•		•			Autologic APS 5/M5	HP LaserJet/LaserJet Plus, PostScript (Apple), QMS Lasergrafix, Imagen	$249
•	•	Unlimited				•		•		•	•	•	•	•	•	Programs	•	•	•	•			Ricoh, HP LaserJet and LaserJet Plus	$69.95
•			•	•	•	•	•	•	•		•	•	•	•			•	•				Linotronic 100, 300, 500	PostScript-compatible, HP LaserJet series	$295
•		Unlimited	•	•	•	•	•	•	•		•	•	•	•			•	•				Compugraphic MCS and PowerView	PostScript-compatible	$1495
•			•			•	•	•		•	•	•										Compugraphic MCS and PowerView		$695
•	•	20	•	•	•	•	•	•		•	•	•		•	•	Programs, scanners	•		•			PostScript-compatible	PostScript-compatible	$695
•	•	Unlimited	•	•	•	•	•			•	•	•	•				•		•	•			HP LaserJet, LaserJet Plus	$495
•	•	6	•			•	•	•	•	•	•	•	•	•	•	Programs, scanner	•	•	•			PostScript-compatible	PostScript-compatible	$695
•	•	Unlimited	•			•	•	•	•		•	•	•	•	•	Programs, scanner		•		•	•	LinoType 200, 200N, 202W, 300; Compugraphic 8000, 8400, 8600	HP LaserJet Series, and PostScript printers	$695-$1295
•	•	9	•	•	•	•	•	•		•	•	•	•	•	•	Programs, scanner	•		•			Linotronic 100, 202, 300; Siemens, Autologic, Compugraphic	PostScript-compatible, Canon CX-compatible	$2495
•												•	•	•	•	Programs				•	•		PostScript-compatible	$750-$1450
•	•	Unlimited	•								•		•	•	•	Programs, scanner	•	•	•	•	•		All Canon (w/ JLaser Plus) and Ricoh (w/ JLaser 2) printers	$495
•	•	24	•	•	•	•	•	•	•				•	•	•	Programs	•	•	•	•				$495
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•	•	20: 6 snaked		•	•	•	•	•	•			•			•	Programs, scanner	•	•				Monotype, Linotype	Apple LaserWriter and LaserWriter+, HP LaserJet series	$395

Table 2: *Macintosh-based desktop-publishing packages and their distinguishing features.*

Vendor	Product	Hardware requirements	Imports from word processing programs	Import ASCII files	Command-driven	Menu-driven	Icon/mouse-driven	Spelling verification	Size(words)
	TEXture 1.0			•	•	•	•		
	PageMaker 2.0 for the Mac	drive.	Microsoft Word, Microsoft Works, MacWrite	•	•	•	•		
	MacPublisher III 1.0		Microsoft Word, MacWrite	•		•	•		
	MacTEX 2.0			•		•	•		
	ReadySetGo 3.0	Switcher	MacWrite, Microsoft Word	•		•	•	•	
	Megaform 2.3		Megafiler				•		
	Megaform 2.3/Megafiler		MacWrite				•		
	Word for Macintosh 1.0		MacWrite	•		•	•		
	PS Compose 1.0			•	•	•	•		
	Stylo-Type I 1.11			•	•	•	•		

Macintosh. Programs written for the IBM PC tend to be command-driven and appeal to the more technical end user, while Macintosh programs are menu-driven and appeal to nontechnical people. There are exceptions to these rules, but for the most part, software seems to fall into one of these categories, which have relative advantages and disadvantages. Menu-driven programs are easy to learn, interactive, and appeal to nontechnical users, but they can lack full composition functionality, have both limited text formatting and typographic options, and are often slower to use than command-driven programs.

Command-driven programs can offer a high level of composition functionality, extensive text formatting and typographic options, and faster response time. Thus, they will appeal to technical people and those already familiar with composition. However, they can have commands that are difficult to learn and remember, and they do not always employ interactive page makeup using a graphics display. When examining a program, you should consider the level of technical expertise of the intended users as well as your requirements for interactive page makeup using a graphics display.

The following is a brief discussion of some of the relative advantages of Macintosh-based publishing software versus IBM PC-based programs. Most of the time, the program's capabilities are directly tied to the machine's capabilities.

The Macintosh Platform

High-resolution, easy-to-manipulate graphics are the Macintosh's forte, and the user interface provided with the Macintosh operating environment is by far its biggest virtue. Publishers of desktop-publishing software have used this interface to their best advantage, predominantly relying upon the mouse and limiting keystrokes to a few commands. Macintosh programs generally make it easy for you to import text and graphics and to arrange these elements in the document.

Macintosh-based programs can, however, present problems for more demanding users. In a business setting, for example, although some of these programs can serve for many internal applications, none seem to have all the features necessary to produce true typeset-quality documents. These programs cater to ease of use and let you produce nice-looking documents quickly. But often the Macintosh programs cannot produce camera-ready output and generally do not permit composition of a lengthy document.

The early market leaders in the electronic-publishing software market for the Macintosh include PageMaker from Aldus, MacPublisher from Boston Publishing Systems (formerly Boston Software), and ReadySetGo, developed by Manhattan Graphics and sold by Letraset. All three packages can import text and graphics from other Macintosh programs such as Microsoft Word, MacWrite, and MacPaint.

The packages differ in the way they let you design a page, the type of tools they offer, and so on. For example, PageMaker lets you decide how many columns you want, and you can then adjust column sizes with a mouse. ReadySetGo is less interactive but more precise: You tell the system exactly how big you want a

Columns	Snaking	Number available	Tables	Index/table of contents generation	Footnotes	Hyphenation	Automatic	Discretionary	Interactive	Batch	Kerning	Leading	Layout visible on screen	Text/graphics integration	Graphics from ext. sources	Source	Automatic pagination	Interactive pagination	Batch pagination	Drawing	Data-driven charts	Typesetters supported	Laser printers supported	Suggested list price
			●	●	●	●	●		●	●	●					ns	●		●				Postscript-compatible	
●						●	●	●	●		●	●	●	●	●	Programs, scanner	●	●					Apple LaserWriter, LaserWriter Plus, Dataproducts LZ4 2665	
●	●			●		●	●	●	●		●	●	●	●	●	Programs, scanner		●		●			PostScript-compatible	
●	●										●	●	●	●	●	Scanner	●		●				Apple LaserWriter, LW Plus and other PostScript-compatible	
			●					●	●							Programs	●	●		●			Apple LaserWriter and LaserWriter Plus	
●	●		●													Programs, scanner	●	●		●			Apple LaserWriter	
●	●		●													Programs, scanner	●	●		●			Apple LaserWriter	
●	●		●		●	●		●	●			●				Programs	●		●				Apple LaserWriter	
●	●		●													Programs, scanner	●	●	●	●			PostScript-compatible	
			●		●							●	●			Programs	●		●				Apple LaserWriter	

column to be by typing in a size. ReadySetGo can also repaginate automatically, a feature missing in PageMaker.

PageMaker was originally the most expensive of the three major publishing applications for the Macintosh—at $495, it cost nearly two and a half times as much as MacPublisher or ReadySetGo, even though PageMaker did not at the time offer a proportionately larger number of features. Still, it became the leading seller for the Macintosh. All three programs currently feature many more professional composition features than they did in 1986, with consideration finally given to hyphenation, page numbering, kerning, and leading.

The IBM PC Platform

Desktop-publishing packages available for the IBM PC appear to place emphasis on producing text-based documents. In keeping with the system's features, IBM PC–based packages tend to be command-driven systems that can provide full composition functionality. This feature is attractive to composition professionals but does require that you have some familiarity with the operating system. One feature lacking in text-only composition systems is the ability to merge graphics with text.

Perhaps the most capable of PC-based publishing programs is Ventura Publisher from Xerox. Built upon the GEM desktop environment, Ventura Publisher combines a screen-based WYSIWYG interface with "style sheets" that let you determine the exact specifications for any page, paragraph, image, or other element by choosing from a menu of predefined "tags."

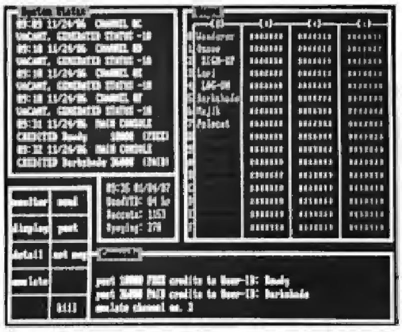
Text files written or changed from within Ventura Publisher can be saved and used by word-processing programs—a unique feature and a good one if you want to archive text and use it again.

Finally, the recently released version 1.1 of Ventura Publisher is compatible with a variety of page-description languages such as PostScript, Interpress, and DDL. Ventura can produce output on Apple's LaserWriter, the HP LaserJet and a host of other printers. At $895, Ventura is more expensive than other PC-based packages but is considered by some to rival expensive dedicated publishing systems produced by companies like Interleaf.

Aldus Corporation has begun shipping an IBM PC–based version of PageMaker that is similar in look and feel to the Macintosh version. PageMaker PC uses the MicroSoft Windows environment to support a mouse and interactive WYSIWYG page makeup.

MagnaType, from Magna Computer Systems, is one of a small number of packages available for use on a personal computer that act as a front end for an actual typesetting system. Its ability to compose text or import it for composition further narrows the field of competition. Deskset from G.O. Graphics and PC-Type from Modtek are typesetting composition programs that compete with MagnaType, but Magna has the reputation and exposure that these other packages lack. MagnaType's capabilities reside in its ability to drive a wide variety of typesetters as output devices and to take advantage of the composition features of these machines. As a typesetting software package, MagnaType has few peers.

continued



Some documents such as newsletters or brochures can be done page by page, which is handled best on an interactive graphics display.

Bestinfo's Superpage is a high-end desktop-publishing system in the same league with MagnaType as a typesetting composition package. However, Superpage offers a greater degree of display interactivity than other typeset composition packages. This ability to see what you are designing is important for newcomers to text composition or typesetting.

Superpage also lets you design forms precisely, an important feature if you plan to read data off of the form with an optical character reader (OCR), which often requires precise alignment of material. The program's filing capability lets you keep track of the text files with which you are working, which version you are using, and so on. All these features are important in producing composed documents, especially to the inexperienced user. In comparison, MagnaType is much more code-intensive for these functions.

Frontpage (formerly Do-It) from Studio Software is an IBM PC–based desktop-publishing program that is easy to use and takes advantage of a mouse. Those intimidated by any command-driven software might gravitate toward packages such as Frontpage. Frontpage allows for professional-looking typeset-quality text and also permits a degree of manipulation in terms of the location and size of the text. Although considered a low-end typesetting package, Frontpage has a relatively high price (compared to the more capable systems mentioned above) when you take into consideration the add-ons it requires.

If you have already invested in an IBM PC and HP LaserJet printer, the package of choice may be Lexisoft's Spellbinder Desktop Publisher. This composition software package lets you graphically depict a made-up page before outputting it. Lexisoft was the first to offer this feature at a relatively low cost.

Like most desktop-publishing programs, Spellbinder Desktop Publisher lets you incorporate into your publication any file created on another word processor as an ASCII file. Although this can also be said of the typeset composition packages from Magna and Bestinfo, these are several times more expensive.

Word Processor as Publisher

Word-processing programs are limited in what they can do to affect text size, appearance, and layout. Composition programs, on the other hand, are designed to manipulate the size and style of characters as well as the placement of copy and graphics on the page. Finding a powerful word processor to serve as a front end to the composition program is as important as selecting the publishing package itself.

A number of IBM PC–based word processors are well suited to interface with composition software. Microsoft Word, for example, has more flexibility in selection of fonts and more detail in spacing and margin specification than its competitors; it will convert files from other formats; and, perhaps most important, it will store page formats for later recall—an important step toward publishing periodical material.

The Macintosh version of Word is alone in its competitive class. MacWrite is its only serious competitor at the word-processor level, but early versions of MacWrite were more of a beginner's word processor than a package for the prolific writer.

The MS-DOS version of Word has a distinct advantage in output flexibility. It offers a greater choice of output devices, which gives you a variety of configuration options. The ease with which you can choose different fonts encourages creative use of type in Word documents, an important aspect of publishing. And the MS-DOS version of Word is easy to learn and use.

Word's biggest challenger appears to be WordPerfect from WordPerfect Corporation (formerly Satellite Software). The programs have similar capabilities and are very popular with professional writers.

Another popular word processor is XyWrite III. As a text-processing system that supports minimal graphics and can drive a laser printer for the production of newsletters and manuals, XyWrite III compares favorably with Word and WordPerfect. It is also less expensive.

As a microcomputer-based text generator for composition systems, XyWrite has no competitors. XyWrite's compatibility with almost every other system in the composition-systems market has made it the most popular text-processing package for microcomputers in the publishing industry. It has become the program of choice for people in the composi-

continued

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Reno, NV 89513
(702) 322-1884

TYX Corporation
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(703) 471-0233

West End Film
1825 Q St. NW
Washington, DC 20009
(202) 232-7733

WordPerfect Corporation
266 West Center St.
Orem, UT 84057
(801) 227-4404

Xerox Corporation
101 Continental Blvd.
El Segundo, CA 90245
(800) 822-8221

Xyquest Inc.
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Bedford, MA 01730
(617) 275-4439.

The word processor that serves as a front-end to the composition program is as important as the publishing package itself.

tion business and is commonly used to emulate the editing functions of large editorial systems such as Atex—perhaps because its founders came from the publishing systems industry rather than the office-automation industry.

Guidelines for Selecting Software

Before looking for a desktop-publishing program, you should ask some questions. First, what user interface level do you desire? Are the users nontechnical or technical people? If you prefer using a mouse or similar pointing device, the number of programs to choose from narrows.

What programs will be used to create text and graphics? They must be compatible with whatever publishing program you select.

Does the application call for graphics capability? Knowing specifically the kind of graphics you require will greatly aid in selecting software. Some programs let you draw or construct graphics from within the program. Others allow merging with externally produced illustrations and even scanned images. More common are packages that simply allow holes or windows for inserting photos or illustrations after the text is composed.

Is networking a need or possible need?

Is the page makeup performed interactively or in a batch mode? Some short documents such as newsletters or brochures can be done page by page, which is best done with an interactive graphics display, while long documents that have a strict predesigned format can best be made up in an automatic batch mode that puts text files into the desired page layout.

Finally, will the program need to interface to a laser printer or typesetter? Many programs allow the use of many fonts and character sizes. The use of these features naturally requires a laser printer as an output device. You can use a dot-matrix printer for producing draft-quality output for review. More advanced (and therefore more expensive) programs provide interfaces to typesetting devices.

As you might expect, the cost of microcomputer-based publishing programs runs the gamut from about $195 for a basic Macintosh program to between $2000 and $8000 for a high-level IBM-based program. You must study the level of commitment and desired results closely before selecting a program.

Distinguishing Features

To the casual observer, most desktop-publishing programs look the same. It is common to come away from a trade show featuring publishing software and not have the slightest idea of the differences between one program and another. All the demonstrations tend to look the same, and unless you attempt some kind of benchmark using each program, the pros and cons of a package are not likely to surface immediately.

If the programs' specifications read the same and they all seem somehow adequate for your application, take a closer look by exploring the following nuts-and-bolts considerations. These features are often overlooked but largely define the true usefulness of a publishing program.

What output devices are supported? Which makes and models of laser printers? Which typesetters?

What interfaces exist between this program and word-processing and graphics programs? Can it accept files from your text and graphics software?

How does the system paginate? Is it done interactively (page by page) using a WYSIWYG display? Or is it done in a batch manner based on user-programmable document specifications? Keep in mind that paginating long documents is no fun if you have to do them manually, page by page on the screen.

Is a hyphenation program available?

Can you specify the leading (line spacing), or do you have to live with a limited number of default settings?

Is kerning (intercharacter spacing) available? Kerning permits the professional spacing of words and characters on a line for the sake of justifying copy.

Is automatic page numbering available?

Will the program automatically produce a table of contents and/or an index of your document?

Can the program create equations as graphics elements in a document?

Does the program provide footnoting capability?

These features separate the good, the bad, and the ugly in desktop-publishing software. By answering the questions about your application and then applying the answers to table 1, you can be confident that the program you buy will do the task you have in mind with a minimum of headaches. ■

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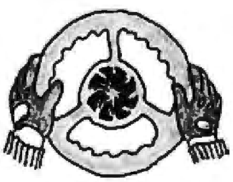

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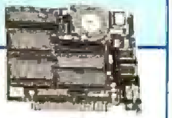

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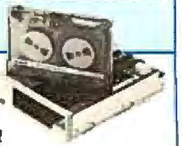

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Designing a Raster-Image Processor

The road from screen display to hard copy is circuitous

Jon Barrett and Kirk Reistroffer

ASKING THE QUESTION "How do you drive a laser printer?" is less like "How do you drive a car?" than like "How do you drive to Cambridge?" The question "How do you drive a car?" has a fairly specific and uniform answer having to do with using a steering wheel and two or three floor pedals. But "How do you drive to Cambridge?" depends on where you are starting from and whether you want to take the fast or the scenic route. Similarly, "How do you drive a laser printer?" depends upon where you are starting from and what kind of results you expect.

Despite this, some generalizations can be made about the aims and methods of driving laser printers. In this article we will talk about a generalized front end for a raster-image processor (RIP) and explain how what shows up on-screen finally shows up on a laser-printer output. First we will describe some of the page-description languages (PDLs) important in the desktop-publishing world. Then we will explain how RIPs work in general. Finally, we will discuss our approach to the hardware and software necessary to drive a laser printer, with emphasis on what we think are some innovations in the technology.

In our generalized example of an electronic publishing system (EPS), we have several aims. First, we want it to show on-screen what will appear on paper. That is, we want a WYSIWYG (what you see is what you get) system. Second, it must generate sophisticated graphics, allow easy revision of them, and display them on-screen. Third, it must allow for mixing typefaces and sizes on any one page, preferably without limit. Fourth, it must allow mixing of graphics and text, preferably without any limit on complexity. Fifth, it must be able to print out, with fidelity, all that the user has created. Sixth, the quicker it can do this, the better.

To accomplish these aims, we need several components. The front end on the host computer must let you create documents of arbitrary graphic and typographic complexity. Second, documents must be translated into a PDL, a series of commands which a laser printer can "understand." Finally, the system must have hardware that takes the digital information describing the page and turns it into modulations of the laser, causing the image to appear on the paper. This hardware is called a RIP. (A raster, or raster scan image, as used in the context of computer graphics, is a two-dimensional array of pixels.)

It might seem that the process of getting the document's image onto the CRT screen is essentially the same, from the logical point of view, as getting it onto paper. To a certain extent, that is correct. The image on paper and the CRT image are both views into the same database, in this case a document. But several issues arise that distinguish the two processes. Chief among these are the questions of hardware and resolution dependence. Most EPSs have opted for some form of independence in both regards. That is one reason why PostScript is so popular; a PostScript description of a page will theoretically produce the same page, given differences in resolution, on any PostScript output device. Thus, EPS software designers can write a single driver for their system and have confidence that it will produce accurate printed pages when hooked up to a variety of printers. The chief disadvantage is that this dependence prevents an EPS from taking full advantage of a specific output device.

In fact, as we shall explain, in our design we opted for some limited device and resolution dependence. This means that we do not have to pass parameters with enough information to drive a typesetter at 2000 dots per inch if we are in fact driving a 300-dpi laser printer. This optimizes for data compression, which can improve the printer's total throughput. This is especially true when the communication channel is relatively slow, as in the case of the 9600-bit-per-second serial AppleTalk line used by Apple's LaserWriter. Obviously, a resolution-dependent system demands more initial work from the designers. Also, our device dependence enables us to hand-tune fonts for the particular printers we support, optimizing them for legibility and style.

The question of machine dependence is not academic. For example, some laser printers write to white and some write to black. That is, some consider the image

continued

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drum in the printer to be a black object that must be "erased" to carve out black letters, and others consider it to be a white object onto which black dots must be placed. In either case, you want to lay down dots that are slightly larger than a pixel so they will overlap. If you are writing to black (laying down black dots), the character so constructed will be noticeably fatter than one carved out of a black background (see figure 1). A font that works well on one printer can look ungainly on another. Therefore, there is a real reason to use machine-dependent drivers.

But to understand how RIPs and PDLs have evolved the way they have, it is necessary to know a little about the short history of laser printers.

History of Laser Printers

Although laser printers have been around since the mid-1970s, they were text-oriented and in the $500,000 price range. Thus, when Canon introduced the LBP-10 laser printer in 1979 for $10,000, it caused a great deal of excitement.

The first laser printers using the Canon engine, while exciting, were inadequate for the needs of the generalized EPS that is our example. They did support downloaded fonts, but they did not have sufficient graphics capabilities. For example, they could not fill an arbitrary polygon.

Then, in 1981, Imagen introduced a laser printer with an important advance. To compose an entire page before printing, you need enough memory to hold data about each of the dots to be printed, about a megabyte's worth for a 300-dpi printer. At that time, a megabyte was expensive. So Imagen figured out a way to print full pages without having the entire page in memory. This technique was implemented in their RIP. The Imagen technique was clever. It internally considered a page to consist of a matrix of "postage stamps," each of which it could compose in real time. If a "stamp" were text only, it would create the raster image on the fly. If the data were part of a large, uniform area, it would take one "stamp" and replicate it, saving memory.

This was an improvement over the Xerox laser printers of the time, for while they could print as much text as wanted on a page, virtually the only graphics they would print were horizontal and vertical lines for tables. But the early Imagen laser printer could not print pages with very complex graphics. And it did not do clipping. (To clip an image is to crop off selected portions of it.) Also, the amount of memory available too severely limited the number of vector lines that could be printed. (Vector-line graphics is a method for drawing graphics using straight lines. Each line is usually described by its end points.) This is an important limitation when your set of geometric primitives does not include circles and arcs, so curves have to be represented by hundreds or even thousands of vector lines. Finally, because the letters were logically ORed into the graphic "stamps," the printer could not produce white text on a black background: Assuming that a set bit is one that prints, ORing a set and a reset bit results in a set bit.

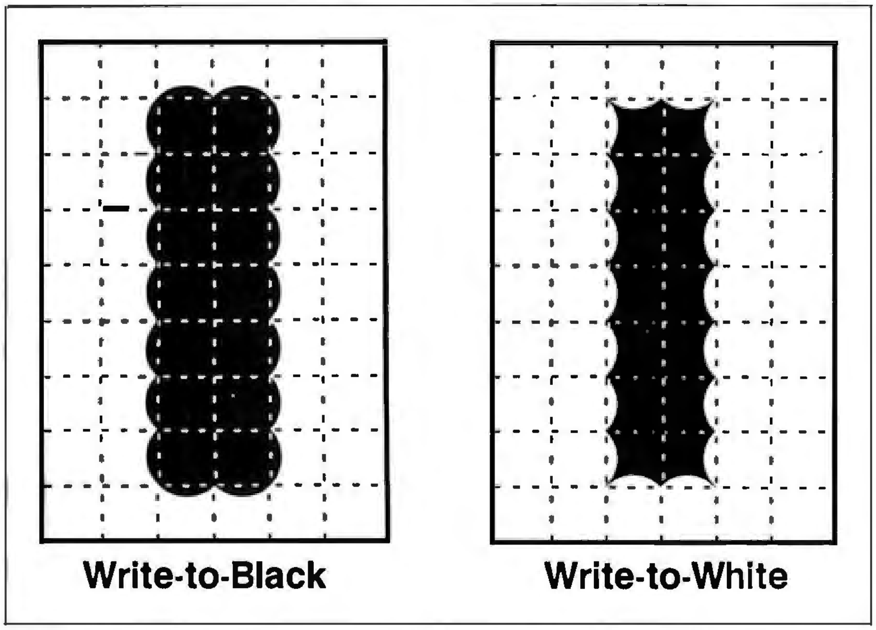

Figure 1: *With write-to-black printers, black pixels are written to a white background. With write-to-white printers, white pixels are written to a black background. The resulting fonts can appear substantially different, as in the case of the sans serif l's shown here. Hand-tuning fonts for specific printers can enhance legibility and style.*

Previously available laser printers, such as the Hewlett-Packard LaserJet, were very popular although not the most functional. They could handle text adequately but did not shine when it came to complex graphics. The latest generation of laser printers from Hewlett-Packard, Imagen, and other vendors has overcome many of the limitations of earlier models, in large part because memory has become cheap enough to make large memory boards that can hold a full-page bit map. The memory generally consists of at least 1.5 megabytes. Of this, about 1 megabyte is for the page bit map, and the other 0.5 megabyte is for temporary storage, variables, and cached fonts. (Cached fonts are, in essence, fonts downloaded from the host computer or computed from outlines.)

In addition, ROMs are available that may contain font bit maps that the printer will use to compose the text on a page whenever the PDL has told it to insert some characters. The ROM's bit map is compatible with the printer's resolution if the PDL is device-independent. Most printers in this class offer between 1.5 and 2 megabytes of memory. Improved software has enabled these printers to produce pages of considerable complexity.

Putting the Image on Screen and Paper

The main section of an EPS program, which puts the characters on the display screen, is fairly standard. The basic display loop for our generalized EPS has to grab the bits that compose the character and put them into an arbitrary place in memory, typically a screen buffer dedicated to the task. To draw the character quickly, you need to grab the largest chunk of data you can at a time. Our imaginary computer uses the Motorola 68000 that has a 16-bit data bus. Thus, the most data available for grabbing in any one cycle is 16 bits. These bits are then moved into a two-dimensional array.

This would be fairly straightforward if you were dealing with monospaced text, since each character would then occupy a bit map of the same size. But our generalized EPS does not. It provides on-screen proportional spacing. Further, there is the problem of kerning letter pairs in which one character hangs over another as in the case of the letters VA or italicized lower case f's (see figure 2). (Some systems treat some commonly kerned pairs, such as ff, as single bit maps. In traditional typography, such pairs, occupying a single piece of type, are called ligatures.) To achieve this, you cannot treat each character as occupying an inviolable rectangle. Rather, you must logically OR bit maps that intersect. When you OR them, all bits currently set in the destination bit map remain set, while those set in the intersecting source bit map next set the appropriate bits in the destination bit map.

This solves the problem of displaying bit-mapped, proportionally spaced characters on-screen. But the 300-dpi resolution of a laser printer is four times greater than the approximately 75-dpi resolution of workstation display screens, which means the printer has 16 times the number of dots per page. Although the algorithm is basically the same, because it is 16 times the data, the job is slower.

The problem is how to blit, that is move or logically OR a source bit map of a glyph (i.e., a bit map that contains a character or a symbol, typically one that will be reused) into the destination bit map (screen or printer). ("Blit" as a verb comes from BLT, an acronym for bit boundary block transfer.) As an example, let's take a simple case such as blitting the letter A. If the source is an array one word wide, we want to write this to a destination that is also one word wide. But remember that we are dealing with proportionally spaced text. Thus, glyphs will not necessarily fall on word boundaries in the destination. With a 16-bit word (which is the size of the word we actually deal with), the chances are only 1 in 16 that the glyph will fall on the boundary. Thus, our problem is writing a glyph that is one word wide to a destination where it will straddle two words. (In general, if n is the width of the glyph in words, the problem will be to write it to a destination $n+1$ words wide.)

The basic loop for a software blit (see figure 3) consists of the following steps: First, you get the source word, then shift it right to reflect the offset from the destination's word boundary. Next, get the destination word. OR the shifted source and destination word, and write it to the destination. Get the source word again (or keep it in a register), then shift it left to reflect the offset. Get the destination +1 word. OR the shifted source and destination +1, and write to destination +1.

The second access of the source word is necessary to take care of any portions of the source bit map that run over into a second word space.

Document to PDL

We now have some characters on the screen. How do we get them to the printer? Remember that what is written to screen and what is written to the printer are two views of the same document. This document, at least the text portion of it, is one-dimensional. In putting it on the screen, the EPS software has to make decisions about how to bring it into two dimensions: where should the line breaks

continued

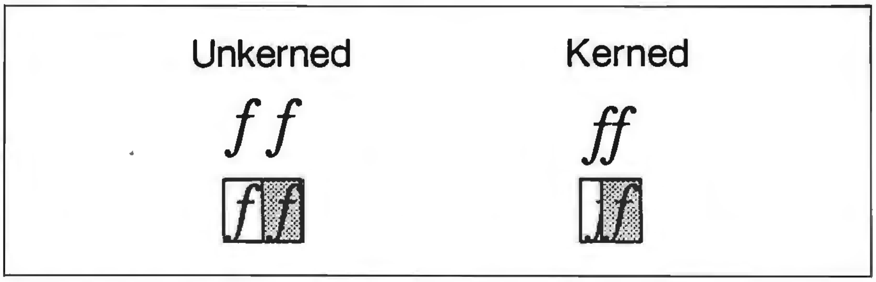

Figure 2: *Unkerned italicized f's, shown on the left, each occupy an inviolate rectangle. Kerned letters, on the right, overhang each other, complicating the bit-mapping algorithms.*

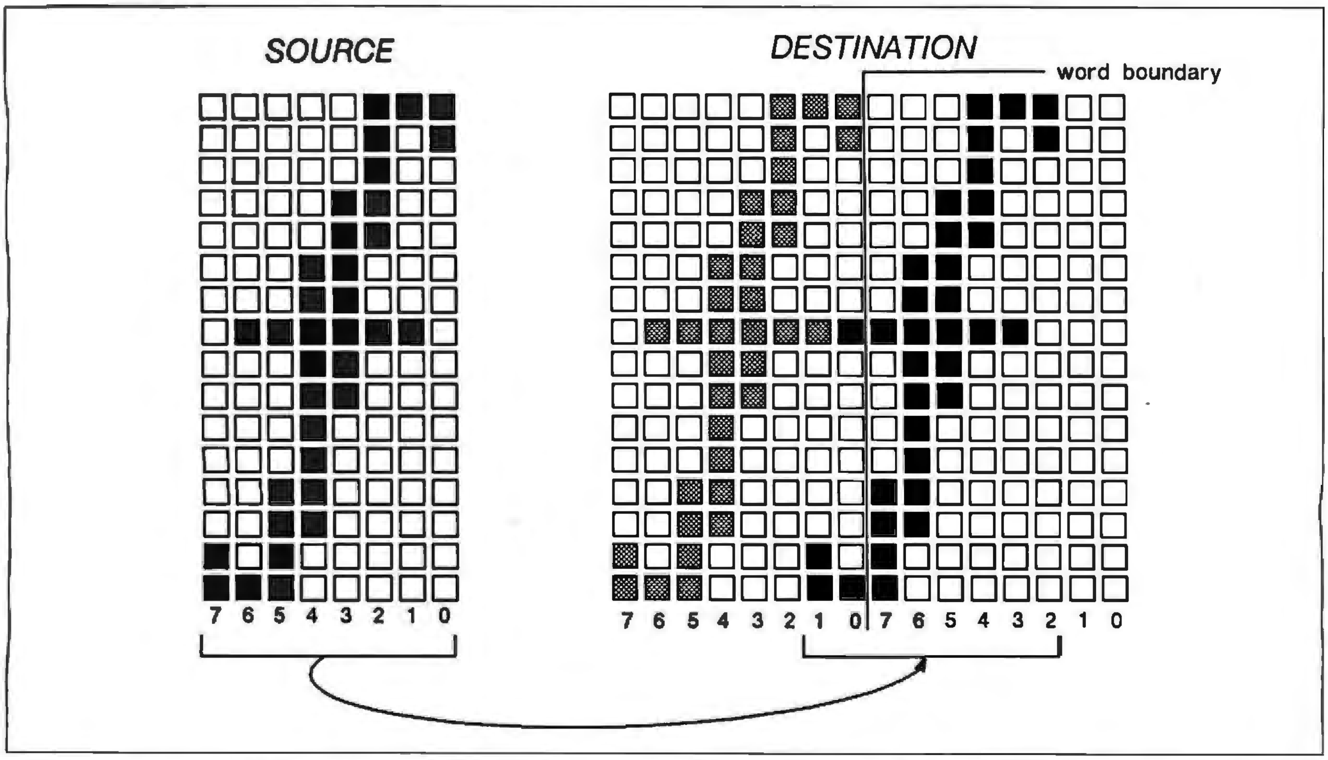

Figure 3: *To move the source bit map row by row into the destination bit map (which can straddle word boundaries), each row must be shifted by the offset from the word boundary. In this case, the offset is six. In this example, kerned italicized f's are shown, but the problem can occur with any letter. This figure uses 8-bit words to simplify the diagram.*

be, where should the page breaks be. In non-WYSIWYG systems, such as batch systems, those decisions are made after all editing has been completed. In a WYSIWYG system, those decisions have to be made on the fly to keep the screen updated. This can be a daunting task, since inserting a single letter while editing can cause a sentence to drop onto the next page, setting off pagination ripples throughout the document. Further, some EPSs (such as Interleaf) provide on-screen hyphenation, which means that after you type each word-terminating character, you have to check the preceding character string against a dictionary to find the hyphenation points. (You can use an algorithm in lieu of a dictionary.)

In a true WYSIWYG system, those problems have been solved, and document integrity is maintained at all times. No post-editing formatting is required to prepare for printing. But you cannot simply ship bit maps over the screen to get the printer to work well, if only because that would grossly underutilize the printer's ability to produce relatively high-quality output.

A variety of techniques have evolved, but the fundamental steps are the same. The PDL must generate the commands to tell the printer which fonts to use. (If it does not have fonts stored, describe the fonts by sending bit maps or mathematical descriptions of them.)

The PDL then generates the commands to tell the printer where to place the characters. It describes the graphics and takes care of bookkeeping chores, such as sending an end-of-page command when appropriate.

The first step is for the host to translate the document into pages that can then be described by the PDL. (In our generalized EPS, pagination is done in real time; some older-generation systems require a separate pagination process after editing is complete.) If the system designers want to be able to deal with several different sorts of printers and PDLs, they might decide to have the host generate an intermediate language sufficiently generic to be intelligible to various PDLs. The intermediate language might also be optimized for graphics. For example, a circle can be described in various ways, including treating it as a polygonal shape, using coefficients, or giving its center and radius. The intermediate language might optimize for data compression by describing the circle in the way that requires the least data, while still providing sufficient data for various PDLs to reconstitute it accurately.

It is perfectly possible, and not uncommon, to use no intermediate language at all. But in a network environment it is useful to separate the different phases of the translation from document to PDL, and consequently intermediate languages become more important. For example, if the document's host emits an intermediate description of the page, the printer server can translate it into the specific PDLs of the various printers it might service. Thus, one server can drive several different sorts of printers. Also, the intermediate language can be optimized for data compression, which is especially important when operating in a network environment.

Page-Description Languages

At the moment, several PDLs are vying to become the standard, although there is even debate about whether a standard is desirable. The two best-known ones are PostScript from Adobe Systems and Interpress from Xerox Corporation. A more recent contender in the standards fray is Imagen's Document Description Language (DDL).

PostScript seems to be gaining ground in the low-end desktop-publishing market. For example, PostScript drives the Apple LaserWriter. Interpress might prove to be more adept at dealing with very high speed printers such as the 120-page-per-minute Xerox 9700. DDL is a strong contender, especially since Hewlett-Packard has announced that it will support this language in some future products. One such product is a low-cost RIP that can be added to IBM PC AT systems to turn a previously installed LaserJet into a full-functionality text and graphics printer. Finally, RIPrint is the PDL we designed; we will discuss it later (see reference 1).

Interpress

Interpress was created in 1982 by Robert Sproull and William Newman at the Xerox Palo Alto Research Center. It remained for internal use only until 1984, when some versions were made public.

Interpress is a tokenized language, within which documents are represented in an encoded form. Each variable is preceded by a length field so that the interpreter knows in advance how much data the current token requires to be read from the input stream. This facilitates the transmission of documents quickly and reliably over a network without recomposition. This is an advantage for demand publishing on high-throughput printers, but for most users the benefit seems small.

The body of an Interpress document contains the characters to be printed and printing instructions as to the desired appearance of the document (e.g., whether

continued

Alsys launches PC AT-TO-370 ADA Cross-Compiler at November ADA Expo; 80286 Debugger also introduced.

A new Alsys cross-compiler permitting Ada programs to be written on an IBM-PC AT and executed on an IBM 370 was introduced at the November Ada Expo in Charleston, W. VA. The cross-compiler, pre-validated to AJPO test suite 1.7, is priced at $2,995 and includes a 4 MB RAM board.

Two compilers, the Alsys validated PC AT self-hosted compiler, and the AT-to-370 cross-compiler, are offered as an option at $4,995. One RAM board serves both compilers.

The cross-compiler, and especially the two-compiler option, implements a "distributed programming" environment for which the Ada language and its "package" concept is particularly suited. The two-compiler option permits developers to program in Ada and test their results at their workstations before uploading 370 object code to the mainframe.

Alsys also introduced its PC AT debugger called AdaPROBE at the Expo. AdaPROBE combines a unique Ada-VIEWER with regular debug facilities.

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DDL can produce both a user-readable and a tightly encoded form.

to print on two sides, and how to stack it in the printer). The document creator can determine and alter the coordinate system at any time, affording a measure of device independence. Generally, Interpress documents do not carry with them bit maps of characters. Bit-map images are supported for printers with resolution of about 300 dpi (the standard for low-end laser printers). Publicly available Interpress printers support limited transforms on characters, permitting, for example, rotations of only 90 degrees.

PostScript

Adobe was formed in late 1982 by John Warnock and Charles Geschke, both of whom left Xerox to design PostScript. The first PostScript-based laser printer, the Apple LaserWriter, became available in the spring of 1985.

PostScript is an interpreted language for describing, in a device-independent fashion, the way in which pages can be composed of characters, shapes, and digitized images in black and white, gray scale, or color. PostScript characters are produced by specifying a font name and size. As with Interpress, the creator can determine and alter the coordinate system at any time. Because PostScript is a rather rich programming language, a PostScript program is likely to specify graphics objects in some normalized, parameterized form and apply an appropriate transform, derived from the parameters, to the object before committing its image to the page. It is completely user-readable, in 7-bit ASCII form. For this this intelligibility, however, you pay a performance price in lower communications throughput.

When dealing with complex pages (a function of the amount of detail in the page), PostScript is severely limited. For every change in font or size, the printer must compute a bit map from the outline font (unless that font is cached). The bit map is preserved (so it does not have to be recomputed) until memory runs short; then it is discarded to make room for new bit maps. The result is that complex pages that contain text print slowly. The same is true, but more so, for pages that contain complex graphics. For example, *The Seybold Report on Publishing Systems* (the major independent industry source) reported that a map of the United States took 13 hours to typeset using PostScript. Further, the maker of the typesetter defended its performance by saying that this was because the user had encoded the graphic poorly. When the typesetter company recoded it, it still took six hours to output (see reference 2).

Document Description Language

The designers of DDL sought to avoid what they regarded as the bad design features of Interpress and PostScript, while incorporating the good. For example, DDL can produce both a user-readable and a tightly encoded form. The first allows more rapid application development, but the second allows faster host-to-printer communication.

Also, DDL has the graphics richness of PostScript, but produces document-description (as opposed to purely page-description) facilities, as does Interpress. This latter facility is important for making intelligent spooling systems that might need to know about page size, fonts needed for the entire document, where the page data ends, and so on. This kind of capability is so useful that Adobe Systems promulgated a PostScript "comment convention" by which a PostScript creator can indicate these parameters in a standard way. In effect, this convention is a recognition of PostScript's inability to deal with certain problems that arise when printing a document.

Digits to Dots: RIPs

Now that the PDL has transmitted the information describing the page, the RIP must decode the information and translate it into instructions for the printer.

The basics of a RIP are fairly uniform. In the simplest case, such as with the original Apple LaserWriter RIP, the RIP takes input, uses instructions in ROM to compose a page bit map in RAM, and then outputs it line by line through a video output section.

Let's look at this a little more closely (see figure 4). The input section receives a page description from a host computer. As the page description comes in, the 68000 CPU interprets the PDL, using the interpretation code in ROM, and generates a page bit map in RAM. When the bit map is ready, the 68000 reads a word and sends it to a shift register in the video section. The video section sends the contents of the register to the printer as a raster, much like a television signal, over a single line. The contents of the register control the laser, which in turn places the dots on the paper, producing the end result you see.

The entire operation is under the con-

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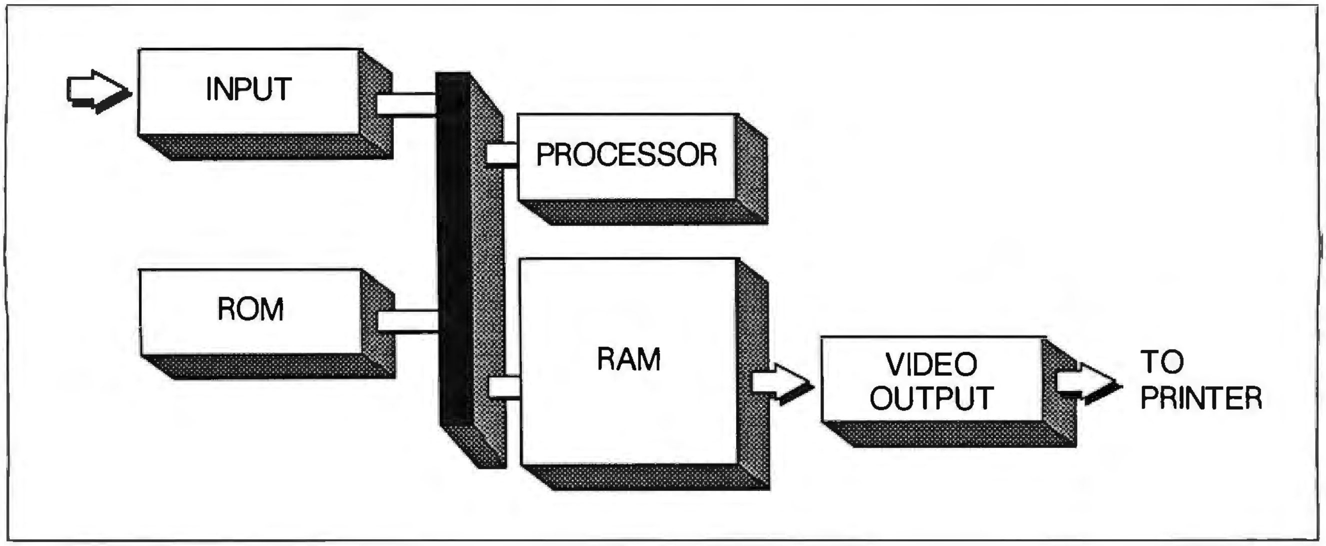
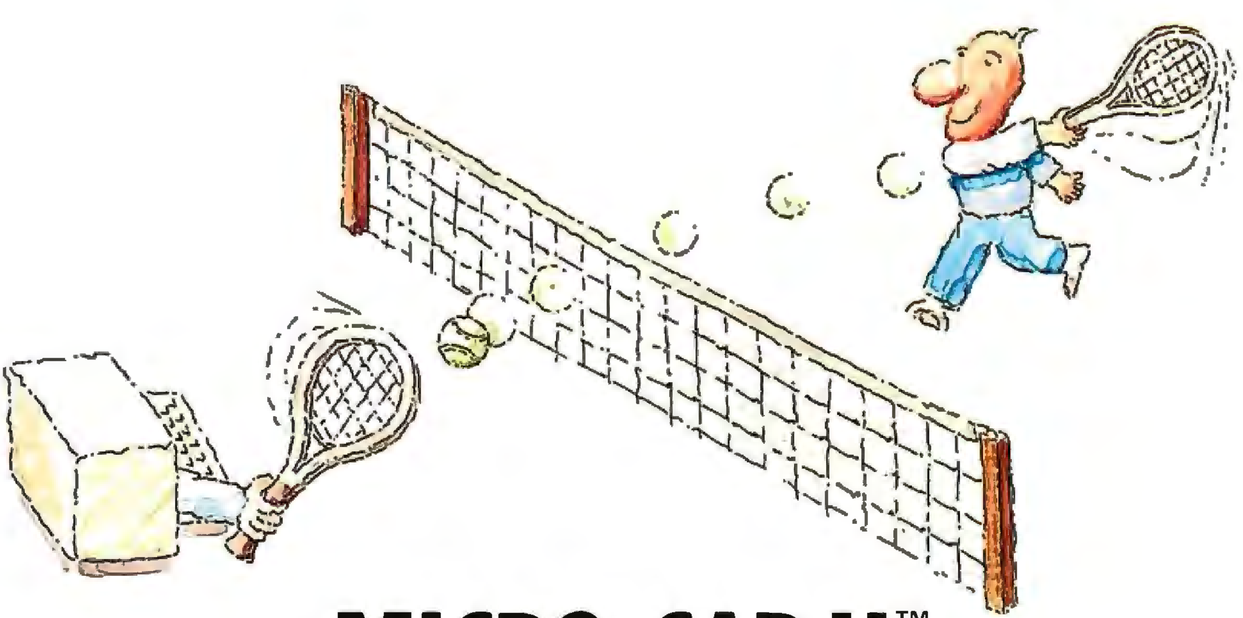


Figure 4: *A simple raster-image processor.*



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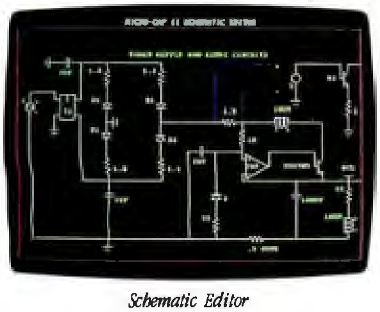

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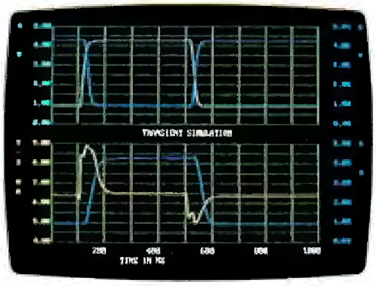

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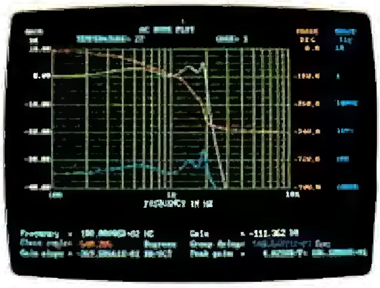

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A RIP needs memory for three purposes: to store code, to store glyphs, and to act as a page buffer.

trol of a 68000 CPU. In the case of Apple, data is sent either serially or through AppleTalk. The CPU handles all handshaking and timing details for inputting from the host, composing the bit map according to the ROM-based specifications, and outputting through the video section to the printer itself.

RIP Innovations

So far, we've described a generalized picture of how RIPs work. Getting more specific, we'll discuss the Interleaf RIP in particular and look at some hardware modifications that improve performance. By describing them, we can present the next level of detail in RIP technology.

In our design, we decided to allocate the RIP's memory dynamically. A RIP needs memory for three basic purposes: to store code, to store glyphs, and to act as a page buffer. While it is tempting from the hardware point of view to segregate memories (reflecting the analytic, segmented nature of most hardware design), we had reasons for leaving the memory unsegmented.

First, having separate memories for each function can require complicated memory circuits. Also, with a minimum of 2 megabytes of dynamic RAM, not only can a second 8- by 11-inch page be composed while the first is printing, but with dynamic memory allocation, the same RIP can also print 11- by 17-inch pages by using the second megabyte for the oversize page's composition. Similarly, if you need a huge amount of font storage for some task, the memory is there to be allocated.

The bit map is made by a series of reads and writes. The reading and writing occupy much of the RIP's processing time required by the 68000 CPU. Therefore, we decided to add a hardware assist in the form of a blitter.

The 68000 can address up to 16 megabytes of memory. The Interleaf RIP has 3 megabytes installed so that it can compose the next page while the current page is being printed. Because this leaves the upper 2 address bits unused, we can use these bits to select the memory's mode. The most significant bit of the address is used to select the blit mode. When the hardware sees this bit set, it knows to address the existing 3 megabytes, but in the blit mode. The data is shifted to the right, inverted, and then put on the write-enable pins of 16 dynamic RAMs. This process is then repeated for the second word, except with a shift to the left and with the memory address incremented (see figure 5). Both writes are done in one write instruction. The data input pins on the RAMs during this process may all be set to ones or zeros. If set to one, the result is an OR. If zero, the result is a KO, or knock out (i.e., every one in the source data results in a zero in RAM).

This is a direct OR to memory, done in one cycle. It speeds up the drawing of glyphs and bit-map images by a factor of eight. A character of up to 32 by 32 pixels that are not word-aligned, for example, may be ORed to the bit map in less than 200 microseconds.

The word-boundary offset (n) arrives via its own special hardware path. The 68000 cannot address particular bits within words in one cycle, which is precisely what we need it to do. So we created a special bit-address register that contains, in 4 bits, the information necessary to address a bit within a word.

The system also has direct-memory addressing for the output to the printer, for the input from the host, and for refreshing the dynamic RAMs used. The DMA output to the printer can also be used to clear the bit map, saving approximately 0.25 second of processor time per page. To enable this function, the DMA controller uses an otherwise undefined function code when it reads the data from the

continued

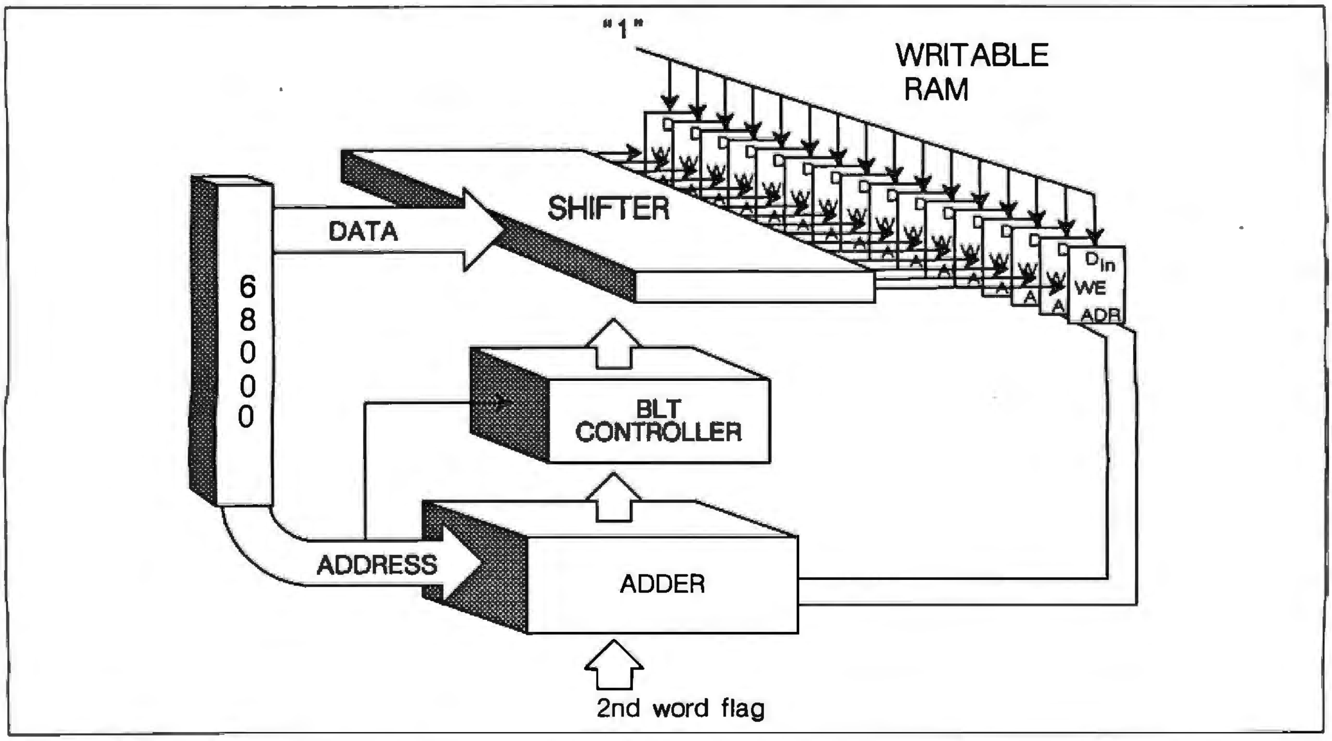

Figure 5: *The most significant flags blit mode. Data is shifted and sent to the write-enable pin of the dynamic RAMs. For the second word, the address is incremented. The result is a direct OR to memory in one cycle.*

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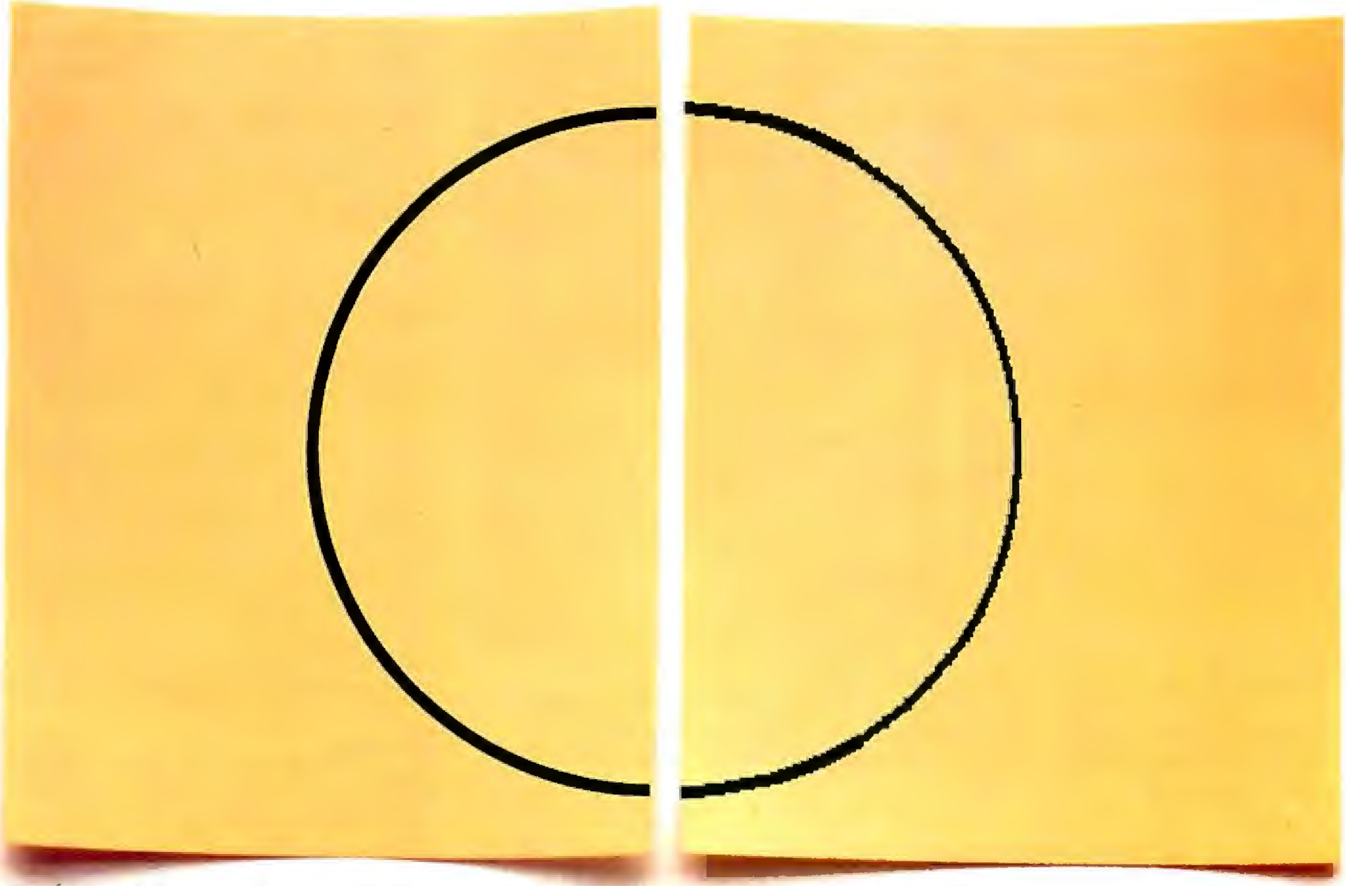

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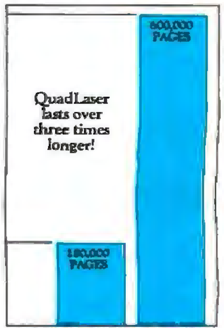

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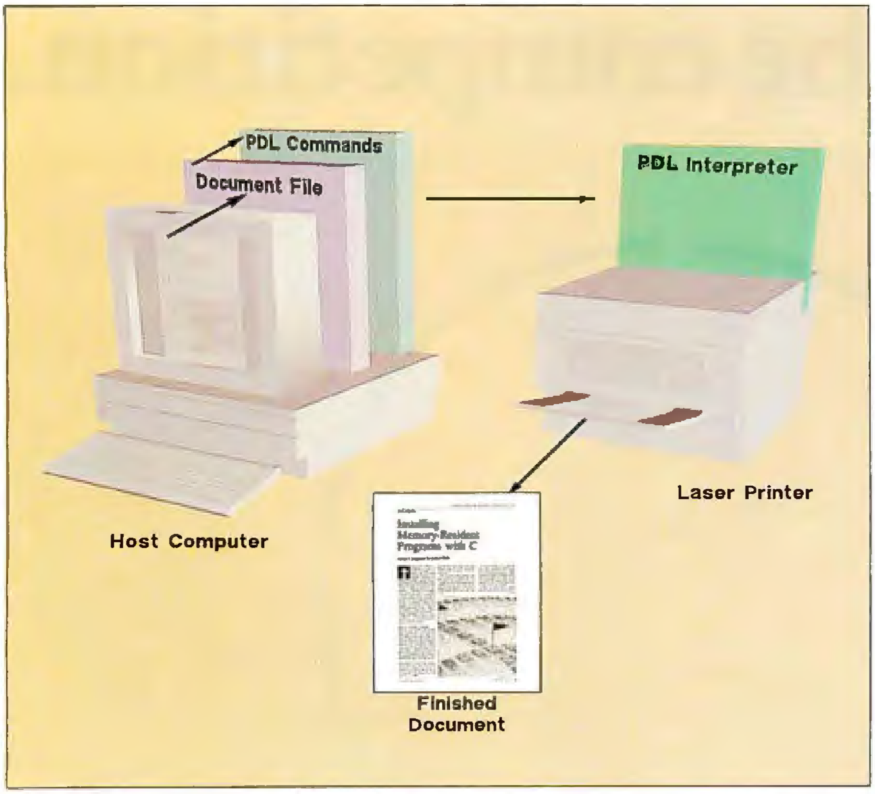

Figure 6: *The document is created on the host computer and converted into a document file, in this case a Printerleaf file. A filter translates that file into the appropriate PDL. The PDL commands are passed to the PDL interpreter on the RIP. The RIP translates the commands in the pulses of the laser, which produces the finished document.*

memory for the printer. This function code causes the memory controller to do a read-clear cycle rather than a read cycle. If you want multiple copies of a page, the bit map is not cleared.

These changes in design make a RIP capable of printing pages of great complexity at very high speed.

Software Decisions

Interleaf also designed its own document description language (Printerleaf), comparable to Interpress in many of its design considerations, and its own PDL (RIPrint) to take special advantage of the design of our RIP. The design considerations are, we think, illustrative of the challenges PDLs create.

We knew that the output from our electronic publishing software would be directed toward a wide variety of printing devices, ranging from laser printers to typesetters. Thus, we decided that the most flexible approach was to provide printing systems capable of supporting device and language independence so that documents could be transparently directed toward many existing and to-be-announced printers. Also, we recognized that many users would want to direct output to a choice of printers in an office setting that might contain various printers roughly in the same class (e.g., 300-dpi printers). In such a situation, you do not need device independence with the performance penalty it inevitably exacts (e.g., passing 2000 dpi's worth of information to a laser printer capable of only 300 dpi).

Further, we decided our PDL would be resolution-dependent, although the code would be device-independent. By making it resolution-dependent, we hoped to gain speed, quality, and control. We would gain speed because we would not have to go through the complicated algorithms necessary to translate a generic, resolution-independent, mathematical description of a font into bit maps; we would download the bit maps directly and save transmission time for lower resolution printers. In short, resolution dependence means more work at our end but produces qualities users desire.

The overall RIP software design allows for any selection of PDL interpreters to be either resident on, or downloaded to, the RIP. The RIP software is divided into the low-level RIP system interface and the higher-level PDL interpreters. The lower-level software provides communications services, print-engine interface services, memory management services, and access to functions such as blt( ), which might have hardware support. This layer of software shields the PDL interpreters from any particular hardware implementation dependencies. It also modularizes the software, easing ports to new RIP hardware implementations and adaptation to new print engines.

Our PDL, RIPrint, includes an extensive set of commands for drawing on the page, as well as controls for the printer. A RIPrint file is actually a series of immediately executed commands. Because they are immediately executed, not buffered, there is no limit to the number of commands you can use to describe a page.

The commands are encoded in binary, not ASCII. This results in compact code and efficient machine-to-machine transfer; the time savings can be orders of magnitude. If the most significant byte is set, the byte is considered a high-level command. If the MSB is not set, it is considered the Draw Thyself command. In fact, a single byte can cause a character to draw itself and set the XY position of the next character. The four Boolean operators included (OR, KO, MOV, and XOR) can, unlike with most typesetters, be applied to both text and graphics.

Summary

In general, the method for getting a document on the screen to paper is as follows (see figure 6): The document editor on the host computer produces the document file. Then a filter translates the document file into the PDL for the target printer. The PDL commands are then passed as a data stream to the PDL interpreter on board the RIP. The RIP translates the commands into the pulses of the laser in the laser printer. These pulses cause the toner to adhere to the paper to produce the printed words and graphics.

The result is a successful interaction of hardware and software to produce a high-quality document with minimum effort on the part of the user. ■

ACKNOWLEDGMENTS

We would like to thank Michael Mark, Riaz Moledina, Robert Morris, and David Weinberger for their help.

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1. We wish to thank Robert A. Morris, of Interleaf and the University of Massachusetts at Boston, for his contribution to this section on PDLs, much of which is drawn from his article, "Page Description Languages," Proceedings of the ProText II Conference, Boole Press, Dublin, 1985.
2. "PostScript: Can It Cut the Mustard?" *The Seybold Report on Publishing Systems*, March 17, 1986, Vol. 15, No. 12, page 20.

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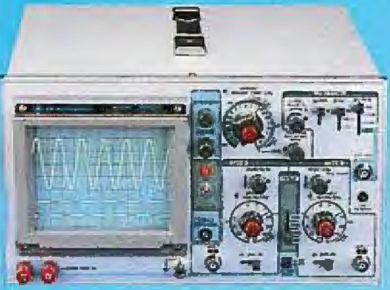

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Programming in PostScript

Techniques and applications in vision research, plus a survey of PostScript hardware and software

Denis G. Pelli

MOST PEOPLE WHO use PostScript-driven printers have never seen a PostScript program because their application software generates and sends the necessary PostScript commands automatically whenever they say "Print." For routine applications, this is as it should be. However, programming directly in PostScript opens up many new possibilities, particularly for creating images from mathematical descriptions.

For instance, I use PostScript to produce patterns to help my study of the visual system. In this article, I will use some of those patterns to illustrate PostScript's power. I'll also list some useful PostScript products and services.

PostScript programming is best for those occasions where you begin by knowing only a mathematical description of an image and want to find out what the image would look like. This approach is old hat to anyone who has done computer graphics on a video display. Unfortunately, it is difficult and expensive to obtain an accurate photograph of what's on the screen, primarily because of the nonlinearity and variability of photography. PostScript lets you get faithful renditions directly on paper.

Another attraction of PostScript is that you can debug and refine your picture-generating programs using a relatively low-cost (around $5000) laser printer such as the Apple LaserWriter, which will produce fair-quality drafts (300 dots per inch) immediately for a few cents per page. For the final output, you can send the same program by modem to a $60,000 printer like the Linotype L300, which will produce superb quality prints (2540 dpi) for $10 per page. The same program runs on both printers because PostScript is machine independent. (This article includes examples produced by both printers.)

Overview

PostScript is a full-fledged structured language. Like FORTH, it is stack oriented and uses postfix notation. For example, to add 2 and 2 you say `2 2 add`. Each PostScript printer has a built-in microprocessor and a PostScript interpreter that will run your program. The page is represented by a bit map, with 1 bit per pixel. (PostScript incorporates some limited support for color, but none of the available printers supports color.) When the page is printed (usually by the `showpage` command), the bit map is transferred to the page, making each pixel either black or white. However, to preserve machine independence, you are not allowed to read from or write to the bit map. Instead, your program includes "painting" operators that set and clear bits within defined areas of the bit map.

PostScript offers three kinds of painting operators, allowing three quite different approaches to describing your image: one-dimensional paths, two-dimensional sampled images, and text. Before explaining the three kinds of painting, I should say a few words about an operation that can be applied to all three: digital halftoning.

Each pixel in a PostScript image is either black or white. PostScript produces the illusion of intermediate gray levels by digital halftoning—breaking the image up into cells, each containing many pixels, and setting some of the pixels to white and the rest to black. If the cells are too small for the eye to resolve, the viewer will see a uniform gray, and the illusion will be successful.

You can adjust the size of the cell by the `screen` operator, which lets you specify how many cells per inch. When you request a particular gray level, PostScript will set approximately that fraction of the pixels in each cell to white and the rest to black.

Obviously, there's a trade-off here. You'd like to have very small cells so that the eye can't resolve them and the picture will look continuous. But if the cells are small, they will contain few pixels and you will have only a few possible gray levels.

Your gray levels will be coarsely quantized (approximated by the nearest available discrete level). In images where the gray level varies smoothly, such as in a person's face, coarsely quantizing the gray level will produce noticeable contours at the transition between gray levels.

Note that digital halftoning is quite new and the terminology has not yet settled. In particular, the word "dot" refers

continued

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to two quite different things. If the resolution of a printer is specified as "300 dpi," it means 300 pixels per inch. If a halftone image is "18.75 dpi," it means 18.75 halftone cells per inch. If the image is produced by digital halftoning, you can assume that each cell has many pixels. For example, nearly all the black-and-white continuous-tone images in BYTE have 120 cells per inch. Most of those images were produced by traditional halftoning, which does not involve pixels at all.

The faces below (see figure 2) were produced by digital halftoning with 120 cells per inch and 2540 pixels per inch, so each square cell contains $(2540/120)^2 = 448$ pixels. In principle, this would allow for 449 different gray levels (from 0 to 448 pixels set to white in each cell), but an undocumented limitation of PostScript is that the requested gray level is quantized to 8 bits, allowing, at the most, 256 different gray levels.

Paths

One of the fundamental design goals of PostScript is to be independent of the details—especially the dot resolution—of the particular printer used. To achieve and enforce this, PostScript does not let you ask any questions about the state (black or white) of the pixels that make up the page's image. Instead, you create an image by defining an area or "path" and then filling it.

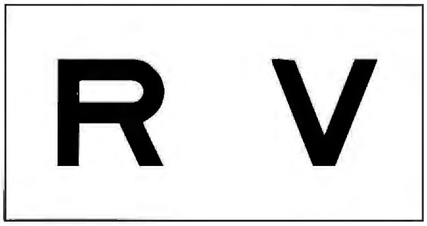

Figure 1: *Two letters of the Sloan font for vision testing produced by listing 1 on a Linotype L300 at 2540 dots per inch.*

A path is a series of lines and curves, like a line drawing. However, the path itself is not a drawing. To make an image, you must use a painting operator. The two painting operators that can be applied to paths are stroke and fill. Stroking a path produces an image on the page consisting of a line of specified thickness. (You can also specify the gray level, the kind of dashes for a dashed line, the type of line termination, and the shape of corners.) Filling a path causes areas that are inside the path to be painted with a specified gray level, without affecting areas that are outside. The meanings of "inside" and "outside" are obvious for a simple closed curve. For more complex paths, PostScript offers a choice of two different rules for determining which areas are inside and out.

Figure 1 was produced by stroking paths. The R and V are two of the ten characters (C D H K N O R S V Z) in the Sloan font, named after its designer, Louise Sloan. The Sloan font is recommended for vision testing (reference 1).

Obviously, if you are designing vision tests, it is helpful to be able to use the officially sanctioned font. Listing 1 shows the programs that I wrote to produce R and V. I wrote similar programs for the other eight characters in the Sloan alphabet. With some extra statements, you could make this a proper PostScript font, usable in any place where you would like to display text.

The first two statements in listing 1 are comments. Everything from a % to the end of the line is ignored. It is traditional for the first line of a PostScript program to begin with %! to help your computer identify it as a PostScript file. The third line begins /preSloan, which pushes the name preSloan onto the stack. Then comes a procedure enclosed in braces that extends over several lines. PostScript treats spaces and carriage returns merely as separators. The procedure is compiled and pushed onto the stack as one item. After the closing brace of the procedure is the word def. That causes PostScript to pop the top two items from the stack and use these to define the word preSloan to refer to the given procedure. It does that by putting the word preSloan in a dictionary, with the procedure as the meaning. From now on, the word preSloan will invoke that procedure.

The following lines similarly define the procedures postSloan, R, and V. The line 50 700 moveto first pushes 50 onto the stack, then pushes 700 onto the stack. Then the operator moveto pops the top two items from the stack and moves the current location to that x-y coordinate. (The default coordinate system puts the origin at the lower left corner of the page and measures distance in "points," 72 to the inch, so the location [50,700] corresponds to [0.69 inches, 9.72 inches], which is 0.69 inches from the left margin and $11 - 9.72 = 1.28$ inches down from the top of the 8½- by 11-inch page.)

The 40 40 scale command amplifies the scale so that one unit corresponds to 40 points. R invokes the R procedure, which draws an R one unit wide and one unit high (where one unit is now 40 points). The R is made up of lines and arcs. It is all "clipped" by a unit square, set up in preSloan, so that only what falls inside the square appears in the final image. It is the same for V. Finally, showpage transfers the image to paper and ejects the page from the printer. You can send this program to any PostScript printer to obtain an image like figure 1.

Figure 2 was also produced by paths.

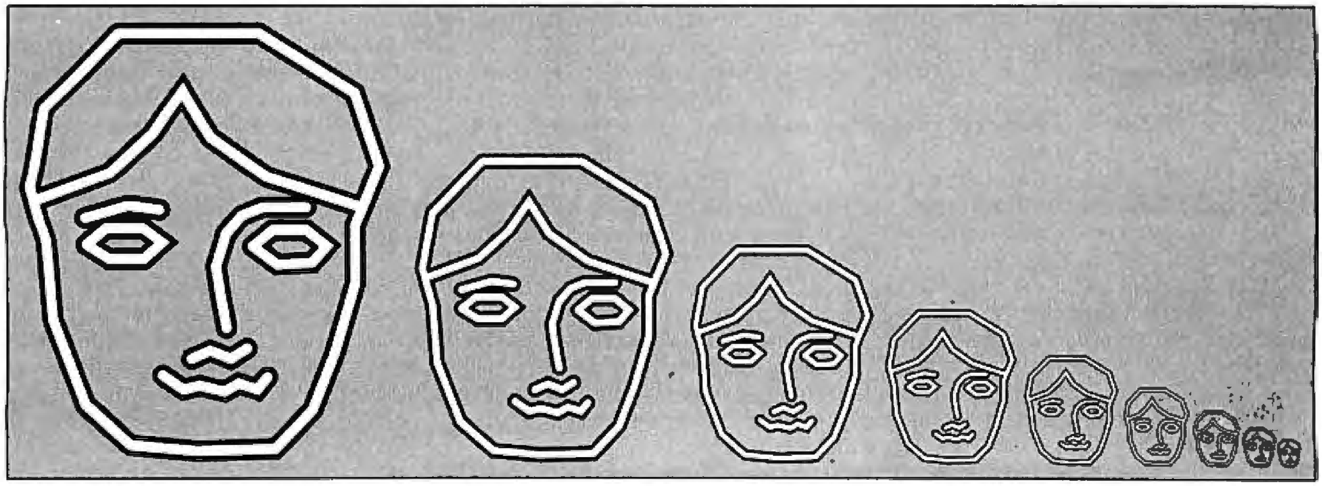

Figure 2: *Faces for testing infant acuity produced by listing 2 on a Linotype L300 at 2540 dots per inch.*

The face in the figure is designed for acuity testing of infants. When you can see anything at all, you can see that it's a face. The black and white lines making up the face disappear when they are too thin for the eye to resolve. The biggest face will disappear when you are about 24 feet away, depending on your visual acuity. The smaller faces will disappear at proportionally shorter distances. The smallest face will disappear at about 18 inches. The trick to making it disappear is to draw it with a ribbon consisting of equal parts of white and black, so that when the white and black are blended together by the eye, the resulting average is identical to the gray background (references 2 and 3).

Listing 2 gives the PostScript program used to produce figure 2. After a few comments the face procedure is defined; it consists solely of moveto and lineto commands that trace a path. The draw procedure is defined next. Then the whole page is painted gray.

The program is optimized for the Linotype L300 running at 2540 dpi. For best results at 300 dpi, such as on a LaserWriter, you should remove the % from the beginnings of two lines labeled "at 300 per inch" and place the % symbol at the beginning of the two lines marked "at 2540 dots per inch." The % causes the rest of the line to be treated as a comment—in other words, ignored. After you remove the % from each line, those lines will give you the best choice of screen density for a LaserWriter.

Note that this does not contradict the claim that PostScript is device independent. When you go from higher resolution to lower resolution, you have to make some trade-offs in coarseness of screen and precision of gray level. You can often get acceptable results by letting the PostScript printer make the trade-off itself, but if you understand the underlying issues, you can usually get better results by specifying exactly what you want. The two gray levels were found by trial and error to produce 50 percent reflectance on the two printers at these screen densities.

The main program is next. It consists of a loop 9{ . . . }repeat, which means that the procedure enclosed in braces should be repeated nine times. Inside the braces you will find the commands face, which lays down the path of the face, and draw, which paints the path, and the operators translate and scale, which shift and shrink the coordinate system to get ready for the next face.

To produce a black-and-white ribbon, the draw procedure must stroke the same path twice. This requires a trick, since

continued

Listing 1: *The PostScript program to produce R and V in the Sloan font.*

```
%!
% Produce Figure 1
/preSloan {gsave currentpoint translate 0.2 0.2 scale
      newpath 0 0 moveto 0 5 lineto 5 5 lineto 5 0 lineto
      closepath clip newpath 1 setlinewidth 2 setlinecap 0
      setlinejoin} def
/postSloan {stroke grestore 2 0 rmoveto} def
/R {preSloan 0.5 0.5 moveto 0 4 rlineto 3.5 3.5 1 90 270
      arcn -3 0 rlineto 4.44370 0 moveto -0.97547 2
      rlineto postSloan} def
/V {preSloan 0 6.34629 moveto 2.5 -6.25 rlineto 2.5 6.25
      rlineto postSloan} def
50 700 moveto
40 40 scale
R
V
showpage
```

Listing 2: *The PostScript program to produce the faces in figure 2.*

```
%!
% Produce Figure 2

% path of face
/face {39  210 moveto 108  210 lineto 155  181 lineto 167
      146 lineto 155  117 lineto 155  89 lineto 145  55
      lineto 134  27 lineto 116  8 lineto 78  7 lineto 46
      10 lineto 23  30 lineto 7  71 lineto 4  110 lineto -
      3  136 lineto 4  174 lineto 39  210 lineto 1  130
      moveto 36  143 lineto 57  162 lineto 71  182 lineto
      85  160 lineto 112  141 lineto 158  126 lineto 24
      121 moveto 45  127 lineto 60  125 lineto 24  108
      moveto 34  116 lineto 52  116 lineto 61  109 lineto
      52  101 lineto 35  101 lineto 24  108 lineto 105
      107 moveto 115  115 lineto 131  115 lineto 141  107
      lineto 134  99 lineto 117  98 lineto 105  107 lineto
      131  126 moveto 110  126 lineto 100  122 lineto 92
      113 lineto 87  97 lineto 89  83 lineto 92  67 lineto
      61  44 moveto 71  37 lineto 79  39 lineto 91  36
      lineto 98  40 lineto 107  37 lineto 112  43 lineto
      75  52 moveto 84  56 lineto 94  52 lineto 102  57
      lineto} def

% Draw high-pass ribbon
/draw {  gsave 0 setgray stroke grestore gsave
      currentlinewidth 2 div setlinewidth 1 setgray stroke
      grestore newpath} def

% Set up screen, etc.
%120 currentscreen 3 -1 roll pop setscreen % at 2540 dpi
%0.69 setgray clippath fill 0 setgray  % at 2540 dpi
30 currentscreen 3 -1 roll pop setscreen % at 300 dpi
0.58 setgray clippath fill 0 setgray % at 300 dpi
1 setlinecap
10 setlInewidth
30 560 translate

% Ever smaller faces across page
9{
  face
  draw
  190 0 translate
  .707 .707 scale
  } repeat

showpage
```

stroking a path eliminates the path. The first command in draw is gsave, which saves the graphics state, including the path. Then the line width is set, the gray level is set to 0 (i.e., black), and the path is stroked. This produces a black line drawing of a face on the gray background. Next, the grestore command restores the graphics state, including the path but not affecting the image, which is not part of the graphics state. Now, after reducing the line width by half and setting the gray level to 1 (i.e., white) draw strokes the path again. This produces a white line running down the center of every black line. After the nine iterations of the main loop, the image is done. All that remains to put it on paper is to give the showpage command.

A reasonable question to ask at this point is: How did I obtain the sequence of lineto and moveto commands to produce the face? I could have drawn the face in pencil on graph paper and read off the coordinates. In fact, I obtained this sequence by using MacDraw to draw the face freehand. I then captured the PostScript output of MacDraw and cleaned that up using Post-A-Matic (a program that translates Macintosh's abbreviated PostScript to standard PostScript commands) and a bit of editing. A new program called Cricket Draw makes this much easier. (Further information on items mentioned appears in the text box at left.)

To test an infant's vision, I would print up many gray cards, each with a single face on either the left or the right. The testing technique is called "Forced Choice Preferential Looking." A person who can't see the test card looks at the infant's eyes and tries to guess on which side the face is by which way the infant is looking. By testing many times, you can determine how reliably the person observing the infant's eyes can guess where the face is. If the infant's eyes tell you where the face is, you can reasonably conclude that the infant can see the face (reference 4).

Sampled Images

The second way to produce an image in PostScript is to use the image operator and provide it with the gray level of the desired image at each point on a regular grid. The most obvious application of this would be to reproduce a photograph that has been sampled previously. Figure 3a is an example. Each sample from the photograph is imaged by a cell containing many pixels. The fraction of the pixels in the cell that are white determines the gray level. Figure 3a was produced by a Linotype L300 at 2540 pixels

continued

PostScript-Related Products

Publications

Colophon PostScript newsletter (free). Adobe Systems Inc., 1870 Embarcadero Rd., Palo Alto, CA 94303, (415) 852-0271.

Computer Shopper, $21 per year. The "Ask the Guru" column by Don Lancaster has occasional tidbits on PostScript. Computer Shopper, P.O. Box 1419, Titusville, FL 32781.

Graphic Perspective PostScript newsletter, $40 per year. Ashley House, 176 Wickstead Ave., Toronto, Ontario, Canada M4G 2B6.

PostScript Language Tutorial and Cookbook, $16.95, and *PostScript Language Reference Manual*, $22.95, by Adobe (Reading, MA: Addison-Wesley, 1985).

PostScript Supplement for the Linotype Series 100, Version 38.0, 1985, revised May 15, 1986. Adobe Systems Inc.

The PostScript Language Journal, $15 per year. Pipeline Associates Inc., 39 East Twelfth St., New York, NY 10003.

Software

Applewriter/Laserwriter Utilities Package (ProDOS software), $49.50. Synergetics, 746 First St., Box 809, Thatcher, AZ 85552, (602) 428-4073.

AppleTalk PC Card, $399. Apple Computer Inc., 20525 Mariani Ave., Cupertino, CA 95014, (408) 996-1010.

Colophon 2 Images disk includes program and sampled image data to produce figure 3. $12 including postage & handling. Adobe Systems Inc.

Cricket Draw program, $295. Cricket Software, 3508 Market St., Suite 206, Philadelphia, PA 19104, (215) 387-7955.

SendPS 1.0 downloader program. Included on the Colophon 2 Images disk. Adobe invites free distribution of SendPS but forbids selling it without permission.

Ehandler.ps 2.1 error break page handler program (free). Adobe Systems Inc.

JustText program, $195. Knowledge Engineering, G.P.O. Box 2139, New York, NY 10116, (212) 473-0095.

MockWrite 4.3.2 desk accessory program, $35, shareware. CE Software, 801 73rd St., Des Moines, IA 50312, (515) 224-1995.

Onyx projection plate media. 3M Company, 6850 South Harlem Ave., Bedford Park, IL 60501.

PC MacBridge Appletalk network interface board and LaserWriter utilities and network software for IBM PCs, $350. Tangent Technologies Ltd., 5720 Peachtree Parkway, Suite 100, Norcross GA 30092, (404) 662-0366.

Post-a-Matic 3.3z program, Canadian $50, shareware. Peter Bennett, Graphic Presentation Charts, 23 Exford Dr., Scarborough, Ontario, Canada M1P 1L5, (416) 751-2727 home, CompuServe 76314,1670.

PostHaste downloader program, $50. Micro Dynamic Ltd., 8555 Sixteenth St., Suite 802, Dept. 2, Silver Spring, MD 20910, (800) 634-7638.

TOPS, AppleTalk network fileserver for Macintoshes, $149 per computer; for IBM PCs, $389 per computer on an AppleTalk network. Centram Systems West, 2560 9th St., Berkeley, CA 94710, (415) 549-5900.

PostScript-compatible printers (more than 300 dpi)

Agfa-Gevaert P400PS (400 dpi)
CompuGraphic CG400PS (400 dpi)
Linotype Linotronic L300 with PostScript RIP (up to 2540 dpi)
Linotype Linotronic L100 with PostScript RIP (up to 1270 dpi)

PostScript-compatible printers (300 dpi)

Apollo Domain/Laser 26
Apple LaserWriter and LaserWriter Plus
Dataproducts LZR-2665
DEC PrintServer 40
Diconix Dijit 1/PS
Facit Opus 2E and 3 (with optional PostScript cartridge)
Hanzon Data LP-5000
ITT Qume Scrip TEN
Laser Connection PS Jet (upgrade for existing printers, including HP LaserJet)
NBI Model 908
NEC SilentWriter LC-890
QMS PS 800 and PS 2400
Sun Microsystems LaserWriter
Texas Instruments OMNILASER 2108 and OMNILASER 2115

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per inch. Figure 3b was produced by sending exactly the same program to an Apple LaserWriter Plus, which prints at 300 pixels per inch.

However, there is a more interesting application of the PostScript image command. You can use mathematics to synthesize an image that never existed before. Figure 4a is an example. By just looking at this pattern, you can perform a systems analysis of your visual system.

Any patch of the pattern is a sinusoidal grating, varying from white to black and back again. However, from left to right across the image, the fineness of the grating increases until it disappears. Similarly, from bottom to top the contrast of the grating decreases until it disappears. The lower the contrast of the grating, the higher the contrast sensitivity required to see it. If you follow any one bar in the image from the bottom up until it disappears, the height at which it disappears is the contrast sensitivity of your visual system for a grating of that fineness.

The fineness of a grating is usually specified as a spatial frequency—in cycles per inch, for example, where a cycle is a pair of light and dark stripes. However, the sensitivity of your eye depends not on the number of cycles per inch but on the number of cycles per degree of visual angle subtended at the eye (try looking at the pattern from various distances), so for vision work it is preferable to specify spatial frequency in cycles per degree.

The outline of visibility of all the bars describes the sensitivity of your visual system over a wide range of spatial frequencies. Notice that the vertical bars when taken together form a hump, peaking in the middle and falling off toward the left and right. The falloff to the right is determined largely by the optical quality of your eye. The falloff to the left is determined by neural limitations of your eye. This outline of visibility explains many characteristics of vision, including many visual illusions.

Figure 4a was produced by the program in listing 3. After a few commands to set up the coordinate systems of the sampled image and the page, the equation for the image is supplied to the image operator. The equation is essentially

$$g = 0.5\ (1 + 10^{-y} \sin 10^{x}),$$

where g is the desired gray level (i.e., re-

continued

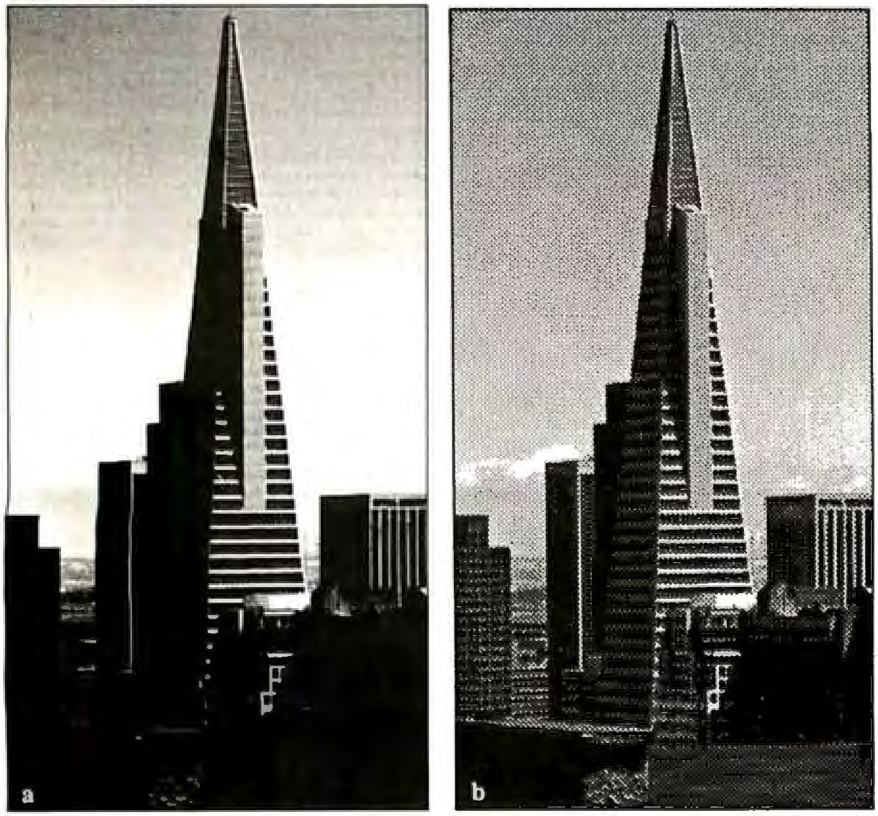

Figure 3: *Digitized image of the San Francisco skyline. Program and image file courtesy of Adobe Systems Inc. (Included on the COLOPHON 2 IMAGES disk; see the text box.) 3a: Produced on a Linotype L300 at 2540 dots per inch. 3b: Produced on a LaserWriter Plus at 300 dpi.*

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flectance), and *x* and *y* specify the position on the page. As *x* increases, the argument of the sine function, namely 10^x, increases more and more rapidly and the value of sine 10^x oscillates between -1 and $+1$ more and more rapidly. The program figures out the resolution of the printer and chooses the maximum spatial frequency (and thus the maximum value of *x*) accordingly. This is because proper representation of a sinusoid requires at least two samples per cycle. If the grating is so fine that fewer than two samples occur in each cycle (a pair of light and dark stripes), there will be a moiré effect, resulting in very broad stripes where there should be fine stripes.

The PostScript printers are not smart enough to take into account the content of your image in their efforts to print the image faithfully at whatever the printer's resolution happens to be. Thus, programmers must watch out for moiré effects. Figure 4a was produced by running listing 3 on a Linotype L300, at 2540 dpi and 127 cells per inch. Figure 4b was produced by running the same program on an Apple LaserWriter Plus at 300 dpi and 18.75 cells per inch. Note that figures 4a and 4b represent different images because the program explicitly changed the image to best take advantage of each printer's resolution and avoid moiré effects.

This kind of image, a sinusoidal grating swept in frequency and contrast, was first produced by Fergus Campbell and John Robson at Cambridge University in the early sixties (reference 5). John Robson explained to me how they did it. They used two sawtooth oscillators to sweep the beam of an *x-y* oscilloscope in a vertical raster pattern, so that one vertical line took about 20 milliseconds and a whole frame took about a minute. The sinusoidal grating was produced by a sinusoidal oscillator connected (via a relay and capacitor) to the oscilloscope's intensity-control input.

Campbell and Robson produced the vertical fading in contrast by using a high-speed relay to quickly charge a capacitor to the oscillator voltage at the bottom of each vertical line and letting the capacitor discharge through a resistor as the beam swept upward. The horizontal variation in frequency (fineness of the grating) was produced by manually adjusting the frequency of a sinusoidal os-

continued

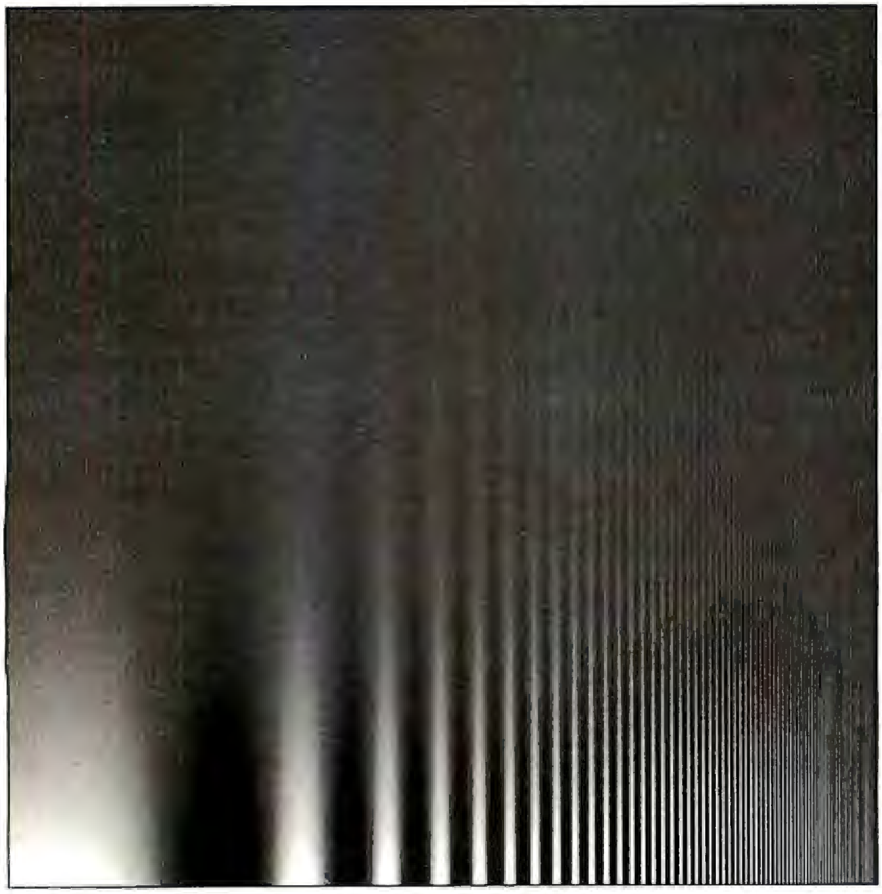

Figure 4a: *Sinusoidal grating swept in frequency and contrast. Produced by listing 3 on a Linotype L300 at 2540 dots per inch and 127 cells per inch.*

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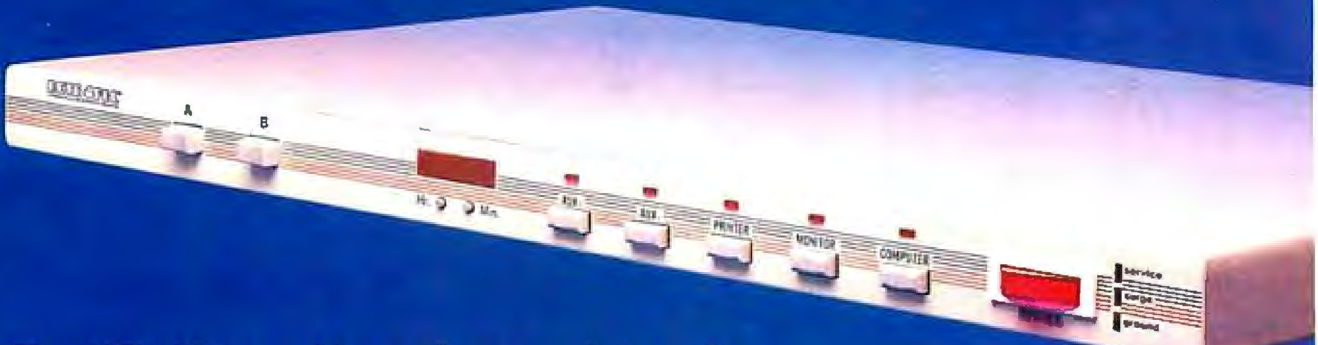

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Listing 3: *The PostScript program to produce the sinusoidal grating test in figure 4a.*

```
%!
% Produce Figure 4
/inch {72 mul} def
/width 4.54 inch def
50 400 translate
% make square image of desired width
width width scale
/dpi
  72 0 matrix defaultmatrix dtransform dup mul exch dup
      mul add sqrt
  def
/screen dpi 16 div def
screen 127 gt {/screen 127 def} if
screen currentscreen 3 -1 roll pop setscreen
% number of cells across image
/n width screen mul 72 div 2 sqrt mul 0.99 add cvi def
/nx n 2 mul def
/ny n 2 idiv def
/fbase 0.5 n mul 1.0 nx div exp def
/fa 360  nx div fbase ln div def
/c 1 def
/cbase 0.003 1.0 ny div exp def
/S nx string def

nx ny 8 [nx 0 0 ny 0 0]
  {/c c cbase mul def /f fa def
  0 1 nx 1 sub{S exch f sin c mul 1.0 add 126.5 mul cvi
      put /f f fbase mul def}for
  S}
  image

showpage
```

cillator as the beam swept across the screen.

Campbell read out the desired frequencies from a table, and Robson adjusted the dial. They recorded the image on film by taking a long-exposure photograph.

Working with Text

The third way to produce an image in PostScript is to use text.

PostScript makes it very easy to create characters of arbitrary size and rotation. In fact, the font machinery for producing text is built from the commands for producing paths. Each character is created by its own program. Typically, a program to produce a character creates a path and then fills or strokes it. However, because writing text is such an important use of PostScript, several things were done to make it easy and fast.

First, fonts are stored in special dictionaries inside the printer, with a little program for each character, and special commands are provided for specifying what font you want to use and at what size. Commands are also provided to produce a whole line of text from an ASCII string, which is just a list of the desired characters. There are even facilities for kerning, or adjusting, the spacing between particular letter pairs, such as "TA," which looks best if the "A" is tucked slightly under the hat of the "T."

Second, it takes a lot of computation to run the programs corresponding to each character in a page of text. To alleviate this burden, whenever PostScript computes a character to paint it onto the page, it also saves a copy of the character's bit map in a special area of memory called the "font cache." If the character is needed again, PostScript retrieves it from the cache instead of computing it again. Naturally, the cached copy can be used only for the same character from the same font at the same size and rotation.

Figure 5 (produced by listing 4) is a simple example of the use of text. This is a test chart to measure visual acuity, much like one you might see in an optometrist's office. The letters are all at high contrast and get smaller and smaller until they disappear. The smallest letter that you can read is a measure of the resolution limit of your eye.

continued

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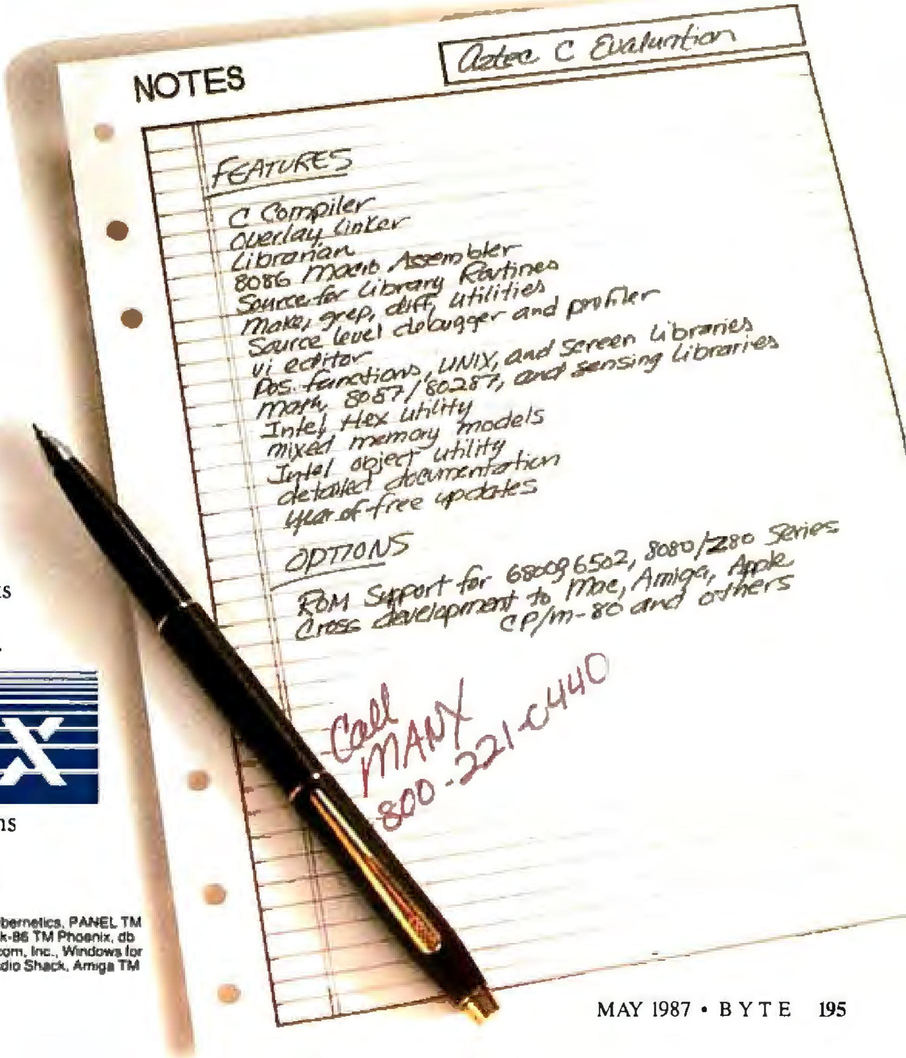

NOTES

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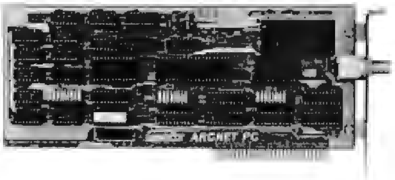


Figure 6 (produced by listing 5) is a new kind of test chart. The letters are all the same size, but they vary in contrast, fading out until they disappear. The lowest contrast that you can read is a measure of the contrast sensitivity of your eye. The combination of acuity and contrast sensitivity results in a more complete assessment of the visual function of your eye than would acuity alone.

Incidentally, you may note a similarity between figure 4a and figures 5 and 6. In fact, the finest letter that you can read provides a useful estimate of the finest grating that you can resolve (the right edge of the hump in figure 4a), and the lowest contrast letter that you can read provides a useful estimate of your contrast sensitivity for gratings—the height of the hump in figure 4a (reference 6).

Figures 5 and 6 were produced by moving to a new location on the page for each character, setting the gray level, setting the font size, and printing the character by the `show` command. The programs are given in listings 4 and 5.

Note that figures 5 and 6 were produced with the Sloan font, which you won't have. The programs in listings 4 and 5 explicitly check to see if Sloan is available; if not, they substitute Helvetica.

Tools for Programming in PostScript

First you'll need the *PostScript Language Reference Manual* and the *PostScript Language Tutorial and Cookbook*, both written by Adobe Systems, the company that invented PostScript and put it in the public domain. These clear, well-organized books are models for how manuals should be written, with a clear separation of the tutorial and reference functions. The tutorial has lots of real examples, and the reference manual is organized alphabetically.

You'll also need a computer with a plain text editor (to write your program) and connection to a PostScript printer. Your computer won't be doing much, just sending your program to the printer and receiving any messages from the printer. It's the printer that interprets and runs your program.

The simplest way to connect any computer to a PostScript printer is by a serial line, using any simple communication program. However, most users do not

continued

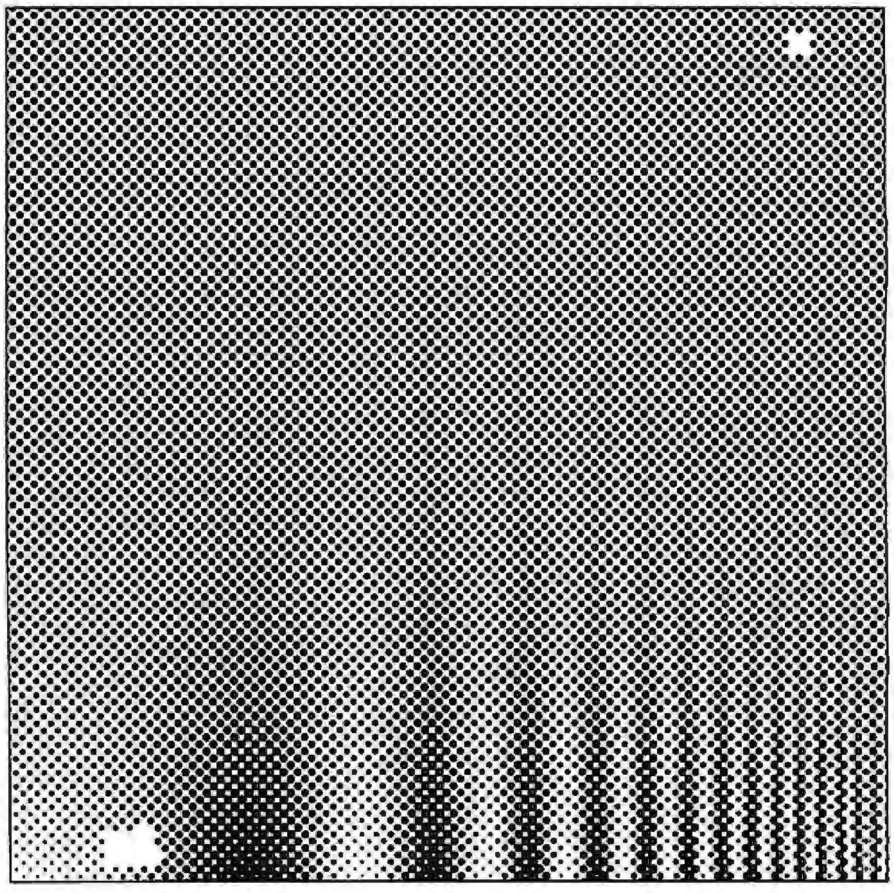
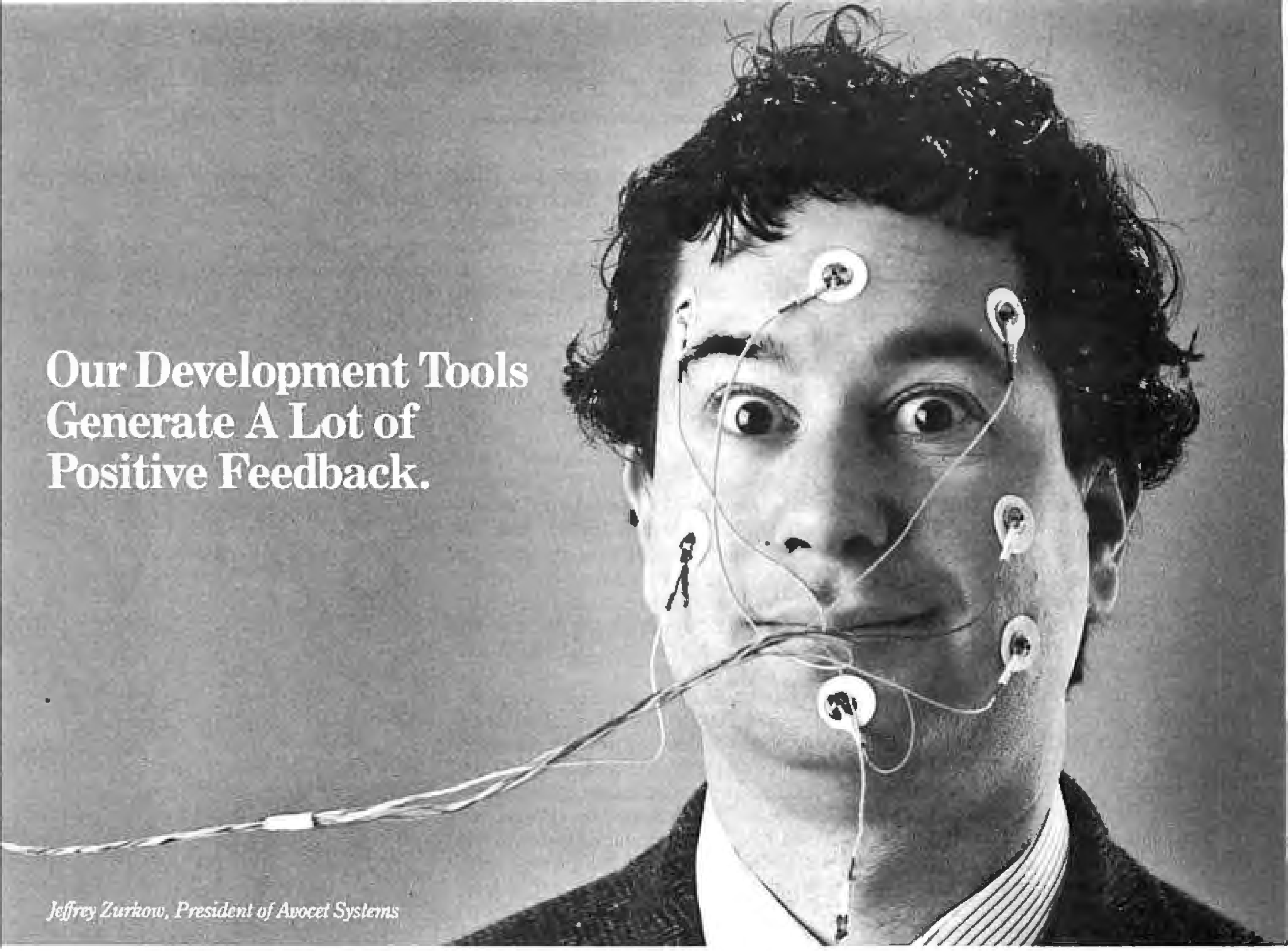


Figure 4b: *Sinusoidal grating printed at 18.75 cells per inch on a LaserWriter Plus.*



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own a PostScript printer. Typically, they share one over a network. This arrangement requires that you use a downloader program to send your PostScript program (a text file) via the network to the printer. A good downloader should also be able to receive, display, and save any messages sent back from the PostScript printer.

Receiving messages from the printer is very important; otherwise, you'll only know when your program crashes by the fact that no paper comes out of the printer. I debugged my first few PostScript programs that way, running to the other room, waiting to see if I got any output—usually I didn't—and walking back to edit my program a bit and trying again. It's reminiscent of using the toggles on a PDP-11/20 to program in machine code—obviously something best left to "real programmers," as no sane person would enjoy such a tedious procedure.

If you can't receive messages from the printer, a less convenient solution is to use Adobe's free "error break page handler," a PostScript program you send to the printer once. From then on (until you reset the printer), when any program crashes you'll get a printed page showing the error message, the offending command, and a peek at what's on the stack. However, this still requires running back and forth between your computer and the printer.

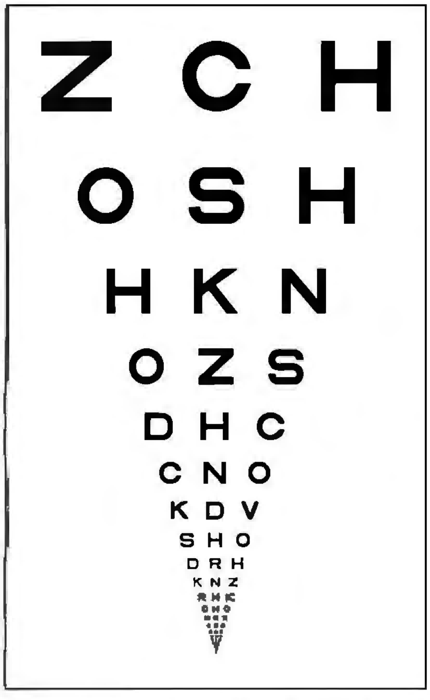

Figure 5: *Conventional acuity chart produced by listing 4 on a Linotype L300 at 2540 dots per inch.*

Several good downloader programs are now available for the Macintosh. The best one is free. SendPS from Adobe Systems will send your program over AppleTalk to the Apple LaserWriter. It will also receive any messages sent back over AppleTalk from the printer, show them to you as they arrive, and automatically store them in a file for your later perusal. You can also ask for a report on the status of the printer at any time, and you can initiate a remote reset of the printer. SendPS doesn't include a text editor, so you'll need one. (I recommend the shareware desk accessory MockWrite.) PostHaste and JustText have all the features of SendPS (except showing messages as they arrive), plus built-in multiwindow editing, and JustText comes with extra programs that convert MacPaint, Thunderscan, and MacVision files into PostScript.

Cricket Draw, from Cricket Software, lets you edit and download a PostScript program but does not receive messages from the printer. Its main attraction for the PostScript programmer is that it lets you make a MacDraw-like drawing (or read in a MacDraw file) and convert it into pure PostScript. It has a handy PostScript help function that lets you look up a brief explanation of any PostScript operator—`moveto`, for example.

One feature I'd like to see in future PostScript downloaders is an `%%Include: filename` statement that would indicate to the downloader that another file (e.g., containing your favorite subroutines) should be included when the program is downloaded. This is a standard feature of most modern languages, but PostScript lacks it and thus deprives the programmer of many of the main advantages of modular programming. You have to put everything in one file, making nontrivial PostScript source files unreasonably long and making it difficult to keep all your copies of a given subroutine up to date.

At present, much less software is available for PostScript downloading for nonMacintosh computers. Synergetics sells some utilities for programming in PostScript on an Apple IIGS, IIc, or IIe. Several companies offer hardware and software (see table 1) to connect an IBM PC-compatible to an AppleTalk network; some of these products let you receive messages from the printer. Now that IBM has endorsed PostScript for use in its future desktop publishing products, things are bound to improve for IBM PC users.

Many computer companies, such as Digital Equipment Corporation and Sun Microsystems, are bringing out new PostScript printers and providing them with interfaces to connect to computers from those manufacturers. (A list of PostScript printers appears in the text box on page 188.) Most of the existing and forthcoming printers have 300-dpi resolution, like the Apple LaserWriter.

Linotype makes two high-resolution

continued

Figure 6: *Pelli-Robson Letter Sensitivity Chart produced by listing 5 on a Linotype L300 at 2540 dots per inch. Copyright 1987 by Denis G. Pelli.*

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*hard disk recommended

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Listing 4: *The PostScript program to produce the conventional acuity test chart in figure 5.*

```
%!
% Produce Figure 5
50 750 moveto
/width 250 def
/size width 6 div def
/cuberoot2 2 1 3 div exp def
width 2 div size -1.5 mul rmoveto

/showrow
   {gsave
   FontDirectory /Sloan known
   {/Sloan findfont size scalefont setfont}
   {/Helvetica findfont size 1.8 mul scalefont setfont}
   ifelse
   dup stringwidth pop -2 div 0 rmoveto
   show
   grestore
   /size size cuberoot2 div def
   0 size -2 mul rmoveto
   } def

(Z C H) showrow (O S H) showrow
(H K N) showrow (O Z S) showrow
(D H C) showrow (C N O) showrow
(K D V) showrow (S H O) showrow
(D R H) showrow (K N Z) showrow
(R H K) showrow (C H O) showrow
(N K S) showrow (C Z R) showrow
(S O K) showrow (D N C) showrow
(C H D) showrow (R O H) showrow
(S N D) showrow (O C H) showrow
(Z H K) showrow (C V H) showrow
(V N Z) showrow (S C K) showrow
(N D C) showrow (C N D) showrow
(O V N) showrow (Z H V) showrow
(H S K) showrow (D N O) showrow
(N S K) showrow (D C Z) showrow
(V H K) showrow (S K V) showrow
(V R K) showrow (V R S) showrow
(K Z N) showrow

showpage
```

PostScript-compatible printers, the L100 ($35,000) with a maximum resolution of 1270 dpi, and the L300 ($60,000) with a maximum resolution of 2540 dpi. Linotype calls them its Series 100 printers. Oddly enough, the resolution of these computerized printers must be set manually, to 615, 1270, or (on the L300) 2540 dpi.

The 300-dpi LaserWriter is fine for drafts, and the 2540-dpi L300 will produce excellent final prints on either Kodak RC (resin-coated) paper or film. (3M has just announced a polyester plate called onyx that can be exposed on the Linotype L100 or L300 and used as a plate on small duplicator presses to print up to 25,000 copies.)

My experience is that the L100 is useless for halftoning because any gray areas that you print will have dark streaks every inch or so down the page. Apparently, this is a result of the many stops and starts during printing and of the L100's poor paper handling when compared with the L300. (The dark streaks seem to be due to enlarged dots. It's only a problem for halftones and bit maps. Solid black and white areas, even fine text, are not noticeably affected.) Prices for using the L100 and L300 are similar, about $10 per page, so use the L300.

Table 1 lists the print shops I know of that will run PostScript jobs on Linotype L300 printers. All will accept job submissions by modem or on a Macintosh disk. They typically charge $10 per page (plus postage) and try for, but do not promise, one-day turnaround. I always ask to have my printout sent by express mail. (I've only used MacTypeNet, and I'm happy with its service, though it doesn't always achieve one-day turnaround.)

Some Linotype print shops will charge extra or refuse to run jobs that take many hours. For example, figure 4a took seven hours on an L300, and I was told, "Never again!" However, the Adobe books give no information about timing. Some of my jobs take only slightly longer to run on the Linotype than on the LaserWriter; others take much longer.

I find that I can get an upper bound on Linotype run time by measuring how long the job takes on the LaserWriter and multiplying by the factor by which the number of pixels will be increased. For instance, if the job takes 1 minute at 300 dpi on the LaserWriter, it might take up to $(2540/300)^2$ = 72 times as long (i.e., 72 minutes) at 2540 dpi on the L300. This is because the LaserWriter (and the LaserWriter Plus) and the Linotype L100 and L300 all use the Motorola 68000 microprocessor.

However, I've just learned that Linotype plans to upgrade the ROMs in all the Linotype L100 and L300 printers to PostScript version 42.5 soon. Apparently, this upgrade speeds up printing a lot, ranging from a factor of 1.5 times faster for printing noncached fonts to a factor of nearly 20 for bit-mapped images.

An odd deficiency of PostScript, given that it is a device-independent page-description language, is that it lacks any general device-independent way to describe the size of the page. To obtain nonstandard page sizes on the Linotype printers (up to 11.7 inches by 25.7 inches at 1270 dpi, less at 2540 dpi), you need to use a special operator, setpageparams, which is documented in a supplementary manual for the Linotype printers (see the text box on page 188).

PostScript Displays

Sun Microsystems recently announced a machine-independent standard for windows, called NeWS (Network/extensible Window System), which is based on building a PostScript interpreter into each window. What is to be displayed in a window is transmitted to the window as a PostScript program. NeWS is good for networking because you can easily load into the window a PostScript program that will interpret other window protocols, such as MIT's X windowing protocol, thus making NeWS highly compatible. NeWS will be a boon to PostScript programmers because it will let them try out their programs quickly on any display supporting NeWS, without waiting for a printer.

Debugging

The error messages from PostScript are quite specific and helpful, particularly

continued

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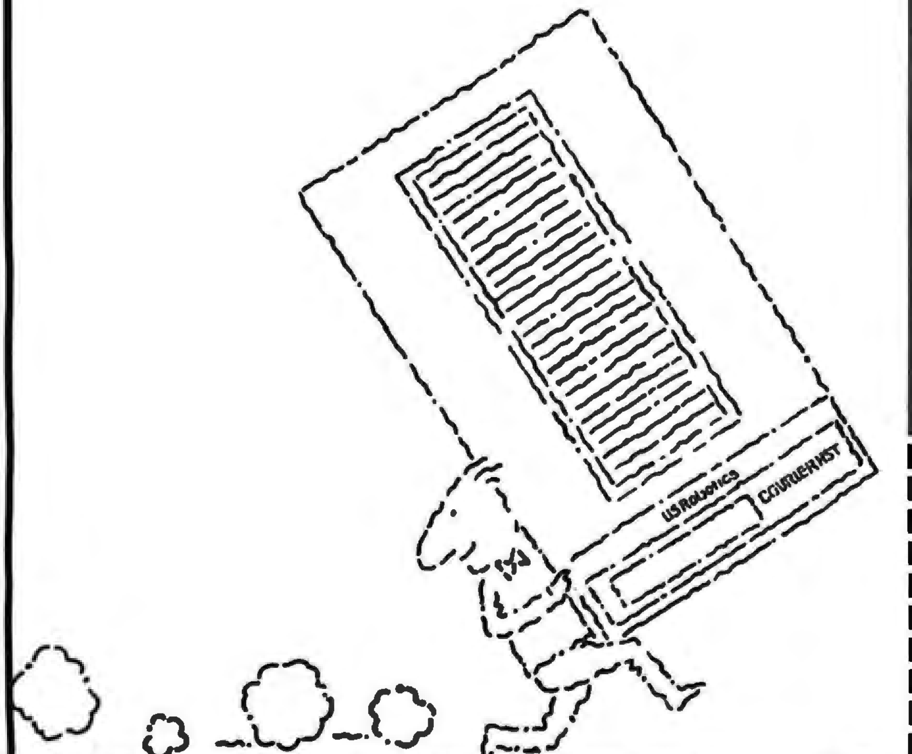

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Listing 5: *The PostScript program to produce the Pelli-Robson Letter Sensitivity test chart in figure 6.*

```
%!
% Produce Figure 6
50 750 moveto
/width 250 def
/size width 6 div def
width 2 div size -1.5 mul rmoveto
FontDirectory /Sloan known
  {/Sloan findfont size scalefont setfont}
  {/Helvetica findfont size 1.8 mul scalefont setfont}
  ifelse
/dpi
  72 0 matrix defaultmatrix dtransform dup mul exch dup
      mul add sqrt
  def
/screen dpi 16 div def
screen 127 gt {/screen 127 def} if
screen currentscreen 3 -1 roll pop setscreen
/c 1 def

/setcontrast {1 sub neg setgray} def

/showrow
  {gsave
  dup stringwidth pop -2 div 0 rmoveto
  c setcontrast
  show
  grestore
  /c c 2 div def
  0 size -2 mul rmoveto
} def

(N C R) showrow (C H V) showrow
(Z R H) showrow (S H N) showrow
(V D K) showrow (N K Z) showrow
(S Z O) showrow (R D N) showrow
(R Z S) showrow (Z R N) showrow

showpage
```

Table 1: *Print shops that output PostScript jobs on Linotype L300 printers.*

Company	Location	Telephone
Ampersand Typographers	Toronto, Canada	(416) 422-1444
Cobb Typesetting	Cincinnati, OH	(513) 241-1146
Design North Inc.	Racine, WI	(414) 762-1320
Desktop Publishing Inc.	San Rafael, CA	(415) 258-0767
MacTypeNet	Livonia, MI	(313) 477-2733
National Colorite Corp.	New Berlin, WI	(414) 784-8980
ProTypography	Chicago, IL	(312) 266-8973
Typesetting Services Corp.	Providence, RI	(401) 421-2264

because all the PostScript operators do extensive type and range checking of their arguments and give out a specific error message if they don't like them.

PostScript has several "print" commands that are helpful in debugging. They do not put ink on paper—instead, they send a message back to the host. (To put ink on paper, you say showpage.) One especially useful print command is ==, which will print whatever is on the top of the stack. What's great about that is that anything can be put on the stack, even a compiled procedure, and == will uncompile it and print it out for you. It took me a while to realize just how useful printing is, since the Adobe books don't say much about debugging.

Incidentally, there are bugs in the PostScript interpreters (version 38.0) resident in the PostScript printers. For example, I discovered that stroking very large arcs can get a PostScript printer so confused that all subsequent jobs fail with a limit-check frame device error until you reset the printer. Adobe has acknowledged the bug and promises to fix it in a future release of the PostScript interpreter. The PostScript operator version returns a string with the version number of the interpreter.

Wrapping Up

You might find four periodicals interesting. Don Lancaster's "Ask the Guru" column in *Computer Shopper* has clever ideas for nonobvious uses of PostScript and the LaserWriter. *Colophon* and *Graphic Perspective*, glossy newsletters illustrated with fancy PostScript illustrations, often include program listings. Finally, the *PostScript Language Journal* will publish its first issue about the time you are reading this.

PostScript isn't really meant for programming, but it is very handy as a programming language to create images from mathematical descriptions. It offers various ways of describing your image, a high degree of machine independence, the possibility of debugging on moderately priced, widely available printers, and final printing at 2540 dpi for $10 a page. PostScript makes it easy to produce images on paper that would be difficult or impossible to produce otherwise. ■

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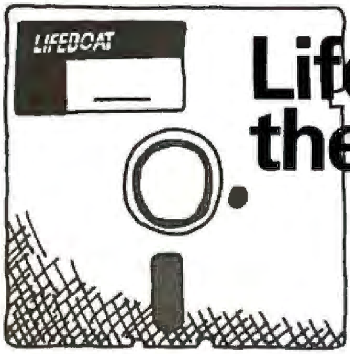

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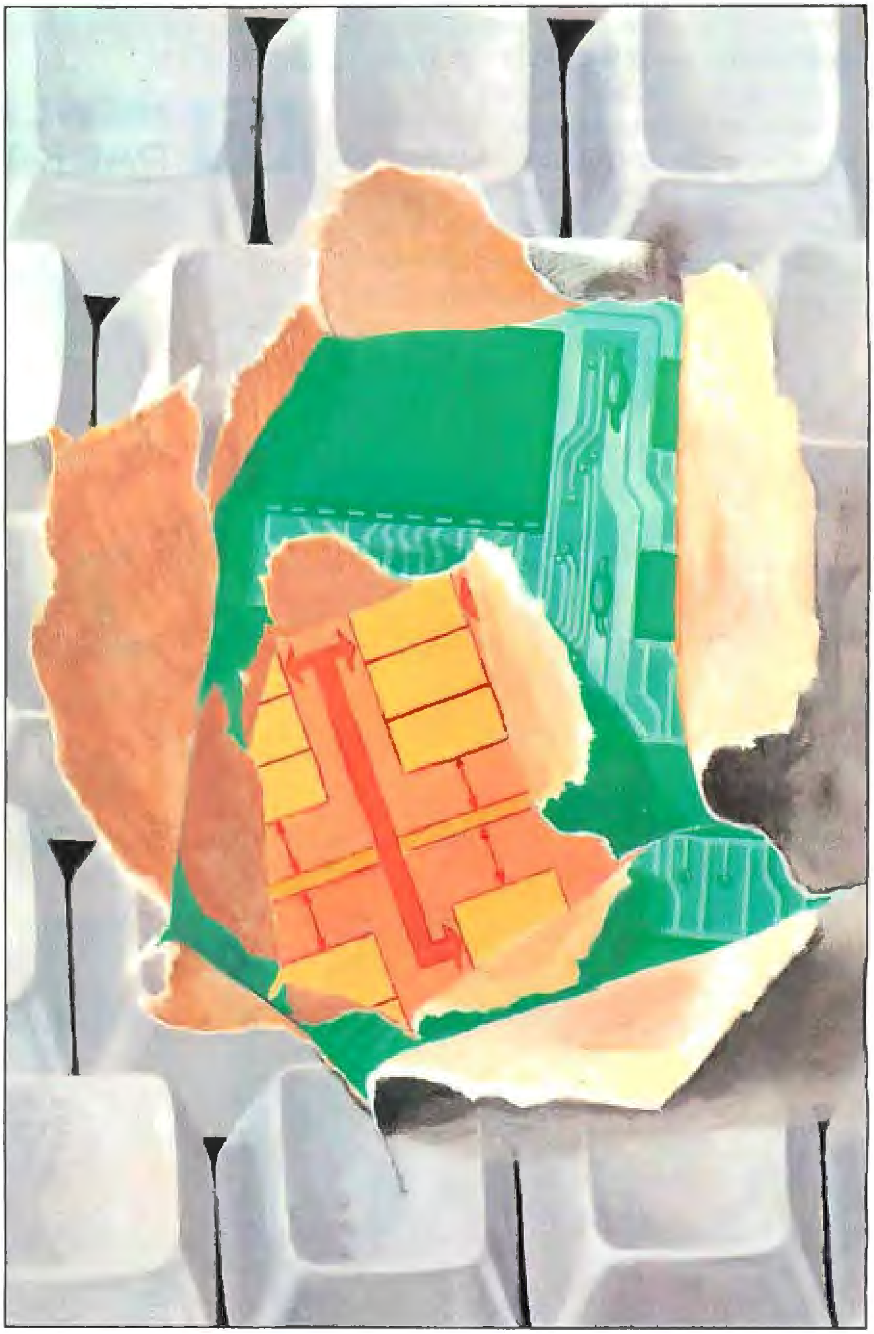
Reviews

Special BIX supplement: The following bonus reviews appear in the may87.supp BIX conference: "Removable-Cartridge Drives" by Alexis Lane, an evaluation of removable-media drives for the IBM PC and compatibles; "OPS5+" by Leonard Moskowitz, a review of this production-system language for the IBM PC, XT, AT, and compatibles; and "The Cauzin Softstrip System" by Gregg Williams, an evaluation of a device that hooks up to an Apple II, IBM PC, or Macintosh and reads high-density paper data strips. (For information on joining BIX, see page 256.)



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Inquiry 143

Soup
Canned Soup Council

Mr. J. C. Ryan, President
Flossmoor Soup Company
Flossmoor, Illinois 60422

August 1, 1987

Dear Mr. Ryan:

In an effort to help you *stay competitive*, we are publishing 5-year sales projections for two soup categories: canned and dry. Please keep these projections handy as they will aid you in your product planning over the coming years. Of special interest to you are the dry soup projections.

	CANNED	DRY
1987	$6,700,000	$1,100,000
1988	$7,300,000	$2,100,000
1989	$8,400,000	$2,600,000
1990	$9,300,000	$4,800,000
1991	$9,900,000	$7,300,000

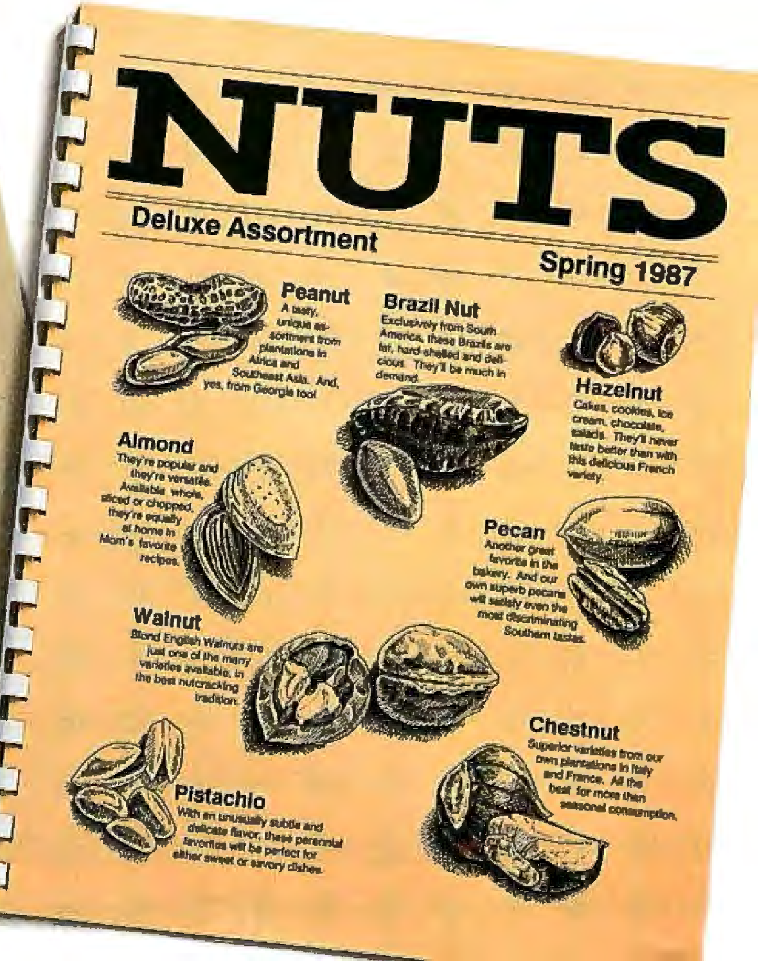
As you can see, industry experts project that the gap between dry and canned soups will begin to close by 1990. They also believe mergers will follow.

Noodle Price Hike
Bad news this month comes from TNG (The Noodle Group). By year's end, they project the price of noodles to double – up to eighteen cents a barrel. How will this price hike affect you? A two-cent per can increase on all noo soups you sell.

Recommended Reading-"*Cup or Bowl*"
This in-depth study discusses the habits of the American soup eater. Cal and I'll send you a copy.

Sincerely,

Mr. R. Welke
Director, Canned Soup Council



NUTS

Deluxe Assortment

Spring 1987

Peanut
A tasty, unique assortment from plantations in Africa and Southeast Asia. And, yes, from Georgia too!

Brazil Nut
Exclusively from South America, these Brazils are fat, hard-shelled and delicious. They'll be much in demand.

Hazelnut
Cakes, cookies, ice cream, chocolate, salads. They'll never taste better than with this delicious French variety.

Almond
They're popular and they're versatile. Available whole, sliced or chopped, they're equally at home in Mom's favorite recipes.

Pecan
Another great favorite in the bakery. And our own superb pecans will satisfy even the most discriminating Southern tastes.

Walnut
Blond English Walnuts are just one of the many varieties available, in the best nutcracking tradition.

Chestnut
Superior varieties from our own plantations in Italy and France. All the best for more than seasonal consumption.

Pistachio
With an unusually subtle and delicate flavor, these perennial favorites will be perfect for either sweet or savory dishes.

REVIEWER'S NOTEBOOK

Last month's review of more than 50 dot-matrix printers included results of benchmark tests for all but a few models, which we were unable to test in time for the review. BYTE technical editor George Stewart has completed the tests on two of these printers: NEC Information Systems' Pinwriter P5XL, a 24-wire printer that sells for $1674, and Newbury Data's OSP-3, an 18-wire model that costs $1560. Throughput for the Pinwriter P5XL came in at 137 characters per second in draft mode, 58 cps in near-letter-quality mode, and 598 cps in graphics mode. Corresponding measurements for the OSP-3 are 136, 86, and 338 cps. Sound levels in draft, NLQ, and graphics modes were measured at 69, 73, and 75 decibels for the Pinwriter P5XL, and 71, 72, and 84 dB for the OSP-3. Finally, on a scale of 1 to 5 (5 being the best and 1 being the worst), BYTE editors rated print quality for the Pinwriter P5XL at 3, 4, and 3 in draft, NLQ, and graphics modes; the OSP-3 was rated at 3, 4, and 4, respectively.

We've also discovered that table 1 (page 205) in the April printer review contains a consistent error in the sound levels recorded for the printers' graphics modes. The dB levels we published are far too high; the correct figures appear on page 254 in this issue. Generally, sound levels for the graphics mode ranged from 5 percent to 10 percent higher than those for NLQ mode. At the low end of the sound range, for example, dB levels for the Tandy DMP 130 rose from 62 in NLQ to 65 in graphics mode. Near the high end of the range, Output Technology's OT-700e had a 10-point jump from 79 to 89 dB. In the more common mid-range level, the Alps America ALQ324 shifted only slightly from 71 to 72 dB.

Our lineup this month starts off with Stephen Satchell's review of 10 high-speed internal modems, a follow-up to his evaluation of 23 external modems in the December 1986 issue. Once more, Stephen simulated a bad telephone line to test the modems. For this review, he also ran a set of "street tests" to see how the units are likely to hold up during transmission on an average telephone line.

Another highlight this month is John Unger's review of the Compaq Portable III, a 12-MHz transportable with a 20- or 40-megabyte hard disk. The Portable III has more power and speed than many desktops; its performance is unmatched by any other portable computer—at least those available at press time.

Completing this month's section are reviews of the Commodore 64C, a $229.95 8-bit computer bundled with the GEOS window-and-icon operating system; SCSI hard disk drives and BASIC compilers for the Macintosh; Q&A version 2.0, a file manager teamed with a word processor and natural-language front end; and Lyrix, a word processor that runs under UNIX and XENIX.

As a bonus, three additional reviews are available on BIX in the may87.supp conference, the supplement to this issue of BYTE. (For information on joining BIX, see page 256.) Here are brief summaries for readers who don't subscribe to BIX.

First, Alexis Lane evaluates removable-cartridge drives for the IBM PC and compatibles: Iomega's Bernoulli Box Plus, Sysgen's DuraPak, and IDEAssociates', Diskit 2 and Diskit 2 Plus. All four units use 10-, 15-, or 20-megabyte removable cartridges to provide virtually unlimited disk storage, file security, and transportability of data.

Of the units tested, Alexis's favorite was the Bernoulli Box Plus, though it was also the most expensive at $3775 (a price that includes a booting controller board). This model holds one 80-megabyte hard disk drive and two 20-megabyte removable-cartridge drives. The unit is reliable, its documentation is complete, and it comes with a useful selection of utilities. For more information, contact Iomega Corp., 1821 West 4000 South, Roy, UT 84067, (801) 778-3000.

The DuraPak, the least expensive unit at $2295, also performed well. It holds two 15-megabyte removable-cartridge drives and comes with a controller card. Contact Sysgen Inc. at 556 Gibraltar Dr., Milpitas, CA 95035, (408) 263-4411 for details. The Diskit 2 ($2995) and Diskit 2 Plus ($3595) each have two 10-megabyte removable-cartridge drives; on the 2 Plus, you also get DES-based file-encryption capabilities for added security. For more information, contact IDEAssociates Inc., 29 Dunham Rd., Billerica, MA 01821, (617) 663-6878. The two Diskit units, Alexis found, have the best installation program; but one of the cartridges developed many bad sectors, causing data loss.

The benchmark tests show that, *in general*, removable-media devices are slower than their fixed-disk counterparts. Overall, though, their compactness and the convenience of the cartridges make them an alternative to fixed hard disks.

Next in the may87.supp conference is Leonard Moskowitz's review of OPS5+, a production-system language for the IBM PC, XT, AT, and compatibles from Computer*Thought Corp. (840 Avenue F., Suite 104, Plano, TX 75074, (214) 424-3511). Version 3.0B, Leonard reports, provides a standard command mode and a menu- and mouse-driven windowing environment.

The benchmarks show OPS5+ to be an excellent performer on a PC AT, sometimes faster than VAX OPS5, and about half as fast as OPS5 on the Symbolics 3670. The $1800 package offers hooks to external Lattice C procedures, first-rate documentation, and useful language extensions. A few minor problems showed up during the review, and the DOS 640K-byte memory restriction limits the size of the production systems you can build. But all in all, Leonard says, it's a professional package that will give you excellent code compatibility.

Finally, BYTE senior technical editor Gregg Williams reviews the Cauzin Softstrip System. This device hooks up to a serial port on an Apple II, IBM PC, or Macintosh and reads high-density data strips printed on paper. Each 8-inch strip encodes about 1000 to 5000 bytes, with up to seven strips per page. The reader ($199.95) comes with an accessory kit ($19.95) containing cables, software, instructions, and sample programs.

Gregg found the system easy to use and reliable on all three computers. He also experimented with The Stripper, a $29.95 program from Cauzin for creating low-resolution data strips with a dot-matrix printer. Cauzin Systems Inc. (835 South Main St., Waterbury, CT 06706, (203) 573-0150) also sells a program for making high-density data strips with laser printers. Gregg concludes that this well-designed piece of technology will be of use if you need to distribute small amounts of software or data.

—Cathryn Baskin
Senior Technical Editor, Reviews

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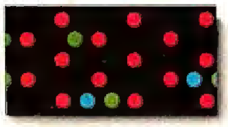

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High-Speed Internal Modems

Stephen Satchell

An evaluation of 10 plug-in modem cards for the IBM PC family

For my review entitled "23 Modems" (December 1986 BYTE), I simulated a bad telephone line and tortured 23 stand-alone modems to see what they could tolerate. For this review, I tested 10 modems that you install inside the IBM PC family of computers (see table 1 for a complete list of the modems and company names). Seven of these modems support 300/1200/2400-bit-per-second operation, and three can transmit at 9600 bps.

A word of caution: I tested these modems only for their ability to originate calls. The resulting data is valuable to people who use their modems for calling information services, bulletin boards, and message systems. I made no tests of the modems' ability to answer calls. This means that service providers and bulletin board operators should not depend solely on these results to select a modem for such services.

Features

Table 2 lists some of the features I looked for when examining these modems. This is by no means a complete comparison chart, but it details some of the basics. The first section shows some elementary capabilities and convenience items, such as the size of the card, whether a speaker is located on the card (this lets you monitor call progress audibly when making attended calls), and whether a phone jack is included on the card for an external telephone (this lets you plug a phone in without a Y adapter).

Luxury features include such things as a real-time clock, support for COM ports 3 and 4, CCITT V.22 quadrature phase-modulation capability at 1200 bps, security support (such as modem passwords and auto-callback), and the number of user-defined communications-parameter setups that you can store in each modem.

The second section of table 2 details the user diagnostics available with each modem. There is nothing like being able to isolate a problem yourself to save needless trips to the repair shop. I consider local analog loopback capability a necessity because it checks the carrier transmit and carrier receive; I would not purchase a modem without it. The other three diagnostic modes (local digital loopback, initiate remote loopback, and response to remote loopback) are nice to have but not absolutely necessary.

Special dialing features such as stored directory entries and automatic redial are duplicated in most IBM PC terminal-emulator programs.

All modems sense the presence of a dial tone, and most allow you to wait for a secondary dial tone (when connecting to a toll trunk, for instance). All can switch from Touch-tone to pulse dialing and back. All allow you to repeat the last command given, providing some limited redial capability. Some modems have a remote-ring indication, telling you that the other end is ringing, while the US-Robotics Microlink 2400 and the Cermetek 2400 SPC will tell you if a voice answers.

Call-progress monitoring is best done by listening on a speaker. Programs that run unattended or hide the mechanics of making a connection require some information to aid in error recovery. All the modems I reviewed return the standard Hayes call-progress-monitoring result codes with the exception of the Cermetek 2400 SPC.

The last section of table 2 details the compatibility of each modem's command set with the basic Hayes command set. For this purpose, I checked to make sure that the commands shown in table 3 were functional. S-registers 0 through 12 and result codes 0 through 10 should be as defined for the Hayes 1200- and 2400-bps modems. Other commands, registers, and results can be anything the modem company wishes to make them. Deviations are listed for each modem.

Several modems require you to set an S-register to indicate the speed you wish to use. If you use the default, the auto-baud feature will cause the modem to attempt to connect at the fastest rate that the remote modem responds to. This means that if you use an on-line information service and wish to use a speed of 300 bps because it is cheaper, you must set an S-register to make this happen. Otherwise, the modem will connect at a faster, more expensive speed.

Modem Basics

In my "23 Modems" article, I went into considerable detail as to how a modem works. For this article, I'll summarize briefly.

A modem (which stands for modulator-demodulator) takes digital data and converts it into a signal for transmission at the originating end of the transmission line, and another modem receives and regenerates the digital data at the other end. Depending on the modulation method, 8 or more data bits are grouped to represent a character, and the characters are transmitted over the telephone line using one of the standard communications modulation schemes.

In full-duplex connections over the switched network (local and long-distance direct-dial telephone service) a maximum of 600 symbols, each consisting of one or more modulation changes, are sent in each direction. In half-duplex connections, up to 2400 symbols are sent in one direction at a time, with the direction changing at prearranged intervals; this is known as line turnaround. A sym-

continued

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Table 1: *Label definitions and prices for the modems tested.*

*AJ: AJ 2400-2H01
Anderson Jacobson
521 Charcot Ave.
San Jose, CA 95131
(408) 435-8520
$650 (no software)

*ANC: Lightning f/i
Anchor Automation Inc.
20675 Bahama St.
Chatsworth, CA 91311
(818) 998-6100
$499 without MicroNet protocol
$599 with MicroNet Level 4 protocol
(prices include LYNC software)

CER: 2400 SPC
Cermetek Microelectronics Inc.
1308 Borregas Ave.
Sunnyvale, CA 94088-3565
(408) 752-5000
$395 without software
$445 with Mirror software

CTS: Half-Pak #24
CTS Fabri-Tek Inc.
Datacomm Products Division
6900 Shady Oak Rd.
Eden Prairie, MN 55344
(612) 941-9100
$395 (no software)

DCA: IRMA Fastlink
Digital Communications Associates Inc.
1000 Alderman Dr.
Alpharetta, GA 30201
(404) 442-4000
$1195 (includes Crosstalk-Fast)

EV: Fastcomm 2496B
Fastcomm Data Corp.
12347-E Sunrise Vally Dr.
Reston, VA 22091
(703) 620-3900
$1079 (no software)

HAY: Smartmodem 2400B
Hayes Microcomputer Products Inc.
705 Westech Dr.
Norcross, GA 30092
(404) 449-8791
$799 (includes Smartcom II)

MER: Mercury Fastmodem
Creative Digital Inc.
1662 West 820 North
Provo, UT 84601
(801) 373-9843
$495 (includes Mirror software)

OMN: Encore 2400 HB
OmniTel Inc.
5415 Randall Place
Fremont, CA 94538
(415) 490-2202
$449 (includes Bitcomm)

TEL: TrailBlazer
Telebit Corp.
10440 Bubb Rd.
Cupertino, CA 95014
(408) 996-8000
$1195 without software
$1390 with Crosstalk XVI-Fast

USR: Microlink 2400
USRobotics Inc.
8100 North McCormick Blvd.
Skokie, IL 60076
(312) 982-5010
$599 (includes Telpac software)

VEN: Half Card 24
Ven-Tel Inc.
2342 Walsh Ave.
Santa Clara, CA 95051
(408) 727-5721
$599 (includes Crosstalk XVI)

*These modems were not tested due to failure during initial pretest operations.

bol encodes 1 or more data bits using a variety of modulation changes. The data rate is defined as the reciprocal of the length (in seconds) of the shortest element in the transmitted signal. The data rate can therefore be different from the bps rate; again, this is dependent on the type of modulation used. Generally, though, for the commonly used *frequency-shift* modulation, they are considered to be the same.

What Goes Wrong

Most modems have no difficulty recognizing the symbols transmitted on an ideal telephone connection, such as the one you get when you connect two modems together with a standard modular telephone cord. Very little degradation of the modulated signal occurs.

As you start putting more wire between the modems, transmission imperfections start appearing. These imperfections, called impairments by the telephone industry, can interfere with the modem's ability to recognize each symbol correctly. At some point in the telephone network, the telephone company will split your connection into two, handling each direction separately. This eases some of the difficulties of long-distance telephoning, but it also means that each half of the connection can have its own problems. You can have a clean connection going in one direction and a noisy one going in the other direction.

To complicate the matter of testing a modem on a switched network, you cannot depend on having the call routed the same way twice. But even if the calls could be routed, line conditions change due to the weather, the age of the telephone lines, replacement of lines and switch equipment, and even introduction of new technology into the circuits, such as fiber optics.

Test Setup

To subject these modems to exactly the same conditions with each other and with the modems that I evaluated in my other review, I built a telephone connection simulator (see figure 1) by using a Bradley Telcom Corporation 2A/2B line simulator, a reference modem (an AT&T 2224B), a Hewlett-Packard 4437A attenuator, passive hybrid splitters, and a Ramsa 8210 recording mixer (used to synthesize the line amplifiers). The computer used was an IBM PC AT model 099. The modem being tested was installed in slot 4 of the PC AT.

In my prior evaluation, I placed the AT&T 2224B in digital loopback mode. Thus, the data was sent from the modem under test to the reference modem over a clean line, looped back into the reference modem, and then returned to the modem under test through the impairment generator. For this review, I elected to send the data directly from the reference modem (see figure 1). This better approximates actual operation. I spot-checked several modems with the 2224B in loopback mode and obtained exactly the same results.

This change supports realistic testing of the high-speed modems: the Fastcomm 2496B, the Telebit TrailBlazer, and the DCA IRMA Fastlink. Since the throughput of the modem under test could be

Table 2: *Features of the modems listed in table* 1.

Modem	AJ	ANC	CER	CTS	DCA	EV	HAY	MER	OMN	TEL	USR	VEN
Feature												
Half Card	—	—	Y	Y	—	Y	—	—	Y	—	—	Y
Speaker	Y	Y	Y	Y	—	Y	Y	Y	—	—	Y	Y
Com 3 and 4 support	—	Y	Y	—	Y	Y	—	Y	Y	Y	Y	Y
CCITT V.22 (1200 bps)	Y	Y	—	Y	Y	—	Y	Y	Y	Y	—	—
Phone jack	Y	Y	Y	Y	—	—	Y	Y	Y	—	Y	Y
User-stored setups	1	1	—	1	—	1	2	—	—	—	—	—
Real-time clock	—	—	—	—	—	—	—	—	—	—	Y	—
Security support	Y	—	—	—	—	—	—	—	—	—	—	—
Speed set by auto-baud	—	Y	Y	Y	—	—	Y	Y	Y	—	Y	Y
In-modem help	Y	Y	—	—	Y	Y	—	—	—	Y	Y	—
Diagnostics												
Local analog loopback	Y	Y	—	Y	—	—	Y	Y	Y	—	Y	Y
Local digital loopback	Y	—	—	Y	—	—	Y	Y	—	—	—	Y
Initiate remote loopback	Y	—	—	Y	—	—	Y	Y	—	—	—	Y
Response-to-remote loopback	Y	—	—	Y	—	—	Y	Y	—	—	—	Y
Dialing												
Directory entries	20	10	—	1	10	—	4	—	—	10	—	—
Automatic redial	Y	—	—	—	—	—	—	—	—	—	—	—
Call-progress status (exceptions)												
Busy signal	Y	Y	Y	Y	Y	—	Y	Y	Y	Y	Y	Y
Remote ringing	—	—	Y	—	Y	—	—	—	—	Y	Y	—
Voice answer	—	—	Y	—	—	—	—	—	—	—	Y	—
Hayes command set												
Missing/different basic commands	—	—	M,W	—	X	W	—	—	!,W	X	—	—
Missing/different S-registers	—	11	—	11	—	—	—	—	10	—	—	—
Missing/different results	—	—	6—9	—	—	—	—	—	—	—	—	—

The call-progress result codes and Hayes commands from table 3 that are not shown are present in all the modems tested.

limited by the ability of the test program in the IBM PC AT to feed and check data, I tried using the package on a null modem cable, creating a data-turnaround loop. The modem test program was able to pump 1813 characters per second over a 19,200-bps connection.

Mortality

Before running the battery of tests, the subject modem had to prove that it was working properly. This was necessary for two reasons—to make sure I knew how to get the modem under test working properly in my test setup, and to make sure that the single-impairment studies wouldn't be marred by spurious errors caused by a flaky modem. As a result, I found out how to get the modems to connect at every speed. However, two modems didn't make the cut.

The first Anderson Jacobson AJ 2400-2H01 that I tested was unfriendly enough to short out the power supply in the IBM PC AT. When I examined the way the board was placed in the slot, I discovered

continued

Table 3: *Hayes-compatible commands.*

A - Answer
D - Dial
E - Command echo
H - Hook control
M - Speaker control
O - Go on-line

P - Pulse dial
Q - Response disable
R - Reverse orig/ans
S - Read/set S-registers
T - Tone dial
V - Verbose/terse responses

W - Wait for dial tone
X - Select response set (X0,X1)
Z - Reset
, - Pause
; - Stay in command mode after dialing
! - Hookflash

Table 4: *Definitions of impairment labels.*

Sens: Sensitivity in dBm to initiate error-free connection.
P-mod: Phase modulation in degrees.
A-mod: Amplitude modulation in percent.
White: White noise signal-to-noise ratio in dB.
G-hit: Gain hit in dB.
P-hit: Phase hit in degrees.
Err: Number of errors in the two-minute worst-case test.
CPS: Throughput in characters per second in the worst-case test, truncated to the nearest character by the test program.

that the edge connector was misaligned with the PC AT system board connector. This was due to improper manufacturing tolerances when the board outline was trimmed, as well as improper location of the support bracket. Luckily, this caused no damage to the PC AT. The second AJ 2400-2H01 that I tested was able to get a clean connection at 300 bps, but 1200- and 2400-bps connections were not error-free. Repeated calls to Anderson Jacobson about this problem produced no response.

The first sample of the Anchor Automation Lightning f/i that I received would not connect cleanly at any speed. The second sample was better at 300 bps, but it was not error-free at 1200 bps and, at 2400 bps, I couldn't get the modem to finish the connection sequence. Anchor Automation said it was surprised at this result but offered no explanation.

Test Conditions

A test series consisted of two sensitivity measurements, four test sets, and two error-count measurements. The first set was run at −8 dBm (decibels referenced to 1 milliwatt, measured at the modem), the second at −16 dBm, and the third at −26 dBm. The fourth set was run at −8 dBm. All levels were set using the 2225-Hertz answer tone of the AT&T 2224B reference modem.

A test group consisted of23 single-impairment tests. I increased the level of each impairment until the modem under test started to generate errors. I then backed the level of impairment off until the modem transmitted data for 15 seconds without error. (See the text box "Impairment Parameters" on page 213 for a detailed description of the impairments.)

Error Count and Throughput

The real test of a modem is how well it transfers data in the face of anything a telephone line can throw at it. The main difference between this evaluation and my last one is that I used no filtering during the error-count test.This is mostly because the frequency response reported in the AT&T/Bell Laboratories' "1982/83 End Office Connection Study" (see bibliography) shows that the frequency response is flat within 2 dB. Because of this difference in test methods, you cannot directly compare these numbers with the numbers reported in my prior evaluation.

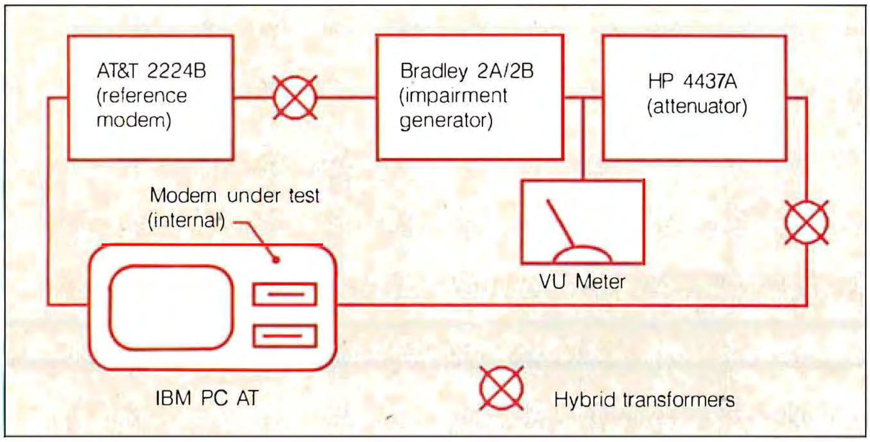

Figure 1: *The impairment-generating test setup used for modem evaluation.*

I performed two separate error-count tests on each modem at speeds of 300, 1200, and 2400 bps. The first test is the torture-track test, which is characterized by excessive levels of impairments. The signal level is −16 dBm with 10 degrees of 60-Hz phase modulation, 2 percent of second- and third-order harmonic distortion, white noise at 23 dB below the signal level, and a combined phase and amplitude hit of 10 degrees and 2 dB once every 5 seconds. The modems were allowed to sit with the connection for 15 seconds; I then took error counts and a character throughput count for two minutes.

The second error-count test, which I did not perform in my previous evaluation, is more of a "street test" of the modems, simulating a typical 1983 average telephone line as defined in the "1982/83 End Office Connection Study." Here I threw only three impairments at the modems: 4 degrees of 60-Hz phase modulation, 1 percent of second- and third-order harmonic distortion, and a 33-dB signal-to-white-noise distortion. All the modems breezed past this two-minute test at 300, 1200, and 2400 bps. This data, therefore, does not appear in the result tables.

For the three high-speed modems, I contrived an additional set of throughput tests for their top speed. All these tests were run with an interface speed of 19,200 bps for five minutes to reduce

Table 5: *Results of the 300-bps connection test. With the exception of White Noise, higher numbers indicate better performance. The number-of-errors and throughput results are from worst-case tests.*

	Sens	P-mod	A-mod	White	G-hit	P-hit	Err	CPS
CER	−39	45 to >85	70 to 80	13 to 12	11 to 14	70 to >85	0	29
CTS	−40	55 to >85	70 to >85	12 to 10	18 to >20	65 to >85	0	29
DCA	−39	30 to >85	20 to 60	16 to 14	6 to 11	60 to >85	0	29
EV	−40	45 to >85	70 to 80	13 to 12	12 to 14	70 to 90	0	29
HAY	−40	45 to >85	60 to 80	13 to 11	11 to 14	60 to >85	0	29
MER	−42	50 to 65	65 to 85	13 to 11	5 to 08	65 to >85	0	29
OMN	−44	35 to >85	35 to >85	27 to 26	7 to >20	30 to >85	55	21
TEL	−39	30 to >85	20 to 60	16 to 14	6 to 11	60 to >85	0	29
USR	−36	25 to >85	30 to 55	25 to 24	4 to 10	35 to >85	19	27
VEN	−35	45 to >85	60 to 80	14 to 13	10 to 14	55 to >85	0	29

An entry of 29 in the CPS column indicates a perfect run at 300 bps due to the test program truncating the cps to whole characters and the timing starting at the beginning of the test instead of when the first character reaches the serial port.

Impairment Parameters

The following are the details of the impairment parameters I used to test the 10 modems. Based on the "1982/83 End Office Connection Study," I used two distinct impairment levels: a level of impairment higher than that measured on 95 percent of the connections in the study (the 95 percent level), and a level higher than that measured on 50 percent of the connections (the 50 percent level). Table 4 lists the abbreviations of the test parameters as they appear in the test results. In cases where all modems passed the tests, I did not list the results.

Sensitivity

A sensitivity measurement determines the lowest signal level at which the modem will answer and receive random data without errors for 30 seconds. This is a signed value, so lower numbers in the tables represent better performance; that is, −45 is better than −40.

Phase Modulation

Phase modulation (also known as phase jitter) is a regular back-and-forth shift in the waveform with respect to time. Moderate amounts of phase modulation should not affect 300-bps operation. Other more complex modulation methods use phase modulation to encode symbols, so any unwanted phase modulation can make decoding difficult or impossible. I used steps of 5 degrees and took measurements at 20 Hz, 60 Hz, and 120 Hz. I found the frequency band from 10 Hz and 300 Hz to be the most sensitive to phase modulation. Higher numbers in the tables represent better performance. The 95 percent level is 8 degrees, and the 50 percent level is 4 degrees.

Amplitude Modulation

Amplitude modulation is a regular change in signal level. It is the equivalent of turning a volume control up and down at a regular rate. I used steps of 5 percent and took measurements at 20 Hz, 60 Hz, and 120 Hz. Higher numbers in the tables represent better performance. The 95 percent amplitude modulation level is 4 percent, while the 50 percent level for 20-Hz to 300-Hz modulation is 3 percent.

White Noise

White noise, the hiss you hear on long-distance calls, is a band noise distributed evenly throughout the frequency spectrum. As this noise gets louder in relation to the signal level, the modem has a harder time determining what is part of a symbol and what is background noise. The values reported in the tables are the differences between the noise level and the signal level. I made adjustments in 1-dB increments. The connection study reports noise in absolute levels. From my −8-dBm reference, the 95 percent level is 43 dB, and the 50 percent level is 53 dB. From the −16-dBm level used in the error-count test, the 95 percent value is 35 dB, and the 50 percent value is 45 dB. In other words, a higher dB value indicates less noise in relation to the signal; 45 dB is a noise level that is 45 dB below the indicated signal level. Therefore, lower number values indicate better noise rejection.

Gain (Amplitude) Hit

A gain hit is a long-term step in the level of the signal; I used steps of 5 percent. The modem was subjected to one gain hit per second. Each hit shifted the level, held the new level for 100 milliseconds, and then shifted the level back. Three shift speeds, which measure the time required to accomplish the shift, were used: 20 ms, 2 ms, and 200 microseconds. Adjustment was in 5 percent increments. Higher numbers in the tables represent better performance. No gain hits were counted in five minutes at either the 95 percent level or the 50 percent level.

Phase Hit

A phase hit is a short-term shift out of phase, with possibly a shift back. Each modem was subjected to one hit per second. Each hit shifted the signal, held the shift for 100 ms, and then unshifted the signal. I tested three shift speeds: 2 ms, 20 ms, and 200 μs (essentially instantaneous).

Adjustment was in 5 percent increments here also. Higher numbers in the tables represent better performance. One 10- or 15-degree hit in five minutes is the 95 percent level, and no hit is the 50 percent level.

Frequency Shift

A frequency shift is a long-term translation of signal frequency. No modem in this or the prior evaluation was affected by a shift of as much as 5 Hz up or down. Testing was complicated by the Bradley 2A/2B's tendency to change the signal's amplitude as I changed the frequency. Once I equalized this, all the modems turned in error-free performance.

Single-Frequency Interference

Single-frequency interference is a single-frequency signal superimposed on the modem signal. For this evaluation, I restricted single-frequency interference to 20 Hz, 60 Hz, and 120 Hz. No modem was affected by a level exceeding 6 to 8 dB above the modem signal level.

Harmonic (Nonlinear) Distortion

This impairment is almost always due to a telephone line amplifier that does not faithfully represent at its output what it sees in its input. No modem in either of my evaluations was affected by a level of 5 percent of both second- and third-order harmonic distortion.

The "1982/83 End Office Connection Study" does not provide information for harmonic distortion but instead reports intermodulation distortion. The 95 percent level is under 2 percent intermodulation distortion, and the 50 percent level is under 1 percent IMD for both second- and third-order IMD.

Impulse Noise

Impulse noise is a transient voltage (amplitude) spike on the transmitted signal caused by lightning, relays, repairs, or other causes. None of the modems reviewed was affected by impulse noise that was 2 dB above the signal level.

biasing the numbers with the initial start-up of the transfer. I used no protocols; I blasted bytes to the modems as fast as they would accept them. My first test was the same torture-track test used at the 300/1200/2400-bps speeds. The second test was the torture-track test with white noise at 28 dB below the signal level of −16 dBm. The third test was done with the street-test setup. The forth test was done with no impairments at all to show how fast the modems can operate under local connections.

The reason that the character rates are 29, 119, and 239 for perfect runs at 300, 1200, and 2400 bps in tables 5, 6, and 7 is that the program truncates the calculation of characters per second to whole numbers, and the timer starts when the test begins, not when the first character actu-

continued

Table 6: *Results of the 1200-bps connection test. With the exception of White Noise, higher numbers indicate better performance. The number-of-errors and throughput results are from worst-case tests.*

	Sens	P-mod	A-mod	White	G-hit	P-hit	Err	CPS
CER	−38	65 to 75	70 to >85	12-11	16 to >20	40 to 65	0	119
CTS	−40	25 to 65	30 to 50	14-13	6 to 10	30 to 60	0	119
DCA	−44	40 to >85	10 to 70	13-12	7 to 9	35 to >85	0	119
EV	−40	60 to 75	75 to >85	13-12	18 to >20	40 to 65	0	119
HAY	−40	60 to 70	70 to >85	12-13	18 to >20	40 to 65	0	119
MER	−43	60 to 70	65 to 80	12-11	5 to 8	35 to 65	0	119
OMN	−43	50 to >85	50 to >85	14-13	16 to >20	40 to >85	0	119
TEL	−44	40 to >85	10 to 70	13-12	7 to 9	35 to >85	0	119
USR	−36	35 to 70	50 to 75	16-12	3 to 7	40 to 90	0	119
VEN	−38	65 to 75	75 to 80	12-12	16 to >20	35 to 65	0	119

An entry of 119 in the CPS column indicates a perfect run at 1200 bps due to the test program truncating the cps to whole characters and the timing starting at the beginning of the test instead of when the first character reaches the serial port.

Table 7: *Results of the 2400-bps connection test. With the exception of White Noise, higher numbers indicate better performance. The number-of-errors and throughput results are from worst-case tests.*

	Sens	P-mod	A-mod	White	G-hit	P-hit	Err	CPS
CER	−38	20 to 30	20 to 25	21 to 20	2 to 3	15 to 35	22	214
CTS	−40	5 to 20	5 to 20	22 to 22	2 to 3	10 to 25	44	188
DCA	−39	20 to 60	20 to 25	23 to 21	2 to 3	15 to 70	28	205
EV	−40	20 to 25	20 to 25	22 to 21	2 to 3	15 to 30	20	215
HAY	−40	20 to 30	20 to 25	21 to 20	2 to 3	15 to 35	15	222
MER	−43	20 to 25	20 to 25	21 to 20	2 to 3	15 to 30	103	84
OMN	−39	10 to 25	15 to 20	21 to 20	2 to 2	15 to 40	*	0
TEL	−39	20 to 60	20 to 25	23 to 21	2 to 3	15 to 70	28	205
USR	−32	10 to 15	10 to 15	24 to 21	2 to 3	15 to 30	29	206
VEN	−38	15 to 25	15 to 25	21 to 20	2 to 3	15 to 30	111	82

*The OmniTel Encore 2400 HB would not pass the worst-case phase-modulation impairment test, and it disconnected. It passed all the other tests.

An entry of 239 in the CPS column would be a perfect run at 2400 bps due to the test program truncating the cps to whole characters and the timing starting at the beginning of the test instead of when the first character reaches the serial port.

Table 8: *High-speed 19,000-bps connection test results. The Worst results are from a torture-track test. The Modified Worst results are from a torture-track test with the noise at 28 dB below a signal of −16 dBm. The Average results are from a street test. The Best results are obtained when there are no line impairments.*

	Worst		Modified Worst		Average		Best	
	Err	Cps	Err	Cps	Err	Cps	Err	Cps
EV	*	0	0	495	0	773	0	985
TEL	0	265	0	555	0	886	0	1495
DCA	0	265	0	555	0	886	0	1495

*Unit failed to connect under worst-case conditions.

ally gets to the serial port hardware. (For a complete tabulation of the test results, see tables 4 through 8.)

Winners and Losers

Common wisdom says that "if all else fails, use 300 bps." Unfortunately, this rule of thumb does not hold for the US-Robotics Microlink 2400 and the Omni-Tel Encore 2400 HB. The problem is that these modems are more susceptible to noise than the others by more than 10 dB. I was able to verify this by reducing the white noise level by 6 dB with the Microlink 2400 and was rewarded by an error-free run (see table 5).

When the going was easy, all modems performed well at 2400 bps and worked well with local connections. When the going got tough, they all had problems at

2400 bps. The modem that performed best in this test was the Hayes Smartmodem 2400B, followed closely by, in order of performance, the Fastcomm 2496B, Cermetek 2400 SPC, Telebit TrailBlazer, DCA IRMA Fastlink, US-Robotics Microlink 2400, and the Half-Pak #24. The Mercury Fastmodem and the Ven-Tel Half Card 24 brought up the rear. The OmniTel Encore 2400 HB never made it out of the starting gate; it failed to establish a connection on my worst-case line with the reference modem.

All 10 modems passed the street test and handled the torture-track test at 1200 bps without problems. This is a welcome finding, since more and more bulletin board services offer connections at 1200 bps.

Finally, with the high-speed modems, making the initial connection in the torture-track tests required repeated attempts. I almost gave up on the Telebit TrailBlazer, but I had to give it just one more try and was astounded when it connected and passed data. The Fastcomm 9600 Turbo couldn't operate when the white noise was 23 dB below the signal level, but at 28 dB it was fine. The TrailBlazer and the DCA IRMA Fastlink proved to be faster modems, but they are also more expensive.

The winner in the 300/1200/2400-bps modem class is the Cermetek 2400 SPC ($395 for the modem only, $445 with Mirror software). It placed third in the torture-track test. Its lack of a speaker-control command, a wait-for-dial-tone command, and its nonstandard call-progress result codes can cause trouble with software that relies on exact result codes but, overall, it is the clear winner of the price/performance trade-off. ■

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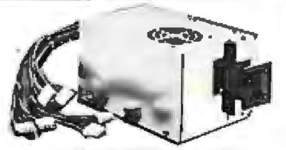

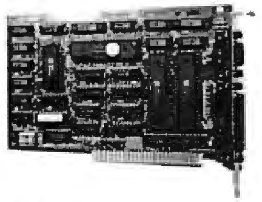

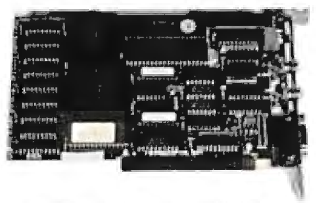

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Copy Block	86.9	231.7	199.0	123.8	189.5

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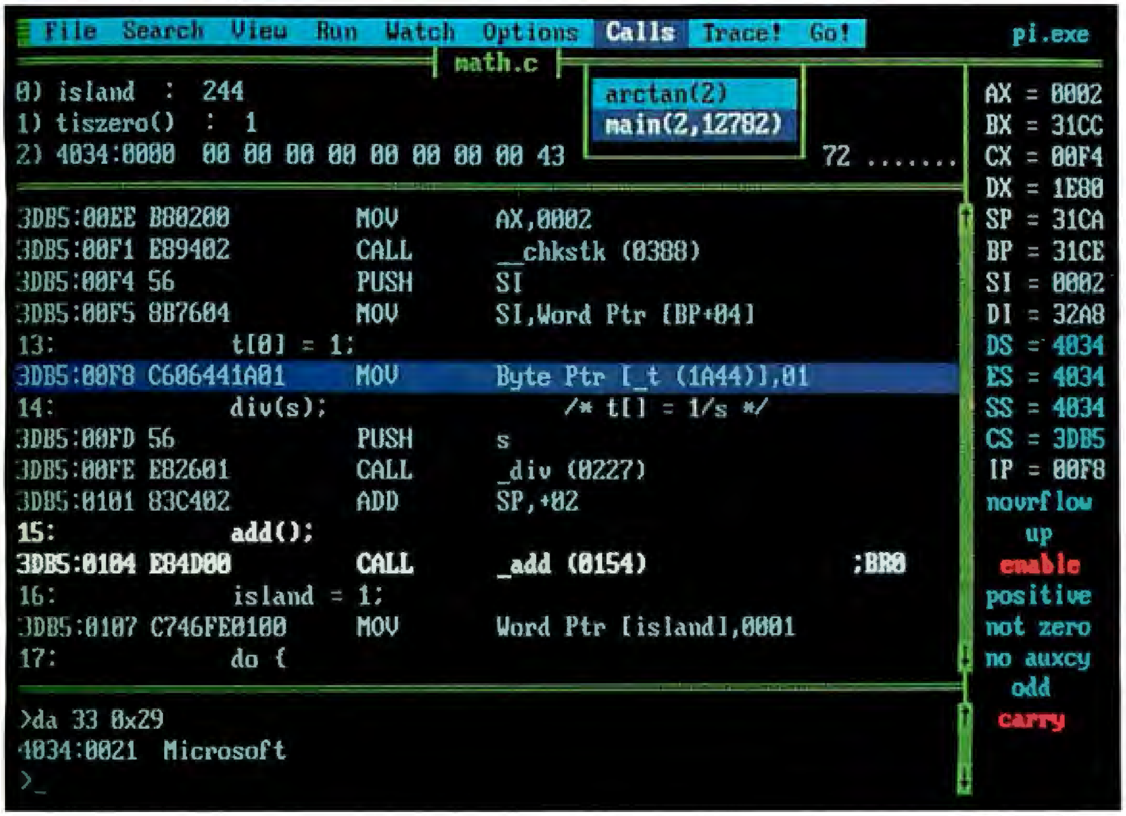

```
0) island   :  244                              arctan(2)
1) tiszero()  :  1                              main(2,12782)
2) 4034:0000  00 00 00 00 00 00 00 00 43                      72 .......
3DB5:00EE B80200           MOV      AX,0002
3DB5:00F1 E89402           CALL     __chkstk (0388)
3DB5:00F4 56               PUSH     SI
3DB5:00F5 8B7604           MOV      SI,Word Ptr [BP+04]
13:             t[0] = 1;
3DB5:00F8 C606441A01       MOV      Byte Ptr [_t (1A44)],01
14:             div(s);              /* t[] = 1/s */
3DB5:00FD 56               PUSH     s
3DB5:00FE E82601           CALL     _div (0227)
3DB5:0101 83C402           ADD      SP,+02
15:             add();
3DB5:0104 E84D00           CALL     _add (0154)              ;BR0
16:             island = 1;
3DB5:0107 C746FE0100       MOV      Word Ptr [island],0001
17:             do {
>da 33 0x29
4034:0021  Microsoft
>_
```

```
AX = 0002
BX = 31CC
CX = 00F4
DX = 1E80
SP = 31CA
BP = 31CE
SI = 0002
DI = 32A8
DS = 4034
ES = 4034
SS = 4034
CS = 3DB5
IP = 00F8
novrflow
  up
enable
positive
not zero
no auxcy
 odd
carry
```

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The Portable III doesn't sacrifice performance for portability

The Compaq Portable III Model 20 is neither a laptop nor a desktop computer; it lies somewhere between the two. Its size (10 by 16 by 8 inches), weight (20 pounds), and AC line voltage (instead of batteries) dictate that it should reside on a desk or tabletop. However, it is also smaller and lighter than the average desktop computer—small enough to fit under an airline seat or in an overhead rack and light enough to be carried. It is the smallest and lightest of Compaq's portables to date: It is two-thirds the size and three-quarters the weight of the Portable II Model 4.

The Portable III's 80286 microprocessor is user-switchable between 12 and 8 MHz. The computer can also use an optional 8-MHz 80287 math coprocessor. It has 640K bytes of RAM on its main board and comes in three configurations: the Model 1 ($3999), which includes a 1.2-megabyte floppy disk drive; the Model 20 ($4999), the unit that I reviewed, which comes with the same size floppy disk drive and a 20-megabyte shock-mounted 3½-inch hard disk drive; and the Model 40 ($5799), which has a 40-megabyte hard disk drive in addition to the floppy disk drive. The machine also features a high-contrast, dual-mode (640- by 400-pixel text/graphics mode and 640- by 200-/320- by 200-pixel IBM CGA mode) gas-plasma display, a full-size detachable keyboard with a numeric keypad, a hefty power supply, and a voltage sensor for the power line with automatic switching between 110 and 220 volts (domestic and international currents, respectively). Options include a 360K-byte floppy disk drive to use in place of the 1.2-megabyte floppy drive, an external expansion unit capable of containing two full-length PC AT-compatible 8- or 16-bit add-on cards, an internal 300/1200-bps Hayes-compatible modem, and up to 6.6 megabytes of RAM.

The exterior case of the Portable III is made of light gray plastic, and, except for the power supply's case and the metal cage holding the disk drives, all its internal partitions and structural elements are also plastic. The inside of the Portable III and the expansion unit are coated with a metalized spray to suppress RFI (radio-frequency interference). The keyboard fits securely over the gas-plasma display to protect it when you carry the computer. After sliding two plastic latches to detach the keyboard and expose the display, you simply plug in the Portable III to get it up and running. The power switch is located at the bottom of the left rear of the computer; a green LED in the upper right corner of the front panel glows when the computer is turned on. Depressing two more plastic latches on the top edge of the display screen releases the display and activates an ingenious arrangement of levers and grooves that enable you to raise the display about 4 inches and tilt it forward or backward 10 to 15 degrees. An optional desktop tilt-and-swivel pedestal provides a secure base for the computer, raises it 2 inches, and gives the unit and its display a wide range of viewing angles.

The organization of the Portable III's major components is straightforward. Its internal layout is composed of three sections. The screen occupies the front section, the main circuit board and I/O interfaces are mounted in the rear section, and the space in the middle is taken up by the power supply and disk drives.

A large and comfortably padded handle is located on the top of the Portable III. If you need to move the computer for any great distance, you will want the optional padded carrying case; its shoulder strap makes the 20-pound computer easier to carry, and the padding protects it.

Unlike the smaller keyboards found on laptop computers, the Portable III's keyboard is large enough for a full-function keypad/cursor section on its right side. Its overall layout is similar to that found on the early IBM PC ATs except that the 10 function keys are located in a row across the top. The keys have a somewhat

continued

John Unger (P.O. Box 95, Hamilton, VA 22068) is a geophysicist for the U.S. government who writes graphics software and uses computers to study the structure of the earth's crust.

Compaq Portable III Model 20

Company
Compaq Computer Corp.
20555 FM 149
Houston, TX 77070
(713) 370-0670

Size
10 by 16 by 8 inches; 20 pounds

Components
Processor: 16-bit 80286 running at 8 or 12 MHz; optional 80287 math coprocessor running at 8 MHz
Memory: 640K bytes of 100-ns RAM, expandable to 6.6 megabytes internally
Mass storage: One 1.2-megabyte floppy disk drive and one 20-megabyte hard disk drive
Display: Red-orange 5¼- by 8¼-inch flat gas-plasma with 80-column by 25-row text and 640- by 400-pixel high-resolution monochrome graphics; also emulates IBM CGA 320 by 200 and 640 by 200 modes
Keyboard: 84 keys; 10 function keys; separate keypad/cursor keys; LED indicators for Caps Lock, Num Lock, and Scroll Lock keys
I/O interfaces: RS-232C port with 9-pin D-shell male connector; Centronics-compatible parallel printer port with 25-pin D-shell female connector; RGB monitor port with 9-pin D-shell female connector

Software
ADAPT (Advanced Display Attribute Programming Tool); Screen-Save

Options

Internal modem:	$399
20-megabyte hard disk drive:	$1399
40-megabyte hard disk drive:	$2199
360K-byte floppy disk drive:	$225
External expansion unit:	$199
Compaq enhanced color graphics board:	$599
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Memory-expansion board:	$225
512K-byte memory upgrade:	$250
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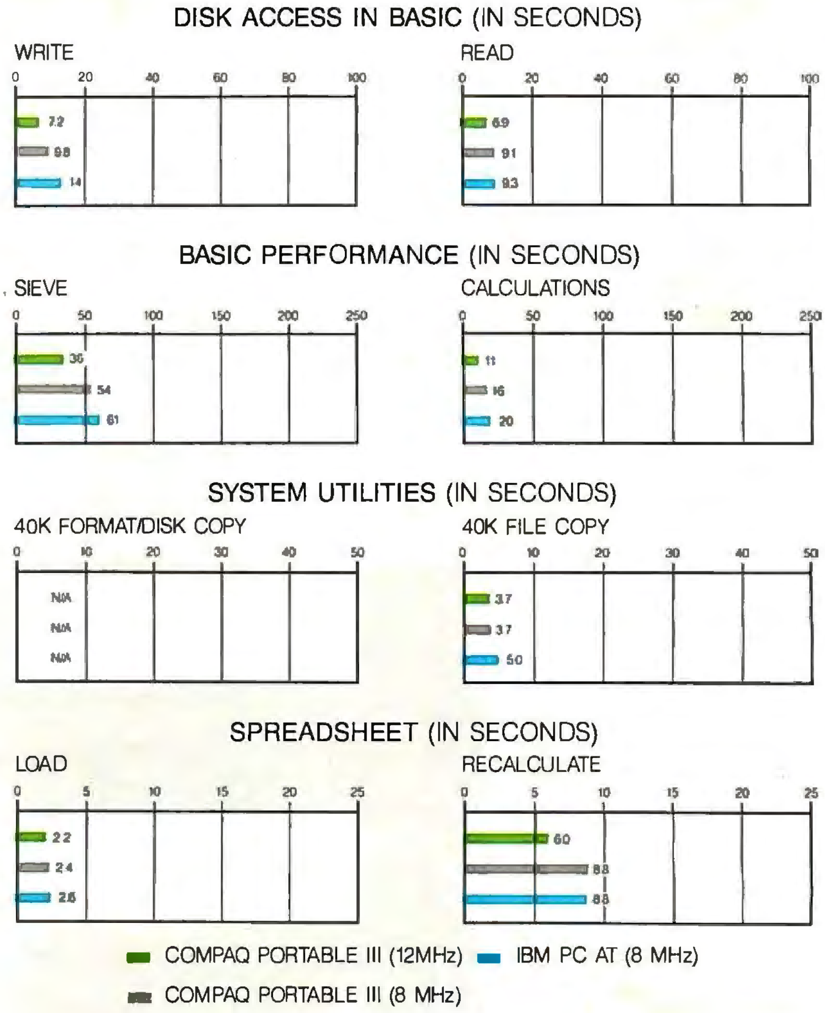
8-MHz 80287 math coprocessor:	$349
Nylon carrying case:	$89
Desktop pedestal:	$89
MS-DOS/BASIC release 3.2:	$95
Technical Reference Guide:	$99

Documentation
Operations Guide, 58 pages

Price
Model 1: $3999
Model 20: $4999
Model 40: $5799



The graphs for Disk Access in BASIC show how long it takes to write and then read a 64K-byte sequential text file to a 20-megabyte hard disk. (For the program listings, see BYTE's *Inside the IBM PCs*, Fall 1985, page 195.) 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 10,000 division operations using single-precision numbers. The 40K Format Disk Copy benchmark was not performed because the computers had only one floppy disk drive. The 40K File Copy graph shows how long it takes to copy a 40K-byte file from a floppy to a hard disk using system utilities. The Spreadsheet graphs show how long it takes to load and recalculate a 100-row by 25-column Microsoft Multiplan (1.10) spreadsheet in which each cell equals 1.001 times the cell to its left. All BASIC benchmark programs were run with MS-DOS 3.10 and GW-BASIC 3.0.

softer feel than the PC AT's and give very little audible feedback. However, by pressing the Ctrl/Alt/+ key combination, you can increase the volume of a software-generated click from low to full volume over a range of 15 distinct levels. The Ctrl/Alt/− key combination decreases the volume.

The tightly coiled cable that connects the detached keyboard to the main unit begins to pull the keyboard out of your grasp when you try to get farther away than about two feet from the main unit. This is a nuisance if you like to type on your lap. Also, the cable runs diagonally from the left rear of the keyboard to the right front of the computer; you can't move the keyboard away from the main unit without the cable's tending to twist it clockwise. The bottom rear of the keyboard has two small plastic feet that flip out and raise it about ¾ inch.

High-Horsepower Hardware

The Portable III is made for speed. Its 80286 runs at 12 MHz, a speed unmatched by many full-size desktop computers. You can use the Ctrl/Alt/ \ (backslash) key combination to toggle between 12 and 8 MHz, or you can use Compaq's AUTO mode, which allows the 80286 to run at 12 MHz and automatically switch to 8 MHz when accessing the floppy disk drive to avoid copy-protection-scheme compatibility problems. The boards in the optional external expansion unit operate at 8 MHz (with the 80286 at either 12 or 8 MHz). The machine has no hardware reset switch for rebooting the system when the normal Ctrl/Alt/Del combination won't bail you out. In these cases, you must then turn the power switch off and on.

The optional 80287 coprocessor runs at 8 MHz regardless of the speed of the 80286, and the 640K bytes of RAM are made up of 100-ns 256K-bit chips. The RAM chips are mounted nine to a card and come in half-size DIP packages with connector pins at the ends and on the sides. They are mounted on the cards side-by-side and on top of each other, overlapping in a space-saving shingle-like fashion. Compaq uses CMOS gate arrays with surface-mount technology to implement six ASICs (application-specific integrated circuits) of its own design—three work with the 80286 to improve processing speed, one acts as the hard disk controller, one works with the floppy disk drive and the printer-interface controller, and one is for the gas-plasma display. All the system components, including the disk controller and display adapter circuits, are mounted on one system board (see photo 1).

The only empty area inside the tightly packed machine lies beneath the two disk drives, where the optional internal modem and RAM expansion slots are located. Once the memory-expansion board is installed, you can choose one of two possible memory-upgrade paths with 100-ns chips: The first uses 256K-bit RAM chips and consists of three modules of 512K bytes each; the second has 1-megabit RAM chips, and each of the three modules adds 2 megabytes to the system. The total amount of RAM available with the first option is 2.1 megabytes; the second option provides an impressive total of 6.6 megabytes of high-speed memory.

The internal modem and the memory-expansion board fit on the same internal memory/modem interface card. If you order either option, you also receive the interface card.

The power supply is rated at 145 watts and is adequate to power not only the internal components, but also any other add-on boards you might want to install in

continued

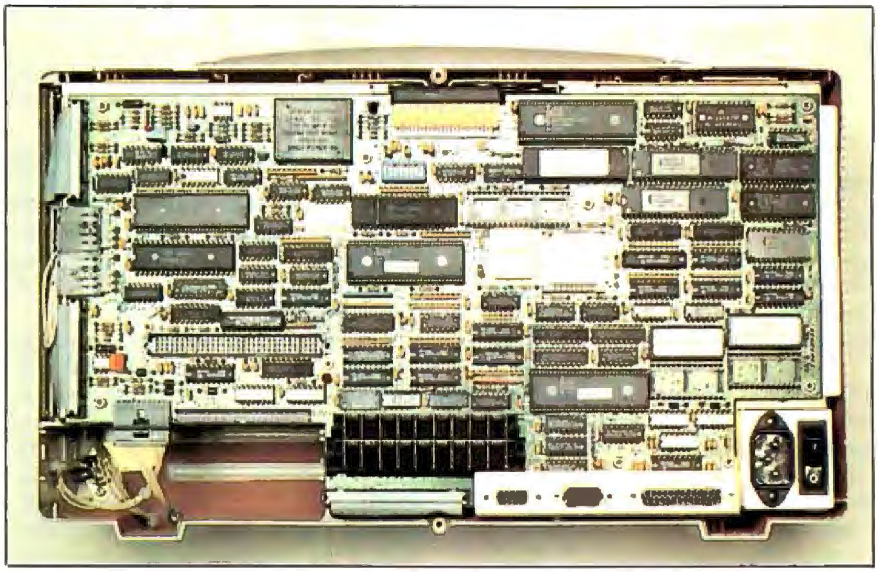


Photo 1: *The internal configuration of the Portable III Model 20.*

Photo 2: *The rear view of the Portable III Model 20. Note the various ports, the sliding cover over the 96-pin port, and the machine's built-in padded handle.*

The display is as sharp as that found on any standard CRT.

the two-slot external expansion unit that attaches to the rear of the machine. The Portable III also has a small, quiet fan to pull cooling air in through the rear of the computer and exhaust it out the left side.

One of the Portable III's most interesting options is the external expansion unit, which is electrically connected to the computer by a 96-pin port (see photo 2). This unit is a more flexible option than the completely detached expansion units made for other portables. Because it gets its power from the computer via this port, you can securely attach it to the Portable III, leave it in place, and carry it with you as if it were part of the machine. You can also have more than one expansion unit configured for different needs, allowing considerable versatility. The expansion unit adds 2½ inches to the depth of the Portable III. Compaq's enhanced color graphics board is not an internal option and, if installed, must be used in the external expansion unit. It is compatible with IBM's EGA. I did not test any expansion boards with my review unit.

Dual-Mode Gas-Plasma Display

The Portable III's gas-plasma screen displays clear, bright, orange-red pixels on an orange-tinted gray background. The display is as sharp and readable as that found on any standard CRT display and is steady and free from flicker. However, the 12-MHz microprocessor is so fast that when you scroll a long file with the TYPE command, the display becomes a blur; it's difficult to stop the scrolling where you want.

The display is thin—only about 1¼ inches thick. The screen surface is flat, so you must be careful about glare and reflections. For example, when bright lights or objects are in front of the screen, it can act like a mirror, making viewing difficult. The screen's aspect ratio is 1.6 to 1 (width to height), a bit larger than the 1.3 to 1 or 1.4 to 1 found on most CRTs but less than the aspect ratio on many laptop LCD displays, which generally ranges from the Toshiba T1100 Plus's 2.3 to 1 to the Bondwell 8's 3.1 to 1. (The Zenith Z-181 is unique to the laptop world with its 1.3 to 1 aspect-ratio screen.) The main impact of this difference is that the shapes produced on machines with other aspect ratios by graphics software written for a CRT will become more distorted as the aspect ratio diverges further from 1.3 to 1 or 1.4 to 1. For example, pie charts produced by Reflex look a bit squashed on the Portable III's screen but are not as badly distorted as they would be on the average laptop.

A convenient dial located at the bottom right corner of the Portable III's front panel controls the display contrast and brightness. Although I used this control near its maximum level most of the time, I never felt as if I were running out of sufficient brightness.

The Portable III is highly compatible with the IBM PC AT: It runs IBM software and can use PC AT–type 16-bit bus-expansion cards in its external expansion unit. It ran my collection of IBM software, including WordPerfect, Reflex, Ready!, WordStar, Jet, and Starflight, without a hitch. The major incompatibility is in the monochrome gas-plasma display. Although it can display graphics with software that uses the IBM CGA 320 by 200 mode, the gas-plasma display has a more limited range of intensity and therefore cannot display the various shades of gray used by a monochrome CRT to emulate colors. However, you can add an external color monitor via the RGB port to display full-color software.

In text mode, characters are formed from a 640 by 400 matrix of pixels. Text is displayed in 80 columns by 25 rows; each character is derived from an 8- by 16-pixel matrix. The characters are not as sharp as those generated with the IBM Monochrome Display Adapter, but they are well formed and easy to read. The display shows all the normal monochrome text attributes except highlighting; that is, it displays normal, reverse-video, blinking, high-intensity, half-intensity, and underlined characters. I found it most effective to show highlighted text as half-intensity characters. For programs that use highlighting to distinguish between choices on a menu, the Portable III has two programs that allow you to display highlighted characters. One is an expanded version of the familiar Mode program that can use arguments that enable you to change the appearance of highlighted text. The other is a memory-resident program called ADAPT (Advanced Display Attribute Programming Tool), which you can use from within an application program to change the display. According to Compaq, the Portable III will come with a disk of supplemental programs, including ADAPT and ScreenSave, a program that lets you set an inactivity time limit at which the system will blank out the display. The supplemental disk was unavailable at the time of this review.

Besides the standard IBM text and graphics modes, the Compaq BIOS includes a high-resolution (640- by 400-pixel) text/graphics mode for the gas-plasma display. You can access the 640 by 400 mode by calling mode 40h with the BIOS video interrupt 10h, the same as that used by the AT&T PC 6300 to access its 640 by 400 monochrome graphics. This means that you can use graphics-based software that has an AT&T PC 6300 high-resolution driver, such as Microsoft Windows or Borland's Reflex, to obtain the Portable III's high resolution. When I used Reflex's AT&T driver with the Portable III, Reflex displayed in 43-line text mode as well as 640- by 400-pixel high-resolution graphics mode. The Portable III also functioned perfectly with graphics software I have written specifically for the PC 6300's high-resolution mode.

Internal and External Peripherals

The Portable III Model 1 comes with a single 1.2-megabyte one-third-height 5¼-inch floppy disk drive. I had no trouble formatting or writing files to 360K-byte floppy disks with this drive, nor did I have any problem reading those files on my PC 6300's standard 360K-byte drive.

To use this computer to its fullest, you will need a hard disk of some kind. The performance of the Model 20's 20-megabyte hard disk at 12 MHz on the Write benchmark shows a 48 percent improvement over that of the 8-MHz IBM PC AT. Even at 8 MHz, the Model 20's increase is 29 percent (see the benchmark results on page 000). The Read benchmarks also show improvements, although they are more modest: 26 percent at 12 MHz and 2 percent at 8 MHz. Compaq rates its hard disk's access time at less than 30 ms; my tests measured an average access time of26 ms.

Two LEDs located below the power indicator turn on when there is activity in either the floppy or the hard disk. The documentation says that the floppy disk's LED is supposed to be orange when the computer reads or writes to a 360K-byte disk and green when it accesses 1.2-megabyte floppies, but I got a green light regardless of the type of disk I used. Both drives are extremely quiet, and the only clue you have that the hard disk is doing anything is its blinking LED.

The Portable III comes with a standard Centronics-compatible parallel printer port with a 25-pin female connector and an RS-232C serial port with a 9-pin male connector like the IBM PC AT's. The CGA-compatible display card has a 9-pin female port for connecting an optional RGB monitor. The memory-expansion card and internal modem attach to an internal connector on the system board. The modem installation kit also includes standard telephone jacks that are accessible on the right side of the computer beneath the disk drives. A sliding panel on the rear of the computer conceals a 96-pin male connector for attaching the external expansion box.

Documentation and Service

The documentation that came with my review unit was in preliminary form. Both the *Operations Guide* and the optional *MS-DOS Reference Guide* are essential for using the Portable III. (The MS-DOS guide comes with the optional MS-DOS 3.2 operating system.) The optional *Technical Reference Guide* is valuable if you want to access some of the machine's special features, such as writing software that manipulates the dual modes of the gas-plasma display, but you won't need it to operate the machine with regular software.

The Portable III has a one-year limited warranty for parts and repairs on the computer and internal options installed by an authorized Compaq dealer; external options such as the color monitor and the expansion unit are not covered under this warranty but have their own warranty coverage (usually 90 days). You can obtain warranty service from Compaq or an authorized dealer, but you are responsible for the transportation to Compaq or the dealer.

Performance and Portability

At the present time, there is nothing else available in a portable with the computing power of the Compaq Portable III. The 12-MHz 80286 microprocessor, large potential memory capacity, and fast hard disks make this machine a stunning performer. The Sieve and Calculations benchmarks show that the computer is significantly faster than an 8-MHz IBM PC AT. Because of obvious similarities—the gas-plasma display, 80286 microprocessor, and internal hard disk—this microcomputer will inevitably be compared to the Toshiba T3100. The T3100 is smaller, five pounds lighter, and, although it needs an AC power source like the Portable III, it looks and feels more like a true laptop. However, the T3100's 10-megabyte hard disk drive has a slower average access time (between 80 and 90 ms) and microprocessor (8 MHz). The Portable III Model 20 clearly outperforms the T3100; however, it also costs $800 more.

The Portable III does not sacrifice performance for portability. While Compaq designed it as a carryon, you can add options such as the two-card expansion unit, internal memory expansion and modem, and desktop pedestal to make it into a full-featured desktop machine. ■

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Inquiry 370

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The Commodore 64C

Alastair J. W. Mayer

Commodore's latest personal computer is a C-64 in new clothing

The Commodore 64C personal computer is simply the old Commodore 64 repackaged in a beige C-128–style case and bundled with the disk-based GEOS (graphic environment operating system) version 1.3. The GEOS is a surprisingly good window and icon operating system, considering that it runs on an 8-bit microprocessor in 64K bytes of memory. The combination sells for $229.95; you can purchase the GEOS software separately for $59.95 if you already own a C-64 or a C-128. The 64C's case is more attractive than that of the C-64, and the mechanical action of the keyboard is slightly more responsive, though it is still not great.

For those not familiar with the hardware of the C-64, both it and the 64C use the 6502-compatible 6510A microprocessor running at 1.02 MHz. (For more information, see the review of the Commodore 64 by Stan Wszola in the July 1983 BYTE.) It has 20K bytes of ROM, which contains the operating system and the BASIC interpreter version 2.0; 64K bytes of RAM; 320- by 200-pixel graphics; up to 16 colors (although the graphic modes restrict your choices); an impressive three-voice Sound Interface Device (SID); and, alas, a slow serial disk interface, although the GEOS uses some proprietary techniques to speed this up.

Some recent additions to the line of peripherals available from Commodore for the 64C are the 1541C disk drive ($229) which, internally, is the same as the 1541, but it has a beige case to match that of the 64C. The 1351 two-button mouse ($49), which can operate in either proportional or joystick mode, is quite an improvement over the 1350 two-button mouse, which could operate only in joystick mode. In joystick mode, the 1351 mouse transmits joystick-like commands to the computer, for example, move up, move down, move right, and move left, depending on which direction you move the mouse. In proportional mode, the mouse knows and transmits its position as an analog signal (in modulo 64) to the computer. A proportional mouse is more responsive, but the joystick mode is provided for use with joystick-compatible software. The 1802 color monitor ($249) accepts both composite and RGB video signals and has a button on the front that changes the screen to green. According to Commodore, the 1764 RAM expander ($149), which boosts the system RAM to 256K bytes, will be available this spring. This expander, a cartridge that plugs into the cartridge/expansion port, comes with an external power supply. Due to limitations of the built-in BASIC interpreter, the extra RAM is accessible only if you use machine language programs or PEEKs and POKEs, or you can use it as a RAM disk.

GEOS—The 64C Does Windows

GEOS, developed by Berkeley Softworks, is an icon-oriented system similar to the Xerox PARC model popularized by the Macintosh. It provides windows and icons, and you can control it by using the cursor keys, a mouse, or a joystick. Drivers are also included for bit pads, such as the Koala Pad, and for light pens.

Berkeley Softworks has implemented a copy-protection scheme wherein you must always boot from the original GEOS disk. The first thing that you should do when you start working with GEOS is make a backup of the system disk so that if you accidentally delete or otherwise lose a file on the original disk, you can restore it from the backup. However, if the original disk gets physically trashed, you are out of luck. Once you've backed up the GEOS disk, you must create a work disk—a pared-down system disk that you can use once you have loaded GEOS.

GEOS comes on one double-sided disk. On one side is the GEOS operating system, geoPaint, and geoWrite, and on the opposite side is a telecommunications program, Q-Link, for accessing QuantumLink (a bulletin board designed spe-

continued

Alastair J. W. Mayer is a member of GeoVision Corp. (1600 Carling Ave., Suite 350, Ottawa, Ontario, Canada K1Z 8R7), a developer of geographic information systems. He is also the author of CoSy, the BIX conferencing software.

GEOS is impressive, considering it's used on a five-year-old, 8-bit computer.

cifically for Commodore users). The GEOS provided with the 64C also includes a tailored work disk.

Desktop and Accessories

The GEOS desktop (see photo 1) consists of a pull-down menu bar along the top, icons representing the disk drive or drives, a wastebasket and printer, and a Disk Notepad window, initially showing icons for the active disk. The Disk Notepad window works a little differently than that on the Macintosh or the Atari ST. On the latter machines, the disk window is a viewport for a larger area. If there are too many file icons to fit the display all at once, you can scroll the Disk Notepad window up and down or sideways. In GEOS, the Disk Notepad page has room for eight files, and its size and position on the screen are fixed. The technique GEOS uses is to let you "flip the pages" of the window as though it were a book. While the GEOS desktop is not as versatile or elegant as that of the Macintosh or Atari ST, it's pretty impressive when you remember that GEOS is implemented on a five-year-old, 8-bit computer. The Macintosh and the Atari ST both use the 32-/16-bit 68000 microprocessor; the Macintosh has been around for only about two years, and the Atari ST for one year.

The desk accessories provided with the 64C are a notepad, a calculator, and a preference manager (similar to the Control Panel of the Macintosh) that allows you to set the time and date; set the velocity or edit the shape of the pointer; change the background, foreground, border, or pointer colors; and reset the values back to the standard GEOS default value. The photo manager and text manager enable you to cut and paste pictures and text among different applications.

The "language" of mouse-button clicks and moves is similar, but not identical, to that used by the Macintosh and the Atari ST. As with the other systems, double-clicking on an icon on the 64C will open that file or activate that application. However, with the other two systems, you hold the mouse button down throughout the entire operation, using a technique commonly referred to as press-drag-release. With GEOS, you do not hold the mouse button down throughout the entire operation; instead, dragging an icon (or a drawing in the paint program) is done by clicking once, moving the mouse, and clicking again (called a click-drag-click). The problem with this procedure is that if you are a little slow in double-clicking to open an application, GEOS may instead interpret this as a click-drag-click.

You can run Commodore's BASIC interpreter from the GEOS desktop by choosing "BASIC" from the menu. GEOS replaces the default nonmaskable interrupt vector with the reboot code vector for the desktop, which is located between C000 and C100 hexadecimal. This enables you to reboot the desktop from the original GEOS disk by pressing the Restore key. It takes the same amount of time to reload the GEOS desktop whether you type LOAD "GEOS",8,1 or hit the Restore key; however, the latter method saves you some keystrokes.

If your BASIC program is smaller than 26K bytes, the GEOS will be able to use some of its techniques for speeding the program's load into memory. Otherwise, you use the normal Commodore DOS routines.

While Berkeley Softworks will not disclose the techniques it uses to speed up the serial drives, one well-known technique is to use the clock line as a data line, which gives you two data lines going into the drive, and then to asynchronously send information to the disk drive. You can also shorten the software timing loops used to control this process. Shortening the timing loops may make the serial transfer more prone to noise, but this has not been a problem from my experience.

Since the GEOS is necessarily disk-based, it is somewhat limited by the serial disk drives. The software speedups that Berkeley Softworks includes with GEOS help some. It also helps if you have a second disk drive. Installing the second drive is simple; if it is configured as a peripheral other than unit 8, nothing further needs to be done. Otherwise, you turn the drives on one at a time, selecting "install drive" from the pull-down menu before turning on the second drive. Having two drives is almost a necessity if you are going to make extensive use of geoPaint: On a single-drive system, the software insists that a copy of the program must exist on the same disk as the data files. (Copying geoPaint is permitted; only the GEOS kernel is copy-protected.)

GeoPaint version 1.2, a paint program, and geoWrite version 1.2, a word processor, are easily integrated with GEOS; you simply double-click on their respective icons. GeoPaint provides a window onto a full 8½- by 11-inch page and enables you to combine images and text on a document. A full array of brush styles, fill patterns, and colors is provided, although I had occasional problems with color due to the way the 64C's graphic modes work: The screen can contain all 16 colors at once, but any 8- by 8-pixel region is restricted to two colors in high-resolution mode, and 4- by 8-pixel regions are restricted to four colors in medium-resolution mode.

GeoWrite comes with a small font library. You can display a variety of text

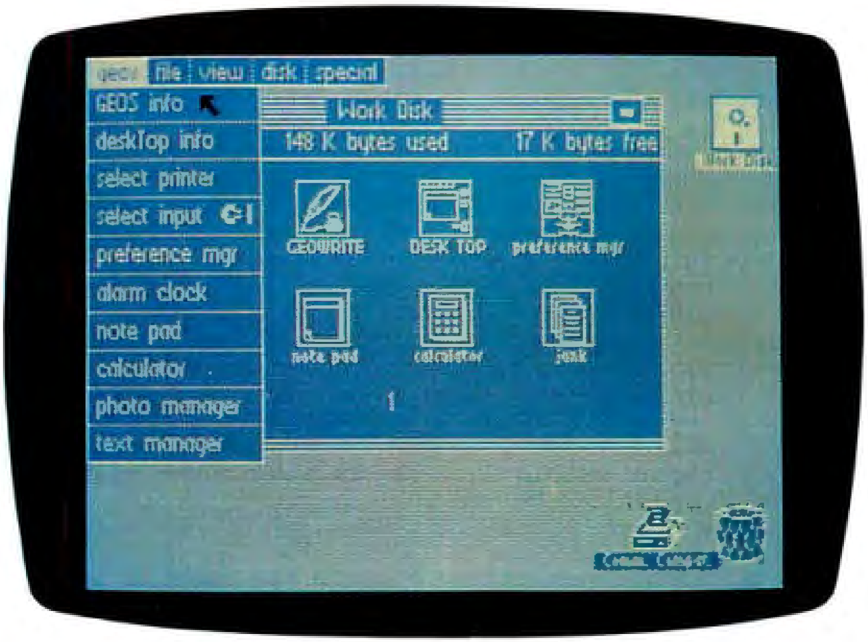


Photo 1: *The GEOS desktop.*

Commodore 64C

Company
Commodore Business Machines Inc.
1200 Wilson Dr.
West Chester, PA 19380
(215) 431-9100

Size
16 by 8 by 3 inches

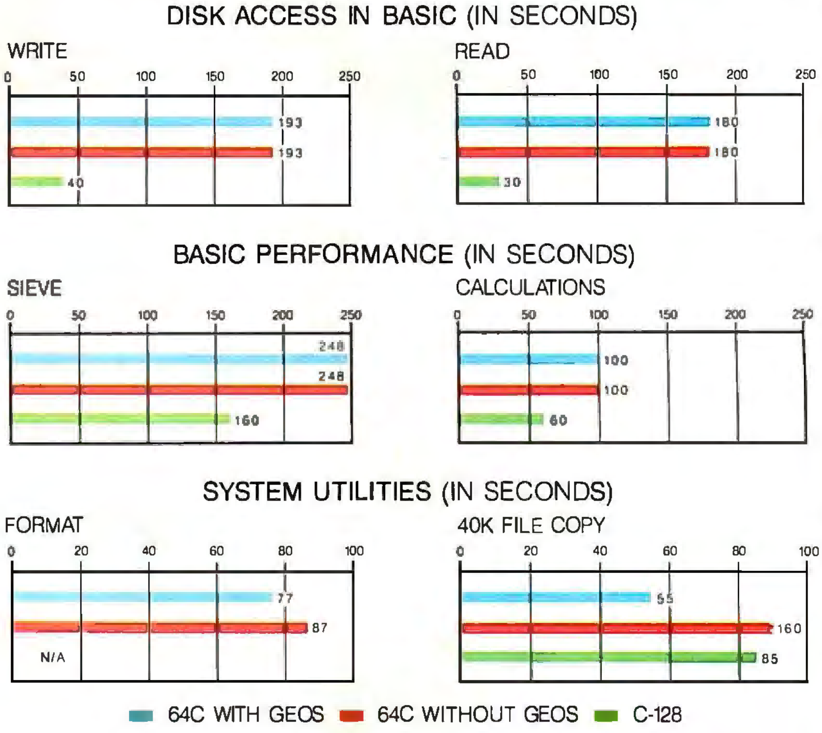
Components
Processor: 6510A running at 1.02 MHz
Memory: 20K bytes of ROM; 64K bytes of RAM, expandable to 256K bytes
Mass storage: See Options
Display: 40-column by 25-row text; 320- by 200-pixel high-resolution graphics
Keyboard: 66-key Commodore 64-style keyboard; four function keys; keyboard-selectable graphic characters and character colors
I/O interfaces: Two 9-pin control ports; 44-pin bus-expansion port; RF output; video, serial, cassette, and general-purpose user ports

Software
BASIC 2.0 in ROM; GEOS 1.3 operating system; geoWrite 1.2; geoPaint 1.2; QuantumLink V.4 Telecom

Options
1764 RAM expander: $149
1802 color monitor: $249
1541C disk drive: $229
1351 mouse: $49
GEOS software: $59.95

Documentation
Commodore 64C Introductory Guide, 32 pages
Commodore 64C System Guide, 198 pages
GEOS and QuantumLink User's Guide, 126 pages
The Official GEOS Programmer's Reference Guide, 340 pages

Price
$229.95



The graphs for Disk Access in BASIC show how long it takes to write and then read a 64K-byte sequential text file to a blank floppy disk. (For the program listings, see BYTE's *Inside the IBM PCs*, Fall 1985, page 195.) 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 10,000 division operations using single-precision numbers. The System Utilities graphs show how long it takes to format a disk using the 1541C drive. Also shown is the time required to copy a 40K-byte file using the system utilities. The times for the Commodore 128 with a 1571 drive are shown as a comparison.

fonts simultaneously on the 64C's screen with GEOS, since it uses the graphic screen rather than the character screen. You can also print these text fonts.

Setup and Documentation

The 64C comes with a 32-page *Commodore 64C Introductory Guide*, which describes the various components: the monitor, disk drive, and all the necessary cables. Setup is quite easy; it is simply a matter of plugging the cables into the only connectors that they will fit and then turning everything on. The power transformer is a separate unit, as are the disk drive and the monitor. This can make for a bit of a cable snarl, and, when everything is set up, there is little clear space left on a desktop. A separate shelf for the monitor and disk drive is definitely recommended.

Also included with the 64C is a 198-page *Commodore 64C System Guide*, subtitled "Learning to Program in BASIC 2.0." The book includes examples of the various BASIC commands, as well as short sample programs for using the 64C's graphics and sound capabilities. These use a lot of PEEKs and POKEs; BASIC 2.0 does not have built-in commands to manipulate graphics and sound. A novice programmer may want to look for something more tutorial about programming in general, and any programmer interested in digging into the system will want the separately available *Commodore 64 Programmer's Reference Guide*.

The GEOS documentation is quite good, containing many examples. The 64C comes with a 126-page *GEOS and QuantumLink User's Guide* for those people interested in writing GEOS applications. This manual is not recom-

continued

Inquiry 338

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mended reading for the casual user, however, unless he or she has an interest in making system calls. Also included with the 64C is a 340-page manual entitled *The Official GEOS Programmer's Reference Guide.*

Benchmarks

The system that I reviewed included two 1541C disk drives, a 1902A composite/RGB monitor, the 1351 mouse, and GEOS version 1.3. Since the hardware of the 64C is the same as that of the C-64, I ran the benchmarks of the 64C with and without GEOS and compared these results to those from tests on the C-128. The BASIC benchmark results for the 64C were the same whether BASIC was entered from the GEOS menu bar or directly from boot-up. The System Utilities test results show the effect of the GEOS speedup on the serial access of the drive. See page 231 for the benchmark results.

The Bottom Line

The Commodore 64C is an attractive restyling of the venerable Commodore 64. It has the C-64's built-in BASIC, a vast library of software, and impressive sound and graphics capability for an 8-bit, 64K-byte machine. The serial disk drive is a bottleneck that is alleviated somewhat by tricks used in GEOS. The inclusion of the GEOS graphic environment with the 64C is a smart move on Commodore's part, and it will also breathe new life into the C-64. However, Commodore should bundle the mouse with the 64C, as it is a much better way of interacting with GEOS than the cursor keys.

The GEOS itself is worth serious consideration by any C-64 or C-128 owner who is not entirely comfortable with those systems' rather primitive command interfaces but is not ready to upgrade to a completely new machine. The geoPaint and geoWrite programs also make an upgrade to GEOS an attractive consideration. The copy protection on the kernel disk is a negative factor, however.

Still, the 64C is only an 8-bit, 64K-byte machine. Even with a RAM upgrade to 256K bytes, this computer still does not have the graphics capability or computing power of the newer 68000-based machines. With BASIC included in ROM and the GEOS, the 64C is an attractive entry-level system for the new user, and, with the existence of more than a million Commodore 64s, you'd hardly have to worry about the 64C becoming an "orphan." However, if you'll want to expand your system significantly or if you get frustrated by slow disk drives, you would do well to balance the cost against the extra power of some of the newer Amiga, Macintosh, or Atari 1040ST systems. ■

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Inquiry 230

SCSI Hard Disk Drives for the Macintosh

Chris Crawford and Eva White

These 20-megabyte units vary widely in most features except benchmarks

Before the Macintosh Plus, the only way to add a hard disk to a Macintosh was through the slow floppy disk drive or the serial port. Although no SCSI (small computer system interface) drives were available at the time the Mac Plus was announced, third-party companies have wasted no time in coming out with fairly inexpensive drives. The benchmark tests on the 10 external 20-megabyte SCSI drives reviewed here indicate that they are all roughly comparable in performance. (See the complete benchmark results in table 1.) The 10 drives are the SuperMac DataFrame 20 and XP 20, General Computer's HyperDrive FX/20, Relax Technology's Hard 20 Plus, the ProAPP 20, Western Computer's Big Mack Twinpack, Peripheral Land's PL20, Mirror Technologies' MagNet 20X, the LoDown 20, and Peak Systems' Plus-20. Potential buyers of hard disks should base their decisions on the support software provided (such as backup utilities and print spoolers), the drive's footprint, price, and, if expandability is important, the ease of daisy-chaining the drives.

Chaining SCSI Devices

One of the big selling points of SCSI devices is that you can daisy-chain up to seven of them together. Most SCSI devices come with two SCSI ports so that when you want to add another, you simply plug it into the unused port of the last one. Daisy-chaining these drives is fairly simple, but not without some drawbacks. Not all SCSI cables are alike. Some drives come with DB-25 SCSI ports and require a cable with a DB-25 connector on either end, while others come with 50-pin SCSI ports and require a cable with a DB-25 connector for plugging into the Mac and a 50-pin Ampherol connector on the other end for plugging into the drive. All the drives mentioned in this review come with their own cables, but you have to purchase a cable with 50-pin male connectors on both ends to chain the drives with 50-pin SCSI ports. The drives with the DB-25 connectors have the advantage since you can simply use the cables included with the drives to daisy-chain them together.

Once you have the right kinds of cables, you have to set the SCSI address of the drive. The HyperDrive FX/20 and the DataFrame XP 20 make this easy by allowing you to change the SCSI address with software. Two of the drives, the Big Mack Twinpack and the ProAPP 20, have DIP switches accessible on the outside of the drive case. All the other drives have jumpers on the SCSI controller card that you have to open the case to get to.

If you are chaining three or more drives, you must make sure the terminating resistor packs are present only on the drives on either end of the chain. The HyperDrive FX/20 comes with an external terminating resistor pack that you plug into the unused SCSI connector. The other drives have socketed resistor packs on the SCSI controller boards.

Distinguishing Characteristics

One problem with reviewing these drives is that the software, manuals, and, in some cases, even the drives themselves are changing rapidly. When we first received the review drives, much of the system software was buggy and unstable, and many of the manuals were photocopied 8- by 11-inch paper stapled in the upper left corner. Some of the manuals had diagrams that did not match the hardware. For example, the Peak Systems' Plus-20 manual explained how to chain drives, but it showed a picture of a controller board that looked nothing like the actual board inside the drive. According to the manual that came with the LoDown 20, there are plugs on the bottom of the case that you can pop out to get to the jumpers. Unfortunately, on the model we reviewed, the holes did not line up over the jumpers and we had to open the case to get to them. According to LoDown, a redesigned case will be shipped with later models.

Many of the manuals sidestepped the whole issue of daisy-chaining by recommending that only a service technician make any necessary changes. Each time we called the technical help line provided, we were able to locate the right jumpers and set the addresses. Also, in most cases, we got an updated manual and the latest system software.

SuperMac Technology has a faster version of its DataFrame 20 drive, the DataFrame XP 20, which is supposed to be faster for large contiguous transfers to and from the disk. A DataFrame XP 20 costs $1299, but for $149 you can obtain a kit that upgrades a DataFrame 20 to an XP 20. You simply install a new ROM in the drive and change a jumper to complete the transformation. We upgraded our DataFrame 20 for this review. The benchmarks show only a slight speedup for the Boot test and for opening a 67K-byte MacWrite file. We backed up 10 megabytes from the comparison non-SCSI Apple Hard Disk 20 onto the DataFrame 20, installed the upgrade, and backed up again. This didn't show any real speedup, either; the backup took 798 seconds on the DataFrame 20 and 776 seconds on the DataFrame XP 20.

The HyperDrive FX/20 comes with more system software than the other drives, is rugged, and has a built-in han-

continued

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Table 1: *SCSI drive features, bundled software, and benchmark results. All dimension sizes are in inches; footprint sizes are in square inches. All times are in seconds. The benchmark tests were performed using Apple's System 3.2 and Finder 5.2. The Boot test was timed from the sound of the "bong" on the Mac Plus to the appearance of the File, Edit, View, and Special menus. LineWrite writes a single linear file 512K bytes long; FileRead reads that file. FragWrite writes sixteen 2K-byte files and then appends fifteen 2K-byte sections onto them in an interleaved fashion. Microsoft BASIC version 1.0 was used for these tests. The file entitled "What's New," which is included with MacWrite version 4.5, was used in the 67K-byte MacWrite file test. For comparison, we also performed benchmarks on the non-SCSI Apple Hard*

updates on hardware and software features.

Name	DataFrame 20	DataFrame XP 20	HyperDrive FX/20	Hard 20 Plus	ProAPP 20	Big Mack Twinpack
Company	SuperMac Technology				ProAPP Inc.	
LineWrite	76	80	89	88	89	85
LineRead	91	90	92	92	91	91
FragWrite	523	530	494	489	522	482
		145				
	Yes	Yes	Yes	Yes	Yes	No
	Yes	Yes	Yes	No	No	No
	Yes	Yes	Yes	Yes	Yes	No
	No	No	Yes	No	No	No
Price	$1099			$1195		$1495

dle. The design of the case gives the drive a lot of stability; it measures 3½ inches at the bottom and tapers off to 3 inches at the top. The FX/20 also lets you change the SCSI address in software.

Given that Relax Technology also retails surge-protected power strips, you might guess that its drive, the Hard 20 Plus, comes with a four-outlet, independently controlled power strip with a 30-decibel noise filter and surge and isolation suppression.

The Big Mack Twinpack comes with an integrated tape drive; it also comes with the most unstable system software of the group and a woefully thin manual entitled *Temporary Operating Manual*. A call to Western Computer's technical help line did not get us a new manual or updated software. We used a Teac CT-5000 high-density cassette drive to back up 10 megabytes; this took about 6 minutes. If we erased the tape first and then backed up the drive, we got a system bomb. The drive backed up with no problems if we didn't erase the tape first. Only backups of the entire disk are possible.

The LoDown 20 is the only bottom-placement drive of the group without a fan. The case is made of pressed metal and has ventilation holes on the bottom, side, and top. Although the drive heated up, we left it on under a running Macintosh for a couple of days with no problems. The LoDown 20 comes bundled with scads of public domain software and shareware, though none of the software fell into the categories listed in table 1. These programs can save you the connect charges and phone bills required to download them from bulletin boards, but, if you decide you want to use these programs, you must be sure and check to see if the author requires a shareware fee.

Peripheral Land's PL20 and Peak Systems' Plus-20 are solid, basic drives. The ProAPP 20's selling point is that you can also hook it up to the Apple IIe/IIc line. The drive has three ports on the back—a SCSI port, a floppy disk port, and a printer port.

PL20	MagNet 20X	LoDown 20	Plus-20	Hard Disk 20 (Non-SCSI for comparison)
Peripheral Land	Mirror Technologies	LoDown	Peak Systems Inc.	Apple
8.2	8.1	8.9	8.5	9.7
79	88	79	89	84
90	90	90	92	89
500	478	476	490	558
141	136	136	139	147
14.3	13.6	14.1	13.2	18.5
Jumper	Jumper	Jumper	Jumper	N/A
50-pin	25-pin	25-pin	50-pin	N/A
Yes	Yes	No	Yes	N/A
No	Yes	No	No	N/A
No	Yes	No	Yes	N/A
No	No	No	No	N/A
No	No	No	No	N/A
9.5	5	9.5	9.5	9.5
9.5	9	9.5	11	10.5
3	3	3.5	3	3
90	45	115	104	100
Bottom	Side	Bottom	Bottom	Bottom
Yes	No	No	Yes	Yes
No	No	No	No	No
No	Yes	No	Yes	Yes
Internal	External	Internal	Internal	Internal
$995	$1095; $1195 with MacServe	$995	$1095	$1195

For an extra $100, you can get Mirror Technologies' MagNet 20X bundled with Infosphere's MacServe disk server. If purchased separately, MacServe is a $250 package. The MagNet 20X depends on the capabilities of MacServe for backup programs and print spooling. Both the ProAPP 20 and the MagNet 20X have external power supplies.

Software

The software included with these drives is where the differences in the drives really show (see table 1). This set is not all-inclusive; we included only what we considered to be relevant to this review.

Many of the drives include a head parker, which moves the disk drive read/write head to an unused sector on the platter. The heads should always be parked before you move or ship a drive; this gives added protection to files when you shut off the drive.

The Imagewriter spooler on the DataFrame 20 is superior to that on the HyperDrive FX/20. The DataFrame 20's Imagewriter print spooler, SuperSpool, is accessible from a desk accessory, which allows you to view the status of your print jobs or delete and reorder individual jobs in the print queue. The HyperDrive FX/20's Imagewriter print spooler is accessible only from the desktop; you must leave your application to get to it. While you can view each job, you cannot alter the job's order, and the only way to delete a job is to flush the whole queue. The MagNet 20X's Imagewriter spooler is part of the MacServe package bundled with that drive.

All the drives except for the LoDown 20 and Peripheral Land's PL20 have some sort of backup utility. We found those included with the DataFrame 20 and the HyperDrive FX/20 easy to use. They both have incremental, individual-file, and volume backup. They also worked only with these drives. The ProAPP 20 has a very good backup utility, Quickbackup, which is licensed for ProAPP 20 users only. Relax Technology's Hard 20 Plus comes with a shareware backup program, HardSave version 1.1; you must send the author at least $20 if you decide to keep it and use it. HardSave 1.1 can back up an entire volume or individual files and folders and then save the output of the backup program to a file. Peak Systems' Plus-20 comes with a backup program called Archiver that, according to a message on the program, is provided free by the author. We couldn't get Archiver to work, and the program has no help screens. The Big Mack Twinpack, being an integrated drive and tape-backup unit, does not need a backup-to-floppy program. The MagNet 20X's backup utility is part of MacServe.

The HyperDrive FX/20 is the only drive of this group that comes with a LaserWriter spooler. The program, LaserSpooler, consists of a printer resource that creates the PostScript file and a desk accessory that spools these files to the printer and shows you the printer's status. It took 23 seconds to spool out the 12,620-byte file, Release Notes version 1.00, included with the HyperDrive FX/20. Checking the print queue gives only the job that is currently printing. Unfortunately, Aldus PageMaker documents will not spool with LaserSpooler; these documents simply print as if LaserSpooler were not installed.

Both the HyperDrive FX/20 and the Big Mack Twinpack have a file-encryption utility. The program included with the HyperDrive FX/20 is explained thoroughly in the user's manual and is easy to use. The utility included with the Big Mack Twinpack is not mentioned in the user's manual, and we noticed it only when looking at the desk accessories.

The final entries in table 1 give the physical characteristics of the SCSI hard disks. The footprint is the amount of desk area taken up by the drive; this is less significant with those disks that are placed underneath the Macintosh. The ability to be placed underneath the Mac is indi-

continued

cated in the Placement row. The cables supplied with all the drives are too short to permit anything other than placement at the side or the bottom of the Macintosh.

Benchmarking SCSI Drives

Table 1 shows the results of the benchmark tests we ran and some of the distinguishing characteristics of each drive, such as software included and footprint size. The main set of tests was written in Microsoft BASIC version 1.0, and the tests were run on a Macintosh Plus with 2 megabytes of memory and one 800K-byte internal floppy disk. To decrease the variables in the tests, we formatted each SCSI drive with the low-level format provided with it and put only the amount of data on the drive that was required to run the benchmarks. This consisted of the System 3.2, Finder 5.2, the Apple Hard Disk 20 (which enabled us to compare SCSI drives to a drive on the floppy port), the Clipboard file, the four BASIC programs (LineWrite, LineRead, FragWrite, and FragRead), MacWrite version 4.5, and the 67K-byte MacWrite file. We disabled the Mac's disk cache and did not move the mouse during the test. For comparison, we also ran the benchmarks on the non-SCSI Apple Hard Disk 20, which plugs into the floppy port. [Editor's note: *The benchmarks are written in Microsoft BASIC version 1.0 for the Macintosh and are available on disk, in print, and on BIX. See the insert card following page 324 for details. Listings are also available on BYTEnet. See page 4.*]

In the Boot test, we measured the time between the first "bong" of the Mac Plus and the appearance of the File, Edit, View, and Special selections on the top line of the desktop. Opening the 67K-byte MacWrite file was timed from the double click on its icon to the appearance of the I-beam cursor. The LineWrite program writes a single linear 512K-byte file to the disk, while LineRead reads that same file back.

Fragmentation

To understand the purpose of FragWrite and FragRead, we must explain the notion of file fragmentation. Ideally, the system software for a hard disk will write all the bytes for a file in one long sequence. This minimizes the amount of movement that the read/write head must go through to reach the information on the disk surface. Since head motion is one of the major factors in determining a hard disk's speed, this ideal case produces the fastest times for the hard disk.

Unfortunately, most hard disks in the real world don't work so well. Every time you delete a file, you create an empty spot in the hard disk where that file had been stored. Later, when you create a new file, some of that file might be placed in the gap left by the earlier file. As more files are deleted and added, more gaps are created and filled. After a while, the disk surface is pockmarked with hundreds of little gaps left over from all this activity. New files fill these gaps and are thereby scattered all over the surface of the disk. Retrieving fragmented files is slower than retrieving linear files because the head must move over a larger area of the disk to get to the information. Most simple benchmarks of hard disks never address this common problem because the reviewer normally works with a brand-new disk drive that has not been pockmarked with heavy use.

Products Mentioned

DataFrame 20, DataFrame XP 20
SuperMac Technology
950 North Rengstorff Ave.
Mountain View, CA 94043
(415) 964-8884

HyperDrive FX/20
General Computer
215 First St.
Cambridge, MA 02142
(617) 492-5500

Hard 20 Plus
Relax Technology Inc.
3101 Whipple Rd., #22
Union City, CA 94587
(800) 848-1313
(415) 471-6112

ProAPP 20
ProAPP Inc.
10005 Muirlands, Suite O
Irvine, CA 92718
(800) 424-2425
(714) 855-9088

Big Mack Twinpack
Western Computer
17781 Mitchell
Irvine, CA 92714
(714) 553-1611

PL20
Peripheral Land
47800 Westinghouse Dr.
Fremont, CA 94538
(415) 657-2211

MagNet 20X
Mirror Technologies
2209 Phelps Rd.
Hugo, MN 55038
(612) 426-3276

LoDown 20
LoDown
10 Victor Square, Suite 600
Scotts Valley, CA 95066
(408) 438-7400

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1201 Spyglass
Austin, TX 78746
(512) 328-0747

To simulate the effect of fragmentation, the FragWrite test creates deliberately fragmented files. The technique was to write sixteen 2K-byte files and then append 15 more 2K-byte chunks onto these 16 files in interleaved sequence. FragRead reads these fragmented files.

Which Should You Buy?

Most of these hard disks perform similarly in the benchmark tests. The stability and ease of use of the software bundled with them varies greatly. We found the DataFrame 20's software easiest to use, with the HyperDrive FX/20's running a close second. The PL20, Plus-20, LoDown 20, and Hard 20 Plus are all roughly comparable. Western Computer's Big Mack Twinpack would be a good choice if ease of making backups is important, but Western Computer needs to provide better system software and support. The MagNet 20X and the ProAPP 20 work well enough, but their external power supplies are just one more thing to find room for on your desk or floor.

If you are interested in using the hard disk as a file server, then getting MacServe bundled with the drive would be attractive. The ProAPP 20 would be good for people who have both a Macintosh and an Apple II. ■

[Editor's note: *By press time, many of the SCSI hard drive companies told us they had made changes to either their hardware or software. Relax Technology said its Hard 20 Plus now has the ability to change the SCSI address in software. Peak Systems has made the SCSI jumpers on its Plus-20 accessible outside the case as DIP switches, and it has also added an Imagewriter print spooler. The LoDown 20 now has a head-parking utility, and the MagNet 20X now has a fan and a head-parker. Peripheral Land's PL20 now has a backup-to-floppy utility.*]

BASIC Compilers for the Macintosh

Scott L. Norman

Three packages from Addison-Wesley, Zedcor, and Pterodactyl Software

Addison-Wesley's True BASIC 1.0 ($99.95), Zedcor's ZBasic 3.01 ($89.95), and Pterodactyl Software's PCMacBasic 1.65 ($39.95) enable you to produce programs that capitalize on the familiar Macintosh interface. Each compiler has its strong and weak points, as well as a distinctive feel. These programs also follow different design philosophies. True BASIC and ZBasic come in several versions for different computers, while PCMacBasic is a more specialized Macintosh-only product intended to be highly compatible with the IBM PC's BASICA dialect at the source code level. The degree to which the development cycle intrudes on the creative process varies among the three.

True BASIC

True BASIC bears the cachet of John G. Kemeny and Thomas E. Kurtz, two of the major forces behind the development of the original BASIC. Kemeny and Kurtz have been forceful advocates for their version of the language, energetically opposing the spread of a dialect of BASIC they call "Street BASIC."

True BASIC is a structured language that encourages you to adopt a convenient, modular programming style. It offers several types of decision-making constructs, some interesting facilities for handling arrays and doing matrix arithmetic, and some extremely handy features for manipulating graphics. It is also supported by site licensing and, in the Macintosh version, additional libraries for sorts, searches, three-dimensional graphics, and communications. Unfortunately, True BASIC does not generate stand-alone applications by itself; its Compile option generates tokenized versions of the source code that requires True BASIC to run. You need the runtime package, which is available separately for $150, to generate stand-alone programs.

You can divide the True BASIC screen into separate windows for command entry, source code editing, and program output. You can also shape the output window to leave the code visible while a program runs, or you can use the default full-screen window. A nonstandard Control Box at the left edge of the screen includes icons for opening and closing the command and output windows, and it has a unique "traffic light" symbol that lets you start, stop, or interrupt programs by clicking on one of the lights. You can also handle these control functions via a conventional Run menu with command-key options.

The editor is similar to other Macintosh text editors except for its ability to select a block of lines according to either line numbers or ordinal positions in the code. There is also an Include feature that is handy for importing library source code into a new program. The editor also supports the numeric keypad of the Macintosh Plus.

A Format menu contains commands to number or unnumber your source code, and it can also put keywords into all-capitals format or indent the interior statements of loops. It does not generally capitalize the second keyword in a construct like DO UNTIL, however. The editor seems to be forgiving of mixing uppercase and lowercase text, but it does not tolerate the omission of spaces. For example, terminating a loop with NEXTj instead of NEXT j constitutes an error.

Line numbers are not necessary in True BASIC, and, in fact, they are not even mentioned in the user's guide. However, you cannot refer to blocks of ordinary code (as distinguished from subroutines) by labels, so you will need line numbers if you use GOSUB or GOTO to control program flow.

In normal operation, True BASIC simulates the interactive nature of a BASIC interpreter by recompiling the source code each time you give the RUN command. The compiler is fairly fast; it compiled the benchmark programs in well under 1 second, and you get the impression of quick feedback when debugging a new program. You might be reluctant to go through the process with a long, thoroughly tested routine, however. It is possible to save your tokenized code and subsequently execute it instead.

Syntax and Features

True BASIC's code should look familiar to anyone who learned programming with Microsoft BASIC. This is because Kemeny and Kurtz didn't start from scratch. They did make some changes in the syntax, however. One change that is not likable is that the keyword LET is mandatory in assignment statements (e.g., LET x = 1), just as it was in the earliest BASICs. Also, you cannot have multiple statements in one program line (comments excepted), and each of the alternatives in a multibranch decision-making structure must be written on its own line. That, at least, makes for clarity.

To allow for repeated calculations, True BASIC adds DO UNTIL. . . LOOP UNTIL and DO WHILE. . . LOOP WHILE statement pairs to the familiar FOR. . .NEXT construct. In addition, a flexible Pascal-like SELECT CASE statement directs program flow among discrete alternatives. For example:

```
SELECT CASE character
  case "0" to "9"
    call process__number__digit
  case "A" to "F"
```

continued

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```
    call process__char__digit
  case else
    print "You didn't enter a
        hexadecimal number"
```

allows your program to handle numeric input in a reasonable fashion without a large amount of code.

An improved DIM statement lets you adjust the bounds on an array's subscripts to suit the particular problem; for example, DIM expenses(1980 to 1986) sets up an array named "expenses" whose elements can be instantly identified by year. True BASIC supports the series of MAT commands that let you read, print, add, subtract, and multiply arrays. Arrays can have up to 255 dimensions on a 512K-byte Macintosh. The accuracy of variables is 14 digits, and it is 10 digits for transcendental numbers.

Graphics and ROM Support

True BASIC allows you to define the screen boundaries to any value you like rather than using a fixed coordinate system. You use the SET WINDOW command to specify the range of values (say, dollars and years) that you would like the screen dimensions to represent for a particular problem. For example, you can plot sales prices versus years using the actual sales figures by typing the statement SET WINDOW 1980, 1986, 1000, 10000. This eliminates writing an algorithm for translating these values to screen coordinates.

True BASIC introduces the concept of a "picture," the graphic equivalent of a subroutine. Pictures add flexibility to True BASIC graphics, but they are not Macintosh QuickDraw routines. You can store pictures in libraries, which are called with a DRAW statement, and you can geometrically transform them. Built-in transformation functions are available for shifting, scaling, and rotating picture data. These routines work on all computers that support True BASIC.

To make use of special Macintosh ROM features (e.g., the Menu Manager, Dialog Manager, Event Manager, and QuickDraw), you need the 13 libraries on the True BASIC Toolbox disk. A document called "Read Me (512K)" explains them briefly, but, to use them effectively, you need a copy of *Inside Macintosh* or some other detailed treatment of the Mac's ROMs. All three compilers that I tested required this document.

Many of these libraries are concerned with I/O and actually conflict with the generic syntax of True BASIC. For example, you can use Macintosh windows and menus for I/O, or you can stick to True BASIC's INPUT and PRINT statements; you cannot mix the two. However, you can use ROM QuickDraw graphics routines along with True BASIC graphics commands. True BASIC includes its own commands for reading the mouse position and button status, allowing you to supply nontextual input to a program.

The True BASIC package comes with a 310-page user's guide and a 331-page reference manual. The former could serve as a step-by-step introduction to BASIC for the novice; it also contains material specific to the Macintosh. The reference manual is machine-independent and delves more deeply into issues of syntax. One result of this approach is that little information about disk files is in the reference manual, and the information in the user's guide is buried in an appendix. Each book has an index that covers both books, but the boldfaced page entries aren't the first place that a given topic appears, nor the major entry. Instead, the bold entries indicate that the information is located in the reference manual, and plain entries are in the user's guide. This is initially confusing.

[Editor's note: *True BASIC is now in version 1.2; this version supports the Mac Plus's 128K-byte ROMs.*]

ZBasic

Like True BASIC, Zedcor's ZBasic is available in different versions for a number of computers. Zedcor's philosophy is to maintain the highest possible degree of source code portability, which means that device-independent file and graphics functions are included. At the same time, the syntax has been modified to optimize the compiler's performance. The resulting implementation has a few syntactic oddities, and the graphics scheme is a little unusual. [Editor's note: *For details on the IBM PC version of ZBasic, see TJ Byers's review of ZBasic in the May 1986 BYTE.*] On the positive side, if you're a technically inclined user, ZBasic offers some exciting possibilities for extended-precision arithmetic.

The Macintosh version of the language has two editors: the ZBasic line editor, which has a window that you must use to enter direct commands, and Edit, a conventional stand-alone Macintosh editor.

The ZBasic line editor is the core of what Zedcor calls its interactive programming environment. It has an annoying characteristic: It will not rewrite text that is temporarily covered by, say, a dialog box. To assist in program development, a Minicompiler feature enables you to interactively test single lines of code just as an interpreter would. These lines cannot start with an *E* or an *L* because those letters would be interpreted as the EDIT and LIST commands of the line editor.

The language is case-sensitive and requires line numbers for editing, merging, and appending programs. You can also refer to lines with labels to control program flow. You can't use ZBasic keywords anywhere within the names of variables unless you enter the names in lowercase and have not instructed the compiler to convert everything to uppercase. A Configure window lets you specify this conversion and other attributes.

After writing your source code, you can compile what is in memory and run it in one step with the RUN command or its command-key equivalent. Families of commands are available for compiling and running a source file previously saved on disk and for compiling from disk and saving the object code so that you do not have to recompile for every run. For example, RUN* filename compiles a disk source file and saves the result back to disk under the same name.

Once you have saved object code with RUN* filename, that program becomes a stand-alone application. To run it, you leave ZBasic and double-click the program's icon. At this point, you no longer need ZBasic itself. You can go even further and create programs that have their own icons (the RMaker resource compiler utility needed for this comes with the package) or create programs that open automatically when you double-click on any associated data file.

ZBasic allows you to chain or link programs together by using shared or independent variables through a family of LOAD, MERGE, and APPEND commands. The LONG FN command allows you to write multiline function definitions that are terminated by END FN. Subroutines are supposed to be saved as unnumbered source code (using SAVE+) so that you can insert them at any desired point of a calling program.

Major Features

Many other aspects of ZBasic's operation will be familiar to experienced BASIC users. Looping structures include FOR . . .NEXT, WHILE. . .WEND, DO. . . UNTIL, and LONGIF. . .ENDIF. A good assortment of branching commands is included, but there is no SELECT CASE selection statement, as in True BASIC.

ZBasic arrays can have up to three dimensions. The user's manual describes the storage requirements for the digits of accuracy for variables (4 bytes of memory for 6 digits of single-precision accuracy per variable, 8 bytes for 14 digits of double-precision accuracy per variable, and a user-configurable accuracy on the Macintosh for up to 240 digits). You can configure ZBasic for greater or lesser math precision depending on whether

	True BASIC	ZBasic	PCMacBasic
Type	BASIC language for the Macintosh	BASIC language for the Macintosh	BASIC language for the Macintosh
Company	Addison-Wesley Publishing Company Inc. One Jacob Way Reading, MA 01867 (617) 944-3700	Zedcor Inc. 4500 East Speedway Suite 93 Tucson, AZ 85712 (602) 795-3996	Pterodactyl Software 905 West California St. Mill Valley, CA 94941 (415) 388-4827
Format	Two 400K-byte 3½-inch disks	One 400K-byte 3½-inch disk	One 800K-byte 3½-inch disk
Computer	128K-byte Macintosh; 512K-byte Macintosh and external drive recommended	512K-byte Macintosh or Macintosh Plus; external drive recommended	512K-byte Macintosh with an external drive
Documentation	310-page user's guide; 331-page reference manual; reference card	User's manual that contains a 227-page tutorial, a 170-page reference guide, and four appendixes; reference card	162-page user's manual with 80 pages of appendixes
Price	Compiler: $ 99.95 Run-time package: $150 Sort/search library: $ 49.95 Communications library: $ 49.95 Three-dimensional graphics: $ 49.95 Advanced strings: $ 49.95	$89.95	$39.95

your requirements are execution speed or accuracy, and the manual describes the trade-offs. This isn't the sort of information you need every day, but it comes in handy if you're attempting to optimize the performance of your BASIC program.

If you plan to use extensive calculations in your application, you should know that the Macintosh version of ZBasic features enhanced numerical ranges—up to 240 digits of accuracy, as mentioned earlier, for double-precision floating-point calculations (e.g., 9.99^{-16383} to 9.99^{16384}). The defaults are 12 digits for double precision, 6 digits for single precision, and 8 digits for scientific precision. Both 2-byte and 4-byte integers are supported, and integer arithmetic is assumed as the default unless the compiler is configured otherwise.

The manual states that the execution speed is the same for single- and double-precision calculations, which is contrary to my experience with the BYTE Floating-Point benchmark (see table 1). I used the Reconfigure ZBasic option under the Configure menu to set the default variables to single or double precision when I ran this benchmark, and the double-precision computations ran significantly faster.

In addition to ZBasic's device-independent graphics described in TJ Byers's review, the Macintosh version has special enhancements: All MacPaint's patterns are available for filling in figures or for the pen, although the numbering scheme shown in the documentation is incorrect. The pattern identifications actually run from 0 to 37 rather than from 1 to 38 as indicated.

ZBasic's graphics commands will generally be familiar to users of Microsoft BASIC, but oddities such as the use of "brads" (which run from 0 to 255) to measure angles in the CIRCLE command exist. Also, simply plunging ahead with ZBasic graphics will generate elliptical circles; a RATIO command is required to set things right.

One of ZBasic's graphics commands is less versatile than Microsoft BASIC's: You may have to repeat the FILL command with different starting points if you want to fill in the background around a complex object. This is because the algorithm for area-filling starts from the uppermost point in the region and fills from left to right as it works downward. It's possible that this method might miss certain areas in the region, requiring additional calls to FILL. The GET and PUT commands for doing animation by copying, erasing, and redrawing regions of the screen do not appear in conventional ZBasic, but they are available in the Macintosh version.

ZBasic does a good job of invoking pull-down menus and dialog boxes. ROM Toolbox functions and procedures are supported, but *Inside Macintosh* or a similar reference is a necessity.

The latest version of the ZBasic user's manual consists of 227 pages of tutorial material, a 170-page reference section, four appendixes for various operating systems, a reference card, and the unavoidable errata sheets. The Macintosh appendix is 115 pages long. The whole thing is reasonably well-written, but, as with the True BASIC documentation, it can be a little wearisome for the beginner to flip back and forth between general-reference material and Macintosh-specific information.

[Editor's note: *ZBasic is now in version 3.03. It features faster printing, and it supports 20 new Macintosh Toolbox calls.*]

PCMacBasic

A Macintosh compiler designed for maximum syntactic compatibility with the IBM PC's BASICA is something of an oddity. You'll probably be more interested in PCMacBasic's ability to use Macintosh resource files—files that enable you to customize icons, windows, menus, dialog boxes, character fonts, and other attributes of the Macintosh display. PCMacBasic can, in principle, produce the most thoroughly Mac-like programs of the three BASICs described here, but at a price. The package is not simple to use, and, to get the most from it, you should have either Apple's Macintosh Development System (MDS) or Signature Software System's McAssembly assembler and linker.

No special multiple-window program-

continued

ming environment is available in PCMacBasic. It most resembles the conventional development environment in that you use an editor to write the source code, use the compiler to generate object code, and then attempt to run the program. You can use any text editor to create the code for the two input files the compiler needs: the BASIC source program and the associated resource file.

From these files, PCMacBasic can create a stand-alone program. The compiler can also produce an assembler source file in MDS or McAssembly format, should you want to hand-tune the assembly language.

PCMacBasic has a built-in resource compiler, and the documentation contains a certain amount of information on the syntax of resources. A couple of demonstration files are on the disk, but not enough for the novice. To learn about resource files, you are referred to the ubiquitous *Inside Macintosh*. You are also referred to the IBM BASICA manual if you want more than the sketchy information on BASICA commands that is included in an appendix entitled "The Rest of the Statements."

PCMacBasic can compile large (100K-byte) programs, but you must break them into segments, each less than 32K bytes long. You can chain segments together in the source code so that one will call another, and you can pass variables between them by using the COMMON identifier.

The compiler is case-insensitive. Line numbers are optional, and, as in FORTRAN, they do not have to appear in numerical order when you use them. Each program segment must begin with a line number, however, and you can refer to lines only by number—not by label.

Some Syntax Features

PCMacBasic has 13 mouse-sensing commands that you can use to write the editing portion of an application program. The BASIC program can detect single, double, and triple clicks with a single MOUSE(0) function call.

Other MOUSE calls return the starting, ending, and current locations of the mouse. These points are available both as graphic coordinates and as the nearest text-line and column location. PCMacBasic handles all mouse activity for the system, menus, dialog boxes, and scroll bars. You can take care of clicks only within the main windows.

There are no restrictions on the num-

continued

Table 1: *Results from the standard BYTE benchmarks (for the program listings, see BYTE's* Inside the IBM PCs, *Fall 1985, page 195). The Sieve program measures the time required to execute one iteration of the Sieve of Eratosthenes benchmark. The Floating-Point benchmark determines how long it takes to do 10,000 multiplication and 10,000 division operations. The Write program measures the time required to write a 64K-byte sequential text file to a blank disk 128 bytes at a time; the Read benchmark measures the time required to read this file into memory 128 bytes at a time. The benchmark programs had to be modified slightly to run with True BASIC's syntax. For True BASIC, the Read and Write benchmarks in normal mode required a* SET MARGIN 128 *statement after the* OPEN *statement to set the record size to 128 bytes. A* LINE INPUT *statement was required in True BASIC to allow the Read benchmark to read a file in the normal mode. Computers used were a Macintosh with an internal 20-megabyte HyperDrive using Finder 4.1 and System 2.0, and a Macintosh Plus with floppy disks formatted for 400K bytes in the internal drive and using Finder 5.3 and System 3.2. For the disk I/O benchmarks, normal mode indicates that* PRINT *and* INPUT *statements were used in the benchmark code; binary mode indicates that* WRITE *and* READ *statements were used. All times are in seconds.*

	Microsoft BASIC 2.1(b)	True Basic 1.0*	ZBasic 3.01	PCMacBasic
Sieve	86	11	0.8	153 Compiled using simple template file.
Floating Point	22	7	46 Single precision. 32 Double precision using DEFDBL.	43
Write	15 Internal 20-megabyte HyperDrive used, normal mode. 21 400K-byte blank floppy disk, normal mode; 65,535-byte file output.	6 Internal 20-megabyte HyperDrive used, binary mode. 12 400K-byte blank floppy disk, normal mode; 66,048-byte file output. 8 400K-byte blank floppy disk, binary mode; 65,535-byte file output.	3 Internal 20-megabyte HyperDrive used, binary mode. 123 400K-byte floppy disk, normal mode; 66,048-byte file output. 18 400K-byte floppy disk, binary mode; 65,535-byte file output.	6 Internal 20-megabyte HyperDrive used. 15 400K-byte floppy disk, normal mode; 66,048-byte file output.
Read	14 Internal 20-megabyte HyperDrive used, normal mode. 16 400K-byte blank floppy disk, normal mode; 66,048-byte file read.	5 Internal 20-megabyte HyperDrive used, binary mode. 10 400K-byte blank floppy disk, normal mode; 66,048-byte file read. 7 400K-byte blank floppy disk, binary mode; 65,535-byte file output.	2 Internal 20-megabyte HyperDrive used, binary mode. 58 400K-byte floppy disk, normal mode; 66,048-byte file read. 4 400K-byte floppy disk, binary mode; 65,535-byte file read.	7 Internal 20-megabyte HyperDrive used. 12 400K-byte floppy disk, normal mode; 66,048-byte file read.

* True BASIC's run-time package was not available; all benchmarks were run in interpreter mode.

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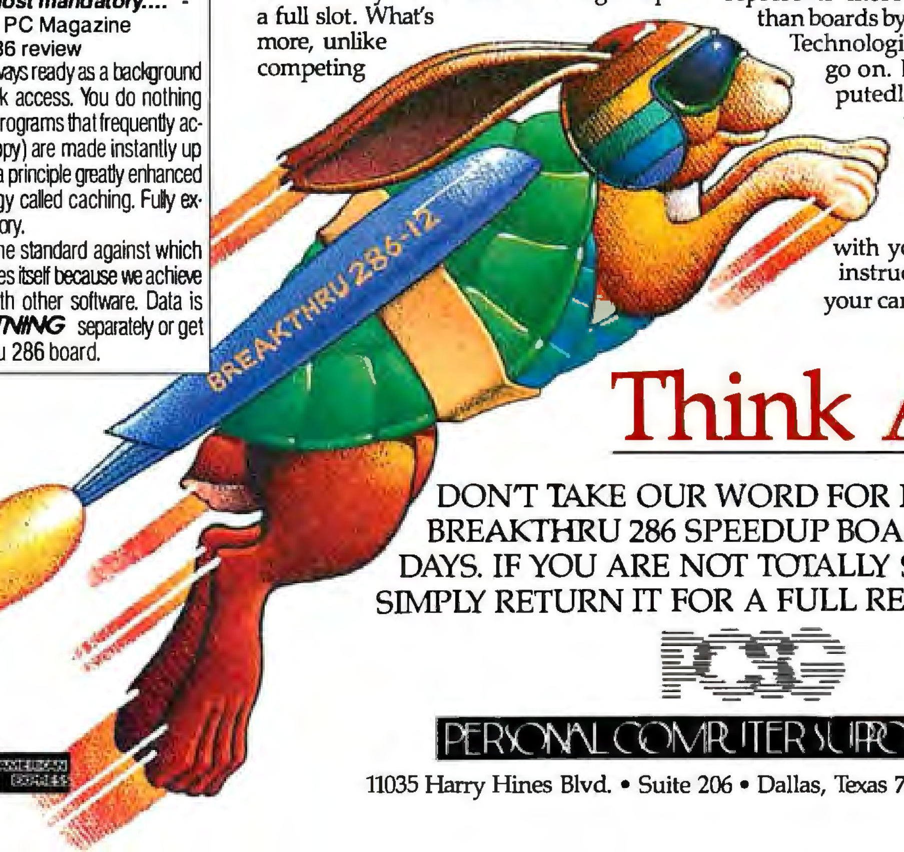

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11035 Harry Hines Blvd. • Suite 206 • Dallas, Texas 75229 • **(214) 351-0564** ber of FOR. . .NEXT loops in a program, and an inner loop can be ended by the NEXT statement of an outer one. You can also terminate loops by a RETURN statement. And, WHILE. . .WEND loops are available.

Arrays are dynamic, and you can erase and re-create them in a different size while a program is running. An array can't use more than 32,766 bytes. The OPTION BASE statement can designate any integer, not just 0 or 1, for the lowest subscript in an array. You can use special ERASE and FRE(" ") commands within a program to fully recover the space taken by unused arrays.

Single- and double-precision numbers are in Apple's SANE format (using 4 or 8 bytes, respectively). Hexadecimal and octal constants are limited to 16-bit integers.

As mentioned earlier, PCMacBasic has extensive facilities for setting up menus. In the same way, it allows you to define function keys, the command-keystroke equivalents of items on a special Function menu. I found that the simplest way to set up the BYTE benchmark programs was to use one of the sample programs as a template. I assigned each benchmark routine to a function key and then simply inserted its code at the designated spot in the sample program outline. The associated sample resource file handled the actual establishment of the Function menu.

Graphics are available in either the medium resolution (40-character-wide) or high resolution (80-character-wide) screen modes, which must first be specified with a SCREEN command. This is a familiar requirement to people who have used Microsoft BASIC on other computers, but it is unusual for the Macintosh. Unfortunately, you have to go through some calculations to get from BASIC coordinates to screen coordinates.

Generalized CIRCLE and LINE statements are available, which have the usual options for drawing ellipses, arcs, and boxes. The photocopied user's manual (which is 162 pages long, including appendixes) does not devote a great deal of emphasis to graphics, but it does describe how to call QuickDraw routines.

[Editor's note: *PCMacBasic's latest version is 1.96. This version provides Hierarchical File System compatibility, and it enables you to compile one program and then link in other modules. A new spiral-bound user's manual is also included.*]

Observations

For the complete benchmark results, see table 1. I used a 512K-byte Macintosh equipped with an internal 20-megabyte HyperDrive for the tests. Since I didn't have the run-time package for True BASIC, I ran all the True BASIC benchmarks using True BASIC as an interpreter. *[Editor's note: Microsoft BASIC interpreter benchmarks are provided for comparison. Also, disk I/O benchmark times for 400K-byte floppy disks are provided. The file I/O benchmarks varied considerably depending on the I/O mode being used. For example, ZBasic didn't fare well using* PRINT *and* INPUT *statements, but it did considerably better using* WRITE *and* READ *statements for binary file I/O. This also affected the size of the benchmark file, since each BASIC adds a carriage return to the end of a string output by a* PRINT *statement. See table 1 for the file sizes generated.*]

I have discussed these products in order of increasing difficulty of use, at least for me. True BASIC's operation and documentation have a professional look, and, although I might quibble with some of its syntactic rigidity, I find it the easiest of the three to use for one of my most common jobs: the construction of fairly short programs that end by putting a financial or technical graph on the screen. I find True BASIC's user-defined coordinate system a terrific convenience.

ZBasic is more of a chore to unlimber for simple applications, but I have other things in mind for it. My professional interests include the mathematical modeling of physical systems, for which I generally use mainframe-style FORTRAN. I am therefore very intrigued by the numerical precision that ZBasic claims, although I am not optimistic about its speed, a judgment based on the floating-point benchmarks. Still, I have every intention of turning it loose on some sizable problems in heat-transfer and semiconductor-device modeling.

And how would I assess PCMacBasic? I guess I must be a graphics-oriented Macintosh advocate, because I can't see the sense of using PC-style graphics on the Macintosh. Although PCMacBasic has a great deal of flexibility by virtue of its ability to use resource files, I had trouble justifying this power with the language's IBM PC emphasis. The manual makes no pretense of catering to the novice. As a result, I often found it difficult to determine whether I was expecting too much from the system or too little. ■

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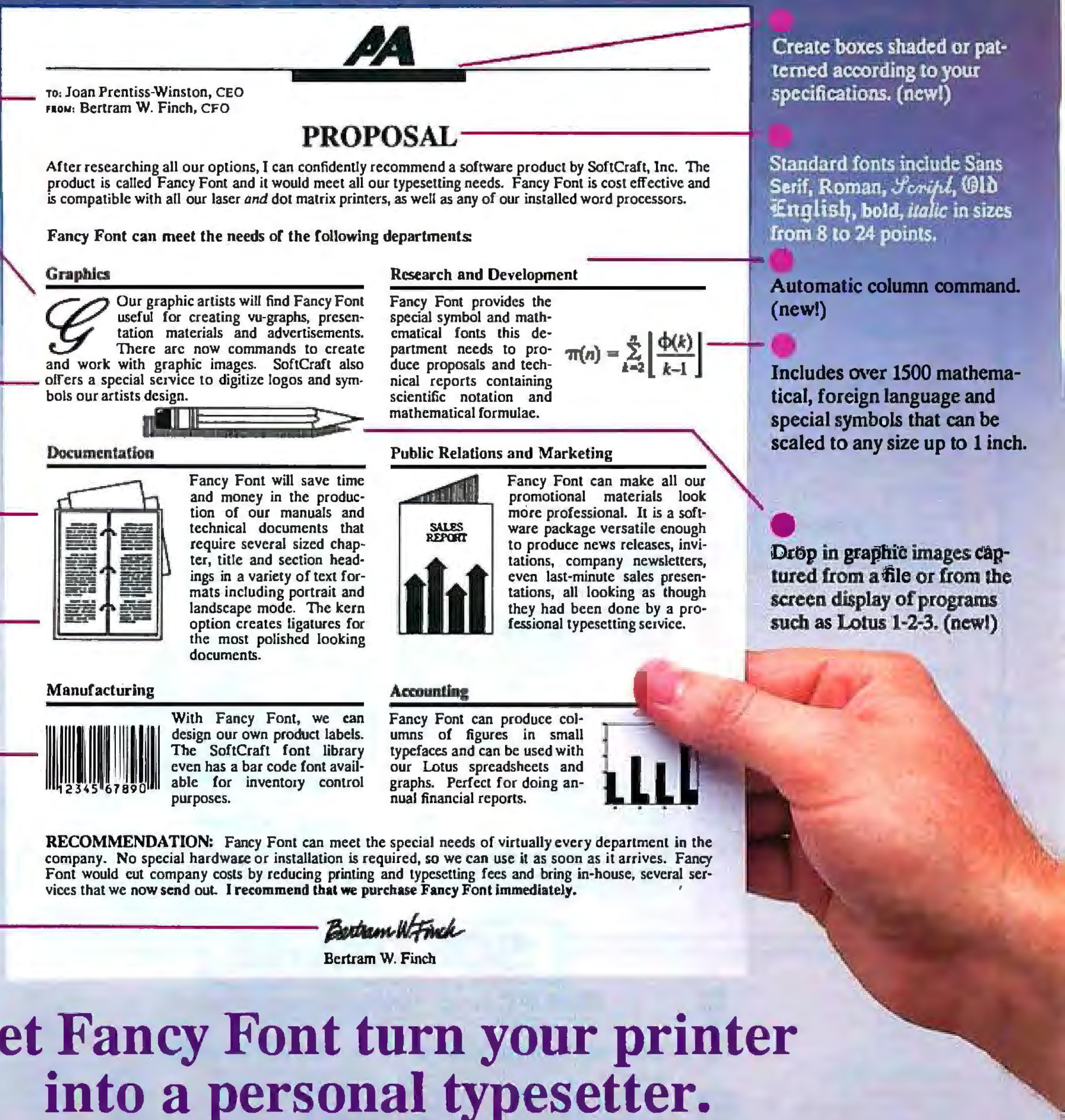

AA

TO: Joan Prentiss-Winston, CEO
FROM: Bertram W. Finch, CFO

PROPOSAL

After researching all our options, I can confidently recommend a software product by SoftCraft, Inc. The product is called Fancy Font and it would meet all our typesetting needs. Fancy Font is cost effective and is compatible with all our laser *and* dot matrix printers, as well as any of our installed word processors.

Fancy Font can meet the needs of the following departments:

Graphics

Our graphic artists will find Fancy Font useful for creating vu-graphs, presentation materials and advertisements. There are now commands to create and work with graphic images. SoftCraft also offers a special service to digitize logos and symbols our artists design.

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$$\pi(n) = \sum_{k=2}^{n} \left[\frac{\Phi(k)}{k-1} \right]$$

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12345 67890

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Bertram W. Finch
Bertram W. Finch

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CWF-287

Q&A 2.0

Phillip Robinson

A file manager with a natural-language interface and word processor

Q&A version 2.0 from Symantec is primarily a flat-file manager for the IBM PC and compatibles. Its File and Report modules are modeled after the original PFS:File program from Software Publishing. Although the Q&A modules retain the familiar interface of that program, they also add a host of sort, format, and search features.

But Q&A is more than a flat-file manager. It also contains a word processor called Write that is complete enough to be a worthwhile product on its own. You call the word processor's features with the File module to create forms, but you can also use it for writing memos, letters, and other documents. A Merge facility in Q&A lets you incorporate information from the data files into Write documents.

Both the database and word processor in Q&A are supported by export and import functions grouped under the "utilities" heading in Q&A's main menu. Other utilities concern printer installation and DOS functions such as listing file names and renaming, copying, or deleting files. A macro facility is available at all times within Q&A; you can use it to capture a series of Q&A commands or to simplify the repetitive input of a long text string during word processing or data entry.

Finally, Symantec beefs up this $349 package with a natural-language front end called the Intelligent Assistant. The IA can analyze a wide range of questions posed in everyday English phrases to directly manipulate the database or to generate reports.

Memory Hungry

Q&A eats up a lot of memory. The program requires a minimum of 512K bytes of RAM, and 640K bytes is recommended. When you use Q&A with the IA, work with a large database, or do reports with multiple sort levels, you'll need the maximum amount of memory. For simple databases, writing, or report generating, 512K bytes will suffice. This demand for memory led Symantec to offer inexpensive ($50) 256K-byte RAM add-on boards to Q&A buyers (through its Turner Hall Publishing subsidiary).

Q&A's hunger for memory doesn't end with RAM: The program comes on six 5¼-inch floppy disks (three disks if you use 3½-inch floppies) comprised of a Startup disk, a File/Report/Utilities disk, the IA disk, a Write/Proof disk, a Tutorial disk, and a Samples disk. Although a couple of these disks come into play only during initial installation, you still need the other four during regular use of Q&A. That leads to a lot of disk shuffling; each of the major components—Write, File, and the IA—are on separate disks. The program prompts you for disk changes but, for efficiency's sake, you'd best use a computer equipped with a hard disk, even if you use 3½-inch floppies.

Welcome Changes

Version 2.0 of Q&A has quite a few changes from earlier versions. [Editor's note: *See the Product Preview of version 1.0 by Jon R. Edwards in the January 1986 BYTE.*] These changes include an improvement in the speed of the IA, inclusion of a database-recovery utility for slightly damaged databases, tighter integration with Lotus 1-2-3, improved macros and programming, more formatting options for reports, networking support in the form of file-locking, and international versions (French, German, and Dutch versions are currently available). The database-recovery tool is particularly welcome because Q&A databases, like other databases, can be damaged when the program is interrupted by a power loss or by a reboot from any point other than a Q&A menu.

Q&A has several features that tailor it to work closely with Lotus 1-2-3. First, you can install 1-2-3 as one of Q&A's main menu choices. That means you can run 1-2-3 directly from Q&A almost as if it were another module. You can also import 1-2-3 worksheets directly into either Write or File and include 1-2-3 graphs in the printed version of Write documents.

Version 2.0 of Q&A can read database files from Q&A 1.0 and 1.1 and put them into 2.0's format, but versions 1.0 and 1.1 cannot use 2.0 files. The user's manual says that 2.0 can use macro files created with 1.0 or 1.1, but changes to some of the menus and the additional use of function keys "may make some macros behave differently." In other words, you'd better write new macros.

I tested Q&A on an IBM PC with 512K bytes of RAM and two 5¼-inch floppy disk drives. Although I did not test Q&A on a network, the user's manual says that the program is compatible with all major LANs that support DOS 3.1 or higher including 3+ from 3Com, NetWare from Novell, and IBM's PC Network and Token-Ring Network. Two people cannot run the same copy of Q&A at the same time on a LAN, but they can share the database. Q&A has file locking, so when one person is using the database, others are locked out.

The Write Module

I wrote this review with the Write word processor. Like the other modules of the program, Write loads slowly. You do most of the editing on the 21 lines of the simple editing display using function-key commands (or WordStar cursor commands, if you prefer). Across the bottom

continued

Phillip Robinson is a BYTE contributing editor and an editor of The Architect's PC *and* Desktop Engineering News. *He can be contacted at Desktop Engineering News, P.O. Box 40180, Berkeley, CA 94704.*

Q&A version 2.0

Type
File manager and word processor

Company
Symantec
10201 Torre Ave.
Cupertino, CA 95014
(408) 253-9600

Format
Six 5¼-inch disks or three 3½-inch disks

Computer
IBM PC or compatible with two disk drives and a minimum of 512K bytes of RAM (640K bytes recommended) running DOS 2.0 or higher

Language
C

Documentation
648-page user's manual; quick-reference guide; quick-reference card

Price
$349; optional thesaurus program: $50. If you bought Q&A version 1.0 or 1.1 after September 14, 1986, a free upgrade to version 2.0 is available. All registered owners of 1.0 and 1.1 who bought Q&A before this date can purchase an upgrade to 2.0 for $50.

are a tabs-and-margins line, two status lines (including one that tells the percent of memory used), and a function-key menu line. The status line gives you a blinking bulletin such as "Saving ..." whenever the program performs some task.

Write has many of the usual word processing features such as edit, delete, set and release tabs and margins, center a line, bold, underline, indent, and search and replace, in addition to block manipulation and printing facilities. But the module also offers more advanced features such as headers and footers, a display of the current date and time, line and box drawing, italics, superscripts and subscripts, a spelling checker, restoring blocks (an Undo function), searching with wild cards (which you can also use to count the words in a document), and math calculation within the text. It can work with documents of up to 20 to 30 pages on systems with 512K bytes of RAM and up to 80 pages with 640K bytes. The spelling checker, unfortunately, is one of the slowest I have used. It does, however, enable you to add words to the 60,000-word dictionary.

For printing, Write has microjustification control, column printing for up to eight columns per page, an envelope-printing routine, and a mail-merge facility. In addition to Lotus 1-2-3 and Symphony spreadsheets and .PIC files, you can incorporate PFS:Graph picture files and BASIC BSAVE formatted files into Q&A printed documents.

Write can import PFS:Write, IBM Writing Assistant, ASCII, WordStar, Lotus 1-2-3, and Symphony documents, and it can write files in its own format or in ASCII. An automatic backup function that you can invoke from the Utilities menu lets you periodically save active files without manual intervention.

Filing

Q&A uses a flat-filing scheme based on forms (equivalent to records) and fields. You design your own forms using the same editing commands as the Write module. You can choose the length, position, label, and information type for each field, make forms up to 10 screens long, and draw boxes on the forms for screen design and printing.

Each file can be up to 256 million bytes and can handle up to 16 million records. In other words, these disk-based files are limited only by your disk space. (The word processing files are RAM-based.) Each form can have as many as 2182 fields or 16,780 characters. The information types for fields are Text, Number, Money, Keyword, Date, Hours, and Yes/No. The Keyword information type lets you input several entries on one information blank, or field, and retrieve entries selectively by searching for keyword combinations.

To add data to the database, you simply call up a blank form and fill it in. Q&A will check the entry for each field and will not allow you to enter the wrong information type. To make data entry easier for someone else, you can define your own help screens to explain the labels and have the screens pop up whenever the user presses F1.

To retrieve a form, you fill out a Retrieve Spec screen that duplicates the labels and fields of the forms. You can specify within each field what range to search using a large variety of operators from "equal to" and "empty" to keyword searches on "includes X, Y, and Z, in that order." You can also use wild-card searches.

Sorting is just as easy to control: You move directly from the Retrieve Spec screen to a similar Sort Spec screen. There you specify each field you want to sort, its sort priority (up to 512 levels), and its sort direction (ascending or descending). Q&A shows you how many records it has searched and sorted as it performs the task. If you want to view more information at once, select the Table View of Forms option to see 17 records stacked vertically with the first five fields laid out horizontally across the screen. You can use another option to change the fields that appear on the table. To change information in a form, you simply retrieve the form, type the new information, and then save the form.

You can print individual forms and mailing labels without going to the Report module. To modify a Q&A database, you change the design, labels, information types, field lengths, and other aspects. If your new field won't accommodate the old information, Q&A will warn you before truncating the information. You can customize databases by selecting the display colors, shading, and underlining; by setting up custom help screens, including programming statements to save keystrokes; setting automatic initial values; and restricting values to prevent data entry mistakes.

To test the speed of Q&A's database, I ran benchmarks on a file of 500 records with 11 fields. Using nonindexed fields, Q&A was able to sort the file in ascending order in 44.9 seconds, and it found the last record in 19.7 seconds. Q&A lets you create index fields to speed up searches. You can have as many as 115 index fields (or "speedy fields," as the manual calls them). But using a large number of index fields will add to the index file and could become a disadvantage by occupying too much disk space.

The programming statements in forms can calculate field values, look up values in tables, figure dates, or move the cursor on the form. The calculations can include a variety of operators, IF. . .THEN statements, and other logical constructs. You enter the program statements on a Program Spec version of the form. The program is executed—either manually or automatically—when you add or update a form.

The Mass Update option lets you change information in all forms within a group at one time. You can perform mass updates with direct input of new information or through calculated values. The Utilities disk has options for importing data from PFS:File, IBM Filing Assistant, Lotus 1-2-3, Symphony, DIF, ASCII, dBASE II, and dBASE III files. You can export files in DIF or ASCII formats.

Reports

Producing reports from the database is fairly straightforward. You select the forms and fields you want, choose columns and sorting patterns for them, and decide on printing formats. You can print as many as 50 columns with up to 50 sort levels. Within this range, you can have as many as 16 derived columns and 49 invisible columns. You can store the report formats and have as many as 100 such formats per database. Within a report, calculations can use a variety of operators, including Total, Average, Count, Min, Max, or subcalculation versions of any of these.

The Intelligent Assistant

When you invoke the Intelligent Assistant from the main menu, you get a natural-language interface to the File and Report modules. After you type a request, the IA software tears it apart and tries to analyze it in terms of its built-in 400-word vocabulary, the labels of the particular database, and whatever words you have taught it. When the IA thinks it understands your question or request, it will tell you what it thinks you want done and ask for confirmation.

From the beginning, the IA works great for simple requests. You can watch the program's analysis progress as a highlighting bar forges its way through your request. Requests such as "show everybody who got a bonus" will cause the IA to dredge File and Report to retrieve the right forms and display them on the screen. You can use the IA to add, retrieve, change, or delete forms and to create reports.

A section of the user's manual explains what types of words confuse the IA and how to best talk to it. If the IA tells you that it doesn't know a word, it will give you a chance to explain. If it warns you that its understanding isn't completely clear, it will give you a chance to end the analysis.

To teach the IA, you type new words that can act as synonyms for words the IA already knows. The number of words you can teach it is limited only by disk space. In time, this ability to customize the IA greatly speeds its analysis of complex requests. You will find it responding promptly to requests such as "Give me a list of all the western managers who are making more than $30,000 but didn't earn a bonus last year." This is exactly what most beginners expect to be able to do with a computer, and it is a massive step forward from the A> prompt. For computer enthusiasts, the IA alone is reason enough to buy Q&A. For business use, a trained IA can insulate a manager from Spec Forms and the like, and it can make a database less frightening and more likely to be used.

Integration a Key

Q&A offers just about everything you could want in a flat-filer. It is easy to learn because of the clear user's manual and the lucid on-disk tutorial, and it is easy to use because of its standard interfaces and commands and on-line help. Conforming to such standards for the interface while expanding the range of database features behind that interface makes for a program that takes advantage of the user's previous training and yet is capable of handling many tasks.

Making the word processor more than just a notepad places Q&A outside the realm of file managers. For many small businesses, Q&A offers a tightly integrated tool for handling the three major office tasks: letter writing, information organizing, and report generating.

Other programs offer the possibility of customization through macros. Q&A has a fine macro facility, but it goes far beyond that level of customization with the IA. Although it is clumsy and slow to use at first, as you learn its habits and vocabulary and it learns yours, you'll soon wonder why all other application programs don't have a similar facility.

The two major drawbacks to Q&A are its lack of relational facilities and its voracious memory demands, which preclude use of one or more memory-resident programs on 512K-byte systems. In addition, although hard disks are becoming standard equipment on PCs, quite a few machines still have just two floppy disk drives. The need for disk-swapping, the slow loading of new modules, and the practical exclusion of memory-resident tools may be too much of a sacrifice for many users.

Still, for anyone who needs a file manager, who could benefit from having a word processor right at hand, and who wants the help of an Intelligent Assistant, Q&A is hard to beat. In fact, it is so thorough that people who have a lot of business correspondence to attend to and are only beginning to discover the utility of database managers would do well to consider Q&A as a word processor that has a file manager attached. ■

Lyrix

George R. Allen

Lyrix version 5.0 from The Santa Cruz Operation (SCO) is a word-processing package that you can use on many different classes of computers, from the IBM PC and compatibles to large systems such as the VAX-11/780. You can transfer text files written on the IBM PC to the larger systems as well. Lyrix is designed to operate in a multiuser environment under UNIX- and XENIX-based operating systems for both word-processing and desktop-publishing applications. It does not operate under a DOS environment on PCs. The version for the IBM PC and compatibles sells for $595; for larger systems, the price of the package varies.

I tested Lyrix on an IBM PC-compatible TeleVideo Model 2605 with 512K bytes of RAM and a 20-megabyte hard disk using SCO XENIX V Complete release 2.1. SCO says you can run Lyrix with a 10-megabyte hard disk, but I would not advise running it with less than a 20-megabyte hard disk.

I compared Lyrix to the UNIX standard vi editor with the associated UNIX text processing programs. The vi editor is the mainstay for word processing in the UNIX environment, even though it is not a true word processor but a text editor. Lyrix won hands down in this comparison. To test the multiuser capabilities of the software, I connected an ADDS Viewpoint terminal to the serial port on my computer to get two-user operation.

Lyrix takes advantage of the file-security capabilities of the UNIX environment. In this environment, you can restrict word-processing files or documents to specific departments or individuals through the use of log-on passwords and file permissions. You can assign permissions to files, groups of people, or individuals to allow file access as required. You can also set up permissions for read-only, read-write, or nonpermission files.

Lyrix will allow only a single user to update a specific document at any one time. This prevents files from being overwritten and data being lost.

Some Comparisons

The vi editor is commonly used on many UNIX-based systems and is very popular; however, it's not easy to learn, and it lacks full-screen editing, menus, and on-line help. It cannot be easily customized

continued

Lyrix 5.0

Type
Word processor

Company
The Santa Cruz Operation Inc.
400 Encinal St.
P.O. Box 1900
Santa Cruz, CA 95061
(800) 626-8649

Format
Two or three 5¼-inch disks, depending on the computer you use

Computer
IBM PC, XT, AT, and compatibles; requires 180K bytes of memory and 64K bytes for each additional user (a minimum of 512K bytes of RAM and a 10-megabyte hard disk are recommended); also, a variety of minicomputers from DEC, NCR, Pyramid, and other companies

Necessary Software
SCO XENIX V operating system or any XENIX system that runs on an 8088-, 80286-, 80386-, or 68000-based computer

Language
C

Documentation
270-page user's manual; 140-page configuration manual; 40-page tutorial; 12-page quick-reference guide

Price
$595 for the IBM PC, XT, AT, and compatibles; contact SCO for other pricing and system requirements

and does not have a mail-merge feature, although it does provide an Undo command and supports underlining, boldfacing, and other text enhancements.

Because vi is a text editor, virtually any word processor will compare favorably to it, and it's no surprise that Lyrix stands out in comparison. Lyrix is suitable for beginners and offers full-screen editing, allowing you to move around the screen by using cursor-control arrows. It provides mail merging, underlining and boldfacing, an Undo command, helpful menus, on-line help, and a what-you-see-is-what-you-get display. You can also customize it more easily than vi.

Lyrix also compares favorably to DOS word processors such as WordStar. It offers all the features of WordStar, including a spelling checker. Lyrix goes further, though, offering additional features that make it more versatile than WordStar and other DOS word processors. For example, Lyrix has a flexible customization capability that allows you to set up multiple printers as required; you can set up as many printers as you have parallel or serial ports on your system. You can also set up a given printer in draft or near-letter-quality mode and add print-quality selections to one of the Lyrix menus. I used this capability to allow printing to either my Epson or Toshiba printer in draft or NLQ modes as required.

In conjunction with UNIX, Lyrix enables you to use multiple printers simultaneously. Thus, it is possible on an IBM PC running Lyrix and SCO XENIX to print on several printers at once. I don't recommend this, as it causes the response times to slow down terribly. An IBM PC is just not fast enough to support this type of operation.

Lyrix also lets you add special command sequences to its menus. You can even customize Lyrix to look like WordStar, though this seemed like a lot of work to me; in addition, the Lyrix menus are easier to read and make more sense than WordStar's.

Desktop Publishing

If you were to compare the vi editor to WordStar in a desktop-publishing environment, you would find that WordStar is much easier to use, but vi offers more functionality. The vi editor, for example, offers automatic paragraph numbering, footnotes, headers and footers, justification, and multiple fonts. Math equation-formatting and support for output to phototypesetters are provided by the UNIX text processing programs, such as TROFF, which are normally used with the vi editor. Its table setup is cumbersome, however, and it cannot mix text and graphics.

Lyrix has almost all the capabilities of vi. It does not offer the equation-formatting or phototypesetting output. Like vi, it does not let you mix text and graphics. However, Lyrix makes it easy to set up tables and, in general, is easier to use than either vi or WordStar. Its commands make sense and are easy to remember. For example, `esc t` gets you to the top of your document, `esc f` is used to find a phrase in your document, and so forth.

Lyrix supports a multitude of printers, including Epson, Diablo, NEC, Okidata, and the Hewlett-Packard LaserJet. You can add additional printers by placing data in a configuration file called the Tcap file, which provides special effects such as underlining, boldfacing, and so forth. Good documentation and examples are provided to allow you to configure a special printer to your requirements.

The Lyrix spelling checker finds misspelled words between the current location of the cursor and the end of the file, and it suggests possible alternatives. It uses the 80,000-word Merriam-Webster Linguibase dictionary. I wrote this article under Lyrix and used the spelling checker to check the document. Only one or two cases occurred where the spelling checker did not display the proper spelling for me; I was quite impressed with its performance.

SCO XENIX and Lyrix

Some of the performance quirks of UNIX observable on larger UNIX-based systems occurred in exactly the same manner on my computer under SCO XENIX. One particular quirk that will occasionally be annoying to hunt-and-peck typists is that the characters typed on the keyboard do not always immediately appear on the screen. Sometimes there is a delay of up to one second after a character is typed before it is displayed. All characters appear on the screen when you use Lyrix, but, under some conditions, you can enter 10 to 15 characters on the keyboard before seeing them displayed. This occurs frequently on both superminicomputers and personal computers, and it appears to be related to how busy the UNIX system is at a given time. On a PC this will be most noticeable when you send a print file to the print spooler. I found the delay annoying, but it did not interfere with the operation of the system or detract from its usefulness. SCO recommends that a PC be limited to two simultaneous terminals to maintain a reasonable response time. You can install up to eight additional terminals, but actual operation should be limited to two at a time.

SCO has set up Lyrix as a shared program, that is, a single program with separate data areas for each user on the system. This maintains excellent response times for both users. I tested this by having two people type on two terminals simultaneously. Neither person was aware that the other was also using the system. I further tested the system by running Lyrix on one terminal and a large game on the other terminal. There was insufficient memory on my 512K-byte system to hold both programs in their entirety, so SCO XENIX attempted to accommodate both by swapping them back and forth between disk and memory. As a result, the system bogged down and became so sluggish that it was impractical to use. This is not a fault of SCO Lyrix or XENIX, but a condition caused by the limited memory of the IBM PC.

Since SCO XENIX will use only 640K bytes of memory on an IBM PC or compatible, a PC is not a good choice if you plan to run two or more programs on multiple terminals at the same time. If you expect to run an assortment of programs simultaneously, your best choice would be to use an IBM PC AT or compatible, on which SCO XENIX will support up to 16 megabytes of memory. Consequently, if you install sufficient memory in your PC AT, you should never run into these problems. For example, a colleague who runs SCO XENIX on a PC AT operates in a multiuser environment using different programs on several terminals. He has not experienced any sluggishness on his PC AT and is pleased with the response of the system.

If you currently use PC-DOS or MS-DOS and wish to convert to SCO XENIX for word processing in a multiuser environment, you can transfer files back and forth between DOS and SCO XENIX by using a series of utilities provided with the system. The main utility that I used was `doscp`, which allows you to copy files from the SCO XENIX portion of your hard disk to and from the DOS portion. This utility may not be of value in all cases; if the files transferred are encoded or are not in ASCII, they may not be intelligible under Lyrix. I used `doscp` to transfer Lyrix text files for this article to a DOS floppy disk.

Setting Up

The documentation supplied with both SCO XENIX and Lyrix is quite good, and there is an enormous amount of it. This is both a plus and a minus, however. Any information that you need to know is in one of three manuals. Unfortunately, it may take a lot of wading through them to find the information that you need.

The manuals describe in detail how to configure and use SCO XENIX and Lyrix under all conceivable conditions. The setup of SCO XENIX is straightforward and is adequately described in the installation guide supplied with the software. The only problem I encountered was that the instructions did not specifically say to install the printer on the system. When my printer did not work right away, I looked in the manual for printer-installation instructions. These instructions were clear and did not present any problems.

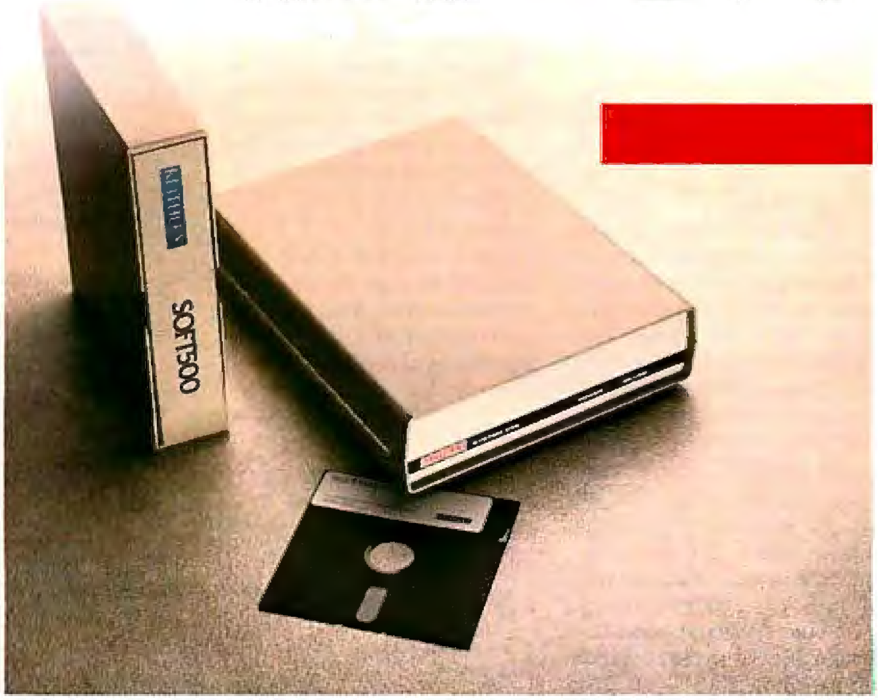
Installation time for XENIX is considerably longer than the installation time for a DOS system. It took me about five hours to install SCO XENIX on my TeleVideo 2605 the first time. This included the time that SCO XENIX needed to format and verify the 20-megabyte hard disk on the computer. While the instructions are straightforward, the installation process will probably be intimidating to a computer neophyte. From a practical standpoint, the installation should be attempted only by someone who is familiar with computers in general. Prior knowledge of XENIX or UNIX is not required.

Installation of Lyrix is quite simple and hardly bears mentioning. The process took me only about a half hour.

A Good Choice for ATs

I have used SCO XENIX with the vi editor for almost a year and have had no problems. I have also used WordStar and Microsoft Windows Write. However, I now use Lyrix exclusively because of its ease of use and flexibility. In my working environment where my two terminals both run Lyrix, performance is good using the IBM PC. I strongly recommend, however, that if you consider using Lyrix and SCO XENIX, that you purchase a PC AT-compatible system to avoid the occasional response problems caused by the slower IBM PC. ■

George R. Allen (P.O. Box 583, Binghamton, NY 13902) has been involved with computer systems for the past 23 years. He is now a software design manager for a large industrial firm, where he works with UNIX-based systems.



REVIEW FEEDBACK

STELLA

Stephen B. Robinson's review of STELLA (December 1986) is exemplary in its dispassionate discussion of what the program can do, as well as the chief things it cannot do—cut, copy, and paste. But STELLA is such a bright star in the software firmament that one could be forgiven for displaying some passion in response to its appearance. Were I to be banished to a desert island with a solar-powered Macintosh and five programs, STELLA would be one of them.

I have three wishes for future versions of STELLA: to be able to add text to diagrams and graphs, to have a simulation pause at programmed times for entry of data through the keyboard, and to have junction boxes and tanks where the total flow in is automatically equated to the total flow out. In Mr. Robinson's review, an Editor's note referred to a preliminary version of an update that includes a cut-and-paste feature. Let's hope that the other omissions that I have mentioned will also be included.

Don Watson
Melbourne, Victoria, Australia

QuickBASIC 2.0

I enjoyed reading Dennis Dykstra's review of Microsoft QuickBASIC 2.0 (February). I own and use QuickBASIC 2.0, BASICA, and True BASIC 2.0. QuickBASIC 2.0 is, of course, an enormous improvement over prior Microsoft compiler/interpreter versions of BASIC and includes a major restructuring of the language. My major regret is that QuickBASIC 2.0 was compared only to ZBasic and GW-BASIC in the review.

I urge BYTE to conduct a real apples-to-apples comparison of QuickBASIC 2.0, True BASIC 2.0, and, perhaps, BetterBASIC. All now have run-time packages that permit the generation of stand-alone .EXE programs. QuickBASIC 2.0 is very good, but, in my opinion, True BASIC 2.0 shines even brighter.

Jerry Davis
Concord, MA

Toshiba T1100 Plus

As an owner and user of a T1100 Plus undergoing the usual second thoughts, I was interested in John D. Unger's article "Four Portable Computers" in the February issue.

Oddly enough, the only problem I have had with my T1100 Plus is in precisely the same area in which I use it most frequently—running Microsoft Word. The integrated keypad design of the T1100 Plus simply will not work with several of the outline-processing features of Word 3.0. However, that is the only compatibility problem I've run into so far.

I would like to point out that Toshiba's Floppy Link, which allows the T1100 Plus to use a desktop's 5¼-inch drive as its own, works with only a limited number of machines and is guaranteed only for the IBM PC and the Compaq.

Finally, the T1100 Plus comes with MS-DOS 2.11, but not with GW-BASIC; in fact, errata slips in the documentation that came with my unit specifically deleted all references to BASIC.

Richard Brzustowicz Jr.
Seattle, WA ■

REVIEW FEEDBACK is a column of readers' letters. We welcome responses that support or challenge BYTE reviews. Send letters to Review Feedback, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Name and address must be on all letters.

*In our April review of dot-matrix printers (see table 1, page 205), the figures for sound levels recorded in the graphics mode were incorrect. The correct figures appear below. Sound level is in dB (0 dB=.0002μbar); * = not available.*

Company	Model	Sound level		
		Draft	NLQ	Graphics
Advanced Matrix Technology	AMT 2002	73	82	*
Alps America	ALQ218	70	70	74
	ALQ324	70	71	72
	P2000	70	67	74
	P2100	65	63	75
Brother International Corp.	2024L	70	73	77
	M-1709	71	68	81
C. Itoh Digital Products Inc.	C-310XP	70	69	74
	C-815 Supra	76	72	82
Canon USA Inc.	A-50	70	71	84
	A-60/G	71	70	79
Citizen America Corp.	120D	71	70	84
	Tribute 224	73	74	*
Dataproducts Corp.	8012	69	67	75
	8070 Plus	73	71	78
Datasouth Computer Corp.	DS 180 Plus	75	*	*
Epson America Inc.	EX-1000	71	70	81
	LQ-2500	72	72	80
Fujitsu America Inc.	DL 2600	70	68	78
	DX 2200	72	71	80
Genicom Corp.	1020	72	71	78
	3210	78	76	86
	3410.02	*	*	*
IBM Corp.	Proprinter XL	75	73	79
Infoscribe Inc.	1100P	77	75	*
	1400	74	72	*
JDL Inc.	JDL-850 EWS	67	65	69
Mannesmann Tally	MT-290	74	72	84
	MT-490	*	*	*
NEC Information Systems	P5XL	69	73	75
Newbury Data Inc.	OSP-3	71	72	84
Nissho Information Systems	NP-2410	72	71	72
	NP-910	72	71	79
Okidata	ML193 Plus	73	71	79
	ML294	72	70	78
Olympia USA Inc.	NP 136	70	69	84
Output Technology Corp.	OT-700e	79	79	89
Panasonic Industrial Co.	KXP-1092i	72	73	83
	KXP-1080i	72	73	83
	KXP-1091i	71	69	*
Printronix Inc.	P1013	79	78	83
Seikosha America Inc.	BP-5420 AI	70	70	78
	MP-1300 AI	71	68	78
	SL-80 AI	67	69	73
Star Micronics America Inc.	NB24-15	74	75	83
	NR-15	74	71	83
	NX-15	72	70	82
Tandy Corp./Radio Shack	DMP 130	63	62	65
	DMP 2110	70	74	82
	DMP 430	72	74	83
Texas Instruments Inc.	Omni 880	70	69	77
Toshiba America Inc.	P341e	75	74	*
	P351-2	71	72	85

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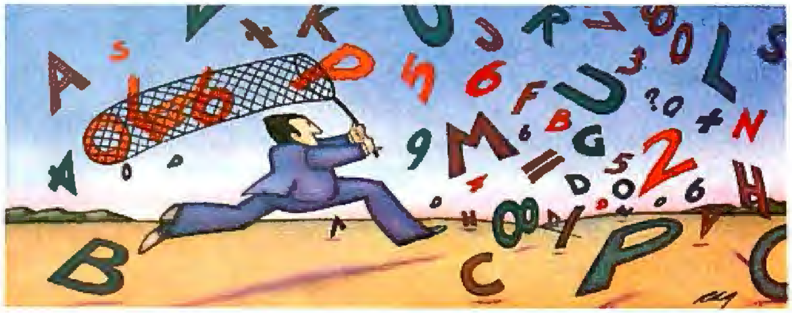

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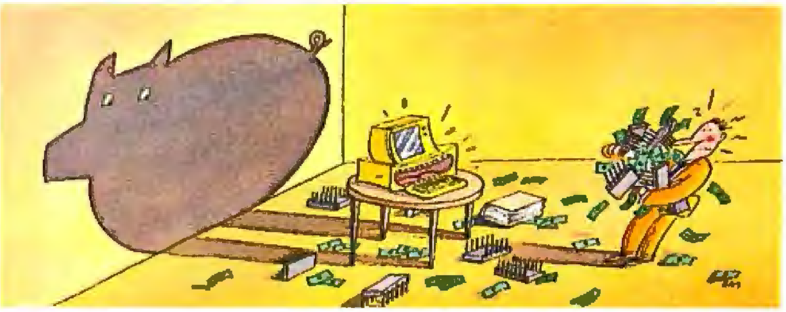

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Bye-Bye Big Kat

Jerry Pournelle

I started this on the BART train under the San Francisco Bay. I was trying to write on Zebediah, my Zenith Z-181 portable, but I didn't get very much done.

It wasn't Zeb's fault. He is a bit heavy, and the case is slick enough that it will slip off your lap if you're not careful, but it is possible to hold the machine there; and that bright blue backlit screen is readable in any light conditions I've yet found. In my experience, two full-feature PC-DOS portables are worth considering: the Z-181 and the Toshiba T3100 with its hard disk. The Toshiba isn't a laptop, but the Z-181 is supposed to be. It runs for hours on batteries. The screen is large enough. But I simply couldn't write on that BART train.

The problem wasn't the computer, but the American Tourister case. I found it impossible to leave the machine in the case, and nearly as difficult to take the machine out and close it up. There's almost no way to keep disks in that case once it's been opened: the thing is optimally designed to drip its contents onto the floor. Since the Z-181 runs only a few hours—three to five, depending on how much disk access you do—between charges, I generally want the somewhat heavy and badly designed power supply in the case with the Z-181, and there's no separate compartment for it. The cords very much get in the way.

In fact, there aren't any truly separate compartments for *anything* in that case. There's a flap, but it's made of thin cloth and holds nothing. The result is that the only stiffening is provided by the computer itself, and once you remove that, all the disks, documents, templates for WordPerfect, small tools, cables, and other stuff that you'd like to keep with a full-featured portable are mixed together into a random stew—or else the stuff falls out onto the floor, as it did with me. I actually missed my BART stop because I was trying to retrieve disks that had dripped from the Z-181's case.

Big Kat goes off to college, and the flaky Zelda replaces him

Apparently Zenith put all its design skill into the Z-181 itself and ordered the case and power supply as afterthoughts. If the Z-181 sells as well as it ought to, someone will make a fortune selling well-designed cases to carry it in. While they're at it, they might design a lightweight handle to attach to the computer itself.

Communication by Alligator

It's a tendency in modern hotels. The phone system is set up so you don't have to talk to anyone to dial out; just dial 8, or 9, and then the number. The phones are almost all Touch-Tone, too, so it ought to be easy to connect them to modems. It seldom is easy, though, because the telephone instrument is hard-wired into the system. Since nearly all modems now expect you to use a modular plug, this presents a problem if it's midnight in the San Francisco Hilton and you desperately need to log on to BIX.

I was in that situation recently. I thought of two possible solutions. First, I carry a spare telephone cord. The *instrument* was hard-wired, but was the other end at the wall? Alas, that was well behind the bed, and short of moving a massive piece of furniture, I wasn't going to find out. (Incidentally, why are phones always at the bed and never at the worktable, even in hotels that say they cater to business travelers?)

The second solution was given to me by Dr. Robert Bussard, who sent me a modular plug that ends in four color-coded alligator clips. I'd carried it to many places, but I'd never been desperate enough to use it. This time I was.

With a certain amount of trepidation, I took the telephone apart with my Swiss army knife. The cover came off easily enough, and once inside the job was simple, barring the fact that the phone was now permanently off the hook. The wires from the wall plug terminated just inside the instrument and had the four colors all phone lines seem to have now. Two of them are still called "tip" and "ring," presumably carryover names from the days when phone plugs and jacks were larger. I don't know which is which, or indeed which two of the four lines are significant, so I used the alligator clips to connect similar colors of all four lines from my bit of phone cable and plugged the other end into the line port on the Z-181's modem.

Voilà! Everything worked fine. There was a bit of line noise, and after I was connected to BIX I managed to hang up the phone instrument. I was still connected, and most of the noise went away. As I'd suspected, the telephone instrument was now totally irrelevant.

I don't suppose the Hilton would have approved, but in fact I had no problems, either with BIX or in getting the phone put back together. Let me hasten to add that I don't recommend that you try this.

Communications, Continued

Last month I mentioned the difficulties I had in getting the Z-181 to communicate files to Big Kat, the Kaypro 286i PC AT clone. The Zenith PCXFER program says "use a null modem," but in fact that's an insufficient instruction. What they mean by "null modem" is a cable of considerable complexity. I'll repeat the formula for those who missed last month's issue.

Take a standard 25-pin RS-232C cable and alter. Pin 1 goes straight through. Cross-connect (i.e., swap over) pins 2 and 3. Swap 4 and 5. Cross-connect 6 and

continued

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

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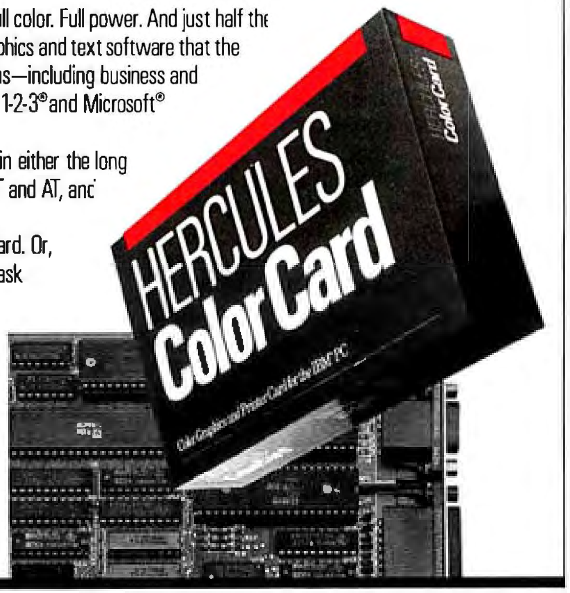

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20. Pins 7 and 8 go straight through. Given all that, PCXFER worked fine to transfer files to and from Lucy Van Pelt, our genuine IBM PC; and indeed, it works with any normal PC or XT. The program is a little slow, but it's automatic and understands wild-card instructions.

I couldn't get PCXFER and that cable to work with an AT. It turns out there was a very good reason: 25-pin connectors on AT-style machines, including the Kaypro, are parallel ports. Serial ports on an AT have only 9 pins.

Okay, I should have known that. It's even stated in Kaypro's documents, and now that I'm sensitized I've seen it elsewhere. The fact is, I didn't know.

The IBM PC has two 25-pin ports, one serial, one parallel. The Z-181 has two 25-pin ports (actually three), and one is the serial port. The Kaypro 286i AT has two 25-pin connectors on the back. One is on the Hercules Color Card video board and is clearly labeled parallel. It ran the printer fine. The other is, of course, on the I/O card that also contains a 9-pin port. For not very intelligent reasons, I assumed those were two different serial ports, or possibly two different configurations of the same serial port. The 9-pin port was used to connect the Logitech mouse, and it worked fine. The 25-pin port wouldn't work with PCXFER, even with the snazzy "null-modem" cable I'd made to Zenith's specs.

It never would work, of course, because the 25-pin port is an extra parallel port and can even be connected to another parallel device, provided only that both devices aren't turned on at the same time.

I found this out from BIX correspondents shortly after filing last month's column. It says a lot for the wretched state of "standards" in this industry that so few were surprised by my problems that it took a week before someone noticed I was trying to do the impossible. People *expect* serial communications problems.

Alas, the Zenith PCXFER documents don't give any clues about cabling to a 9-pin connector. I have a couple of cables that do have a 25-pin port on one end and a 9-pin port on the other, and using those and WireTap (an inexpensive breakout box; see last month's column) I experimented for an hour, but I never did get the Z-181 to talk to the Kaypro or to a Zenith Z-248 AT clone for that matter.

Eventually I ran out of time. I used PCXFER to send my files from the Z-181 into Lucy Van Pelt, then used the CompuPro network to transfer those files to the big CompuPro, and from that to the Kaypro. It meant one more copy command, but nothing else special, so except for

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stringing the network wires it wasn't a lot harder than doing it direct.

I've found another use for the CompuPro network. All my AT machines have 96-tracks-per-inch "quad-density" disk drives. Those drives *read* normal PC and XT disks fine; but when they write files, the probability that a 48-tpi "normal" PC drive will be able to read them is very low. The network solved the problem nicely: we use it to transfer the file to a PC with 48-tpi drives and let it write the file. Now anything can read it.

Enter Zelda

For more than a year, the main PC-DOS machine at Chaos Manor has been Big Kat. He's been so good, in fact, that I've turned down numerous offers of competing AT machines.

He's still working fine; but eventually it was time for a change, if only because I can't go on writing about the same machine forever. When Zenith asked me to look at the Z-248 AT clone, it wasn't a difficult decision. It's the standard machine used at the service academies, and I'm rather fond of Zenith anyway. Their stuff is reliable, and I like their ROM monitor. It took Zenith a while to get one of the machines to me, and until they did I kept Big Kat on-line; but eventually the Z-248 arrived.

First things first. Get the new machine running. That was no problem. When I turned it on, it said "not a bootable partition." When in doubt, read the instructions, and five minutes later I knew how to boot the machine with its floppies and partition the 30-megabyte hard disk. Another five minutes and the hard disk was formatted and set up with command files to be the boot disk.

There was one potential problem. The Z-248 came with an enhanced graphics adapter color board and Zenith's ZVM-1380 13-inch EGA color monitor. I was a little worried that text on the screen might not be big enough for me to be comfortable with. Also, about once every dozen times when I booted the system, the screen images were broken and fuzzy. The condition corrected itself on rebooting, but it was annoying.

It didn't seem fatal. I put it down to something being jarred in shipping and figured that at worst Zenith would send me a new video board.

Now I was left with the question of what to do with Big Kat, a thoroughly debugged and operational AT clone who has served me well for more than a year. In fact, the decision was simple enough. Frank, my #2 son, is studying business and finance at USC and needs a computer. PCs are fine, but ATs are better; with permission from Kaypro, Big Kat would become Frank's machine.

Since Big Kat had been the main PC-DOS machine here, he had a lot of files I'd need on the Zenith. On the other hand, I have a lot of programs I wasn't about to send down to USC. In some cases, I legally own only one copy. Most publishers probably wouldn't mind if I lend my son a copy, but I won't do that without permission. Others are prerelease. And, of course, some are games: college students get enough distractions without my furnishing more. I wanted to keep those files for me, but they'd sure have to be removed from Big Kat.

The simple solution would have been to use Fastback: back up all of Big Kat's files, then restore them on the Z-248. I could then go through Big Kat's files and delete as needed. I didn't think of that. I suppose it's partly because Big Kat had a lot of files that ought to have been deleted long ago, and this was a good opportunity to clean things up. Anyway, I used the network.

Networking on My Own

I had an extra CompuPro ARCNET PC board. Since the Zenith was the Z-248, it seemed reasonable to address it as node 48 (Big Kat had already been designated as 28). Of course, that would be *hexadecimal* 48, since that's how you specify node numbers on the CompuPro network; but I have SideKick, which has a desk accessory calculator that translates hexadecimal to decimal to binary, so surely it should be no problem. I opened the CompuPro ARCNET PC documents with considerable hope.

Hah. Five minutes later I was hopelessly confused. Eventually I called CompuPro and asked for technical support. I got a young chap who seemed to know what he was doing. He chattered gaily about least significant bits and the like and told me how to set the paddles—the individual switches—on SW-2, the eight-paddle DIP switch that tells the CompuPro ARCNET PC board what node it is. I set them and hit Ctrl-Alt-Del.

Nothing happened, of course. You first have to turn off the machine before the ARCNET PC card can read its own switch settings. Try again.

Unfortunately, that didn't work either. Back to phone CompuPro. This time I got Len Ott, CompuPro's very practical software guru. Len's solution was simple: use DEBUG to see what number the ARCNET PC board thought it was reading. A minute later we knew it wasn't reading 48 hexadecimal. Back to the DIP switch and exactly reverse each paddle. Turn off the machine. Fire it up again. Voilà! Everything worked fine.

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As with most such problems, what was needed here was *examples*. In this case, it needed some drawings of switch settings and their corresponding numbers, plus a couple of tables. Fortunately, CompuPro has hired an editorial consultant to revise the documents. I have some new data for her attention.

After that the network worked like a charm. Of course, DOS is too stupid to let me use the network in a single operation; that is, you can't, at the Zenith, issue a command that will bring you a file from the Kaypro, nor can you, from the Kaypro, send a file to the Zenith. Instead, you have to use the Kaypro to send a file to, say, the Golem, my big CompuPro 286/Z80 machine, then go to the Zenith, set up the directory structure you like, and call in the files from the Golem.

To do this, I told both the Kaypro and the Z-248 that they had a local drive called M, which was actually the M-Drive/H (RAM disk) on the Golem. (The network lets you name any drive on any machine any arbitrary thing you like, as long as it isn't something you already have. For example, I could not call a networked drive C if I already had a hardwired drive named C attached to that terminal.) This made things go faster.

Then I noticed that my newly transferred files didn't have date and time stamps. It took a second before I realized why. The Golem's M drive is formatted as Concurrent CP/M media, and while DOS files—including command files—are stored intact, and work fine, the date and time stamps were lost on the way through. That problem was cured by using the C logical drive partition on the Golem; C is configured as MS-DOS media.

After that we had no problems. I experimented with PC Sweep, a couple of other shareware file manager programs, and various other stuff, with no surprises. PC Sweep running on the Z-248 is perfectly willing to believe that the M drive is nothing special and will tag files for transfer or deletion; while the Golem is smart enough to accept commands through the network from the Zenith. In a couple of hours, I had reorganized and transferred all my files.

Norton's Wipedisk

Once I'd done all that, there was still a problem. I'd erased files from Big Kat, but it would still be possible for someone down at USC to recover them; and while I trust my son, I didn't want him to have to put unusually severe security restrictions on access to the machine.

One solution might be to use Fastback to record all the data, then format the hard disk. Alas, I have a couple of utility programs that swear they can recover data even from a disk reformatted under DOS, and while I wasn't sending those programs with Frank, I make no doubt there are plenty of USC students who either have them or could write their own. Surely there's a way to permanently erase files.

There are lots of PC-DOS utility programs, some in the public domain, some shareware; so many that it's impossible to keep track of them all. I've found by and large, though, that the latest edition of The Norton Utilities will solve at least 90 percent of the DOS problems I run into. Norton's programs are well documented, both on how to use them and what they do. It seemed reasonable to look into the Norton manual to see if there was help for the current situation.

There was. Norton's Wipedisk doesn't just erase files, it overwrites them. I'd never used it before, so I ran Fastback to get backup copies of all the files we'd just transferred, then invoked Norton's Wipedisk with the /E option, which, according to the manual, "specifies that only the

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erased or unused data space will be wiped; this saves current data, but wipes erased data."

I am pleased to report that it does just what it says. It's not particularly fast: on a 20-megabyte hard disk about half full, it took most of dinnertime. On the other hand, under the /E option it runs unattended, and when it was finished, I couldn't find a program that would recover any of the wiped data.

I've said this before: if you do much work with DOS, you should have a copy of The Norton Utilities. There may be a better public domain version of every program in the Norton set, but you'll sure spend a lot of time and effort collecting them all, and even then you'll have to sweat some pretty wretched documents. The Norton Utilities are well worth the price.

Cheetah

The next thing was to install the Cheetah Combo, a no-wait-state memory-expansion board for the PC AT. The Cheetah Combo is faster than the built-in memory on most IBM PC AT machines, which means that with a lot of ATs it's a good idea to remove memory the machine comes with and let the Cheetah memory replace it. That's easy to do: Cheetah's documents are clear, and they give you a program that shows you just how to set the switches.

The Zenith, however, is faster than most AT clones. It came with 500K bytes of no-wait-state memory. I set the Cheetah Combo switches to tell it that, and instantly I had a 640K-byte system with an unknown amount of expanded memory. Next thing was to tell the Z-248 about its new memory. That turns out to be easy to do, since unlike the Kaypro, the Zenith tells *you* how much conventional and expanded memory it has. You then have to go into the ROM monitor and change the setup. (I don't know why the machine doesn't just tell itself about the changes.)

The only use that I've found for expanded—as opposed to extended—memory is as RAM disk. Installing that is simple enough. Just use the VDISK.SYS that comes with PC-DOS. In my case, on advice from Cheetah's Gene Sumrall, I put `DEVICE = VDISK.SYS 4096 256 256/E` into the CONFIG.SYS file. That tells the RAM disk to grab everything it can (up to 4096K bytes), format it into 256K-byte sectors, and leave room for 256 entries in the directory. If I were short of memory, I might decide to leave room for only 128 entries.

Once that's done you have to reboot. The first time I tried it didn't work: I had VDISK.SYS in a subdirectory, and the PC looks for CONFIG.SYS in the root directory before it reads the PATH instructions that can tell it to look at subdirectories. Moving VDISK.SYS to the root directory fixed things, and at the next reboot I had 640K bytes of main memory and a 2.48-megabyte RAM disk labeled drive D.

The Cheetah Combo comes with some interesting software. One program will force your programs to use high memory before low to make efficient use of the superfast Cheetah no-wait memory. Because the Z-248 is already plenty speedy, I didn't bother with that except to test it out. It works, but I saw no real speed improvement. With another machine I probably would have.

Above Disc

RAM disk is useful, but my problem is that I like memory-resident software. That eats memory, and neither expanded memory nor RAM disk is a bit of help. What I need is "extended" or "smart" memory, generally abbreviated as EMS. I called Cheetah to see if they had anything that would help and learned about

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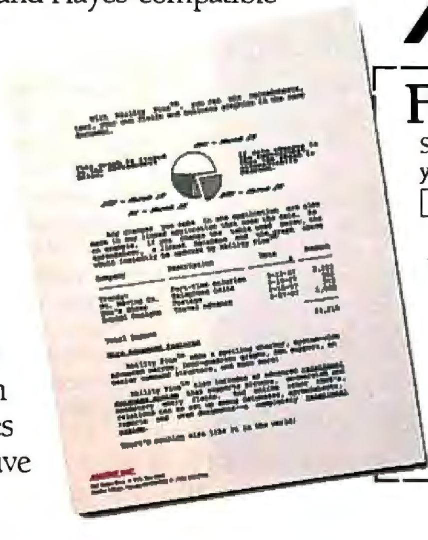

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Inquiry 209

Above Disc virtual memory emulator.

Above Disc is a memory-resident program that uses about 50K bytes of regular memory. It uses that to control a specified portion of your RAM disk and turn that into the equivalent of extended or smart memory. The program swaps in and out of regular memory according to the rules of the EMS standard. In other words, it creates what the big computer people call virtual memory.

Installing Above Disc is simple, provided that you *read the entire manual* before starting. It isn't that long a manual, so this is no real problem, however there are a number of caveats about Above Disc, and you'd better be aware of them.

Once Above Disc was in place, I rebooted to see what it would do for Ready!. The result was very nice: Ready! took up 3K bytes of conventional memory and 160K bytes of the expanded memory created by Above Disc. Ready! also worked perfectly.

Unfortunately, Ready! is the only memory-resident program I'm addicted to that can make use of expanded memory. Philippe Kahn tells me he'll have an EMS version of SideKick Real Soon Now. However, the Above Disc scheme works with DESQview, Lotus 1-2-3, Symphony, Reflex 1.1, and other programs engineered to take advantage of EMS. The instructions explicitly say it will *not* work with Javelin.

Above Disc doesn't have to use RAM disk to do its thing: you can designate part of your hard disk, or even a floppy disk, as "expanded memory," and Above Disc will swap stuff in and out of a reserved area on that disk. Of course it won't be very fast, and if you remove the floppy at some point during the proceedings, you'll really mess things up; but it will work.

The DESQview people, and some others, tell me that Above Disc isn't *really* EMS-standard expanded memory, and I'm sure they're right; but it does quite a lot, and we haven't had any problems with it. The Cheetah Combo and Above Disc make a good combination.

Zelda Goes Mad

I'd had the Z-248 all weekend, and it was giving me no problems, so I sent Big Kat off to USC with Frank. Given the rugged construction of the Kaypro, I wasn't worried about it, and I was right: despite having a bunch of business students banging away on it, Big Kat is working fine.

Alas, that wasn't true of the Z-248. The instant Big Kat left the house, the Z-248 did odd things. First, her screen images began to dissolve, until there were no more than 25 percent of the pixels on the screen. English written in the roman alphabet has a lot of redundancy, so I could just make out words and commands; but it sure wasn't easy.

Resetting the machine would generally cure the screen problem, but it often would introduce a different difficulty: the Above Disc disk-swapping system would load itself and report that all was well, but then Ready!, loading itself on start-up, couldn't find it. Instead, about half the time, Ready! would load itself entirely into conventional memory, as if the Above Disc pseudo-expanded memory weren't there at all.

Then I had real problems getting the machine to work with the OmniTel modem. I've had that modem in Big Kat for two years with no glitch whatsoever, and I refused to believe it had gone sour—and indeed, rebooting would often cure that problem, too. After that I had problems with the ARCNET PC and even with the PATH command.

None of this happened every time, which was annoying. Computers aren't supposed to do things *sometimes.* It was time for some serious diagnostics.

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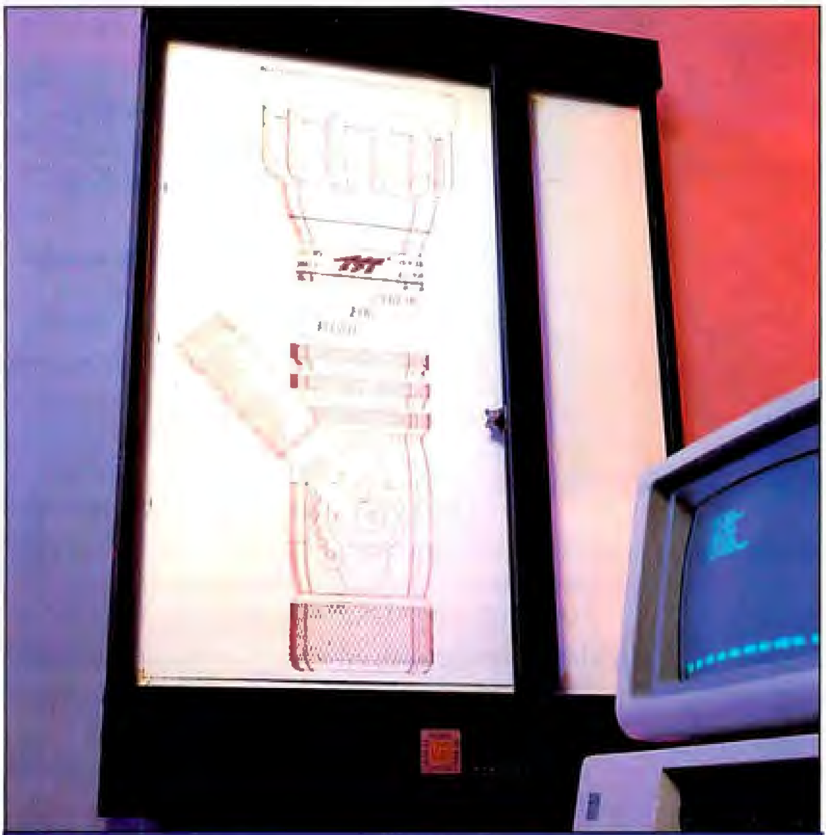

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Inquiry 282

First things first. I took out the Cheetah Combo, ARCNET PC, and the OmniTel modem, leaving nothing but the original Zenith boards. That did no good, but then I hadn't expected it to. The machine still did odd things *sometimes*.

When I mentioned these problems on BIX, Barbara Clifford pointed out that the machine clearly should be named Zelda, after F. Scott Fitzgerald's very fast, and somewhat flaky, wife. Phone consultation with Wayne Rash, who did the formal (and very favorable) review of the Z-248 in the December 1986 issue of BYTE, produced a more technical diagnosis: "It sounds like it's all screwed up."

Waiting for Igor

I called Zenith for help. As luck would have it, the relevant Zenith officials weren't in their offices in Chicago. They were out here; to be exact, in Sante Fe Springs, not more than 20 miles from here. As a result, it took a full day to reach Glen Nelson and explain the problem.

"I don't know if it's the CPU or the video board or both," I said.

"Sounds like the machine was damaged in transportation," Nelson told me. "That's the identical machine Wayne Rash reviewed, and we tested it before we shipped it to you. Let me send you a new one."

That sounded reasonable, but for a test I asked that they send new CPU and video boards. Incidentally, that's one of Zenith's better features: the CPU and system memory are on cards just like everything else, making both repairs and upgrades much easier.

Glen promised to get the boards sent Federal Express, and I went back to trying to understand an increasingly inarticulate Zelda. She was deteriorating rapidly. Sometimes only 10 percent of the pixels would be displayed on-screen. She'd often lose all her path information. Sometimes she'd be unable to find the modem.

My wife watched over my shoulder during one of Zelda's bad spells. "Give up," she said.

"Good advice, but right now this is the only machine I can use to BIX."

"Good heavens. What will you do?"

"It's not so bad," I said. "They're sending a new brain for transplant."

"And when does Igor arrive?" Roberta asked.

"Tomorrow," I said.

Of course the new brain didn't come the next day, or the day after, so there we were, like Dr. Frankenstein waiting for his crazed assistant to come back with a new brain.

Eventually the boards arrived, with mixed results: the video problems went away, but the Above Disc program didn't consistently work. At that point I went off to a conference.

Zelda Cured

When I got back there was a new Z-248 waiting.

First things first. Boot it up. Partition the hard disk. Format it. Transfer DOS to it. Boot again. Everything worked fine. Time to transfer files.

This time I took the simple way: I used the new Fastback with *no* copy protection. I copied the floppy disk to my hard disk, then tried to run the program. That didn't work. Even though there's no copy protection, you must use the Install program. Once you've done that you can put the floppy away.

Fastback is quite easy to use, and pretty soon I had all my programs stored on 12 quad-density disks. The next thing was to transfer all those over to the new Zenith Z-248. I had a moment of panic at my first attempt: the Fastback Restore

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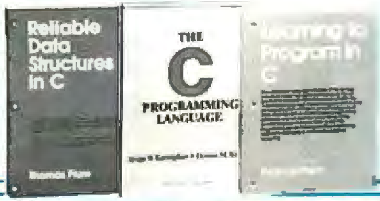

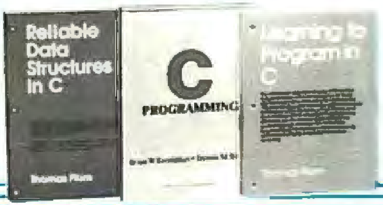

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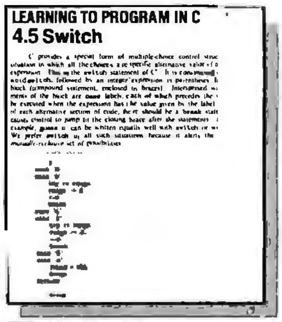
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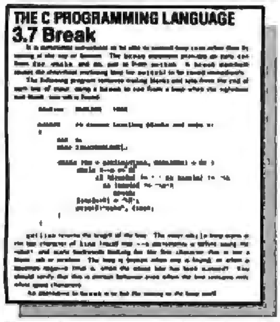
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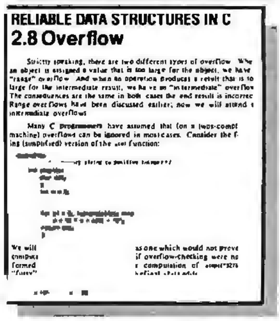
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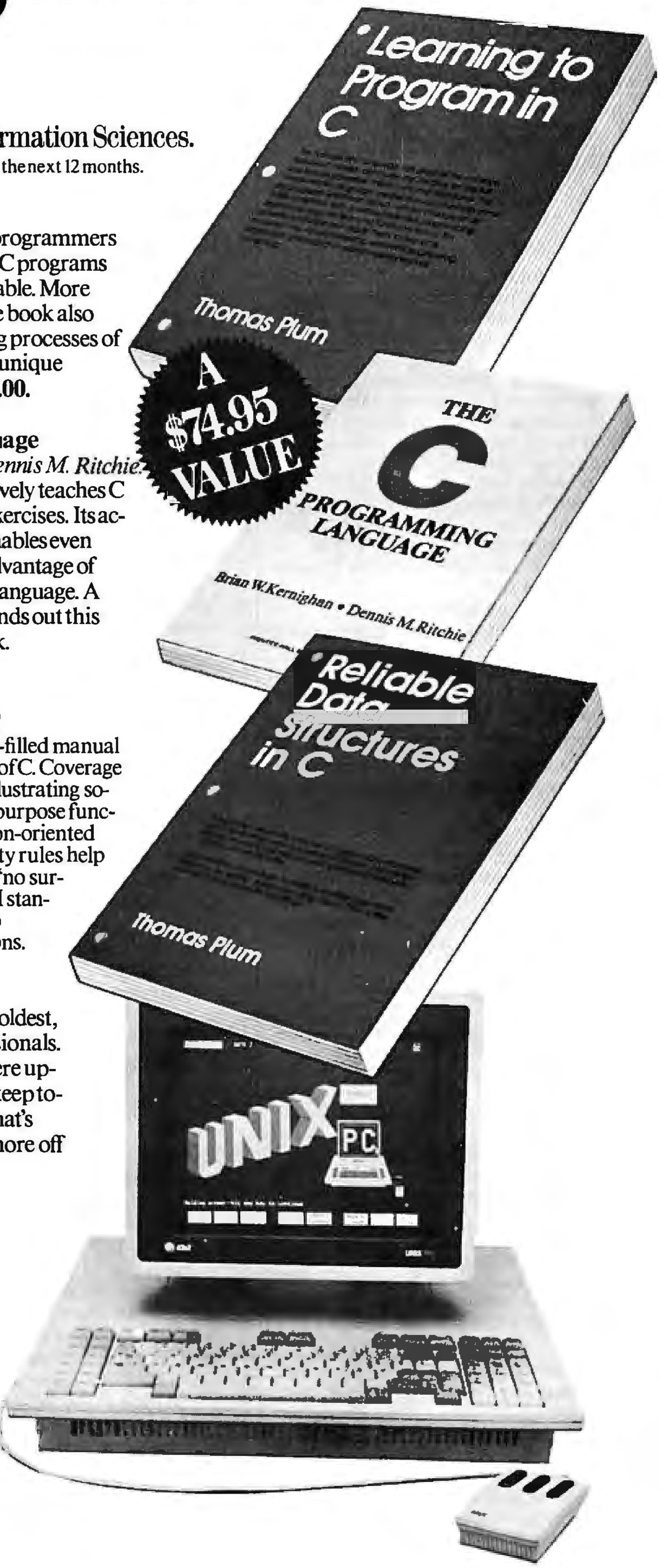

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The bottom line is that I've been using Zelda for three weeks and the cover hasn't come off again. She's fast and reliable and the nicest AT I've come across.

program has several options on what to do about old files, and I'd chosen the "erase them" route. Since there weren't any files to erase, Fastback wouldn't do anything. Eventually I figured that out and changed options, after which Fastback roared away. In less than half an hour I'd not only transferred all the files, but made a backup copy I could keep.

At that point I had a decision. Zelda II seemed to be working fine. Did I dare trust her? After all, Zenith does make good equipment. Wayne Rash liked the Z-248 best of all the AT machines he tested.

Why not, thought I, and proceeded to install the Cheetah Combo, OmniTel modem, and CompuPro ARCNET PC board. Then I not only put the cover on, I screwed it down before turning it on.

Despite such arrogant temptation of fate, the Zenith came up perfectly. Ready! went into the Above Disc equivalent of EMS. SuperKey and SideKick installed fine. The CompuPro ARCNET PC worked perfectly.

The bottom line is that I've been using Zelda for three weeks and the cover hasn't come off again. She's fast, reliable, and quite the nicest AT I've come across.

EGA

As I mentioned, Zelda came with an EGA board and a Zenith 13-inch EGA color monitor. I had some worries about that: I normally wear bifocal glasses, and I don't care to sit close to a screen and tilt my head, yet if I get far enough away to read through the top part of my glasses, the letters are often too small. I'd solved the problem with Big Kat by having his Hercules board feed into a 19-inch Zenith high-resolution color monitor (which also doubled as my VCR monitor when I felt like watching a movie); but you can't feed an EGA into a CGA monitor. Zelda's EGA board produced sharp and crisp letters, but would they be large enough?

The answer turns out to be "almost." That is: I've set up Zelda's screen at eye level and about 30 inches from my nose, and I can indeed read what goes up on it. Not as well as I can read Zeke's 15-inch monochrome screen, but in fact well enough that if I didn't have Zeke I'd be willing to use Zelda to write my books. I'm still looking for a good 15-inch EGA monitor, and I think I have a line on one; and for that matter, it can't be long before Zenith produces 15-inch and even larger EGA monitors. I'm now thoroughly convinced that EGA will be the new standard for business use.

Why Use Zeke?

Back in 1977 I looked at all the available computer systems that could be used for business and serious writing. In those days S-100 systems dominated the micro industry, and it wasn't hard to decide what to get. I bought Zeke II, a CompuPro Z80 system. My partner Larry Niven, who knows little about computers and wants to know less, had our consultant Tony Pietsch build him a copy (actually, *two copies*) of what I got.

Neither of us has ever regretted that decision. We have written millions of words, including three best-selling novels, on those computers. They still work, and work well.

Unfortunately, they're not immortal. Tony Pietsch is moving to Santa Barbara. Spare parts are hard to come by.

There are other intimations of mortality. Last week, as is my practice, I packed Zeke—the world's least portable micro—into the trunk of my convertible and headed for a motel, there to get as much done on a novel—*Prince of Mercenaries*, a Falkenberg/CoDominium novel, for those interested—as I could in five days without telephone and mail interruptions. When I got there and set Zeke up, blue smoke poured out of his 8-inch disk-drive enclosure.

It was clearly panic time, but in fact I managed to stay calm. Proceed slowly. Take things apart. Unplug cables. Work logically. After about 10 minutes it was clear: something had happened to the power supply in the disk-drive enclosure. The drives themselves were all right and so was the computer.

A quick call to Priority One established that they had, in stock, 8-inch disk-drive enclosures with power supply at a reasonable price. I drove out, bought one, brought it back to the motel, and remounted the drives. Within two hours Zeke was humming along. Incidentally, as far as I can tell, transporting Zeke had caused a nut to work loose from one of the bolts holding the fan, and that nut had shaken into a spot where it could short

continued

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something. Anyway, I'd lost little but time, and not a lot of that; but it does give pause to think. Suppose I couldn't find a new enclosure?

A few days later, I was talking with Larry and Marilyn Niven. Marilyn, unlike Larry, does know something about computers. After all, she took a degree in mathematics under Marvin Minsky at MIT. We all agreed that one day soon we'd have to replace our ancient Z80 machines with something else.

Given the way the world is going, that something else will likely be some kind of PC AT compatible with an EGA card. We'll also need a new text editor, one that's as nearly like WRITE as we can find; and that will probably be WordPerfect.

None of this is certain, but we've got WordPerfect 4.2 working with the CompuPro ARCNET PC, something that I couldn't do with 4.1. Now if we can just get oversize EGA monitors.

Still, things change like dreams in this micro world. At CES I was taken upstairs and shown the new Commodore Amiga 2000; the one I saw combined in the same box both a 68020 Amiga and an 8086 PCompatible; and the PC side of the box could take accelerator boards like the Orchid Turbo EGA. Alas, what they later announced as the 2000 wasn't what I saw; but Commodore potentially has a machine to compete with the Macintosh II if they'll just develop it properly.

Meanwhile, Cheetah has a 386 add-on that will turn a normal AT into about nine virtual machines, neatly solving the problem of what to do about memory-resident programs.

By the time you read this, Apple will have their Mac II, the open Macintosh, and IBM will have a new 386. Microsoft will have Advanced DOS Real Soon Now.

With developments like that going on, why change until you have to?

Winding Down

As usual, I started this column full of good intentions. I spent hours selecting software and *covered* my desk with really good stuff; and now, before I've got to much of it, I'm out of space.

I do want to say something about Russ Walter's amazing series, *The Secret Guide to Computers*, which is now available in three volumes, $8 each, from the author. If you need to understand computers and haven't had much luck at it; if you have to teach other people about computers; if you just want to read some good books about computers; then send a check for $24 to Russ Walter, 22 Ashland St., Somerville, MA 02144. Interested parties are invited to write for a brochure before ordering. I can't think you won't like the books, and even if you don't, you'll find someone to give them to who will. Highly recommended.

Then there were the MacWorld Exposition and the Seybold Conference on Desktop Communications. Both were worth attending. On the other hand, the most exciting announcement at the Seybold Conference was Appleshare, a very impressive networking program that links Macintoshes; and there's not a lot of point in talking about the Macintosh until Apple releases the open Mac. The delay between my writing this and your seeing it is, due to heroic efforts by the BYTE publishing people, getting shorter, but it's not *that* short.

There are two books of the month: *Flim-Flam* by James Randi (Prometheus Books, 700 East Amherst St., Buffalo, NY 14215) and *On the Frontiers of Science: Strange Machines You Can Build* by G. Harry Stine (Atheneum). James ("the amazing") Randi is a lifelong skeptic who constantly carries a check for $10,000 that he will pay to anyone who can show him a "paranormal" result he can't explain or duplicate with prestidigitation; while Harry Stine is a rocket engineer who doesn't exactly believe in odd things like dowsing, but who claims to have used such devices with consistent results and will tell you how to make and operate dowsing rods. I've met Randi, and I find his extreme skepticism irritating, while Harry Stine has been a close friend for years. One day I'll build and test some of the machines he describes. Meanwhile, if I had to bet money, I'd bet with Randi, but my heart's with Harry Stine's view.

The game of the month is Strategic Conquest Plus for the Macintosh. It used up far more of my time than I'll admit to *anyone* and is quite simply the best strategic microcomputer war game I've ever encountered. I've managed to win at level 13, but just barely. Now I'm at 14, and in the fight of my life. Highly recommended so long as you understand that it's *really* addicting.

Last-minute report: Big Kat is doing fine at USC. It's a great machine for a student. Now, with any luck, I'll get to that mess of stuff on my desk. ■

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It's mid-January as I start this column, and the wind outside is literally howling. A mass of very cold air has come to visit from the north pole; temperatures have plummeted, and gale-force winds out of Provo Canyon have pushed the windchill factor below zero. This is the first time it has really felt like winter all year. The ski resorts, which had a terrible holiday season, wish that this had hit about a month earlier. Since I don't ski, I don't really care. But on to more important matters.

If there's a theme to this column, it's desktop publishing. It was the dominant theme of the MacWorld Exposition, and some of the products I will look at this month (like the Radius Full Page Display for the Mac) are related to desktop publishing. It doesn't mean that I'm getting away from a technical slant, but during the next few years the personal computer market is going to be heavily influenced by desktop publishing, and those of you looking for new products to develop might well keep that in mind.

Industry Update

Apple announced a new version of the Apple IIe this past week, replacing the old model. The major differences are an expanded keyboard and a platinum case, both of which are designed to bring it into line with the IIGS. The list price is still $829 for the base unit—that price doesn't include monitor or disk drives—and the IIGS upgrade is still $495. It's a good move for Apple, but the price is still quite high, considering that $1095 is now the list price for an Atari 1040ST (1 megabyte of RAM, 68000 microprocessor) with an RGB monitor and a built-in 720K-byte drive.

Speaking of the IIGS, Apple appears to be having a supply problem. While at the MacWorld Exposition, I talked with several companies that also make IIGS products. All these companies indicated that sales of IIGS items were very poor; several estimated the number of IIGS systems shipped to date (early January) at around 20,000. This jibes with reports I've had from some dealers that they didn't get any IIGS systems until just before Christmas. It also explains why Apple turned down my request for a IIGS on editorial loan, even though I explained that a number of firms were willing to send me products once I had a system. For that matter, some firms have already sent me IIGS products, but I have nothing to run them on.

Also on a down note, representatives from some firms that market development software (assemblers, compilers, etc.) for the IIGS mentioned abysmal sales of their products. I don't know if that's because all the IIGS developers are using the versions of Apple Programmer's Workshop (APW) that Apple has sent out or because a lot of firms are waiting to see how many units Apple actually sells and ships.

Atari made a big splash at the Consumer Electronics Show with two sets of announcements. First, the company showed its latest ST machines: the Mega ST 1, 2, and 4 (the numbers refer to the amount of RAM in megabytes). I didn't attend CES, so I haven't seen the machines in person.

From the press releases I've read, though, it appears that Atari wants to get a bit more upscale and has put out a machine that would actually look decent in a business environment: detached keyboard, system unit upon which you can set your monitor, and so on.

More important, they've designed in an expansion path, using an external bus (like the Amiga). Of course, I thought that the Amiga had pretty much proved that an expansion bus wasn't nearly as nice as a few slots, but the bus still beats the relatively closed architecture of the 520ST and 1040ST. Atari also announced a new line of low-cost MS-DOS (IBM-compatible) machines. That startled me since the MS-DOS market is rather cutthroat right now, but Jack Tramiel has cut throats with the best of them, so maybe I shouldn't be surprised. Look for a full report in an upcoming column once I get my hands on the systems.

Commodore also announced some MS-DOS systems; theirs are more expensive than Atari's, but they're also more expandable. And I understand that Commodore was privately showing some other new machines that may well have been announced by the time this sees print.

IBM has yet to announce anything, though (as in times past) various publications are running lengthy articles on unannounced (and possibly imaginary) systems. Most rumors focus on a new line of machines that are relatively cheap (for IBM) and have some degree of MS-DOS compatibility but that have proprietary silicon and a different expansion bus than the current MS-DOS systems.

I'd be interested in seeing IBM introduce such machines; my personal feeling is that they'd go the way of the IBM PCjr, the IBM Portable (not to be confused with the IBM Convertible), the never-materialized PC II, and the IBM RT series. Speaking of which, is there anyone out there who has actually bought an IBM RT or who works for a company that bought one? I've heard that IBM donated a number of RTs to Carnegie Mellon, but I have yet to hear of a single customer who paid cash for one.

continued

Bruce Webster, a consulting editor for BYTE, can be reached c/o BYTE, P.O. Box 1910, Orem, UT 84057, or on BIX as bwebster.

If you have, please write me a letter or send me a message via BIX, MCI, or CompuServe.

MacWorld Exposition

Suits. Lots of suits. If I had to put my finger on what was distinctive about this year's MacWorld Exposition in San Francisco, it would be the large crowds of serious businessmen (and businesswomen) in suits, filling the Moscone Center during the Thursday and Friday sessions that were supposed to be lightly attended. The Mac, my friends, is finally being taken seriously by the business community. Most significant, though, is that it appears to be the end users, not the data processing managers, who are so treating the Mac. They want powerful spreadsheets, innovative database programs, and high-quality publishing software, and they don't want to go through hours of training to learn how to use them. Also, they don't give a hoot if their machine doesn't have those magic letters "IBM" on it.

MacWorld also showed why the Macintosh is still at the leading edge in desktop publishing. The long drought of word processing software has finally ended (thanks to Apple's halt to bundling MacWrite with each Macintosh). Five different word processors were on display: Microsoft Word 3.0, FullWrite, MindWrite, WordPerfect, and Write Now. On top of that were three different publishing programs—PageMaker 2.0, ReadySetGo 3, and MacPublisher III—each of which is ahead of what's available on any other system (although PageMaker 2.0 is due to be released soon on the IBM PC). It's interesting to see how these two groups of products are converging on one another, each side gaining more and more of the features of the other. Also, Adobe showed its Illustrator program, which lets you quickly and easily create object-based illustrations from digitized images.

Aiding all this were three external screens for the Macintosh. Radius had its FPD (Full Page Display), a 640 by 864 display for $1995. The FPD is reviewed in detail later in this column. The Big Picture, from E-Machines, offers a 1024 by 808 display for the same price. The final one is the MegaScreen II from MicroGraphic Images. It has the largest display—1024 by 900—and the largest price tag: $2495 for a basic unit, $2995 for one with NTSC output as well and options for a 68881 math coprocessor and/or a 20-megabyte hard disk (both at extra cost).

Inexpensive SCSI hard drives for the Mac are also proliferating. The installed base of Macs has grown big enough to drive the prices down, and it seemed as though everyone was showing 40-megabyte hard disks linked with 40-megabyte tape drives (for backup). An era of cheap hard disks for the Mac is dawning. I hope to have hands-on reviews of some of those disks in the near future.

Levco, maker of the Prodigy 4 (it includes a 68020 with a 68881) upgrade, has come out with a lower-cost version. The Prodigy Prime sells for $1995 and includes a 16-megahertz 68020, 1 megabyte of RAM (using a 32-bit data path), and an SCSI; a 2-megabyte version sells for $2750. It has sockets for a 68881 math coprocessor and a 68851 memory management unit; memory expansion is limited primarily by cost and software (the spec sheet gives an upper limit of 32 megabytes). The original Prodigy 4 (sans hard disk) has come down in price itself; you can now get it for "only" $4995, which buys you a 68020, a 68881, 4 megabytes of RAM (using 1-megabit chips), and an SCSI.

Table 1: *Benchmarks from product literature, comparing Levco's Prodigy Prime against MacMemory's TurboMax. The lower time for the Mac Plus/Whetstone benchmark is from MacMemory's literature; the higher is from Levco's.*

	Mac Plus	TurboMax	Prodigy Prime
Sieve	3.75 seconds	1.62 seconds	0.66 second
Dhrystone	772/second	1800/second	3246/second
Whetstone	6178/second 7273/second	199,336/second	612,244/second

Incidentally, MicroGraphic Images had in its press kit a release touting the compatibility between the MegaScreen II and the Prodigy Prime. In other words, you can hook both up to the same Mac, and it works just fine (or so the press release said). I'd love to get my hands on such a system, but I'm afraid it would spoil me terribly.

Also, Levco may finally have a competitor. MacMemory Inc. was demonstrating its TurboMax upgrade for the Macintosh. The TurboMax has a 16-MHz 68000, 1½ megabytes of RAM, a socket for a 68881, and a "superspeed" SCSI. It's listed at $1299 and is supposed to be available now. Table 1 shows the timings claimed by MacMemory versus those claimed by Levco. These benchmarks were done using Consulair's 68020 C compiler, with direct access to the 68881 for the Whetstone benchmark on the Prodigy Prime and the TurboMax.

Speaking of Consulair, Bill and Ann Duvall were there, introducing MacC Jr., an $80 C development system for the Macintosh. I haven't had a chance to test it yet—look for that next month—but it looks like a fairly complete system for a very low price. Those of you thinking of doing C programming on the Mac could do a lot worse than to buy this.

All in all, I had a great time at MacWorld. The show is now larger, more lively, and more interesting than the West Coast Computer Faire. I'm tempted to try to attend the one in Boston this summer; I'll have to see what's happening then.

ReadySetGo 3

I don't talk much about applications in my column, but I wanted to mention this product. It's a member of the latest generation of desktop publishing software for the Mac (along with PageMaker 2.0 and MacPublisher III). For those of you unfamiliar with desktop publishing software, it lets you create your document (no, you don't need a separate word processor), establishing just how each page is laid out. You can easily integrate graphics, move blocks around, and generally do just what you'd want to do to create ready-for-printing documents.

RSG3 works well. I used it to lay out my Fritzie Award certificates. I did have to look at the manual once or twice, but beyond that, I was easily able to figure out how it worked. And the resulting certificates looked great when they came out on the LaserWriter.

Be warned, though: Desktop publishing is addictive. Once you've laid out a full-page document, all sorts of ideas start springing up in your head: fliers, posters, newsletters, books. As if I didn't have enough to do.

Desktop Publishing

No, I'm not dredging up the topic again. That's the name of a newsletter: *Desktop Publishing, Bove and Rhodes' Inside Report* (501 Second St., San Francisco, CA 94107, (415) 546-7722). Tony Bove and Cheryl Rhodes originally put out *CP/M User's Guide*, then they started a magazine called *Desktop Publishing*, which PCW Communications acquired and retitled *Publish!*. (Got that straight so far?) Tony and Cheryl have since started one of those high-cost, no-advertising newsletters that industries like ours seem to spawn. It contains all the latest news, gossip, rumors, and conjectures as to just what is happening in the desktop publishing world. It also has comments on new and existing products.

I've looked through all the issues put out so far (publication is monthly, and the newsletter started in September 1986). From what I can see, Tony and Cheryl appear to be doing a solid job. Of course, it's flavored with their own opinions and biases, but theirs are worth more than most folks—which is why people subscribe to newsletters like this. The official yearly subscription rate is $195. However, some recent promotions (like one at MacExpo) have offered a year's subscription for only $95, with a cancel option after the first issue. If you're interested, you might call to see if such a promotion is in effect.

Radius Full Page Display

As mentioned, three different firms were showing large-screen displays for the Macintosh at MacExpo. One firm, Radius, was kind enough to lend me an FPD (Full Page Display) for a week, along with a Mac that already had the internal hardware hooked up. Within 24 hours, I was hooked.

The Radius FPD consists of two parts: a logic board that fits inside the Macintosh and a high-resolution monochrome CRT inside a beige display case. The logic board has 32K bytes of ROM—to help interface the FPD with the Mac—and 128K bytes of RAM—the actual video display memory. The connection port comes out through the "security port" (located on the back left edge of the Mac), so you don't have to cut any holes in your case. A video cable from the CRT plugs into that port.

The CRT itself sits (usually) to the left of the Macintosh; the two units have a combined footprint 21 inches wide by 12 inches deep. The FPD has its own power supply, and there is a switched outlet in the back of the CRT so that you can plug your Mac into it, plug it into the wall, and turn your entire system on with one switch. The screen is designed to show a full 8½- by 11-inch page at a time. Resolution is 640 pixels per line by 864 lines, with 80 pixels per inch (as opposed to 72 pixels per inch on the Mac's screen). The display is pleasant to look at and doesn't have the flicker that the Macintosh does. Additionally, you can attach adjustable feet onto the bottom of the display so that you can tilt it to suit your fancy.

No special software is needed to use the FPD. Just boot your system as you would normally, and the desktop appears on the large CRT with the menu font automatically resized to 16 points for increased readability. The Mac's screen is still active as well, allowing you to stick windows, desk accessories, and other items over there. A built-in "blanker" program automatically turns both screens off after a certain period of inactivity. All windows that appear have the little "full-size" icon in the upper left corner, allowing you to resize the window to the full FPD display with a single click, and a set of "shortcut" commands let you easily move and resize windows.

You can configure the FDP to suit your preferences. Just keep the mouse button pressed during boot-up, and a control panel appears, allowing you to adjust several parameters, including menu font size (12 or 16 points), arrow cursor size (the regular 16 by 16 or an enlarged 32 by 32), FPD placement (left or right side of the Mac), time delay for the automatic blanker (longer or shorter), relative vertical offset of the FPD and Mac displays (up or down), screen combinations (Mac alone, FPD alone, or both Mac and FPD), and full-size icons on all windows (enable or disable). The settings are saved in the Mac's battery-backed parameter RAM, so that they are "remembered" from session to session.

I ran numerous applications on the Mac/FPD combination—which is what got me hooked. Many applications automatically recognized the larger display area and immediately opened any window to the full size available. That full size can make quite a difference. I used one compiler with the font set to 9-point Monaco; the editing window showed 70 lines of code at a time, as opposed to about 25 lines on a regular Mac screen. I was pleasantly surprised at how much easier it was to modify and debug

continued

code with the larger display. I had expected some improvement, but not as much as there actually was. Each click on the scroll bar moved me through the program 70 lines at a time, allowing me to quickly scan up and down through my source code.

Similarly, ReadySetGo 3 was a lot easier to use with the FPD. I originally laid out my Fritzie certificates on a regular Mac screen using RSG3; even with the compressed "full-page" display, it took careful use of the ruler margins and not a little trial and error to get everything laid out perfectly. After I got the FPD, I ran RSG3 again and brought up the same document. The entire page was visible on the CRT; precise layout and alignment would have been a cinch. Other applications, like More and MacDraw, felt more powerful and flexible with the larger display.

Most applications I tried worked fine, though there were occasional problems. For example, SuperPaint wouldn't let me open a window and move it all the way over to the Mac's screen; each time I would position it there, the window would snap back onto the large screen. The manual itself lists problems (mostly minor) with MacWrite, MacDraw, Word (version 1.05), Excel (version 1.00), and FullPaint. Also, as you might expect, games had the biggest problems. Several, like Dark Castle, Ferrari Grand Prix, and Balance of Power, just wouldn't run on the system I had (a Mac 512K-E with the FPD display), all failing or freezing at some point. Others would run but had malfunctioning devices (like the compass and Up/Down buttons in Azarok's Tomb).

I do have two major complaints. First, the CRT should have been wider. I can open up a full 8½- by 11-inch page under ReadySetGo 3, but it obscures the tool icons along the left edge of the screen. Similar problems exist with MacDraw and other applications. The designers of the Radius FPD should have anticipated that and increased the width to 720 pixels or so, allowing an icon strip down the left side while preserving the full 8½- by 11-inch document window.

Second, the FPD is just too darned expensive. At $1995, it's beyond the reach of the average Mac user, and it's substantially narrower than its two major competitors—The Big Picture and MegaScreen II—without being substantially cheaper (the other two are $1995 and $2495, respectively). There may be other advantages the Radius FPD has over its competitors (and vice versa), but since I have not tried the other two yet, I can't say what they might be.

Even with those complaints and the occasional software problems (and when have Mac owners not had to wrestle with software incompatibilities of some sort?), the Radius FPD has me sold on large Mac displays. The regular Mac screen now seems very, very small . . . almost depressingly so.

Zen and the Art of the Macintosh

While wandering through MacWorld, I passed a retailing booth where numerous products were being hawked. Sitting quietly before the tables, autographing books, was a tall, thin, graying young man: Michael Green. I picked up a copy of his book, half-amused, half-annoyed at the title. After two minutes of browsing, I bought a copy, had Green sign it, chatted with him for a while, then walked away, tickled with my purchase and contemplating buying a few copies for friends.

Zen and the Art of the Macintosh: Discoveries on the Path to Computer Enlightenment (available at $16.95 from Running Press Book Publishers, 125 South 22nd St., Philadelphia, PA 19103) is to other computer books what the original Mac was to the rest of the computer industry. It charts Green's discovery of the Mac, his thoughts as to its impact on the human spirit, and his struggles with being seduced by what he terms "the digital undertow." He even talks about how he created the book itself:

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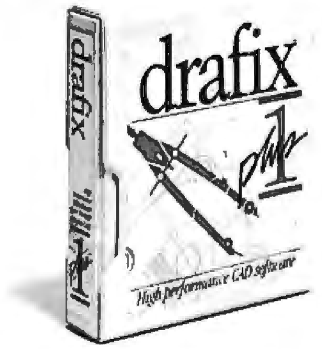

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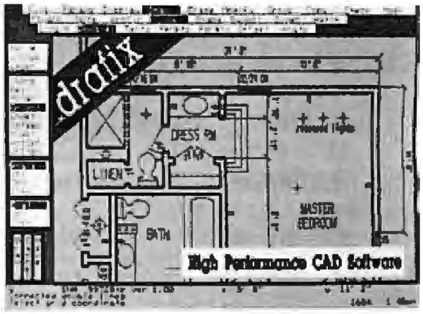

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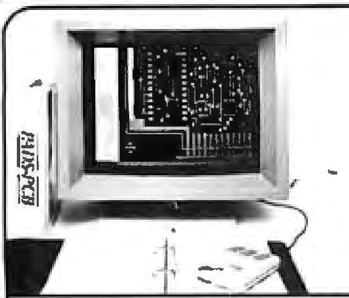

hardware, software, and techniques.

Intellectually, the book is stimulating. The title is a serious one, at least as serious as Zen ever is. The book itself, however, does not take itself or its subject too seriously. In it, Green mixes thoughts and ideas about Zen with discoveries about doing art on the Mac. The result provides a look at the Mac, and at computers in general, that is refreshing, enlightening, and entertaining.

Visually, the book is stunning. The emphasis is on design, layout, flow, and images, with text as an important afterthought. I marvel at the amount of time each page must have taken to create and wince when I realize there are more than 230 pages. I wonder if Green winced as he walked around the show and saw the new large screens and software like Adobe Illustrator. Somehow, I doubt it; Green struck me as one who wastes little time regretting what is done.

Yes, you should buy it. It doesn't cost that much ($16.95), and it's worth it just to see what one person can do with a Macintosh. But it is much more than that. No, I am not a devotee of Zen, but that doesn't lessen the book's worth or impact. I pick it up a few times a day just to browse and find something new each time.

While talking with Green, he mentioned that he was supposed to give a talk later on the future of desktop publishing and that he was gleaning ideas to present. He looked at me, smiled, and said, "What do *you* think is the future of desktop publishing?" I held up his book and answered, "This."

The Macintosh Bible

While we're on the subject of "must buy" books for Macintosh owners, let's look at *The Macintosh Bible* by Dale Coleman and Arthur Naiman (available at $21 from Goldstein and Blair, P.O. Box 7635, Berkeley, Ca 94707, (415) 524-4000). Simply put, it's a compendium (400+ pages) of all those little bits and pieces of Macintosh lore that you tend to overhear in users group meetings or see posted on computer bulletin boards. For example, did you know that if you hold down the Option key when you launch the Font/DA Mover, it will come up prepared to transfer desk accessories instead of fonts? Did you know that Word supports soft hyphens? Did you know that printing documents that are more than 25 percent solid black can cause the print head on the original Imagewriter to overheat and fail?

Well, I didn't either, and I've owned or been using a Macintosh for nearly three years. A lot of things I didn't know because I just didn't care (such as the nonstandard use of Command-Z in OverVUE). But plenty of them are of great interest to me, and I've already picked up a number of shortcuts and techniques that I wish I had known about long ago.

Most notes in the book fall into eight basic categories, each indicated by an icon in the margin: very hot tips, important warnings, shortcuts, very good features, very bad features, bargains, things to come, and gossip/trivia. Not all items are so classified, but the icons help to flag those things you'll be sure to want to read.

The book itself is organized into four parts. Part I, "Maximizing System Software and Utilities," gives tips, hints, and warnings about the user interface, the operating system, and some of the more common system utilities (Font/DA Mover, Switcher, MiniFinder). Part II, "Maximizing Application Programs," does the same for specific applications, like Word, Helix, MacPaint, Red Ryder, and ReadySetGo. Part III, "Maximizing Hardware," talks mostly about printing, and there mostly about using the LaserWriter. Part IV, "Maximizing Your Purchases," gives suggestions on how to get the most for your money and includes brief reviews of a long list of products. The three appendixes are almost worth the price of the book for

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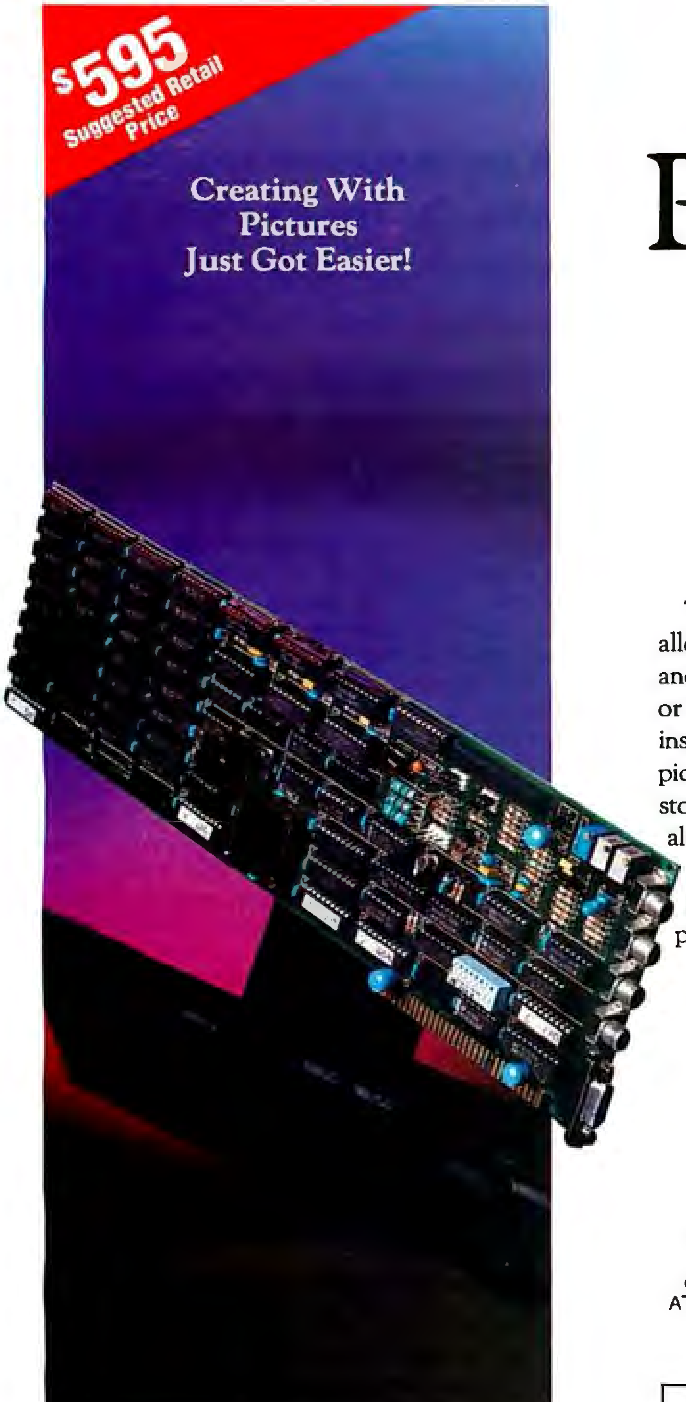

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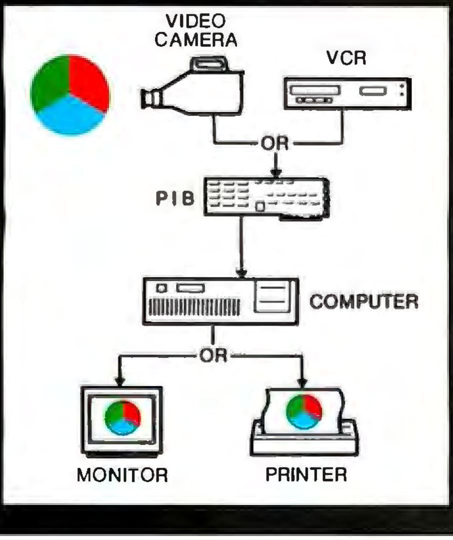

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Inquiry 33

Do I have any complaints about the book? Not really. There's plenty in here that I don't care about, but that's a reflection of how I use the Mac; others may find those sections invaluable.

new Mac owners: a glossary of Mac terms; where to find good information and cheap software; and a list of products and companies.

The book itself—with a copyright date of 1987—is about as up to date as a Mac book can be. For example, it contains a lengthy description of Word 3.0, based on the beta prereleases. The first print run of 500 copies was brought to the MacWorld Exposition and sold out on the first day; the copy I received two weeks later was from the second press run. And the publishers are offering two free upgrades (40-page booklets) to registered owners. There are even spaces inside the front and back covers onto which you paste the update booklets.

Do I have any complaints about the book? Not really. There's plenty of stuff in here that I don't really care about, but that's mostly a reflection of how I use the Mac; I'm sure that other people would find those same sections invaluable. The stuff I do care about is easily worth the price of the book; if I hadn't received a review copy, I would have cheerfully paid money to get it.

I realize I just told you to go out and buy Green's book. Well, buy this one, too; especially if you've just bought a Mac; or even if (like me) you bought one three years ago. If you own a Mac, you should own this book. Trust me, it's worth it.

Product of the Month: Micro Charts

Years ago, while writing a game for the Apple II, I discovered a nifty aid for my 6502 programming: the 6502 Micro Chart, from Micro Logic Corporation in Hackensack, New Jersey. It was an 8½- by 11-inch plastic sheet crammed front and back with 6502 information, including complete instruction set listings, pin-out, memory map, condition code results, unsigned comparisons, and other nice tidbits. In short, it had all the information that you buy 6502 programming texts for but had it all on one handy, nearly indestructible sheet.

Unfortunately, when I left the firm I was working for, I had to leave the sheet behind. And I could never find a place that sold that chart, until I happened to see an ad from Micro Logic, selling the sheets directly. I called them up and talked with James Lewis, the company president. Jim was kind enough to send me a sampling of the 15 different charts his company produces.

Several charts deal with microprocessors: 8048, 6502, 8088/8085, Z80, 8086/8088, and 68000. In almost every case, there is an op-code-to-instruction conversion chart; an alphabetical listing of instructions; a register diagram; a chip pin-out diagram; information on flags; a description of addressing modes; and miscellaneous items, like an ASCII table and a hexadecimal-to-decimal conversion table. The list of items and layouts vary from chip to chip, due to variations in the microprocessors and possibly in the authorship of the cards. Of all the cards, my favorite is the 6502, though that may just be for sentimental purposes. The 68000 chart is the newest; it is also very text-oriented—having few charts, diagrams, or tables—cramming a lot of information into a limited space. I would have preferred to have seen a two-chart set that was easier to use and decode.

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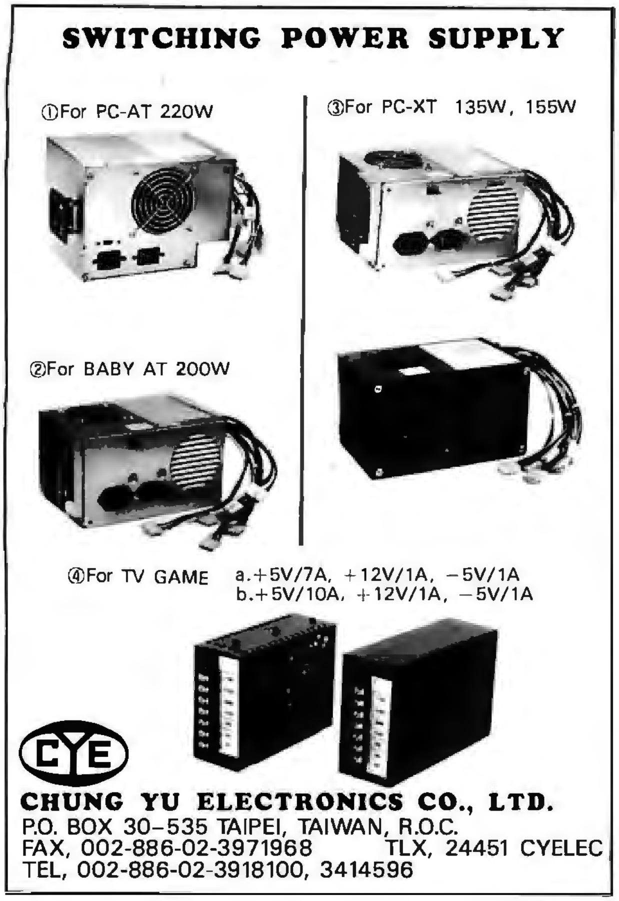

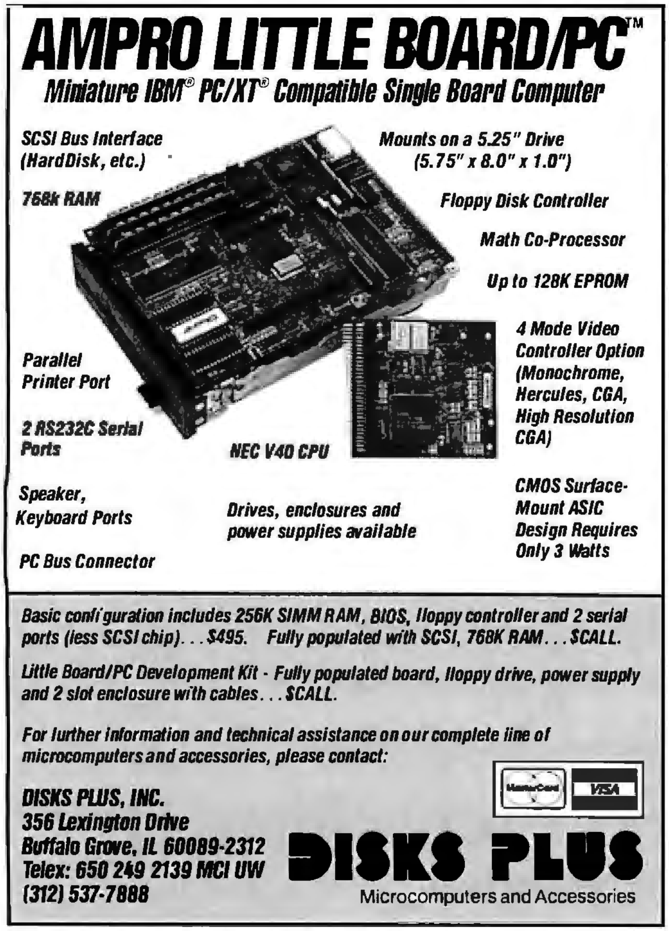

There are other programming charts as well. Two deal with BASIC; one is a general introduction, while the other is a detailed command listing for IBM and GW BASIC. The C reference card is an excellent single-card reference for the language and includes lists of commonly used functions and things to remember when programming in C.

The Algorithms card lists a number of handy routines (written in BASIC), including sorting, searching, and a nifty integer square root routine (which I discovered on this same chart years ago and used in the aforementioned game). There's even a UNIX Shell reference card, based on the Bourne shell of UNIX System V (Release 2). Heaven knows I am not a great UNIX fan; this card should make my ever-increasing forays into that world easier to bear.

There are four more Micro Charts, none of which I've actually seen (but which are described on the brochure that accompanied the other cards). One covers 7400-series TTL pin-outs; another describes electronic components (e.g., diodes and transistors). Yet another, which looks intriguing, tells "how to generalize from a small sample," something we all do anyway and could probably use some help with. The last is a reference card for WordStar.

The Micro Charts don't replace a good book on the corresponding subject, but they're a lot easier to use. They're sturdy, too, and completely resistant to soft drinks, coffee, ketchup, grease, and other substances that programmers spill, drip, or smear while nourishing themselves late at night. Best of all, the charts are only $5.95 each. A minimum order from Micro Logic is two charts, but shipping and postage is only $1, regardless of the number of charts ordered. They even have a 14-day money-back guarantee.

The Hackers Corner

In the November 1984 BYTE, I wrote an article called "A Go Board for the Macintosh." Go, for those of you unfamiliar with it, is a simple yet deep game that originated in China three or four millennia ago and remains extremely popular in the Far East. Two players alternate placing black and white stones on the intersections of a grid. Players can capture groups of enemy stones—an army—by covering all adjacent empty intersections with their own stones. When the game is over, the player who has the highest total of controlled territory and captured enemy stones wins.

My program, written in MacFORTH, was just what it professed to be: a go board allowing two players to carry on a game. I voiced ambitions of allowing the computer to play against humans, but I never pursued that to any degree. However, I still get letters from people interested in a go-playing program for the Macintosh.

As fate would have it, I ran into such a program right here at Brigham Young University. Jim Logan, who works for the electrical engineering department, has written a go-playing program for the Mac. It's pretty good for a computer program, having placed fifth in the International Computer Go Tournament in Taiwan last November. And, currently at least, the price is right. It's shareware.

Space won't permit an exhaustive description here, but it has an excellent user interface and many, many options, including board size, search depth and width, move-numbering, infinite backtracking, analysis of the board and of individual armies while the game is in progress, and twiddling with the factors used to determine the computer's next move. It plays the best game of go I've seen a computer play so far. I'm rusty enough that it keeps me on my toes; for a novice, it should be a challenging program.

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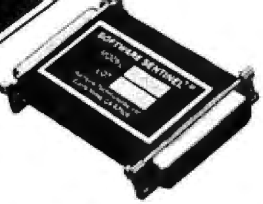

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403 Clyde Building, Brigham Young University, Provo, UT 84602, (801) 378-3617. You can also contact him at loganj-@byuvax.bitnet. He'll send you a disk with his current beta version. He's also selling the source code to an earlier (less intelligent) version. It's on disk and written in Megamax C; you can get that for $50. Oh, and Jim is looking for a dan-level player who's interested in working with him to make the game play better. You see, there's another international computer go tournament coming up soon.

In the Queue

I'm finishing this column up on a different computer than the one I started with. The column began on my old Compaq portable; it's being finished on an Access 386 system with a 16-MHz 80386 microprocessor, a 30-megabyte hard disk, an enhanced graphics adapter, and (only) 640K bytes of RAM. I could get used to something like this. A full report on this next month, along with a look at some of the MS-DOS software that I haven't been able (or willing) to wring out on my Compaq. Until then, see you on the bit stream. ■

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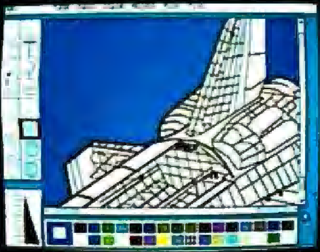
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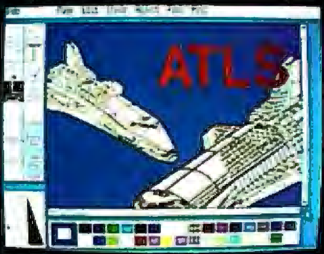

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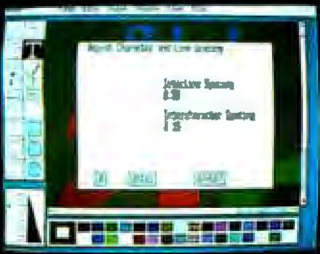
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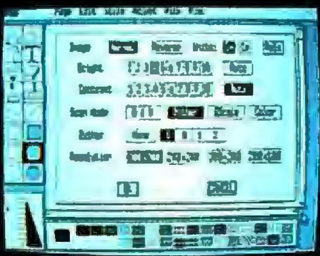
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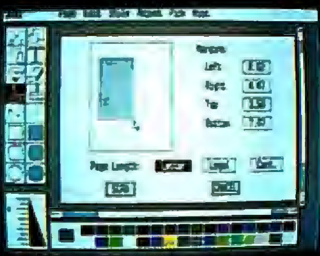
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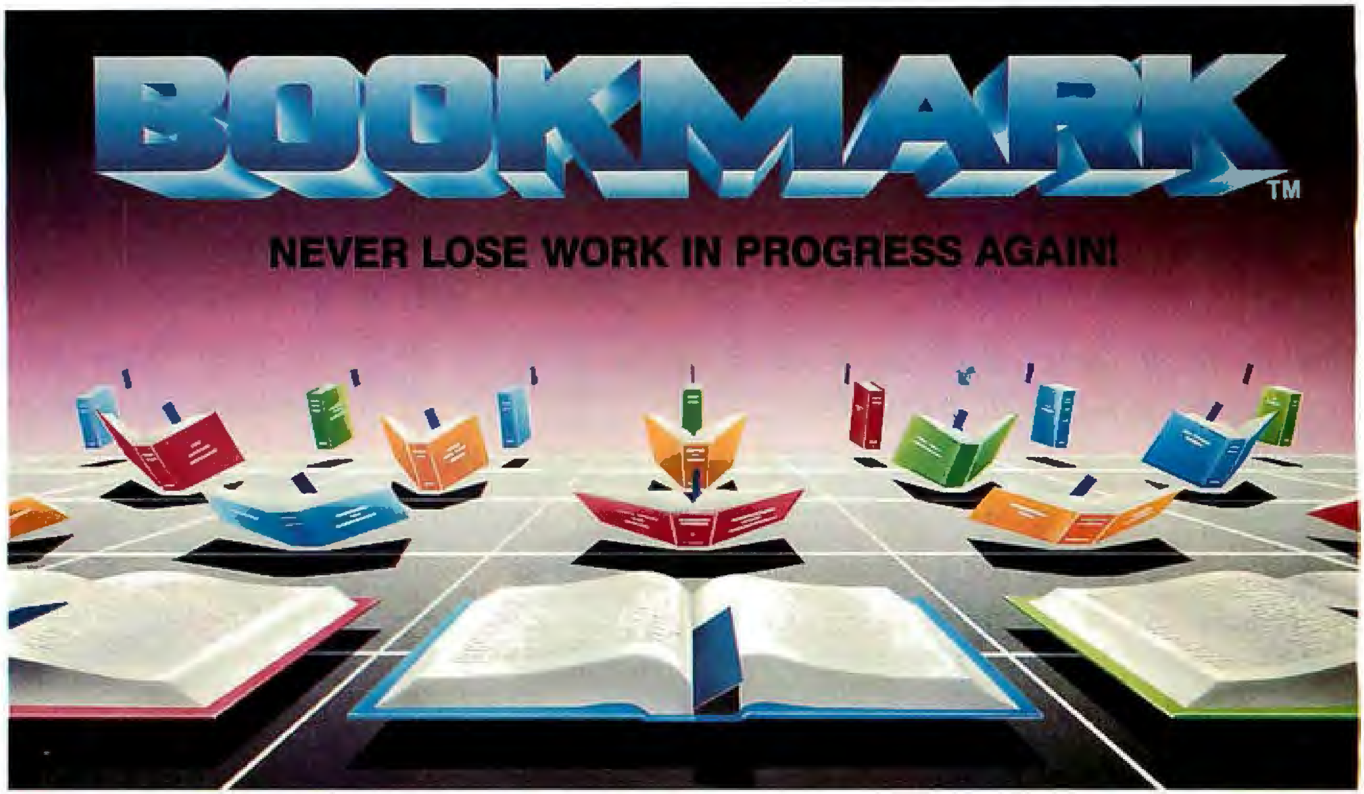

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Mostly Mac

Ezra Shapiro

Two laser tools, a phone dialer, an odd spreadsheet, and some grumblings

A year ago I had to beg for Macintosh software; nothing was happening, and I was overloaded with MS-DOS products. Then Apple introduced the Mac Plus, and the MS-DOS world began to freeze waiting for 386 machines, 286 operating systems, and rumored proprietary machines from IBM. The software scene suddenly reversed itself, and today I'm finding a flurry of activity in Macland and the doldrums in the PC arena. Life is like that, I guess.

Serious Art

A sophisticated art creation program for professional artists and designers who use the Macintosh, **Illustrator** (Adobe, $495) is far too powerful (and expensive) to be lumped in with the pack of drawing and painting programs that characterize the Mac art category. Let me emphasize the word "professional"—this product is not a toy for casual doodlers. Unfortunately, it is easier to demonstrate the program than it is to describe it, which often turns out to be the case with graphics tools.

In the simplest analysis, you create a line drawing that is stored as PostScript code rather than as a bit map of dots. The lines that make up the drawing can have thickness, or they can merely mark off regions that can be filled with gray tints. Because you're dealing with PostScript, which is device-independent, the output on laser printers or typesetting devices is always crisp, smooth, and clean.

Illustrator gives you two planes of visual information. The top layer is your work area, on which you construct your image. The background layer is a template; you can use it to store a picture from another Mac graphics program or from an optical scanner. Thus, you can create a PostScript document that is essentially a tracing of a bit-map picture. But because PostScript works by defining lines as endpoints plus the straight lines or the Bézier curves that connect them, working with Illustrator is not as simple as drawing with MacPaint. You place endpoints on your screen, in connect-the-dots style, and Illustrator builds the curves between the endpoints. If you've got that, hang on, because the explanation gets trickier.

Bézier curves are determined by the starting point and two control points that lie on an imaginary line tangent to the curve. With Illustrator, you draw by placing the starting point, keeping the mouse button depressed, then moving the cursor along that tangent line to the control point in the direction the curve is heading. The angle at which the curve leaves the starting point is determined by the tangent line; the size of the curve is determined by the distance of the control points from the starting point. Since most smooth curves have control points equidistant from the starting point, Illustrator places the second control point for you; you can fine-tune the curve by moving either of the two control points.

Drawing with Illustrator is thus a choppy process of making straight lines that define curves. At first this is odd and downright annoying because you feel you're working sidesaddle, but after some practice you get the hang of it, and it becomes second nature. Believe me, it's not as difficult as it sounds.

The more complex your drawing, the more points you have to set, so a detailed illustration entails a lot of work. The art produced by Illustrator is precise and stylized. Illustrator seems best for projects that should look polished and designed rather than loose and spontaneous—corporate logos, posters, technical drawings, borders, art deco images, and so on. You wouldn't want to use it to produce a simulated crayon sketch; I shudder to think of the amount of labor necessary to create an image with all of the irregularities of freehand art.

You can also use Illustrator to perform one-shot modifications to PostScript typefaces. For example, you could create an elongated gray shadow for a display headline. Illustrator and PostScript together understand how to download a font to the output device and then play with the PostScript outline that defines the letters, but that's beyond my scope here.

Files can be stored in any of three formats. Encapsulated PostScript provides both the code and a bit-map image that can be used by a program (a page layout package, say) that understands the format. Although Illustrator is a Macintosh product, it can generate Encapsulated PostScript in both Macintosh and MS-DOS forms. Or you can save a file as pure ASCII PostScript, which you can then edit, import into an application with a PostScript interface, dump directly to a laser printer, or even send out over an electronic mail service without having to worry about binary file hassles.

Documentation is well written and helpful. Adobe has included a demonstration of the program on videocassette as part of the package, which is a brilliant idea.

This is a very important program, but even a simple drawing can consume a lot of time. I wouldn't suggest Illustrator to anyone who doesn't fully understand its ramifications and isn't willing to dedicate many hours to the product.

Serious Type

While on the subject of Bézier curves, it's time to make a brief nod in the direction

continued

Ezra Shapiro is a consulting editor for BYTE. Contact him at P.O. Box 170040, San Francisco, CA 94117. Because of the volume of mail he receives, Ezra, regretfully, cannot respond to each inquiry.

of **Fontographer** (Altsys, $395), a typeface design program that works much like Illustrator. There are some differences, though. Fontographer places both control points for you, which you can adjust later, so you don't have to draw those choppy lines. You are, however, still playing connect the dots. Fontographer also differentiates between straight lines and curves (Illustrator defines a straight line as a flat curve, with both control points located on top of the starting point), so you have an additional tool for making straight lines. Fontographer generates downloadable fonts rather than ASCII PostScript.

The two programs complement each other nicely; reading the documentation for both products gave me a much clearer understanding of PostScript and Bézier curves than I would have had if I had read only one manual. The interface is similar enough so you can move from one program to the other with little disorientation. Both work well with scanned images as templates.

It's a lot of work to create a new alphabet. Jim Von Ehr of Altsys tells me that many of his customers use the product to create typefaces that contain only a handful of letters, for corporate identification and logos. But some type designers are working with the product, and designing a whole new typeface that looks really good is incredibly rewarding.

Along with Fontographer, you get a special copy of FONTastic, the company's Macintosh font editor, for creating Mac bit-map fonts. Don't assume you can move from the laser font to the bit-map font with no real effort; it takes almost as much work to develop a good bit-map font as it does to produce the downloadable version. You'll spend quite a while tweaking.

I love this program, but I also love type. Whether you need the program for professional uses, or you want to make typeface design a hobby, expect to block out a big chunk of your life for playing with Fontographer. I think it's worth it, and the program is outstanding, but it's not for everyone.

Hot Tip

I don't really appreciate phone dialers—my fingers do the job just fine, thank you—but **Hotline** (General Information, $39.95) is the Cadillac of the category. It's not the dialing that attracts me; it's the built-in phone directory. Hotline comes with a 2000-entry subset of the company's *National Directory of Addresses and Telephone Numbers*, a mammoth compendium of every useful number you could ever want—some 150,000 of them. While 2000 numbers doesn't seem like a lot (there are several hundred per page in the book your phone company gives you), these numbers are *prime.* (Sorry, I couldn't resist.) Major corporations, government agencies, freight companies, airlines, hotels, publications, computer hardware and software firms . . . the list goes on. Even if you don't use the program to actually dial your telephone, I guarantee you'll use the database within the first day you have the package, if not within the first hour.

As for the program, it's an MS-DOS terminate-and-stay-resident program that allows fast searching of both the *National Directory* and a personal directory of 65,000 of your closest friends. It also keeps track of local time for each of the numbers, and, if you like, Hotline will generate an ASCII log of the calls you make, showing number, company, location, and time. You can cut and paste from the log into your major application. You can look up the area code or country code and local time for more than 3000 cities around the world. The databases can be dumped in standard delimited for-

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mat for editing with a word processor or for incorporation into a spreadsheet or database. You can recompile the directories, so you can edit out the numbers you don't need or add new ones. Oh yes, the program will also dial your modem, whether it's Hayes-compatible or not (if not, you have to feed Hotline the modem's command set). You can assign prefixes and suffixes for long-distance services or private branch exchange systems, differentiate between local and toll calls (prefixed with a 1-) within your area code, turn your keypad into a manual phone dialer, and set up 30 numbers for speed-dialing with your function keys.

For Macintosh users, the 2000-entry subset is being distributed by Living Videotext with its newest version of More. You don't get all the nifty logging and keyboard functions, but More does have point-and-dial capability. I prefer the database as a More outline; it's organized into files grouped by category, rather than the full alphabetical list Hotline uses, and More's expansion/contraction by simple mouse clicks is a convenient way to let your fingers do the walking. I'm thinking of being sneaky and loading the database into Acta so I can pop it up from within other applications. Since I'm not particularly interested in the dialing functions, that should work well for me.

Hotline is inexpensive, slick, and well built. For anyone (like myself) who still scrawls phone numbers on odd scraps of paper, this program might finally be enough incentive to get the numbers into the computer. If I gave out stars, Hotline would get a bunch.

Without a Net

Once you get past the silliness of the user interface, **Trapeze** (Data Tailor, $295) is really quite an interesting product for the Macintosh. It's easiest to describe it as an unusual and capable spreadsheet program with powerful output formatting, but that doesn't really cover it. Trapeze is unlike any spreadsheet I've seen.

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data wherever you want them. Each block can contain only one type of item (numbers, formulas, text, imported graphics, or charts).

To build an elementary worksheet—labels on top and left edges, totals on the right and along the bottom, and data cells in the middle—you'd actually have to construct five blocks, one each for the two sets of labels, one each for the totals, and one for the raw data. Blocks can reference each other, but you don't use the traditional row-and-column numbering system; you use names you've given blocks and constants. So to build your bottom strip of totals, you'd simply enter the formula `sum(blockname, #col)`. This sounds cumbersome if all you want to do is set up a simple table, but if you're looking for fancy reports or self-calculating forms, this works nicely.

You can drop interesting fonts or spiffy graphics all over the place for impressive forms design, and the spreadsheet has one of the longest lists of functions I've ever seen.

I'm tempted to go easy on Trapeze because I really want a program like this to be part of my day-to-day toolbox and because I think its authors ought to be encouraged to make it a solid piece of software. However, I was not particularly pleased when I worked with it. As long as I did things by the book, I didn't have any problems. But when I intentionally did stupid things, all hell broke loose.

For example, I filled a large block of cells with integers, then (illegally) entered a formula in one cell that summed the block as columns, including itself. That's a classic circular reference, and it should have set off alarms and angry dialog boxes. Once, only once, I got a circular reference error message and blew up the screen display. Another time, I simply got an #NA error constant in a solitary cell; the original grid had vanished. Other times, I got the message but Trapeze proceeded to calculate anyway and collapsed the block to a single row that summed all the valid numbers in the columns I'd entered; I couldn't figure out how to get back to the original grid from that point. The most common response was no message at all, followed by a quick snap down to that single row. Every so often, the display would show a black block, as if a cell were selected, in my starting position, only by then that spot had ceased to be a cell. I honestly tried this lots of times to see if I could get a documentable bug nailed down, but the results were unpredictable. The critical factors seemed to be whether I had linked another block to the first and how many times I'd gone back and forth.

Note that not only was this a finished, shrink-wrapped product, but Data Tailor had even sent me two new program disks that allegedly corrected unspecified bugs. Also note that I don't care if my misadventures were a result of flaws in the software or my unfamiliarity with the product. Programs shouldn't have bugs, and they should also be prepared to deal with idiots at the keyboard.

I'm curious to see if this sort of thing gets fixed and, if so, how the program handles it. If I'm going to trash a worksheet with one rotten formula, I'd at least like a warning and a chance to back out before an automatic recalculation blows away hours of work.

Now, about that interface: Trapeze is a good argument against getting too carried away with the Macintosh icon-and-mouse disease. You can enter a formula by typing in text, which is simple enough, but if you want to take the Macintosh route and do it all with the mouse, here's what you have to do: There's a bar of four cryptic icons in the upper left corner of the screen. To get to the enter formula icon (a box with two parallel lines inside it; an

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Inquiry 220

equal sign, I guess), you have to move the cursor to the fourth icon and hold the mouse button until you get a drop-down menu of four icons—no words—and select the enter formula icon. Next, you go to the third icon in the bar, which looks like the enter formula icon with a little arrow pointing at the equal sign, and hold down the mouse button. The icon disappears, replaced by a menu that offers you three items: operators, constants, and functions. For good measure, this menu also shows you the names of all the worksheets you have open at the moment, but only when you're entering a formula, which is pretty useless. Select "functions" and keep the mouse button depressed. The cursor changes to a right-pointing arrow, and you slide it to the right and a menu of functions appears—about a zillion of them—in alphabetical order. Slide the mouse down to the one you want. If you let up on the button at the wrong instant, you're doomed. Oof.

Okay, conclusions are mixed. One: This is an innovative product, and I'd love it if it worked for me. As I said, I'm not sure whether the problems are with the software or with me, but either way I'm disappointed. Two: The interface needs rethinking. Three: This is a "love it or hate it" program. If you can make your current spreadsheet jump through hoops, stay with it. Learning Trapeze will be disconcerting, and worthwhile only if you desperately need the formatting power.

Another Approach

On the other hand, if you can get away without all those heavy-duty spreadsheet functions in your forms, I heartily endorse **FileMaker Plus** (Forethought, $295) for the Macintosh. This is a simple database with great desktop publishing capabilities. You can't do table joins and other tasks normally associated with high-power relational products, but FileMaker Plus is excellent at managing data. Fast searches, computed fields, good summaries, a top-notch layout mode, and scripting ability. I've never had any trouble getting the program to work.

For another $70, you can pick up a package of FileMaker Plus templates that work with the preprinted business forms from NEBS Computer Forms. Checks, invoices, purchase orders, etc. You even get samples of the forms and an order blank.

I like this product.

Mailbag

I recently received a letter from David Dunham, author of Acta (the Macintosh outliner), taking issue with my brief comments about that program in my February

continued

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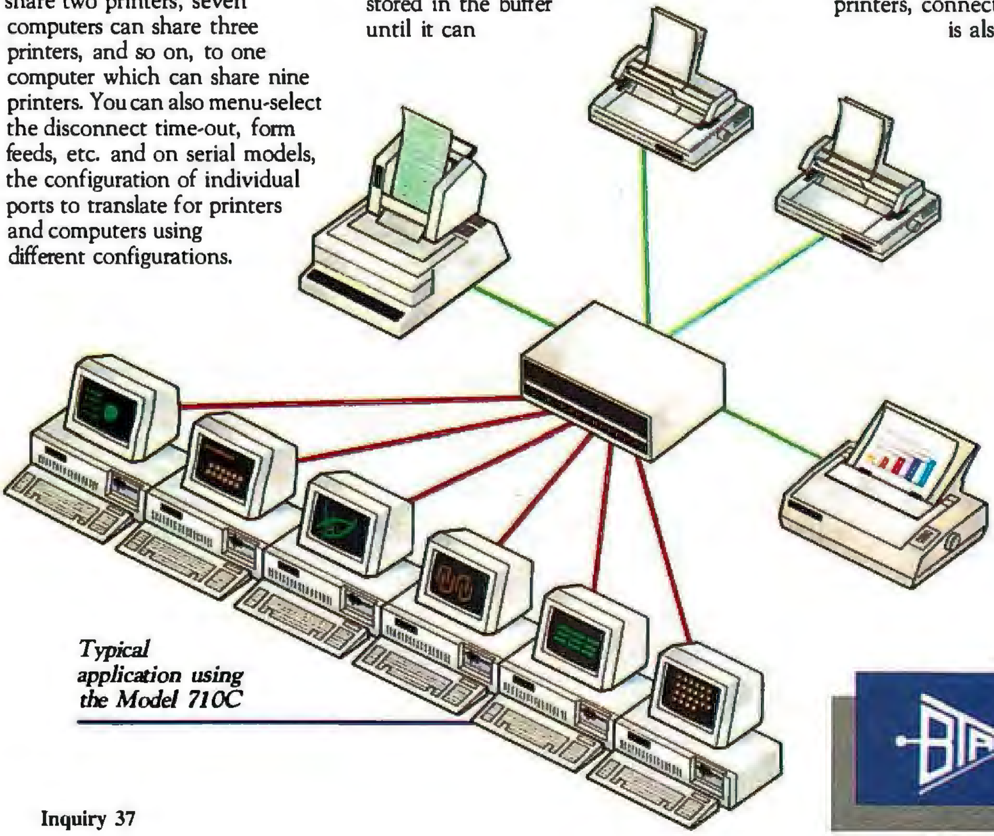

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column. After chatting with him on the phone, I realized that some clarification is in order. The subsequent paragraphs start with Mr. Dunham's comments in quotes; my reactions follow.

"Acta is not really to the Mac as Ready! is to MS-DOS. It is not a stripped-down version of a larger program." Well, Acta is a Mac desk accessory, and Ready! is an MS-DOS terminate-and-stay-resident program, so there is a rough equivalence. And I enjoy using Ready!, so I thought the comparison was complimentary. I don't think of Ready! as a stripped-down version of ThinkTank on the IBM PC; although Ready! lacks a paragraph editor, it has a number of features I'd like to see added to ThinkTank. But whether Ready! is stripped down or fattened up is not really germane to Acta; this is a cheap shot from Mr. Dunham. Both Ready! and Acta are useful tools in their respective environments, and I wouldn't want to be without either.

"This leads me to my second point; [Acta] *can* be compared with stand-alone programs." True. I yield to Mr. Dunham on this point. Acta is a good program, and it can be used in any situation where an outliner is helpful.

Mr. Dunham then goes on to say, ". . . when the article was written, neither ThinkTank [512] nor More had the standard Macintosh Undo." Also true. Acta does have this feature, and it was added to More only with the upgrade to 1.1. However, since More now has an Undo, Mr. Dunham gets points only for being there first.

"Acta lets you paste pictures from the clipboard; ThinkTank pastes only the entire Scrapbook." I wasn't aware of this, and Living Videotext says it isn't true. I'd check ThinkTank if I had it around anywhere, but I've moved on to More.

"Acta allows an arbitrary amount of text in a topic; ThinkTank and More force you to use separate 'windows' if your topic gets too long." I'm assuming that by "topic," Mr. Dunham means "item" or "entry" rather than "file." In that case, he's correct. With Acta, you can type away merrily to your heart's content; the Living Videotext outliners restrict headlines to one line and require you to use a document editor for any sort of long text chunk. So Acta is more "modeless" than ThinkTank and More. But I don't know whether this is better or merely a difference in philosophy. Hitting a carriage return starts a new headline in the Living Videotext products; in Acta, you have to use a command-key combination.

"Admittedly, ThinkTank can do slide shows." Yes, but who cares? The fact that Acta can't do slide shows doesn't strike me as a big failing.

"And [ThinkTank] can print, which the version of Acta you reviewed couldn't (Acta 1.2, a free upgrade, prints to Imagewriter or LaserWriter)." Noted. The ability to print is a major improvement to Acta, which makes it a much better product.

"Another comment was about the lack of formatting. Considering that Acta gives you more flexible formatting than ThinkTank or More (and that Word 3.0 is still nowhere to be seen), I don't think this is a fair comment (even if it is valid for a wish list)." If all he means by "formatting" is "mucking about with typefaces," Mr. Dunham is correct. I have often been annoyed with the blandness of the Living Videotext environment. However, I used the term more broadly, meaning "preparing text for presentation." Since Acta can't do headers, footers, page numbers, tables of contents, and all that sort of stuff, I think it's limited compared to the stand-alone products.

"In any case, there is no standard clipboard data format for text containing sty-

continued

1

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3

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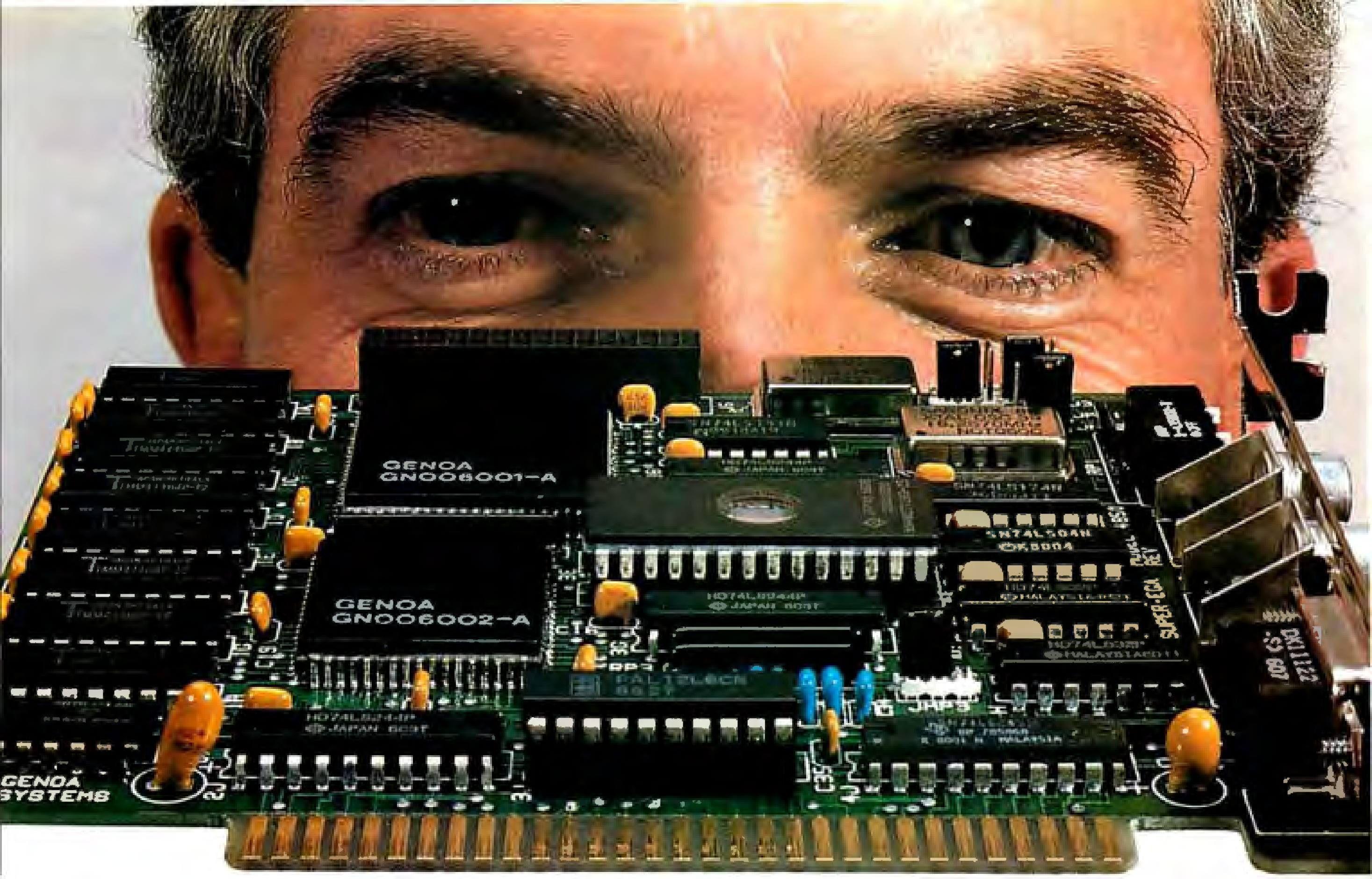
listic variations, or else Acta would support it." True again; my major gripe is with the Apple operating system. However, this does lend weight to my conclusion that if you want to prepare documents with Acta, you'll probably want to massage them with a word processor.

"The above may merely be differences of opinion." Yes. That's the whole point of this column.

"One correction is not, however. Acta has a retail price of $59.95, not $79.95." Whoops. I blew it. Sorry about that. ■



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Around and Around

Robert T. Kurosaka

Exploring the family of curves known as cycloids using computer graphics

If a curve C_1 rolls without slipping along another curve C_2, any fixed point on C_1 traces a path called a *roulette*. One of the simplest of these is the cycloid, formed when C_1 is a circle and C_2 is a straight line. For every rotation of the circle, a cycloidal arch is formed, as shown in figure 1a.

Galileo is credited with naming this curve. He conjectured that the area under one arch is exactly three times the area of the generating circle. In the early 1630s, Gilles Personne de Roberval proved this to be true.

Another interesting property is that the length of one cycloidal arch is exactly four times the diameter of the generating circle; that is, the length of one arch equals the perimeter of the square circumscribed about the circle. For a thorough treatment of the cycloid, I recommend Martin Gardner's excellent *Sixth Book of Mathematical Games from Scientific American* (W. H. Freeman & Co., 1963).

We can expand the realm of cycloids by moving the point off the circle's circumference. If the point is fixed inside the circle, we get a curtate cycloid; an exterior fixed point results in a prolate cycloid (see figures 1b and 1c).

Rolling a circle inside another circle rather than along a straight line produces a hypocycloid. The number of points, or *cusps*, is determined by the ratio of two circles' radii. A fixed-circle radius that is four times the rolling-circle radius produces an astroid, that is, a hypocycloid of four cusps (see figure 1d). As was the case before, moving the point away from the rolling circle's circumference produces prolate and curtate versions of the hypocycloid.

Now consider a circle rolling around the outside of the fixed circle. The fixed point traces an epicycloid in this case. When both circles have the same radius, the curve is the familiar cardioid—a cycloid that has been bent around another circle (see figure 1e). Curtate and prolate varieties apply here, as well.

The upside-down, or inverted, cycloid has remarkable properties. Consider two points A and B on a ramp, with A to the side of and slightly above B (see figure 2). A marble released at point A will travel to point B by the force of gravity. The shape of the path between those points determines how long the marble takes to reach B. If you construct ramps of varying shapes and conduct marble races from A to B, you will find that a cycloidal ramp gives the shortest time. This is true even if the marble has to go uphill part of the way to reach B. The inverted cycloid is thus known as a curve of quickest descent, a *brachistochrone*. Johann Bernoulli's proof of this property is found in *What Is Mathematics?* by Richard Courant and Herbert Robbins (Oxford University Press, 1941).

The inverted cycloid is also a curve of equal descent, an *isochrone* or *tautochrone*. A marble will always take the same amount of time to reach the bottom of a cycloidal ramp, regardless of its starting point.

The Dutch physicist Christian Huygens discovered this property in 1673, which led him to study the possibility of developing a perfect pendulum clock. If a pendulum could swing in a cycloidal rather than a circular arc, its period would be constant regardless of the amplitude of the swing. Huygens attempted such a design, using a flexible pendulum arm (string) and a pair of cycloidal "bumpers" flanking the pivot. However, the resulting friction made the clock even more inaccurate than the circular-arc pendulum, so it had to be abandoned.

What about the error of a circular arc? For relatively small amplitudes, the circular arc is sufficiently accurate, due to the approximation $\sin \theta \approx \theta$ for small θ, measured in radians.

Programming Cycloids

Before the advent of affordable computer graphics, we could only read about these mathematical curves and admire them. Now, with a little programming, we can create curves of our own and experiment with them endlessly.

The programs in this article are all written for an IBM PC with BASIC or GW BASIC. A graphics adapter is also required. However, if your computer has some other version of BASIC with similar graphics capabilities, you shouldn't have much trouble modifying the graphics commands. The remarks in the listings will help in the translation.

The program in listing 1 graphs two complete arches of a cycloid. You specify the location of the fixed point, or pen (as it is referred to in the program), with respect to a circle of radius 1. For example, a pen location of 1.2 places the pen 1.2 units away from the rolling circle's center. However, when the curve is drawn on the screen, these distances are scaled up as large as possible without exceeding the screen size.

The programs in listings 2 and 3 let you explore hypocycloids and epicycloids, respectively. In addition to setting the pen location, you specify the ratio of the fixed circle to the rolling circle. A value of 1 makes the two circles equal; a value less than 1 makes the fixed circle smaller than the rolling circle; and a value greater than 1 makes the fixed circle larger than the rolling circle.

Note that ratios larger than 1 need not be integral. For instance, a ratio of 3.5 is allowed; it produces a curve that closes

continued

Robert T. Kurosaka teaches mathematics in the Massachusetts State College system. He can be reached c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

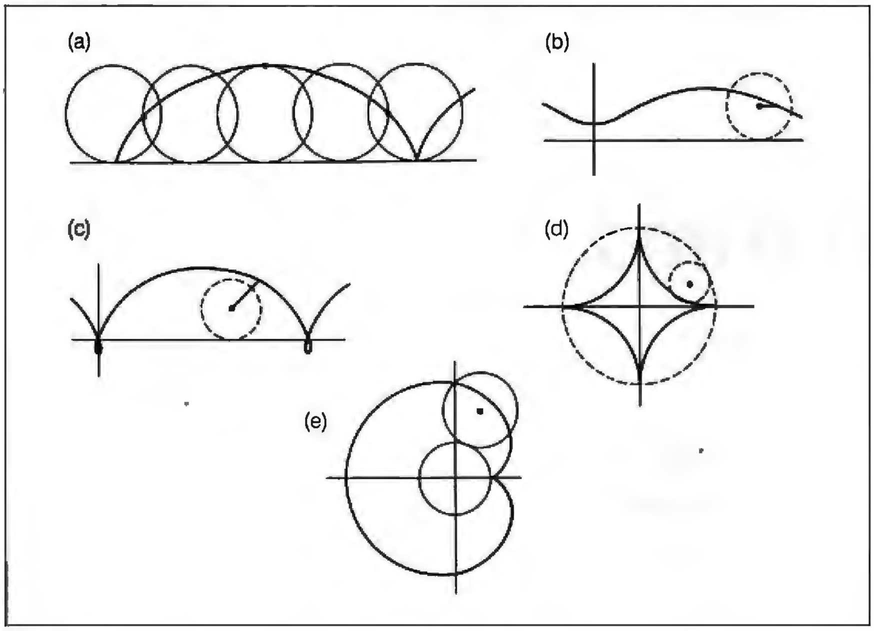

Figure 1: *A variety of curves produced by rolling a circle along another curve: (a) simple cycloid; (b) curtate cycloid; (c) prolate cycloid; (d) hypocycloid of four cusps, or astroid; (e) epicycloid of one cusp, or cardioid.*

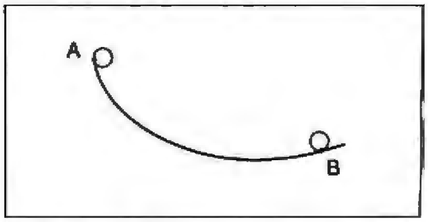

Figure 2: *An inverted cycloid defines the path of quickest descent and the path of equal descent.*

(begins repeating) only after two revolutions and seven cusps. In general, if the decimal ratio is restated as a quotient *m*/*n* in lowest terms, the rolling circle will make *n* revolutions and produce *m* cusps. In theory, an irrational number produces a curve that never closes. However, because my computer says that SQR(2) is 1.4142356, I anticipate a curve that closes after some 25 million revolutions with more than 35 million cusps.

In all three listings, the program plots 100 points per revolution. You can increase the number of points for a better-looking curve, but this will slow down the drawing process proportionately.

Any standard calculus text should provide derivations of the equations used in these programs.

Beyond Cycloids

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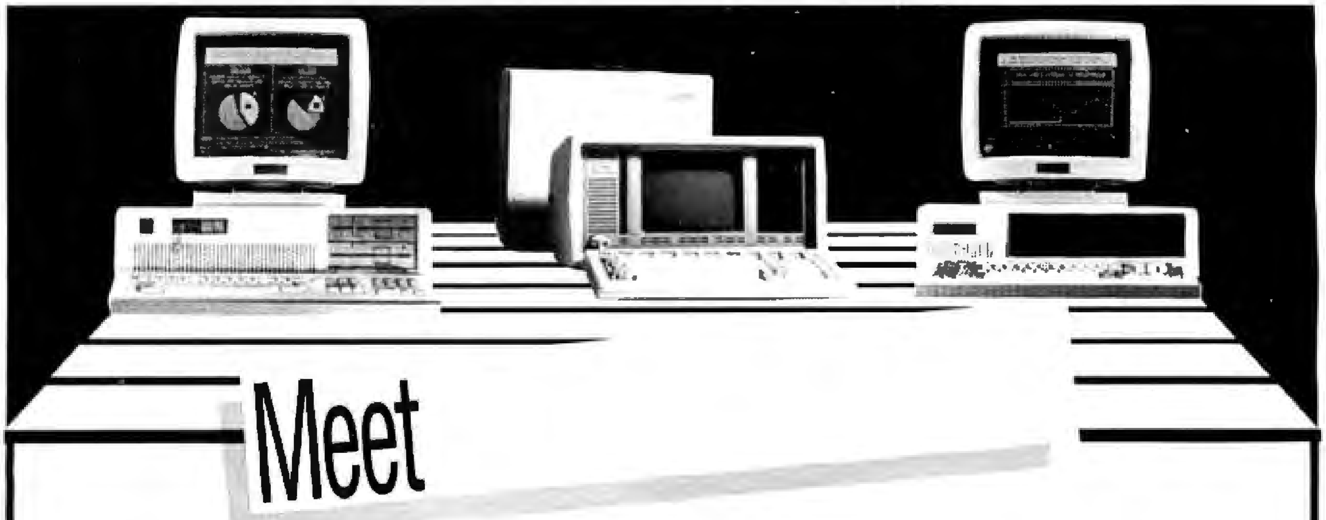
continued



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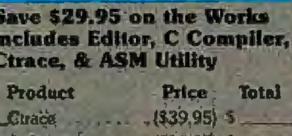

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Listing 1: *The BASIC program to graph cycloids.*

```
100 KEY OFF                  'Turn off key labels
110 DEF FNMAX(A,B)=-(A>B)*A-(B>=A)*B 'Maximum of A and B
120 WD=319                   'Width of 'screen
130 HT=199                   'Height of screen
140 PI=3.1415926#
150 '
160 'Get parameters
170 SCREEN 0,1: WIDTH 80: CLS
180 PRINT "Draw a cycloid"
190 PRINT "Enter the pen position w.r.t. a circle of
     radius 1."
200 PRINT "<1 is inside, =1 is on circle, >1 is outside"
210 INPUT "Pen position (-1 to quit)"; H
220 IF H<0 THEN END
230 '
240 'Distinguish between curtate and prolate cycloids
250 IF H<=1 THEN TN=1: TH=0: GOTO 290    'Curtate
260 TN=SQR(H*H-1): TH=ATN(TN)            'Prolate
270 '
280 'Scale the units
290 A=WD/(4*PI+2*TN-2*TH)           'Radius of circle
300 H=H*A          'Distance of pen from circle's center
310 X0=A*TN-A*TH: Y0=HT-FNMAX(A,H) 'X- and Y-origin
320 '
330 'Set up the screen
340 SCREEN 1,1               '320 x 200 graphics
350 LINE(X0,0)-(X0,HT),2 'X-axis in color 2
360 LINE (0,Y0)-(WD,Y0),2 'Y-axis in color 2
370 CIRCLE(X0,Y0-A),A,3  'Circle at origin (color 3)
380 CIRCLE(X0+2*PI*A,Y0-A),A,3   'Circle at 1 rev.
390 CIRCLE (X0+4*PI*A,Y0-A),A,3  'Circle at 2 rev.
400 PSET(X0,Y0-A),3          'Mark center of each circle
410 PSET(X0+2*PI*A,Y0-A),3
420 PSET (X0+4*PI*A,Y0-A),3
430 '
440 'Graph the cycloid
450 FOR ANG=0 TO 4*PI STEP 2*PI/100       '100 points/arc
460 X=X0+A*ANG-H*SIN(ANG)
470 Y=Y0-A+H*COS(ANG)
480 IF Y<0 OR Y>HT THEN 500
490 PSET (X,Y),1
500 NEXT ANG
510 '
520 IF INKEY$="" THEN 520  'Hold until a key is pressed.
530 GOTO 170
```

Listing 2: *The BASIC program to graph hypocycloids.*

```
100 KEY OFF
110 WD=319: HT=199
120 X0=WD/2: Y0=HT/2
130 PI=3.1415926#
140 '
150 'Get parameters
160 SCREEN 0,1: WIDTH 80: CLS
170 PRINT "Draw a hypocycloid"
180 INPUT "Ratio of fixed to rolling circle ( >= 1 )"; R
190 IF R<1 THEN END
200 PRINT "Enter pen position w.r.t. a circle of radius
     1."
210 PRINT "<1 is inside, =1 is on circle, >1 is outside"
220 INPUT "Pen position (-1 to quit)"; H
230 IF H<0 THEN END
240 IF H<=1 THEN A=.5*HT: GOTO 260
250 A=.5*R*HT/(R+H-1)
```

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```
260 B=A/R
270 H=H*B
280 '
290 'Set up screen
300 SCREEN 1,1: CLS       '320 x 200 graphics
310 LINE(X0,0)-(X0,HT),2 'X-scale, color 2
320 LINE(0,Y0)-(WD,Y0),2 'Y-scale, color 3
330 CIRCLE(X0,Y0),A,3    'Fixed circle, color 3
340 CIRCLE(X0+A-B,Y0),B,3 'Rolling circle, initial pos.
350 '
360 'Hypocycloid
370 ANG=0                 'Initial value
380 ANG=ANG+2*PI/100      '100 points per rev.
390 X=X0+(A-B)*COS(ANG)+H*COS(ANG*(A-B)/B)
400 Y=Y0-(A-B)*SIN(ANG)+H*SIN(ANG*(A-B)/B)
410 PSET(X,Y)
420 '
430 'Keep drawing until a key is pressed.
440 IF INKEY$<>"" THEN 160 ELSE 380
```

Listing 3: *The BASIC program to graph epicycloids.*

```
100 KEY OFF
110 WD=319: HT=199
120 X0=WD/2: Y0=HT/2
130 PI=3.1415926#
140 SCREEN 0,1: WIDTH 80: CLS
150 '
160 print "Draw an epicycloid"
170 INPUT "Ratio of fixed to rolling circle ( 0=quit)"; R
180 IF R=0 THEN END
190 PRINT "Enter pen position w.r.t. a circle of radius
     1."
200 PRINT "<1 is inside, =1 is on circle, >1 is outside"
210 INPUT "Pen position (<=0 to quit)"; H
220 IF H<=0 THEN END
230 A=.5*R*HT/(R+H+1)
240 B=A/R
250 H=H*B
260 '
270 'Set up screen
280 SCREEN 1,1: CLS       '320 x 200 graphics
290 LINE(X0,0)-(X0,HT),2 'X-scale, color 2
300 LINE(0,Y0)-(WD,Y0),2 'Y-scale, color 3
310 CIRCLE(X0,Y0),A,3    'Fixed circle, color 3
320 CIRCLE(X0+A+B,Y0),B,3 'Rolling circle, initial pos.
330 '
340 'Hypocycloid
350 ANG=0                 'Initial value
360 ANG=ANG+2*PI/100      '100 points per rev.
370 X=X0+(A+B)*COS(ANG)-H*COS(ANG*(A+B)/B)
380 Y=Y0-(A+B)*SIN(ANG)+H*SIN(ANG*(A+B)/B)
390 PSET(X,Y),1
400 '
410 'Keep drawing until a key is pressed.
420 IF INKEY$<>"" THEN 140 ELSE 360
```

lection of large tracks and smaller wheels that rotate inside the tracks. When a pen is attached to the wheel, it draws an interesting pattern. A cycloid, right? Not always, because some of the tracks and wheels are ovals, rounded triangles, and odd shapes.

It should be possible to use a computer to simulate these beautiful roulettes on a computer, as long as the track and the wheel can be specified mathematically. I encourage you to explore this problem, but beware: The math required is considerably more advanced than what we've used in this article. (If truth be known, the author hasn't programmed this one yet.)

Your comments are welcome. ■

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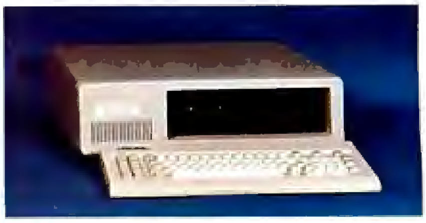

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Computer Tragedies

Dear Jerry,

One of your columns long ago gave me the impression that you were interested in stories of computer programming errors that caused spectacular, or at least serious, failures. Another person who is interested in this is Gerald M. Weinberg (*The Psychology of Computer Programming*, which I highly recommend, and *Introduction to General Systems Thinking*, in which I haven't gotten past page 42). Gerry gave the closing address at the Human Factors in Computer Systems conference in Gaithersburg, Maryland, in March 1982. Unfortunately the talk was not recorded or published, as far as I know.

In the talk, Weinberg said that he was collecting stories of people who were killed or seriously hurt because of programming errors. I don't recall that he had any to tell, but I may be wrong. Apparently the following story didn't meet his criteria:

A boy had been arrested a few months earlier, then gotten out and gone straight. He was stopped for a minor traffic violation, and the police officer radioed in for information. The operator inquired from the central computer system, got the code *WC*, which meant "Arrest Warrant Cleared," and translated it to the officer as "Warrant Current." The officer, obeying what he thought was good information, pulled the boy in. The boy, in despair at ever getting clear of the system, hanged himself. His parents and the press were highly upset.

I found Gerry Weinberg to be a very interesting and interested person, and I think there could be an interesting tale or two if the two of you were to get together. (If you do, I'd appreciate hearing about it.) His address is RR #2, Lincoln, NE 68520-9417.

Pat McGee
Chimayo, NM

I hadn't heard of this project, but I suspect a great number of BYTE readers will have stories.

In thinking about the incident of the young man who hanged himself, I wonder, on the other hand, how many potential victims have been saved because the police were able to find out that someone picked up on a traffic charge was wanted for a serious crime or a jail break? Nothing, I fear, is 100 percent safe from tragic consequences.—Jerry

Two-in-One Drive

Dear Jerry,

In a recent column, you expressed surprise that the AT&T PC 6300 Plus thought floppy drive A was both drive A and drive B. This is not unique to this machine. Most (if not all) MS-DOS machines with a single floppy disk drive work this way.

The DISKCOPY command can be used to copy a disk in drive A to another disk, also in drive A. DOS prompts you at appropriate times to place first the source disk, then the target disk, into drive A. However, if you wish to use the COPY command so that only certain files will be transferred, or so you can add files to a disk already in use, trying to COPY from A to A will result in a message telling you that a file cannot be copied to itself. Instead, you must use the COPY command to copy from drive A to drive B (or vice versa). You will be prompted for a disk swap as each file is copied. Granted, this involves a lot of disk swapping if several files are being copied, but it beats not being able to copy them at all, if all you have is a single-floppy machine.

I really enjoy puttering with new software and hardware, so I find the tales of your experiences quite entertaining.

Elizabeth A. Swoope
Baton Rouge, LA

Thanks. I should have figured it out, and of course, not long after I wrote that column, I did. My Zenith Z-248 works the same way: one physical floppy that can be two logical drives.

I'll continue puttering, and thanks for writing.—Jerry

Uncramming RAM

Dear Jerry,

In a recent column, you described a problem with the loading and unloading of RAM-resident programs under MS-DOS, better known as "RAM Cram." I would like to point you in the direction of two products that may solve your problems.

The first is Referee by Persoft, of Madison, Wisconsin. Its advertisement indicates that it selectively loads and unloads RAM-resident programs as you desire for each application program. This one sounds like it does exactly what you want. The price is $69.95.

The second program is Software Carousel, by SoftLogic Solutions in Manchester, New Hampshire. This package is a TopView-type program that allows up to 10 different tasks to be loaded simultaneously (not multitasking); each task can have its own set of RAM-resident programs loaded. An EMS card or large hard disk is really needed for this one to store the suspended tasks. The price of this package is $59.95.

You could probably con a copy of each of these products, given your persuasive abilities. I haven't tried them, so I can't attest to their quality. Happy computing.

Gary R. Saake
Aurora, IL

Thanks. Both of these packages look good. I don't see them in the Domesday Book (our log of software that has come in), but I'll have a look.

I'm also looking at Framework and DESQview as possible ways out of the mess. We'll see.—Jerry

Spellbinder

Dear Jerry,

I have a fantastic word processor that I heard of years ago from two old pros who made their living doing technical writing.

The program handles files up to disk size. It is available for CP/M-80, CP/M-86, or MS-DOS, and has a powerful command and macro capability, including global search and replace (which searches an entire file, larger than computer memory, with automatic or optional replace). It has lots of other great features, including proportional printing. And it represents a single system to learn that works on either CP/M or PC-DOS machines.

The program is Spellbinder, produced by Lexisoft, P.O. Box 1950, Davis, CA 95617, (916) 758-3630.

Spellbinder is easy to use. While I never could figure out WordStar, Spellbinder gave me great results from the beginning. I think you'd like it.

Robert A. Darrow
Sunnyvale, CA

continued

I have heard good stuff about Spellbinder. At every computer show, I go to Lexisoft's booth. They take my card and swear they will send me a copy. So far, I have yet to see one.

I can only write about what is here, alas.—Jerry

Modula-2 for the Amiga

Dear Jerry,

Since purchasing my Amiga I have been using Amiga BASIC, but I would like to move up to something with a more structured and powerful high-level language. My two choices would seem to be a C compiler or Modula-2.

C language is very "hot" now, especially with the Amiga, since its operating system was written in C. In addition, the examples in the *ROM Kernel Manual* are written in C.

Modula-2 got my attention with a relatively low price and what seems to be an easier-to-decipher code. At present, the Modula-2 compiler from TDI Software of Dallas, Texas, is the only one commercially available for the Amiga. But I hear the TDI Modula-2 compiler has several deviations from standard Modula-2.

There is another Modula-2 being developed by a student (or students) of Professor Niklaus Wirth in Switzerland. Do you think it might be wise to wait for the new compiler because of the deviations by TDI?

Earl Davis
Marion, OH

TDI Modula-2 works. It has some misfeatures, but they keep improving it. I wouldn't wait for ETH (Swiss Federal Institute of Technology) to deliver a commercial product; once they're through, someone else usually has to polish it into something usable.

And I continue to believe that Modula-2 is the right language for a great many jobs.—Jerry

Can't BIX

Dear Jerry,

Picture a child from a poor family, in front of a toy store. He stands in the snow, looking through the window at all the wonderful things that he wants but can't have. He can only imagine the fun of playing baseball with a real bat, or the sound of the toy train whistle. He is sad.

I, too, am sad. I read the "Best of BIX," and realize how much lies beyond what will fit in the monthly section. I imagine what it would be like to converse electronically or exchange BIX mail with authors and editors of BYTE, perhaps even your esteemed self. I contemplate what I could do with some of the software downloadable from the libraries, and the many other benefits of joining BIX. I have a computer, modem, and Red Ryder, and can write procedure files to skin porcupines. But alas, BIX is out of my reach for the foreseeable future, because I have neither Visa nor MasterCard.

I wonder how many others are in the same position. Because we don't buy with plastic, we don't exist as far as BIX is concerned. There certainly are other services available that make no such requirement; GEnie, for example, transfers its payments out of my checking account, and other systems require a deposit. Why couldn't BIX do something similar?

"Since when," you may ask, "is this my problem?" It isn't your *problem*, but computer-assisted conferencing is certainly one of your interests, and since your piece in the December 1986 BYTE described BIX as "the first step into what will be the normal communications pattern of the future," yours was the first name I thought of.

I hope that the "pattern of the future" doesn't exclude us non-Visa-cardholders; after all, the good that a person can derive

continued

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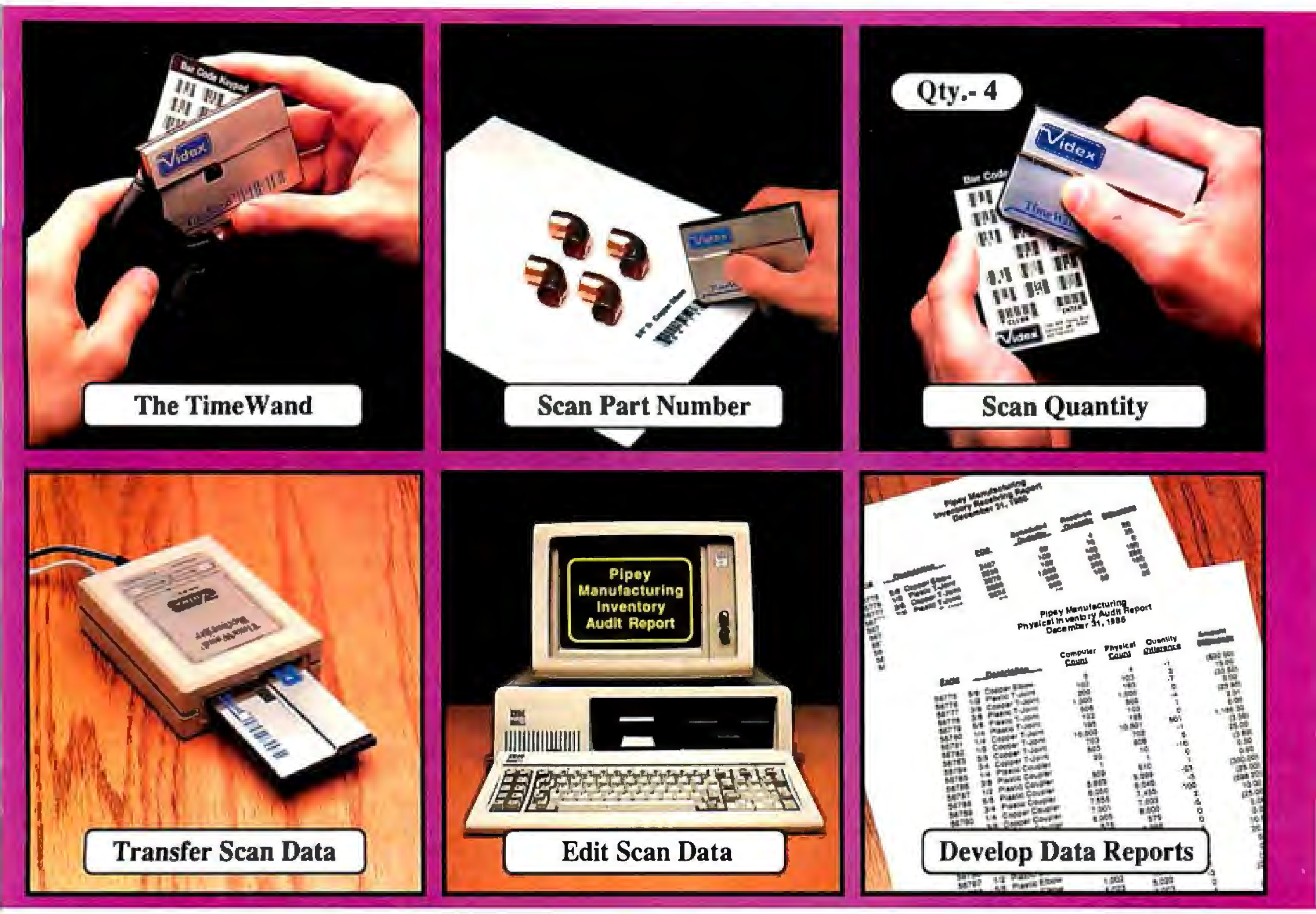

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from, or contribute to, such a forum is not a function of his credit rating. Perhaps you might plead our case with the BIX powers-that-be, or at least pass this letter on to them.

See you on BIX? Someday, I hope.

Lyle D. Gunderson
Pleasant Grove, UT

I believe the BYTE/BIX people are trying to come up with an alternative to MasterCard/Visa for BIX, but it's a problem. How can they check the credit of an applicant? And if asked to prepay, how many applicants will do it?

BIX authorities are looking into bank transfers, and I'll certainly remind them that it's possible.—Jerry

Advertising for Europeans

Dear Jerry,

Small U.S. high-tech companies are not achieving their full market potential in Europe. As an American engineer living in Europe, I'd like to give some often-overlooked facts about commerce here.

1. 800 telephone numbers are *not* accessible outside the U.S. Always include your local number and area code in your advertisements.
2. Always give a full postal address in your ads. This is true even if your ad includes postcard response forms; all too often these disappear or expire before the ad reaches a potential customer. Without an address, written inquiries are nipped in the bud.
3. Accept Visa or equivalent cards as payment. I could write a whole letter about the frustration and cost of transferring funds through "friendly" banks.
4. Respond properly to inquiries. Obviously, to make a sale you must tell the potential buyer about the product. At the minimum, send data sheets and price lists plus shipping costs. Also include information about your other products, even those coming out Real Soon Now. Do it via airmail; regular mail can take three months to arrive.
5. Ship purchases by UPS or DHL. Although such services may not do all they claim to do, especially in a foreign country, they do try harder. Many of today's national postal services are early retirement homes.
6. Package your product to withstand a herd of stampeding elephants. A *Fragile* sticker won't work as a shock absorber.
7. Put several copies of shipping documents in an envelope on the outside of the package. Customs officers need to know the package's contents and its value. Otherwise, they can't deliver it.
8. Tax structures vary a great deal. Itemize and specify a value for each type of product. For example, books, software, and hardware all have different import duties here in Norway. Splitting the total may save the customer some money.
9. We use 220-VAC 50-Hz power here. (The Japanese are responsive to this fact, even if you're not.) Design with a selectable power transformer and a three-prong removable power cord, so we can put on the right power cord to match the wall sockets here.
10. Local representatives can be invaluable—but not if they can't carry on a technical conversation about your product, and not if they're tripling your prices. Choose judiciously.

Bob Clarke
Larvik, Norway

Thanks for the tips. Maybe someone is reading this.—Jerry

Couch Computing

Dear Jerry,

I've followed with interest your search for the perfect writing system. I'm a writer of software and prose myself, and I have a system that may appeal to you.

A couple of years ago I was thinking how nice it would be to be able to write without leaving my comfy spot on the couch. I figured what I'd need would be a remote control keyboard and a large remote control TV set/RGB monitor. I found both, a Cherry keyboard and a Mitsubishi TV/monitor.

The keyboard isn't my favorite, but I haven't seen another I can use from five feet away. Better hurry if you want one—I believe I recently saw them being dumped for $69 in the back of BYTE.

Mark McWiggins
Seattle, WA

Sounds interesting. Actually, though, I have about 10 feet of cable on my wonderful (but no longer obtainable) Archive keyboard that works with Zeke II, the ancient CompuPro Z80 I do most of my writing on. I presume I could curl up on a couch with it, since my 15-inch Hitachi monitor is plenty big enough to see from a goodly distance.

Somehow, though, I've never been tempted. I learned to type sitting reasonably erect, and since I type all day I think I'd have real back problems if I didn't.

Incidentally, my Archive keyboard has Hall-effect keys. They are nearly indestructible, and the action is wonderful. Alas, I think no one makes a keyboard with Hall-effect any longer.—Jerry ■

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AMIGA

This month's Amiga section includes three threads. We start off with a thread on installing an 80-track drive on an Amiga, forge on to the problems of a BIXer with a flaky system, and finish up with a thorough look at the ins and outs of the Amiga's Auto-Configuration RAM.

INSTALLING AN 80-TRACK DRIVE

---

amiga/hardware #1052, from nhimes (Nard Himes), Mon Feb 9 22:43:15 1987.

I have been attempting to interface Teac FD-55 and FD-96 drives to an Amiga using a latch circuit. The problem is that the Amiga will not recognize the drive. I believe the problem centers around the RDY line and ID mode, since the latch circuit works with another 5 1/4-inch drive. Can the interface be modified to cause the drive to Auto Configure or can the mount command be used to make the computer recognize the drive?

---

amiga/hardware #1053, from grr (George Robbins, Commodore Business Machines), Mon Feb 9 22:52:22 1987. A comment to message 1052.

What (if any) kind of icon do you get for the drive?

---

amiga/hardware #1054, from afinkel (Andy Finkel, Commodore Business Machines), Mon Feb 9 22:56:34 1987. A comment to message 1052.

Have you made an entry in the mountlist for it? And what happens when you mount it? (That is, what does the info command tell you, what does the assign command tell you, what does Workbench think when you put a disk in? (Bad?))

---

amiga/hardware #1055, from jdow (Joanne Dow), Mon Feb 9 23:00:33 1987. A comment to message 1054.

He seems to be talking about a 96-tpi 5 1/4-inch drive. If so, he should be very sure it will handle a 3-millisecond stepping pulse period. Then consult message 445 here for the tracing of the Amiga 3 1/2-inch drive applique schematic. Those things will work very well indeed.

---

amiga/hardware #1056, from jdow, Mon Feb 9 23:02:51 1987. A comment to message 1055.

In fact, to further answer, I run four drives here, two are the Amiga internal and one is an external 3 1/2-inch. The other two are Mitsubishi 96-tpi drives with spare gates hacked into the drives to look like the schematic shown. I did have to add a drive-door-open switch, though, to make things like me. (Diskchange seems entirely TOO kludgey.)

---

amiga/hardware #1057, from grr, Mon Feb 9 23:08:08 1987. A comment to message 1055.

Hope he's got the pins numbered correctly. A nonresponsive drive should give a df1:bad-type icon. Screwing up the serial configuration code yields no drive, lots of confusion, and I don't know what else.

A FLAKY SYSTEM

---

amiga/hardware #1067, from s.choi (Seokrim Choi), Wed Feb 11 21:34:22 1987.

My Amiga is not stable. When I turn it on and put the Workbench disk in, sometimes the computer goes down as soon as the disk drive light goes off. Also, when I open the clock window as a background job and use a communications program, the computer crashes, but not every time. Most of the time it works very well.

I sent the unit to the dealer, and they said they couldn't find fault and my Amiga worked very well on their desk. They sent it back to me and when I turned it on again, it crashed.

I checked my power line, monitor, and mouse. I didn't open the unit, since my warranty would become void. So I need your advice. What is the problem with this little monster?

---

amiga/hardware #1068, from jdow, Wed Feb 11 21:38:35 1987. A comment to message 1067.

Have you recopied the Kickstart and Workbench disks you use from your masters? There may be some files mashed in there. Also, be sure you initialize the WB disk with the 1.2 Initialize, if you are running 1.2. Anyway, you MIGHT have a subtly munged file somewhere. (If you are running any of the beta 1.2s, all bets are off.)

Another problem might be thermal. Is your work area noticeably warmer or colder than the store's? And did the store check with YOUR disks?

---

amiga/hardware #1069, from s.choi, Wed Feb 11 23:33:30 1987. A comment to message 1068.

I have checked my disks. That was my first action. I visited my Amiga dealer and got a new copy of WB and Kickstart. But I still have the same problem. My WB and Kickstart version are 1.1. I don't have 1.2.

My room is, of course, warmer than the store. But the Amiga works very well in that temperature most of the time. When my computer goes down, generally it goes to Guru Meditation. But sometimes it just does nothing. I have 512K of memory and one disk drive.

---

amiga/hardware #1070, from jdow, Thu Feb 12 11:33:09 1987. A comment to message 1069.

Hm, it sounds a bit like a weak memory chip. If you are coming up with a virgin start-up sequence (or at least no more modified than to kill the last line - the "endcli >nil:" one).

Try to make note whether or not the problem is worse with the temperature higher. It may be a temperature-related problem. Finding that kind of problem may be most difficult. If you turn your thermostat up and that day have more problems than the next day with the window open a crack, then you have a good

continued

start on describing a temperature problem to the store. Then they should be able to play with a heat gun or hair dryer to duplicate the problem. (That is, if they are reasonably hardware-savvy there. Good repair people are more than a tad hard to find. I wish you were out here and had bought it from KJ. They have a very good policy on warranty repair at the mere hint of problems. That must have some relationship to how well they are doing selling these newfangled mouse-driven computers that sport actual colors on the screen.)

---

amiga/hardware #1091, from s.choi, Fri Feb 13 22:49:31 1987. A comment to message 1070.

I've tested my computer for two days. I found that the crash has something to do with the temperature. I've heard about this kind of problem but never thought I would encounter it. (Anything can happen in New York!)

---

amiga/hardware #1073, from chuckr (Charles Robey), Thu Feb 12 20:08:27 1987.

Oh, yeah, one last thing for s.choi. I have also heard of weird problems like that when one lives too close to an AM/FM/TV transmitter.

---

amiga/hardware #1086, from jdow, Fri Feb 13 04:22:28 1987. A comment to message 1073.

If that is the case, I'd strongly suspect that movement of the mouse cord would affect things greatly.

---

amiga/hardware #1087, from chuckr, Fri Feb 13 18:53:26 1987. A comment to message 1086.

One way to beat it is to put your system on a hellacious ground plane, like a piece of grounded aluminum foil (the way I finally stopped my old PET from blowing up). The mouse line may or may not act as an antenna, depending on the impedance design, I think. RF never was my big bag; I like digital signal processing and digital messing around and communications.

---

amiga/hardware #1092, from jdow, Fri Feb 13 23:43:02 1987. A comment to message 1087.

Dunno about susceptibility, but the mouse leads radiate like crazy. They even interfere with 2-meter ham equipment. (I'm a ham radio operator as well as all this silliness.)

---

amiga/hardware #1099, from chuckr, Sat Feb 14 14:03:43 1987. A comment to message 1092.

That's interesting. I would have thought that while the mouse line could pick up signals, it would not be likely to radiate them. I have taken a quick look at the signals on the mouse line; they look like they are all DC. Don't understand that one. Is it a problem?

---

amiga/hardware #1108, from jdow, Sat Feb 14 21:45:22 1987. A comment to message 1099.

Not much. It is barely noticeable if I have my 2-meter rig's squelch set down very low or if signals are weak. At lower frequencies it might be, but I haven't tried. (And this is with the antenna uncomfortably close to the computer.

AUTO-CONFIGURATION RAM

amiga/hardware #1125, from steveth (Steve Thomas), Tue Feb 17 21:48:47 1987.

I know that RAM placed at $C00000 will AutoConfig under V1.2, as I've got 512K in that range now. What I'm wondering is, aside from the 4K where the custom chips are, of course, how much of that 2-megabyte space will AutoConfig? Is it limited to 1Mb, 1.5Mb, 1.75Mb, 1.996Mb? I'm thinking of cramming a bunch of RAM into that space, and if I can get 2Mb (minus the last 4K), that's what I'll go for.

---

amiga/hardware #1126, from grr, Tue Feb 17 23:34:12 1987. A comment to message 1125.

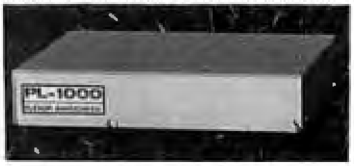
Basically, up to 1.5Mb in 64K increments (may not be 100% exact, but that's the idea).

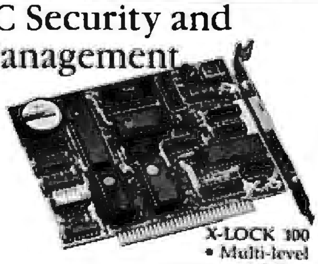
---

amiga/hardware #1128, from steveth, Wed Feb 18 02:34:26 1987. A comment to message 1126.

Okay, 1.5Mb sounds good to me. A couple more questions, if you don't mind:

continued





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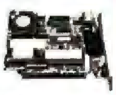

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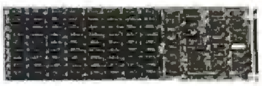

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Inquiry 262

First, I assume that the RAM is checked for by writing to those locations and reading back to verify. Is the original data replaced (i.e., does it do a read before the first write and, if RAM exists, replace the data)? I'm wondering about recoverable RAM disks surviving the AutoConfig.

Second, what is the "legality" of using this address space for RAM? If I build myself a 1.5-Mb card to sit on the expansion bus, am I going to run into any problems down the road with someone *else's* product wanting this address space? How about my RAM getting along with Auto-Configured RAM and other devices?

Oh, why does 1.2 AutoConfig this space? Was it really intended for RAM?

---

amiga/hardware #1129, from grr, Wed Feb 18 02:52:27 1987. A comment to message 1128.

Actually, it works the other way - it starts at C0 and scans upwards until it sniffs at something that looks like the Amiga custom-chip registers.

One word every 64K or so will get popped, so unless your RRD expects this, you're out of luck.

The exact intent of this RAM allocation is no longer clear. It does provide a non-Auto-Config expansion, so perhaps the original allocation predates a final Auto-Config proposal.

The rub is that it overlays the area allocated to the custom-chip registers. The worst case timings involved give no slack for decoding and asserting OVR to inhibit the custom-chip cycles. Boards with built-in expansion RAM decode the C0-D8 space explicitly and are spared this problem.

The Auto-Config stuff is really not that complicated; you might want to consider it, rather than making something potentially flakey.

---

amiga/hardware #1132, from jsan (Jez San), Wed Feb 18 07:51:44 1987. A comment to message 1129.

Rather than losing one word every 64K, why not save the word that was there before you test that it's valid RAM, and then restore its contents so the RRDs don't get choked!

---

amiga/hardware #1134, from jdow, Wed Feb 18 13:25:18 1987. A comment to message 1132.

Because someone didn't think of that at the time the "memory test" was designed. That's a real bummer.

---

amiga/hardware #1130, from jdow, Wed Feb 18 04:07:23 1987. A comment to message 1128.

Like OOPS! That is a possible BAD issue on RRDs. I may have to limit allocations to below that.

---

amiga/hardware #1131, from grr, Wed Feb 18 05:05:48 1987. A comment to message 1130.

Also, AmigaDOS will load itself up there instead of chewing up chip memory.

---

amiga/hardware #1133, from afinkel, Wed Feb 18 10:04:55 1987. A comment to message 1131.

With the current V1.2 Kickstart, one word in each 64K gets trashed if it's RAM. This will mess up an RRD. Except for ExecBase, I think (using the normal Amiga memory-allocation stuff) that memory will be used after any other fast RAM. Perry's RRD does something like allocate from the top, right? So, if he stays out of C00000, all will be well, as the test for Auto-Config memory is nondestructive. An RRD that allocates from the bottom will tend to work anyway if you have Auto-Config fast RAM as well as C00000 RAM (you'd have to have a really large RAM disk to make it fail, anyway). Yes, it would have been nice if the C00000 memory check was nondestructive. Maybe next revision.

---

amiga/hardware #1135, from jdow, Wed Feb 1 13:29:32 1987. A comment to message 1133.

Er, how would you propose to allocate from the bottom without risking having the boot procedures clobber it? That sounds like a VERY risky proposition. It really sounds like the best bet is to limit the allocation algorithm to allocating from the top of the original 8-meg expansion area down. I had mine intentionally planned to limit itself to within the 24-bit standard Amiga address area because I don't want to use up a resource like 32-bit-wide turbo RAM with a RAM disk. I can easily change the test constant. I'm glad, though, that I was warned.

---

amiga/hardware #1136, from steveth, Wed Feb 18 22:20:45 1987. A comment to message 1133.

Wait a sec. I think that all of this RAM trashing doesn't make any difference, unless I'm mistaken. I assume that the routine that checks for extra chip RAM ($080000-$1FFFFF) is the same one that checks for fast RAM ($C00000-$D7FFFF). Now, if this is true, then data will not be stomped. The reasoning behind this assumption is that one of the ways to fix the 512K internal modification that is located at $080000 is to keep the RAM from being enabled until after the location has been checked for RAM. This is accomplished by monitoring the LED of DF0:. The circuit watches for a prolonged period of the LED being turned on, such as during the loading of Kickstart. After the LED goes out, the next time it comes on triggers the circuit to turn on the RAM, and the circuit locks in that mode until power-down. Finally, to the point: The circuit does not reengage on a warm boot (it wouldn't work anyway, as Kickstart isn't reloaded), and the system doesn't configure the RAM as chip RAM again. This seems to indicate that the testing for these RAM areas is NOT done on a warm boot! It would be done if you changed operating systems, as with the ChangeKick program, but I don't think anybody expects an RRD to survive THAT.

This is all coming off the top of my head, but it makes sense, doesn't it?

---

amiga/hardware #1137, from grr, Wed Feb 18 23:09:04 1987. A comment to message 1136.

The routine that checks for C0 RAM is specific to that purpose. It will mash a word in each increment. I think this will only happen when you reset the machine, but I'm not sure.

---

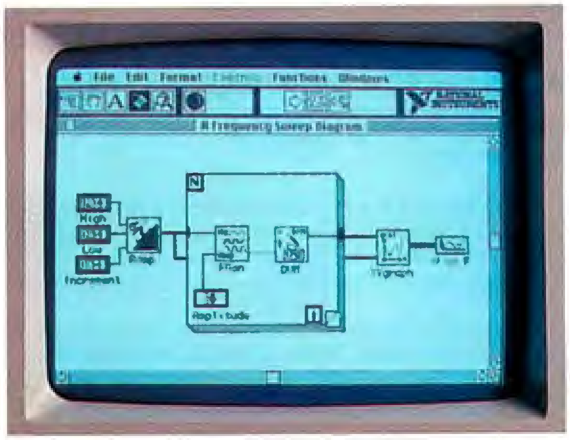
amiga/hardware #1140, from perry (Perry Kivolowitz), Fri Feb 20 16:43:03 1987. A comment to message 1136.

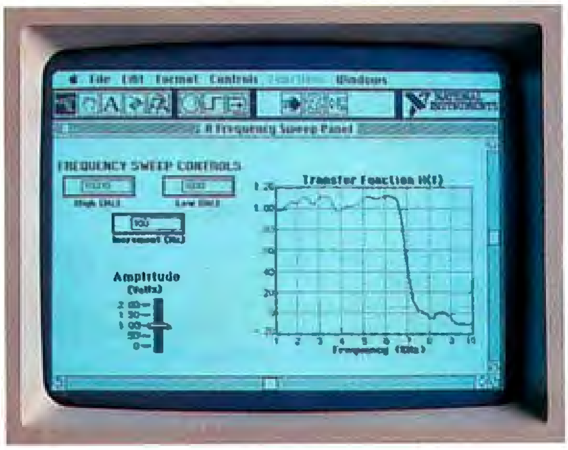
The recoverable RAM disk has been known to survive ChangeKick.

ATARI ST

The trials and tribulations of creating a program that writes IBM PC-compatible text files on a floppy disk starts out this month's Atari section. Next is a discussion of a strange bug in an early version of ST BASIC. Then, there's a thread in which BIXen discuss whether it's better to leave hard disks going all the time or to turn them off.

continued





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CREATING IBM PC-COMPATIBLE TEXT FILES

atari.st/questions #868, from mhadley (Michael Hadley), Sun Feb 1 05:22:20 1987.

Question: I am new here and I'm trying to write a fairly simple program, a short routine in assembler that allows me to use a 5 1/4-inch disk drive with a 6-millisecond step rate to create IBM text files. I am using a 1040ST and an M.C.C. Macro Assembler.

I know I need to be in the supervisor mode to write to the protected memory (to change Seekrate ($0440) or to insert the routine into the VBL queue ($04CE++)), but when I use any of the routines in GEM, BIOS, or the XBIOS, I get bombs. The locations in protected memory remain unaffected in spite of all my efforts to change them.

Here are a few questions for discussion:

1) What am I missing in all this information? This problem really has me bugged because I cannot get into the supervisor mode, no matter what I have tried so far.

2) Is there a SURE way to get into the supervisor mode (and out as well) that is not documented (apparently in error)?

3) Has someone already hacked this problem and is the solution available to us mortals?

---

atari.st/questions #869, from tskinner (Thomas Skinner), Sun Feb 1 14:30:00 1987. A comment to message 868.

I have used the GEMDOS Super function 0x20 with no problems. Are you using this or the BIOS call? It is difficult to know what you are doing wrong without seeing your code. The GEMDOS call is a bit tricky to use so read about it carefully. How many bombs are you getting? That tells you what the exception was.

---

atari.st/questions #870, from jtittsler (Jim Tittsler, Atari Corp.), Sun Feb 1 16:50:55 1987. A comment to message 868.

It should also be pointed out that just changing Seekrate ($0440) is NOT enough to change the CURRENT floppy seek rate.

David Small suggested one way of changing the seek rate in atari.st/questions #767, but you should be aware that since he is using undocumented variables there is an EXCELLENT chance that this scheme will not work with future versions of TOS.

---

atari.st/questions #872, from dsmall (David Small), Mon Feb 2 22:27:08 1987. A comment to message 870.

"Using undocumented variables" is really an apt way to describe my life history. . .heh.

Try setting $A08.W and $A0C.W to $00 from $03; that will slow down the seek rate. Basically, the seek rate in low memory is ignored after a disk is initialized (at system start-up).

While this may seem to be dodging the question, those two locations are not in protected RAM; hence, no problems.

PROBLEMS WITH EARLY BASICS

atari.st/questions #877, from dbetz (David Betz, BIX), 708 chars, Thu Feb 5 10:23:20 1987.

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Eric Jensen, the guy who wrote the BYTE review of the 520ST, gave me a call the other day and reported a rather strange problem that someone reported to him. It seems that there are some *very* strange bugs in ST BASIC. His example was this:

```
x=18.89
```

He said (and I didn't verify this because I don't use BASIC myself) that this resulted in a strange error message having nothing to do with the assignment statement itself, something like "unimplemented function." He further said that multiples of the magic value on the right (18.89) would cause similar but different strange error messages. Can anyone else verify this problem and is there a solution?

---

atari.st/questions #878, from jimomura (Jim Omura), Thu Feb 5 10:38:46 1987. A comment to message 877.

I've confirmed that x=18.89 yields the error report. Where x=18.89, you can use x=x/100 and have 18.89 properly stored. Interesting though.

---

atari.st/questions #926, from neilharris (Neil Harris, Atari Corp.), Sat Feb 21 12:00:31 1987. A comment to message 877.

The numeric accuracy of the original ST BASIC leaves something to be desired. The new version, written to our spec by Metacomco, is one bug away from release, and performs much better this way.

---

atari.st/questions #931, from dbetz, Sat Feb 21 12:07:50 1987. A comment to message 926.

This wasn't really a problem with numeric accuracy. The messages indicated that BASIC got *very* confused while doing a simple assignment. Will the new version fix these problems also?

---

atari.st/questions #932, from neilharris, Sat Feb 21 12:14:31 1987. A comment to message 931.

Well, I just tried x=18.89 in the new BASIC and it works fine.

---

atari.st/questions #933, from dbetz, Sat Feb 21 12:18:44 1987. A comment to message 932.

Thanks for checking it out, Neil. I'll pass the information on to Eric Jensen.

---

atari.st/questions #936, from sprung (Ron Sprunger), Sun Feb 22 00:21:21 1987. A comment to message 926.

Neil, have you tested the new BASIC from a shell? The old one didn't close its windows, so was unusable from a shell.

---

atari.st/questions #938, from neilharris, Sun Feb 22 01:25:37 1987. A comment to message 936.

I don't use a shell as a rule. But I do have the Mark Williams shell on the disk. Will check it out.

(. . . he quickly exits Flash, executes MSH, and runs BASIC. . .)

Everything worked fine, more or less. A bit sloppy-looking, there was an extra cursor when I ran BASIC, and some garbage left in the background, and when I quit BASIC I had a bunch of green on top of the screen, but it did work OK. Is that what you needed to know?

---

atari.st/questions #944, from sprung, Sun Feb 22 18:02:26 1987. A comment to message 938.

Actually, what matters is whether it works from the shell several times in succession, without the desktop being visited in the meantime. The desktop has some means of reclaiming windows, which I for one have been unable to duplicate. I can run BASIC or Logo or 1stWord from my shell once, but if I try to enter them a second time, that's all she wrote.

---

atari.st/questions #946, from neilharris, Sun Feb 22 19:46:48 1987. A comment to message 944.

I did go back and forth to BASIC from the shell several times. No problem.

HARD DISK TIPS

atari.st/questions #892, from jimomura, Fri Feb 13 22:06:39 1987.

What's the current wisdom in hard disk usage? If I use a computer often during the day and daily, is it better to park the head sometimes (say for breaks of 4 hours or longer) or is it better to keep it going? What's the point at which shutting down is better (or is it always better)?

---

atari.st/questions #895, from mlavelle (Mark Lavelle), Sat Feb 14 02:40:44 1987. A comment to message 894.

Parking certainly can't hurt (especially if you live in earthquake country), except to slow down your first access after the park. Shutting down is a tougher call. Mechanically speaking, it might be better sometimes, but the chips don't live as long if they get cycled a lot. Of course, the chips don't like line spikes either.

---

atari.st/questions #898, from jimomura, Sat Feb 14 10:04:33 1987. A comment to message 895.

I should also ask how bad it is to power down the drive without parking. That happened the other day due to a power failure.

Traditionally, the argument against stopping a hard disk at all is that head-crashing usually occurs on powering up. I've heard that a lot has been done about this, but I haven't followed the technology closely. I know that in some large commercial-quality disks, sufficient energy is stored to park the head on any unconventional power-down. I don't know if this is on all disks or just some. I presume that those disks automatically park. I guess I can presume that these disks don't (or you wouldn't need a "parkhead" utility). Leaving a disk running, of course, wears down the bearings in the drives and in time will wear down the capacitors in the power supply.

Also, is there any automatic head-cleaning system in these sealed drives to take off particle build-up that results from head crashes?

---

atari.st/questions #899, from heller (Robert Heller), Sat Feb 14 12:41:35 1987. A comment to message 898.

I know that *old* (open pack and cart) drives have a spring or magnetic arrangement, which retracks the heads on power- or spin-down. I think that the newer/larger hard disks have some similar hack.

Head crashes with Winchester drives: Usually the head/media section is a total loss. Could be rebuilt (i.e., at a factory), but usually those parts are junked. On *little* 5 1/4-inch jobs, it usually means replacing the whole drive. With bigger

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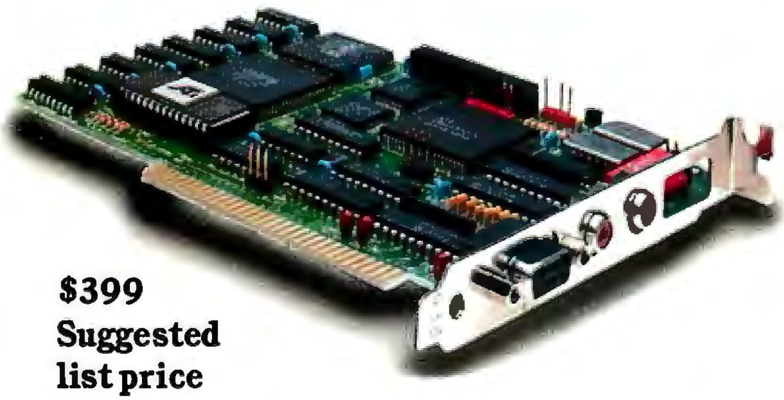

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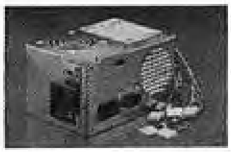


Winchesters (like DEC RA81s) you have to replace the main inner unit (sort of like a rebuild on-site).

Power cycling probably does at least as much harm as continuous running. The chips don't like the power coming and going and the drive motor has to work harder getting the disk up to speed vs. bearing wear, etc. Six of one, half a dozen of the other. I have not noticed severe problems with not parking the heads on little hard disks. It is only a problem if you plan to move the machine around. I always park the heads when I shut down my system. Of course, power failures cause it to be shut down without parking the heads.

---

atari.st/questions #904, from jtittsler, Sun Feb 15 17:38:15 1987. A comment to message 898.

The only time I park the heads of my hard disk drives is when I am planning on moving them somewhere (and I confess if it is just office-to-office, I don't even bother there). They seem to be pretty rugged.

As for cycling the power, I would guess that it could be a wash. I have one that gets cycled with the business day, and one at home that is on all the time for amateur radio purposes and haven't (yet) noticed any difference in this small sample size. I think most drive manufacturers do put some specification on spindle hours, so if you aren't using it, you might as well turn it off.

---

atari.st/questions #907, from jim__kent (Jim Kent), Mon Feb 16 02:03:03 1987. A comment to message 904.

Besides, if it's in the bedroom, the fan will keep you up all night.

---

atari.st/questions #905, from sprung, Sun Feb 15 23:09:14 1987. A comment to message 898.

I've got a dozen or so different hard drives, from 5 to 400 megabytes, most of which run 24 hours a day, 365 days a year. In the last five years, I've had zero disk failures. Because of having to move it around a lot, I parked my Supra 20 for the ST every day for about four months and packed it back and forth in a backpack. Likewise no problems. My brother swears it's better for the electronics to leave them running, so that's generally what I do. In my office at home, leaving three or four computers and drives and printers running all the time makes a lot of heat, so lately I've taken to shutting them down selectively. Hard to see that it makes much difference. I would sure never shut one down for a few hours - more like a few weeks.

IBM PC and Compatibles

We continue this month's Best of BIX with two threads from the IBM PC section. The first investigates the possible causes of a vexing intermittent error message in the system of Doug Webster, BIX's director of business and marketing. The final thread is a very long one that'll tell you everything you need to know about the index holes on floppy disks. This thread evolves into a discussion of where to get basic information on computer systems.

POSSIBLE CAUSES FOR PARITY ERRORS

---

ibm.pc/hardware #2288, from dweb (Doug Webster, BIX), Tue Feb 10 17:23:56 1987.

I've twice had something occur recently and can't figure out where it is coming from. I've got a PC with an internal hard disk and an add-on board that brings internal memory to 640K. Straight memory; no other razzmatazz on that board.

On at least two occasions, I've had XyWrite loaded up (no text file loaded, just Xy), and looked up to find the screen suddenly blank and a message reading Parity Check 1 in very large letters at the top of the screen. The ruler bar for XyWrite was gone and the screen was blank other than this message. I've had it happen on another occasion with a Parity Check 2 message.

I don't know what is generating the message. The system is locked at that point and good old Ctl-Alt-Del won't work. I have to power down and reboot. Then things work fine again. Anybody have any ideas? Is a chip going bad on the memory board?

---

ibm.pc/hardware #2290, from kquirk (Kent Quirk), Tue Feb 10 17:28:59 1987. A comment to message 2288.

Sounds to me like you've got a failing (not failed) memory chip. That's in the IBM BIOS, and it happens whenever the system detects a parity error. A couple of suggestions:

1) Do you have the switches set so that you don't do a memory test every time you boot up? Or so that you have more memory than the switches know about?

2) Run the diagnostics; let the system beat on the memory for a while. I mean the disk-based diagnostics. If you get a failure, that'll tell you which chip to replace. If you don't get a failure, well, back up a lot.

---

ibm.pc/hardware #2292, from dweb, Tue Feb 10 17:36:19 1987. A comment to message 2290.

One, the system is doing a memory test each cold boot-up because it pauses for a fair spell after power-on before booting in DOS from the hard disk. There are no indications of problems at that point. The switches were set per installation instructions to alert the PC to the memory now on-board. From installation until recently there had been no problems.

---

ibm.pc/hardware #2293, from kquirk, Tue Feb 10 17:43:12 1987. A comment to message 2292.

I still think that you should just run the diagnostics for a while. If it's a temperature-related problem, then you might be happy for a bit before failing, and power-up self-tests won't catch it. Also, it sounds intermittent.

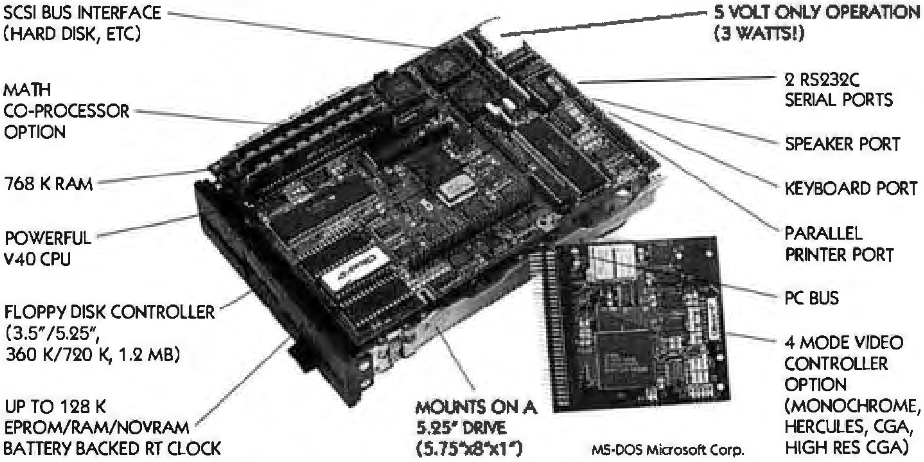
I had a problem like this once, ran the diagnostics overnight, and woke up to find an error message on the printer. I replaced that chip, and it never happened again. Now that I think about it, I think I only removed it and reinserted it. Try that.

---

ibm.pc/hardware #2297, from cdanderson (C. David Anderson), Tue Feb 10 20:46:40 1987. A comment to message 2292.

You might also try pushing the memory chips into their sockets – sometimes they work out a bit over time (especially if you don't leave your machine on all the time) and, I think, this tends to make the connections flakey. Or, even take them completely out and replace them.

continued



---

ibm.pc/hardware #2295, from skluger (Sigi Kluger), Tue Feb 10 19:02:07 1987. A comment to message 2288.

Bus contention. Your add-on board could be violating memory-access specs and overlapping with a main-memory access. I'm sure there are other possibilities, too. . .

---

ibm.pc/hardware #2304, from dweb, Wed Feb 11 08:36:11 1987. A comment to message 2295.

I doubt that, because I've had the extra memory in place for several months and have been using this XyWrite package even longer. I have only recently had the troubles described.

---

ibm.pc/hardware #2296, from brewster (Brewster McPherson), Tue Feb 10 19:56:03 1987. A comment to message 2288.

What else do you have hooked into the same power circuit? I've had an experience with Parity Check 1 before and tracked it down to a power problem. Where the IBM PC was stationed there was a photocopier on the same circuit as well as one of those library gizmos that lets you take a book out, as well as some other assorted stuff. Whenever the photocopier went on, the machine would drop out with a Parity Check 1. We eventually solved the problem by putting a surge sentry/line filter unit on the line, and it worked beautifully after that.

DISK INDEX HOLES

---

ibm.pc/drives #963, from hans (Hans Bottjer), Thu Jan 29 16:52:23 1987.

Somebody asked me what the little hole next to the central hub on a disk is for. I told him it was the index hole, but I'm not sure what it's used for other than giving the disk drive itself an idea where on the disk the heads were. We cut another hole, just opposite the original one and the disk was "Not Ready. . . ," etc. I covered the original hole and the disk worked fine. What does that hole do?

---

ibm.pc/drives #964, from bbrown (Bob Brown), Thu Jan 29 18:26:05 1987. A comment to message 963.

A light and photo detector are on either side of the hole. When the photo detector sees the light, sector 0 is just coming under the heads. That's how the drive and controller know where sector 0 is. They find the rest by counting from the first one.

---

ibm.pc/drives #965, from mhaas (Mark Haas), Thu Jan 29 19:40:28 1987. A comment to message 964.

Just to amplify a bit, the single index hole is found on what are called "soft-sectored" disks. As Bob points out, it is sensed by an optical sensor, which in turn signals the computer that sector 0 is about under the read/write head of the drive. Each sector is defined on the disk by certain data bytes written to the disk during formatting, and once the first sector (0) is located by the index hole, the rest are counted off.

There is also such a thing as "hard-sectored" disks where you would see a bunch of holes around the hub. In this case, each one marks the start of a new sector.

---

ibm.pc/drives #966, from bbrown, Thu Jan 29 21:44:36 1987. A comment to message 965.

I started to include "hard-sectored" in my message, but I realized that I haven't a clue how the controller figures out *which* hard sector is 0. That has to be, er, hard.

---

ibm.pc/drives #967, from skluger, Thu Jan 29 21:54:12 1987. A comment to message 966.

A hard-sectored disk has n + 1 holes, the sector 0 hole being halfway between two index holes. I was using 10- and 16-sector disks on North Star and Vector equipment.

---

ibm.pc/drives #971, from mhaas, Fri Jan 30 02:28:27 1987. A comment to message 967.

Thanks, Sigi. I'll be able to sleep tonight. :-)

---

ibm.pc/drives #970, from mhaas, Fri Jan 30 02:26:25 1987. A comment to message 966.

>haven't a clue how the controller figures out *which* hard sector is 0.

Neither do I, but I managed to write around that point. :-)

---

ibm.pc/drives #973, from hans, Fri Jan 30 09:39:07 1987. A comment to message 966.

More of a comment on 964, but to keep the stream going. . .

Why did the disk work when I cut a new hole in the disk? It wasn't even near sector 0, but the disk still read and wrote information off the disk properly. I know the disk needs some kind of reference point, but I don't think the disk should still work with a "bogus" hole in it.

Somethin' just ain't workin' right here.

---

ibm.pc/drives #974, from dmick (Dan Mick), Fri Jan 30 19:52:10 1987. A comment to message 973.

Did you cut a new hole in the brown oxide-covered disk or the sleeve? If the former, I'd say you were lucky. If the latter, the sensor wouldn't be looking at the right spot to be confused by the new hole. But perhaps the disk stopped on sector 0 (I've seen 'em do that) and it was the right hole, or the first hole it encountered was the right hole. Tricky business, anyway.

Could be that it must be at a certain place compared to the sync marks, too, and that any "fake" hole indications won't screw it up. Bet if you reformatted it'd be unusable.

---

ibm.pc/drives #984, from hans, Mon Feb 2 09:25:57 1987. A comment to message 974.

Well, I cut the new hole in the disk itself, using the hole on the sleeve as a guide. I then covered up the old one with a piece of a write-protect tab.

Worst thing is, I *did* try and reformat it and it still works (although I don't plan on using it for much all the same).

---

ibm.pc/drives #985, from mhaas, Mon Feb 2 12:21:02 1987. A comment to message 984.

Oh. If you covered up the old hole, so there was still only one hole, then that explains why it still works. If you kept both holes, it should get the computer confused.

---

ibm.pc/drives #986, from hans, Mon Feb 2 14:30:44 1987. A comment to message 985.

Ah, but doesn't the hole tell the drive where sector 0 is? Unless the sectors go out from the inside of the disk, that hole should be in sector 4 or something. It did get messed up with both holes open.

continued

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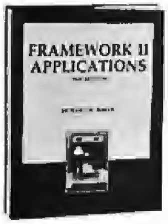
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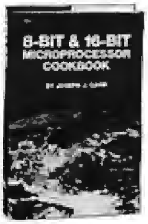
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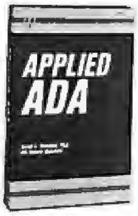
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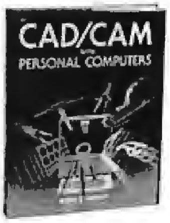
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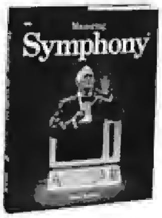
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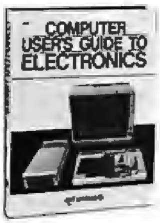
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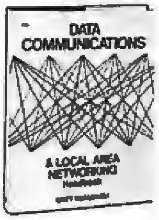
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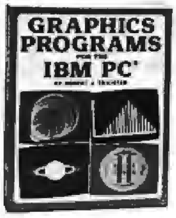
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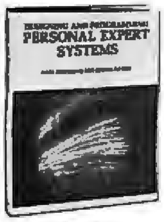
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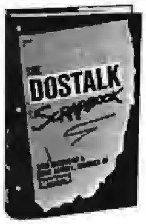
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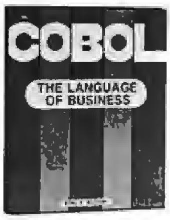
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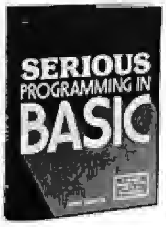
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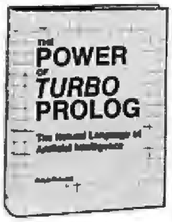
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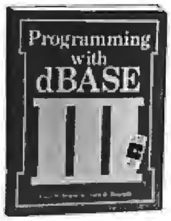
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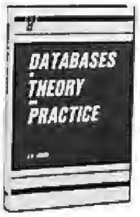
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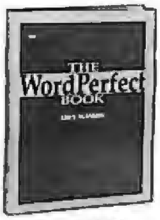
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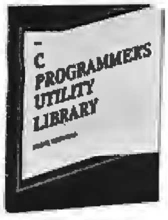
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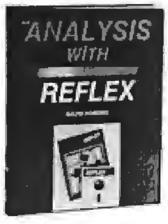

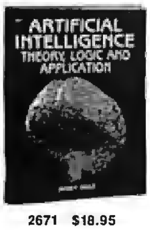
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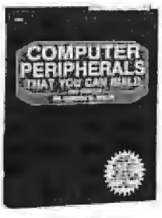
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Inquiry 67

I should mention that reformatting gave me some bad sectors on the disk.

---

ibm.pc/drives #987, from drifkind (David Rifkind), Mon Feb 2 15:09:04 1987. A comment to message 986.

The index hole has two functions. When formatting, it tells the drive where to start the track. When reading and writing, it is used to detect missing sectors. If the drive sees the index hole twice without finding the sector it's trying to read/write, it reports an error. The drive doesn't care about where the start of the track is when read/writing, just about whether the sector you're looking for is there or not.

DOS does not give up so easily, though. If an error is reported while it's trying to read or write the disk, it will try again several times. With an extra index hole, finding the sector before seeing two index marks go by depends on just where the disk is in its rotation when the operation begins, so chances are that one of those retries will succeed. A note to programmers: INT 13h does not do those retries, but INT 25h and 26h do. If you're trying to imitate DOS's disk access, use those services or you might end up reporting errors on a disk that DOS thinks is just fine.

---

ibm.pc/drives #988, from dweb, Mon Feb 2 16:57:55 1987. A comment to message 985.

However, let us suppose that he formatted the disk using the original disk with its original reference hole and then recorded some files on it. If he then put a new hole on the disk and covered the old one, wouldn't he find it impossible to locate those files again, since the files would then be offset from a newly created reference point and the drive wouldn't know where things started? If he reformatted everything after creating the new hole and covering the old one, then the format would correctly reference only the one hole, from wherever it started things on the disk.

---

ibm.pc/drives #989, from geary (Michael Geary), Mon Feb 2 23:14:06 1987. A comment to message 988.

No, once the disk is formatted, the sectors are self-identifying. As David said, the drive just cares that it finds the sector it wants sometime before it sees the index hole twice. It doesn't care where the sector is in relation to the index hole.

---

ibm.pc/drives #990, from hans, Tue Feb 3 15:45:12 1987. A comment to message 989.

Ah HAH! That sounds like a very reasonable explanation. I think this got into a little bit more detail than my friend expected, but *I* still appreciate the effort.

---

ibm.pc/drives #978, from drifkind, Sat Jan 31 14:40:05 1987. A comment to message 973.

MS-DOS retries failed-disk operations, usually four or five times. Depending on the location of your "extra" index hole, I would expect the low-level operation to fail about one time out of four. Depending on timing, you might never see an error message, but disk operations are probably quite a bit slower on that disk. If you use INT 13h to access the disk, you'll see a lot more failures.

---

ibm.pc/drives #968, from nickbaran (Nick Baran), Thu Jan 29 23:33:57 1987. A comment to message 964.

Just curious, but where did you learn that? Are there books available that describe disk drive technology?

---

ibm.pc/drives #969, from bbrown, Thu Jan 29 23:39:16 1987. A comment to message 968.

Beats me! But I have a long white beard and can describe the inner workings of pre-WWII biquinary relay calculators. I suspect that any of the "This is a Computer" books will do. If you have specific questions, ask in the appropriate topic on BIX.

---

ibm.pc/drives #980, from nickbaran, Sun Feb 1 01:21:30 1987. A comment to message 969.

No need to get sarcastic. Most "This is a Computer" books do not describe how photo detectors on floppy disks work. I was hoping you might know of some more in-depth texts on how both floppy and hard disk drives are designed and engineered.

---

ibm.pc/drives #981, from bbrown, Sun Feb 1 11:29:20 1987. A comment to message 980.

Sometimes it's easy to forget that a statement that might sound perfectly reasonable with tone-of-voice and body language clues could be offensive in cold print. I am sorry to have offended; I didn't mean to.

What I was trying to say is that how the index hole works is a bit of knowledge I "picked up along the way," rather than something I learned formally. It may be that I extrapolated that fact from having worked with removable disk packs, which have an analogous "index notch" on the bottom platter. I really *don't* know how I know that. (Ummm, and we really *were* discussing biquinary relay computers in another conference, but that degenerated into a discussion of where quinine comes from. :-)) I am surprised to hear that introductory books don't explain the hardware in enough detail to cover index holes. In the next several weeks I'm going to have to go through several such books to prepare a bibliography. Maybe I can find one that has enough depth. Alternatively, I see from your resume that you have considerable writing experience. Maybe there's a market for a "second level" of computer information books.

---

ibm.pc/drives #982, from nickbaran, Sun Feb 1 14:28:16 1987. A comment to message 981.

I guess the reason I raised the question of in-depth books to begin with is that there are obviously many technically proficient computer users who have a lot of questions and doubts concerning the inner workings of disk drives, as shown by the activity in this conference. Disk drives are clearly fairly complicated mechanisms and from an engineering point of view, there are a lot of technical details that are not covered in popular introductory computer books. There are many books on the inner workings of internal combustion engines, for example, but I haven't seen such books on magnetic storage media in general.

In any case, sorry about the misunderstanding above. As you say, it's easy to misinterpret the written word.

---

ibm.pc/drives #994, from gingle (George Ingle), Wed Feb 4 01:36:54 1987. A comment to message 982.

Alas, with thousands of dollars of computer equipment and software, the act of human communication is still imprecise.

You're right about the current level of books available for, shall we call them, the second generation of users? The first generation being the people who designed and built the forerunners of the systems we are using today. The second generation is now using these systems, without having been intimately involved with their design and construction. I believe this is why so many computer-related publishers have

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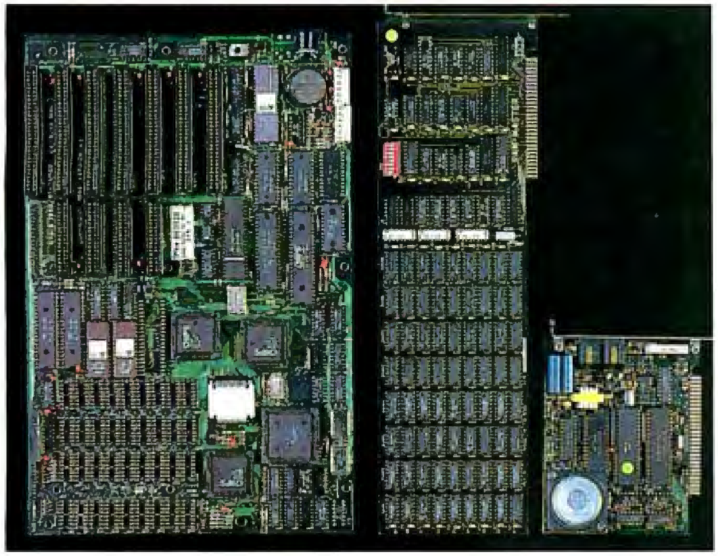

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Inquiry 330

folded over the last few years. The majority of new computer users did not want (or did not have the background necessary) to understand the actual electronics and mechanics of the computers they were using. The best place in the world to get information on disk drives is a technician's service manual.

I think that this why so many computer books were written at the "This is a Computer" level of information.

---

ibm.pc/drives #983, from petewhite (Peter White), Sun Feb 1 21:10:40 1987. A comment to message 982.

From "Understanding Digital Computers," a Radio Shack Publication (62-2027):
"Incidentally, did you notice the three holes in the envelope of the floppy? The center hole, obviously, is for the motor drive mechanism. The rounded rectangular hole permits the recording head to make direct contact with the surface of the floppy. The small round hole permits the drive system to identify various data locations on the disk by one or more holes around its surface. It's called the 'sector hole.'

"Let's discuss the sector hole, since it's very important. Information on each of the data tracks around the surface of the disk can be stored in one or more locations called 'sectors.' There are two ways of dividing a disk into sectors. 'Soft-sectored' disks have only one sector hole. A computer program (software) is required to divide the disk into sectors and, while this provides considerable design flexibility, the program can be difficult to design and use."

" 'Hard-sectored' floppies have 32 or more sector holes, and this permits a data track to be divided into 32, 16, 8, 4, 2, or 1 sectors. Electronic control circuits built into the drive system take care of the 'housekeeping' chores necessary to store and retrieve data in various sectors. Most commercial floppy systems use the hard-sector approach."

Yes, an old book - but one of the best ever found to help explain just about anything in basic digital computers. In fact, it explains hexidecimal arithmetic so well it has helped several who COULDN'T understand hex at all.

Stay tuned, folks, next week it's "Learn about binary logic, how it works, and how to use it."

---

ibm.pc/drives #995, from gingle (George Ingle), Wed Feb 4 01:38:38 1987. A comment to message 983.

Is this going to be one of those "on again/off again" things?

---

ibm.pc/drives #996, from dmick, Wed Feb 4 01:40:33 1987. A comment to message 983.

Does it explain how to *spell* "hexadecimal" as well, Pete? <grin>

---

ibm.pc/drives #1012, from johnf (John Fistere), Thu Feb 12 02:03:12 1987. A comment to message 983.

Does it explain why a "2s complement" is so named? I've heard a few theories, but none that wrap it all up.

---

ibm.pc/drives #1024, from alf (Eric Klien), Mon Feb 16 20:43:56 1987. A comment to message 1012.

A 2s complement is a 1s complement plus 1. 1 + 1 = 2, so it's called a 2s complement.
the "This is the keyboard" level of information.

MACINTOSH

This month's Macintosh section has two threads. The first, long though it is, is a prime example of the type of discussions that evolve on BIX. It covers the potential advantages, disadvantages, and stumbling blocks of converting an IBM PC program written in C to the Mac. If you're wondering about getting started in Mac programming, read this thread. Then there's a short thread on font-spacing problems in MacWrite.

GETTING INTO MAC SOFTWARE DEVELOPMENT

---

macintosh/softw.devlpmt #810, from lee.richardson \ (Lee Richardson), Sat Feb 14 22:49:.25 1987

A couple of questions about Mac software development:

First, I have an application, written in C for the IBM PC, that takes up about 50K after it's compiled. I want to port it over to the Mac using a reasonable amount of the Mac goodies (windows, menus, etc). I know C, and have been using Mac programs for over a year, but have never done any C programming on it. How much time should I allow for learning all the Mac's idiosyncrasies? Any rules of thumb for conversion time after that? I'm looking for ballpark figures.

Second, an obvious question to go along with that: What are some good references for learning the Mac? Is LightspeedC the C of choice right now? Thanks!

---

macintosh/softw.devlpmt #811, from lloeb (Larry Loeb), Sun Feb 15 09:24:07 1987. A comment to message 810.

Gee, that's a hard one. You should read Apple's "Inside Macintosh," of course. That alone can take a good month (part-time). Some C compilers will default a stdio to a default window so you can program the Mac like a glass TTY. But that method doesn't avail you of all the Mac's features (which I'll assume is why you want to port it). My gut feeling is that the average newcomer to Mac programming will take three months to become barely proficient (I have no data to back that up, just a feeling).

And yes, LightspeedC is a very good environment and cheap to buy.

---

macintosh/softw.devlpmt #812, from nwallach (Naor Wallach), Sun Feb 15 16:33:50 1987. A comment to message 810.

Plan to devote a LOT of time. The Mac is not the simplest of computers to write for. Good references are Apple's own "Inside Macintosh," which is currently sold as a four-volume set. LightspeedC is probably one of the better C compilers out there. Current version is 2.0. Good luck!

---

macintosh/softw.devlpmt #813, from lee.richardson \, Sun Feb 15 17:59:.03 1987 A comment to message 812.

Thanks. That's about what I had figured. This would be a contract job and I was wondering how long it would be before I could put any billable hours into it. Was hoping there was something to go along with "Inside Macintosh." I have heard that it can be fairly dense in a lot of places.

---

macintosh/softw.devlpmt #822, from nwallach, Mon Feb 16 18:03:43 1987. A comment to message 813.

Another source of info that might be less dense is "Macintosh Revealed: Programming the Macintosh Toolbox" by Steve Chernicoff. It doesn't cover everything you will need to know, but it will be easier to start with.

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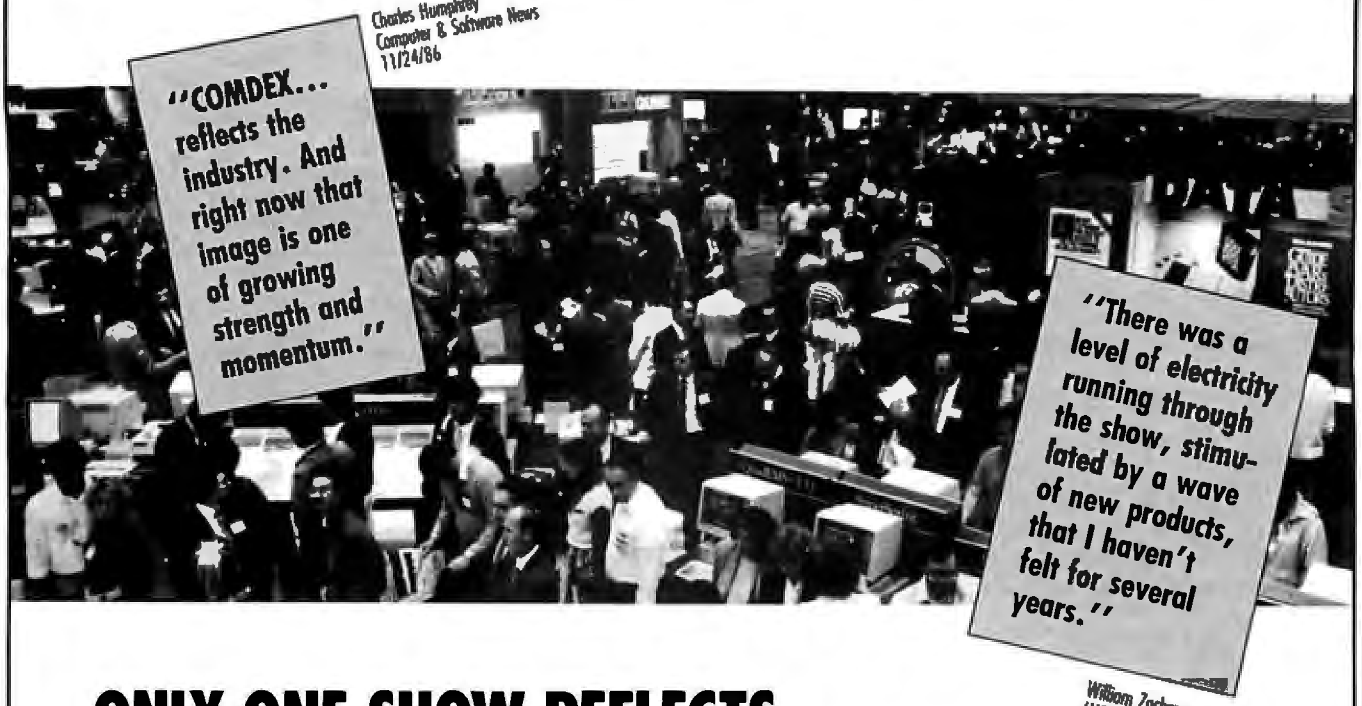

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Another good reference is "Programming the Mac in C" by Cummings and Pollack, which seems to apply very well to your request. It was written with another compiler in mind, but you shouldn't have much trouble converting. Good luck.

macintosh/softw.devlpmt #823, from ccrawfor (Chris Crawford), Mon Feb 16 21:10:00 1987. A comment to message 813.

I very much like Scott Knaster's book "How to Write Software for the Macintosh." It goes a long way towards demystifying the Mac. "Inside Macintosh" is a good reference, but it's murder on somebody just learning the Mac. Scott's book is nowhere near so intimidating, much more fun, and covers all you need to get rolling.

macintosh/softw.devlpmt #826, from lee.richardson \ , Tue Feb 17 02:26:.30 1987 A comment to message 823.

That's the kind of book I had in mind. The classic comment I've heard about "Inside Macintosh" is that to understand any one section you have to understand all the other sections first.

macintosh/softw.devlpmt #814, from ericz (Eric Zocher), Sun Feb 15 19:43:52 1987. A comment to message 810.

I agree with what's been said so far. Another book that might prove useful is "Using the Macintosh Toolbox with C" by Huxham, Burnard, and Takatsuka, published by Sybex. The code in it is written in Consulair C, but that isn't a problem since the LightspeedC manual has an excellent section on the differences between LS and the other Mac Cs.

Another thing that could prove valuable, especially if you're doing commercial work, is the "Macintosh Technical Notes" series, available from APDA.

macintosh/softw.devlpmt #817, from lee.richardson \ , Mon Feb 16 02:17:.50 1987 A comment to message 814.

I'll check out both the Sybex book and the Technical Notes. I figure the more stuff I read, the better chance I have of understanding what's going on. Is there an address for APDA on the board?

Just to get some idea of directions maybe NOT to go in, would MacApp or the Macintosh Programmers Workbench be worthwhile to investigate? It looked like using MacApp would imply learning object-oriented programming (another level of complexity I don't need right now), and that MPW hasn't been released for general use.

macintosh/softw.devlpmt #819, from kschmucker (Kurt Schmucker), Mon Feb 16 10:10:16 1.987 A comment to message 817.

I have a radical suggestion for you: Use MacApp to port your application to the Macintosh. MacApp packages much of the Mac's mysteries for you in easily used objects. Problems like printing, window management, desk-accessory compatibility, etc., just vanish with MacApp, since it takes care of all these for you.

There ARE two problems, however. The first is that MacApp is currently only callable from Object Pascal and Object Assembler. The shell of your Mac application will have to be in Pascal. However, you can still call the C routines that you will port over from the PC. To the extent that your PC application is well-modularized (user-interface stuff separated from the fundamental computations that form the basis of the application), this is usually not too difficult.

The second problem is that you must learn a little bit about object-oriented programming. Luckily, this is not too hard and there is a great book: "Object-Oriented Programming for the Macintosh." (Sorry guys, I just COULDN'T help it!!). Don't let the fact that I wrote the book sway you one way or the other.

Final note: Both MPW and MacApp ARE available in final form from APDA. Even if you don't decide to look into MacApp at this time, get MPW. The development system of choice, especially if you come from a UNIX background.

macintosh/softw.devlpmt #820, from tom_thompson (Tom Thompson, BYTE), Mon Feb 16 15:13:28 .1987 A comment to message 819.

Best bet is to get hold of the SKEL package, which has a basic Mac application skeleton in C. This shows you how to set up event handlers, summon up dialog boxes, and call DAs. I even think it's on BIX somewhere (Larry?). I've used this to build a Mac application in short order but, then, I've been steeping myself with Mac mysteries via "Inside Macintosh" for about a year. You'll need to learn and understand resources before you get too far. Latch onto the Resource Compiler version 2.0 (most C compilers provide it, so it's not a problem) and ResEdit (some compilers provide this also, some don't). You can find out *a lot* by poking around within an application with ResEdit. Just make sure you're working on a COPY of a program; ResEdit can really munge things in a hurry.

I recommend LightspeedC; it's a solid product, and quick. It fits on my Fat Mac and two external disk drives at home. They also provide the resource compiler and ResEdit.

macintosh/softw.devlpmt #825, from lee.richardson \ , Tue Feb 17 02:24:.28 1987 A comment to message 819.

OK, using MacApp sounds like one reasonable direction to go in. However, where do you think the trade-off lies between learning object-oriented programming versus not having to learn quite so many Mac details? I know nice, normal Pascal pretty well, but am somewhat intimidated by having to learn the Mac AND a different programming philosophy.

In a different direction, does using MacApp cause any performance degradation in your resulting programs? Don't you also have to have at least a Mac Plus to use it?

macintosh/softw.devlpmt #828, from kschmucker, Tue Feb 17 07:07:37 1.987 A comment to message 825.

Replies to your MacApp questions:

1. MacApp currently requires at least 1 megabyte of RAM for development, though applications developed with MacApp can run on 128K machines.

2. Performance degradation: Basically, no. This is one of the most common misconceptions of object-oriented programming. Demos I have given of MacApp applications at MacWorld shows and other places typically convince people that this is not the case. (Of course, if you are one of those people for whom tightly hand-coded assembly language is BARELY fast enough, then you may feel otherwise. . . .)

3. Where does the learning trade-off occur? This is a hard question. In my opinion, if you learn QuickDraw and a handful of file-system calls (FSOpen, etc.), you can get your MacApp application off the ground and a long way toward completion. (The best book for this is "Macintosh Revealed" by Chernicoff). Will you want to eventually learn about resources, dialogs, and bunches of other stuff? Sure, but the operative word here is "eventually." Will you ever have to learn about the Window or event managers? Probably not, unless your application is most unusual. MacApp handles all this for you.

continued

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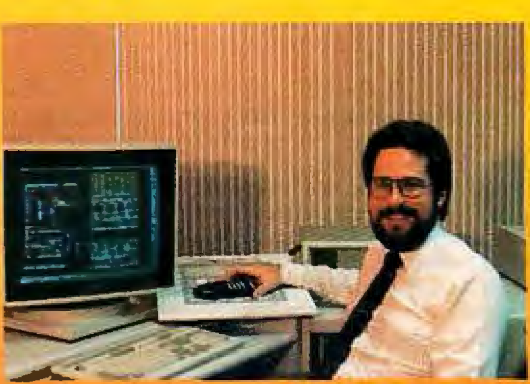

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Don't let buzzwords like "object-orientation" scare you. OOP is really a comprehensive embodiment of all the proven topics in software engineering (data abstraction, modularity, top-down design) with a couple of new ideas thrown in (inheritance and dynamic binding). OOP just gives you language support for the things you are probably doing now on your own.

Consider the following analogy: If someone held your feet to a fire, could you code a recursive algorithm in FORTRAN? Sure you could. It would be messy maintaining your own stacks, popping and pushing for routine invocation, but you could do it. Should you? Of course not. Such a task is only worthy of a student. A real pro, if a recursive algorithm was the best solution, would choose a modern language like C, Pascal, or Ada, since they support recursion. Similarly, OOP and object-oriented languages give you language support for the kinds of things that help you manage your application in the large: modularity, complexity control, flexibility.

(In case you can't tell, I'm a totally committed object-oriented evangelist!! I will get down from the pulpit now.)

---

macintosh/softw.devlpmt #830, from lee.richardson \ , Thu Feb 19 00:44.:16 1987 A comment to message 828.

Thanks for the answers about MacApp - that's just what I wanted. I was at a fairly good-sized bookstore yesterday and couldn't find any reference to MacApp at all (too soon?), so this gives me a better idea of what it is. I did pick up the first volume of "Macintosh Revealed."

I've got a little more info about this possible programming project, and it turns out that there are 60,000 lines of C in the original PC-DOS version of the program (I'm wondering how accurate that is, but that's what I was told). It seems that a program of that size would start to benefit from modularity, complexity control, flexibility, et al, so it may make sense to go the MacApp route. I really have no objections to learning OOP, since it seems like a direction programming is heading in anyway; I just don't want to overload my learning capacity.

Actually, this whole project is beginning to sound unrealistic. The person who owns the program wants a mostly working version in 2-3 months. Completely overlooking any Mac learning time involved, it seems that 2-3 months would be just about enough time to get a solid idea of what those 60K lines were doing to start with, with another 3-6 months to get something decent running on the Mac. One of us is being pretty unrealistic, and I hope it turns out to be him.

---

macintosh/softw.devlpmt #831, from kschmucker, Thu Feb 19 08:05:14 19.87 A comment to message 830.

Most B. Daltons carry "Object-Oriented Programming for the Macintosh" (Hayden/Sams is the publisher). It came out last summer, so it is not too early. As you can probably guess, I look for it in every bookstore I go in. My hit rate of late as been close to 100%.

However, if you are having trouble, call the publisher directly to order: 1-800-428-SAMS. Have your MC or Visa number handy.

---

macintosh/softw.devlpmt #832, from tom_thompson, Thu Feb 19 09:16:26 .1987 A comment to message 830.

60K lines? Hope a lot of that's comments. It would definitely help. If there's no comments at all, I'd toss the thing.

---

macintosh/softw.devlpmt #824, from ccrawfor, Mon Feb 16 21:16:24 1987. A comment to message 817.

I've been using MPW now for two months, and I am very pleased with it. The environment is solid, can be used in numbskull fashion (a great feature for me), and has lots of room for growth. I started off using only its most rudimentary features and was very pleased with it. As time has passed and my confidence has grown, I have started to play with some of the snazzier features, but there's so much in there that I'm sure I'll still be improving my use of it years from now. The Pascal compiler is good, bug-free, and quite fast enough (beats the hell out of Lisa Pascal running out of a ProFile), especially when you use the $LOAD directive. The MAKE facility is *extremely* useful, but takes a while to figure out. You THINK that you're writing a slightly intelligent programmed EXEC file, but in truth you're doing something very different, and until you get the feel of MAKE, it will drive you nuts. Once you get over that problem, MAKE is wonderful.

So I'm very happy with MPW.

---

macintosh/softw.devlpmt #827, from lee.richardson \ , Tue Feb 17 02:27:.28 1987 A comment to message 824.

So it looks like my first step here is to chase down APDA and see what they have to say about both MPW and MacApp, and then go from there. That's certainly enough to get me started.

---

macintosh/softw.devlpmt #818, from frankb (Frank Boosman), Mon Feb 16 02:23:59 1987. A comment to message 814.

Don't forget probably the best third-party book on programming the Macintosh, "How to Write Software on the Macintosh," by Scott Knaster. It contains an excellent section on debugging your program, which is probably what you'll spend most of your time doing.

FONT SPACING IN MACWRITE

macintosh/software #724, from lgeoffrion (Lee Geoffrion), Sun Feb 1 19:55:37 1987.

I ran into a strange problem with MacWrite 4.5 that maybe someone out there can clarify.

A colleague had written his dissertation using MacWrite the in Times font (12 point). Rough drafts were done on an Imagewriter. Since theses have severe format restrictions, considerable time was been spent laying out 400 pages of manuscript.

When he went to print the final draft on a LaserWriter, all lines ran about 3/8 inch longer than the Imagewriter, even though there were no additional characters in each line. More importantly, the final output did not match the displayed rulers.

I thought it might be a spacing difference between the Imagewriter and the LaserWriter. We tested it by converting part of the thesis to Microsoft Word. In Word, the screen line lengths and LaserWriter line lengths agreed perfectly. Thus, the problem seems to reside in how MacWrite calculates character spacings.

Is this just a feature (bug) of MacWrite, or have we done something very wrong?

---

macintosh/software #732, from pbrewer (Phillip Brewer), Tue Feb 3 20:00:29 1987. A comment to message 724.

I've seen this problem discussed on other nets. The solution is to put a LaserWriter driver on the system disk, go into Chose Printer and select the LaserWriter as the printer, and then go into the Page Set-up dialog and click OK. This will tell the text editor that you will really be printing on a LaserWriter and it will adjust the line lengths accordingly. This works even if you don't have a LaserWriter hooked up. ■

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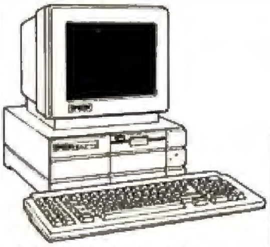

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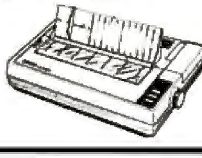

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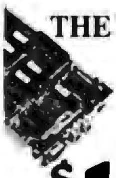

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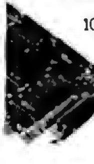

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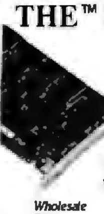

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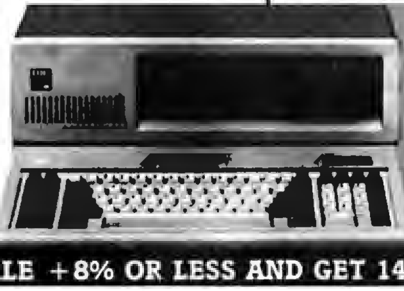

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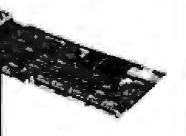

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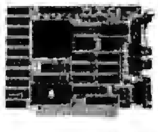

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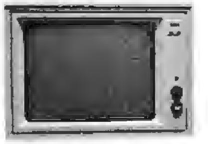

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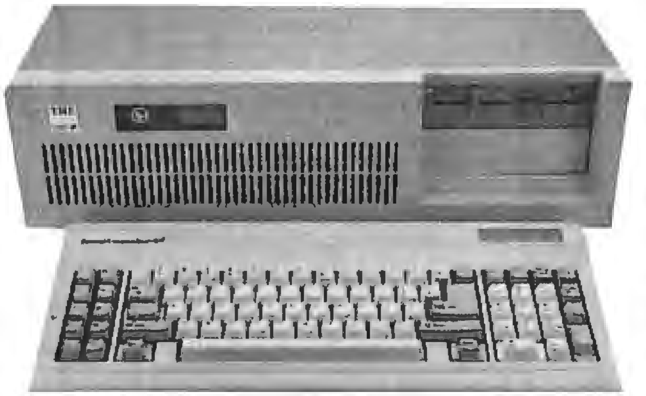

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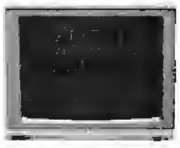

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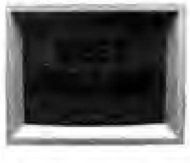

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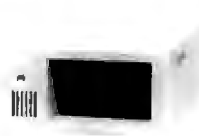

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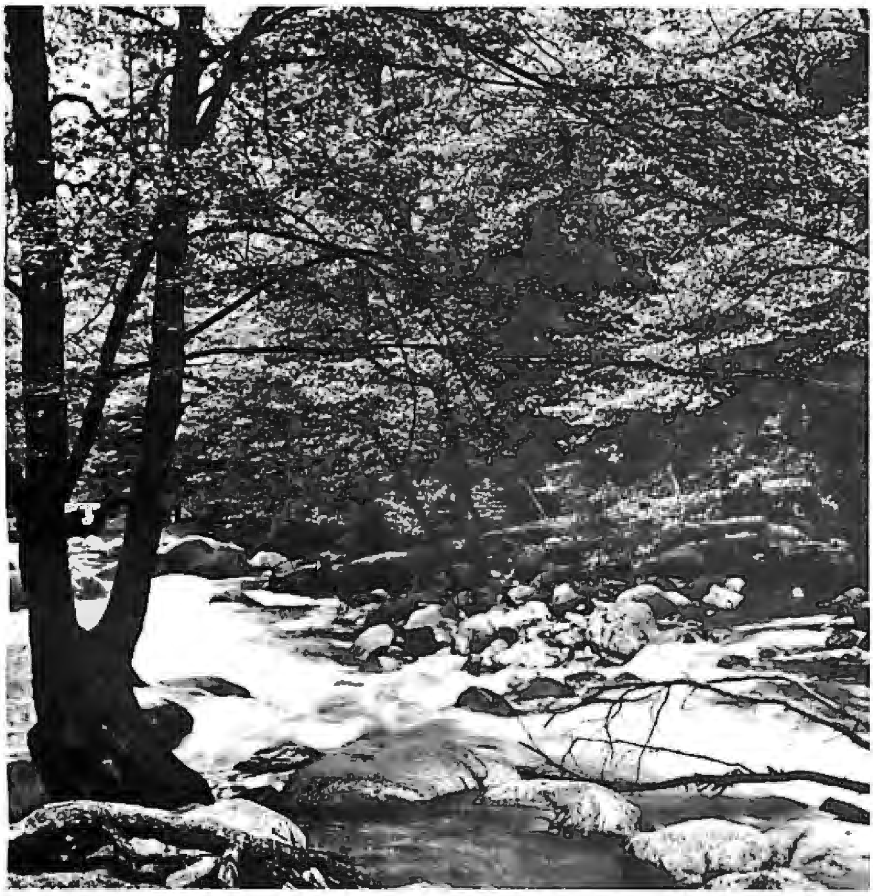

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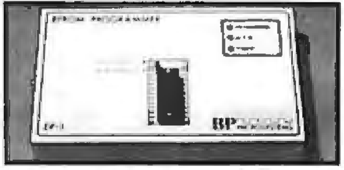

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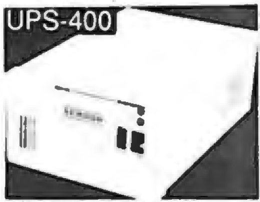

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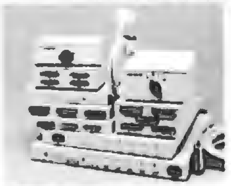

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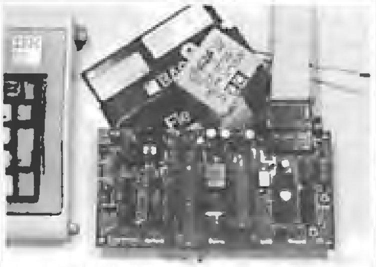

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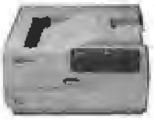

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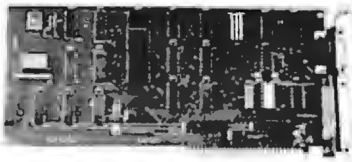

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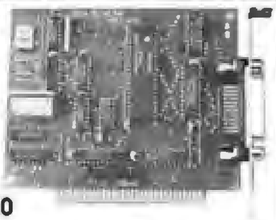

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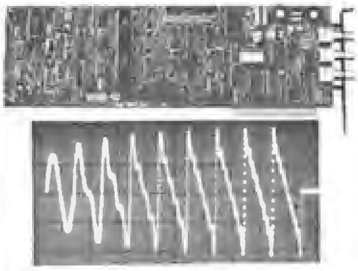

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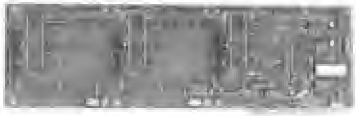

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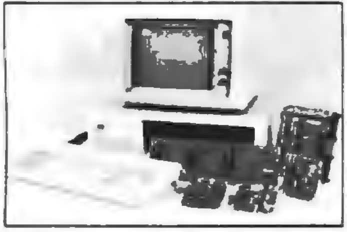

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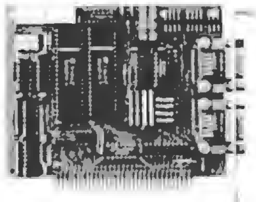

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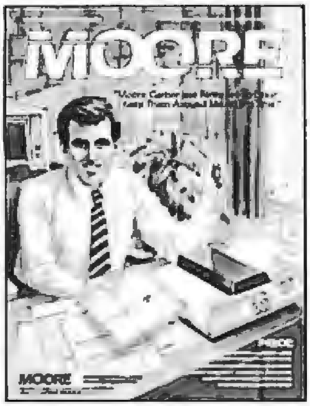

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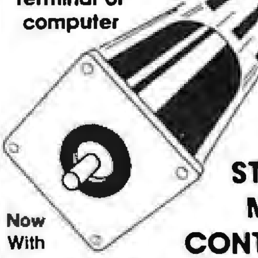

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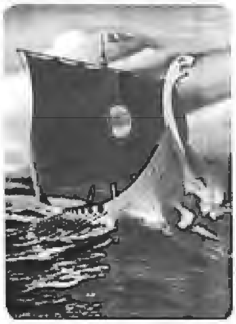


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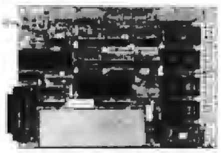

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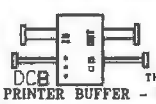

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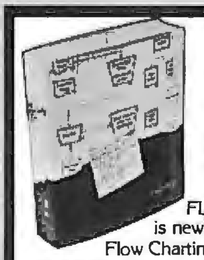

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Inquiry 232

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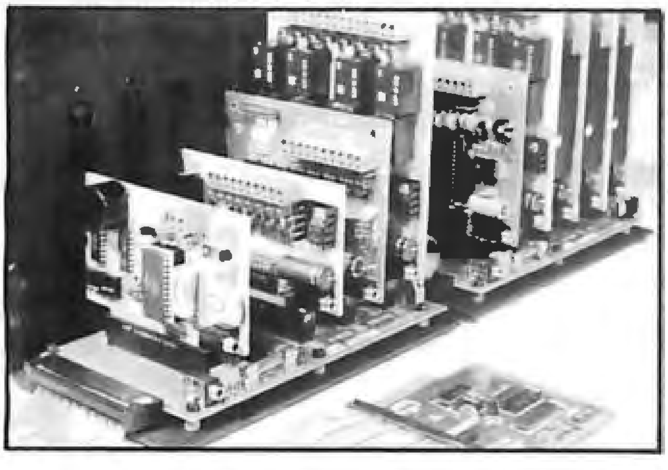

An A-BUS system with two Motherboards

A-BUS adapter (IBM) in foreground

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With the A-BUS you can plug your PC (IBM, Apple, TRS-80) into a future of exciting new applications in the fields of control, monitoring, automation, sensing, robotics, etc.

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The complete set of A-BUS User's Manuals is available for $10.

About the A-BUS:

- All the A-BUS cards are very easy to use with any language that can read or write to a Port or Memory. In BASIC, use INP and OUT (or PEEK and POKE with Apples and Tandy Color Computers)
- They are all compatible with each other. You can mix and match up to 25 cards to fit your application. Card addresses are easily set with jumpers.
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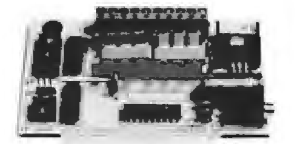
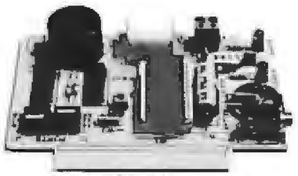
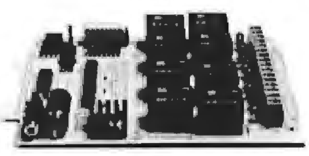




CL-144



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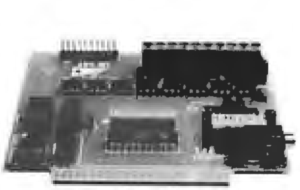

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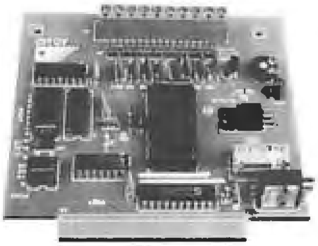

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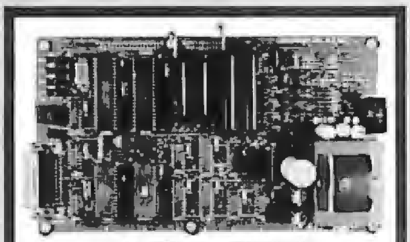

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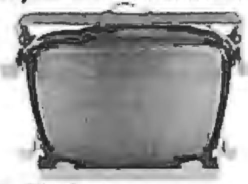

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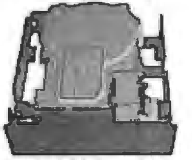

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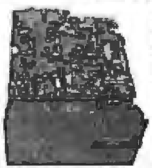

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Mfr — CDC #9409T

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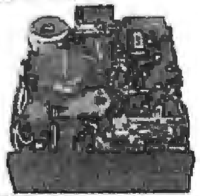

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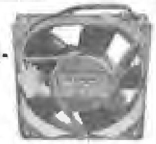

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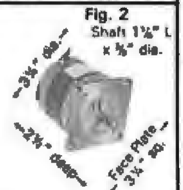
Fig. 2



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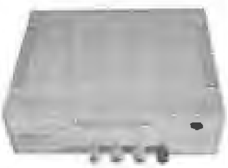

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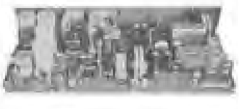

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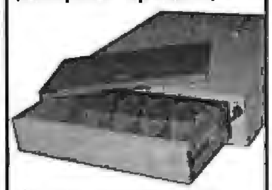

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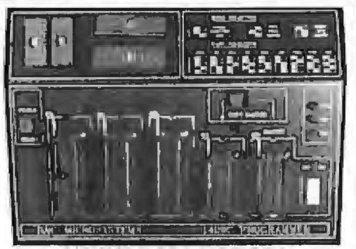

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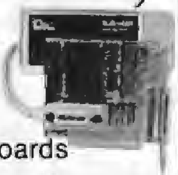

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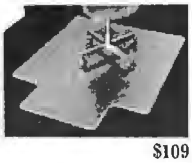

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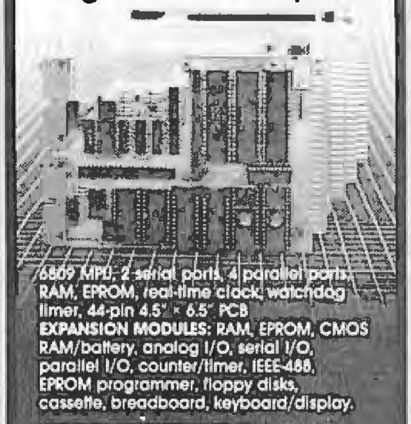
6809
Single Board Computer



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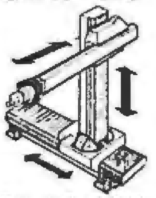

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See page 367 for details of the SC-149

ALPHA Products

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Inquiry 53

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"Printer Data Splitter"
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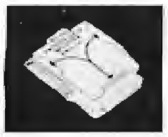

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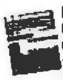

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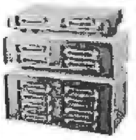

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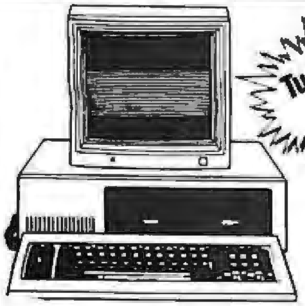

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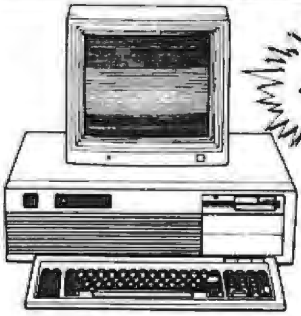

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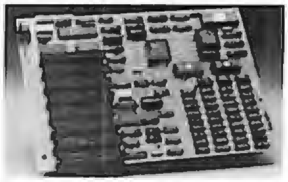

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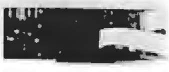

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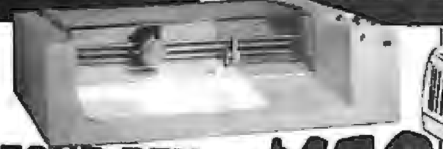

FOUR PEN COLOR PLOTTER

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The manufacturer has asked us not to publish their name. But this four color plotter was produced by one of the Worlds largest makers of computers.
The 410 color plotter will connect to the **serial port** of virtually any microcomputer. Simple ASCII commands direct one of the four color pens to draw circles, arcs or ellipses on paper or transparency material up to 11 by 17 inches. The plotter is capable of producing the full upper and lower case alphabet along with seven international character sets. Text can be printed horizotal, vertical or diagonal in sizes from 1/16 to 6 inches.

Enlargements or reductions are achieved through elaborate firmware. Pen travel is four inches per second with .004" pen resolution. Standard pens are available in an assortment of 32 different colors and widths.

The ideal plotter for architecture, CAD engineering or graphic design. **At $595 it was a great buy, at $159 its a steal.** Support packages for specific computers available. Manual only $15 refundable upon purchase of plotter.

OTHER PLOTTERS AVAILABLE:
Hewlett Packard ● Houston Instruments ● Roland
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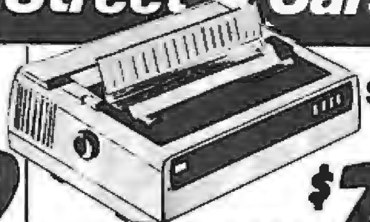

~~$2495~~

$759

80 Character Daisy Wheel Printer

These Fujitsu Daisy Max 830 were manufactured for Motorola's Computer Division. The purchase order was canceled and Fujitsu was forced to liquidate these 80 character per second daisy wheel printers at "fire sale" prices.
Features: bullet proofconstruction, serial RS-232 interface, Diablo 630 wheels and commands, programmable line spacing in increments of 1/96" and column spacing of 1/120". The printer is also capable of underscoring, bold overprint, shadow print, centers and justifies along with vector plotting.
Factory suggested price of the Daisy Max 830 was $2495, while supplies last California Digital is offering this liquidated special at only $759. Also available: tractor and sheet feeders.

COLOR GRAPHICS TERMINAL

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$659

The Lear Siegler 7107 color graphics terminal is both DEC (VT-100 / VT-51) and Tektronix (4010/4014) compatible.
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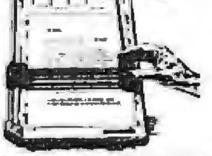

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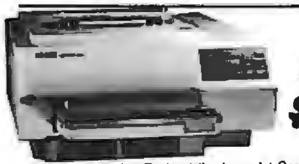

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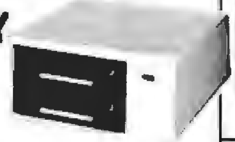

The **Bernoulli Box** by Iomega, features 10 and 20 megabyte removable cartridges, and delivers reliability, expandability, transportability, security and speed in one versatile subsystem. It lets you transfer megabytes of information safely and swiftly for primary or backup storage. Or combine several software programs onto a single cartridge for easy switching from one to another.
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The Bernoulli Box delivers preformance that often exceeds the best of hard disk speed and the convenience of floppy disks. At these prices don't be caught wishing you had one after a loss of irreplacable data.

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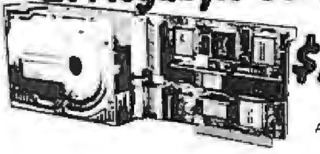
21 Megabyte Gold Card



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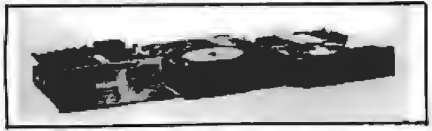

$35

We have them again... The Remex 480 was a sell out two years ago but we located an additional 10,000 units and are offering these 2/3 height IBM/PC compatible 360K/Byte drives at only $35 each at quantity two.

85

The Mitsubishi 4851 was probably the bast 360 K/Byte drive everproduced. The production cost was too high and Mitsubishi discontinued the product. Quantity two $85 each.

115

The Panasonic 475 is jumper selectable between 96 TPI format and 1.2 Megabyte as used in the IBM/AT computer.
Suggested price of the 475 is $189 but California Digital located a computer manufacturer that had to liquidate stock making available 1000 of these choice drives. Quantity two $115 each.

	One	Two	Ten
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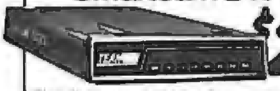
TEAC FD55GF for IBM AT	169	159	155
PANASONIC 455 Half Height	109	99	89
PANASONIC 475 1.2 Meg./96	119	115	109
Switching power supply			49
Dual enclosure for 5¼" drives			59

Smarteam 2400 Baud



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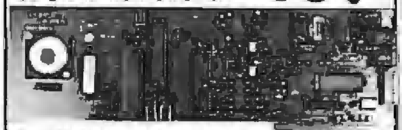

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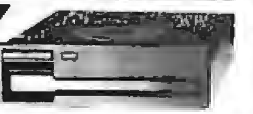

The Sony 53W is a 3½ inch double sided double density disk drive. The drive can be connected to your existing floppy controller but will require MS/DOS 3.2 to properly operate in the PC and compatibles. The 53W is similar to the drive being used in the PC portable.

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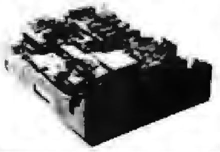

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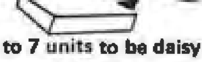

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WD1770 Disk Cont.	19.95	6551 ACIA	3.29	8722 MMU	9.95
SI-3052P 5V Positive Voltage Reg. 2A	5.95	6560 VIC-I	10.95	*251104-04 Kernal ROM	10.95
6502 MPU w/Int. Clock	2.25	6567 VIC-II	14.95	318018-03 Basic ROM-C128	15.95
6504A CPU	1.95	6569 VIC PAL	14.95	318019-03 Basic ROM-C128	15.95
6507 CPU	4.95	6572 VIC PAL-N	14.95	318020-04 Kernal ROM-C128	15.95
6510 CPU	9.95	6581 SID	14.95	325302-01 64K ROM for 1540/1541 Drive	15.95
6520 PIA	1.75	8360 TextEditing	10.95	*325572-01 Logic Array	24.95
6522 VIA	2.95	8501 MPU	10.95	*82S100PLA (906114-01)**	13.95
6525 TPI	7.95	8502 MPU	7.95	901225-01 Char. ROM	11.95
6526 CIA	14.95	8563 CRT Contr.	15.95	901226-01 BASIC ROM	11.95
6529 SPI	4.95	8564 VIC	15.95	901227-03 Kernal ROM	11.95
6532 128x8RAM,I/O,TimAr	6.49	8566 VIC PAL	29.95	901229-05 Upgrade ROM (For 1541 Disk Drive)	15.95
6545-1 CRTC	2.49	8701 Clock Chip	9.95		
		*8721 PLA	14.95		

*No specs. available
**Note: 82S100PLA = U17 (C-64)

MICROPROCESSOR COMPONENTS

MISCELLANEOUS CHIPS

Part No.	Price
D765AC	4.49
WD1770	19.95
2661-3	5.95
WD9216	9.95

Z80, Z80A, Z808 SERIES

Z80	1.25
Z80-CTC	1.79
Z80-DART	4.95
Z80-PIO	1.79
Z80A	1.35
Z80A-CTC	1.49
Z80A-DART	4.95
Z80A-PIO	1.49
Z80A-SIO/0	4.95
Z80B	2.95
Z80B-CTC	3.49
Z80B-PIO	4.29

6500/6800/66000 SER.

6502	2.25
65C02 (CMOS)	8.95
6520	1.75
6522	2.95
6532	6.49
6551	3.29
6800	1.75
6802	3.49
6810	1.25
6821	1.29

6500/6800/68000 Cont.

Part No.	Price
6840	3.95
6843	2.95
6845	2.95
6850	1.49
6852	3.95
6875	8.95
MC68000L8	11.95
MC68000L10	19.95

8000 SERIES

8031	2.95
80C31BH	14.95
8035	1.49
8073	29.95
8080A	2.49
8085A	2.29
8086	6.95
8086-2	8.95
8087(5MHz)	125.00
8087-2(8MHz)	159.95
8088	6.49
8088-2	8.95
8116	4.95
8155	1.95
8155-2	2.49
8156	2.49
8202	9.95
8203	14.95
8212	1.49
8224	2.25

8000 SERIES Cont.

Part No.	Price
8228	2.49
8237-5	4.95
8243	2.25
8250A	5.49
8250B (For IBM)	6.95
8251A	1.75
8253-5	1.95
8254	2.95
8255A-5	1.69
8257-5	2.49
8259-5	1.95
8272	4.49
8279-5	2.95
8741	10.95
8748	7.95
8749	9.95
8751	39.95
8755	14.95

DATA ACQUISITION

ADC0804LCN	3.19
ADC0808CCN	5.95
ADC0809CCN	3.95
ADC0816CCN	14.95
ADC0817CCN	8.95
DAC0808LCN	1.95
DAC1008LCN	6.49
AY-3-1015D	4.95
AY-5-1013A	3.95

DYNAMIC RAMS

Part No.	Function		Price
4116-15	16,384 x 1	(150ns)	.89
4128-20 (Piggyback)	131,072 x 1	(200ns)	4.49
4164-120	65,536 x 1	(120ns)	1.75
4164-150	65,536 x 1	(150ns)	1.15
4164-200	65,536 x 1	(200ns)	.95
TMS4416-12	16,384 x 4	(120ns)	4.25
8118	16,384 x 1	(120ns)	.69
41256-120	262,144 x 1	(120ns)	3.95
41256-150	262,144 x 1	(150ns)	2.75
50464-15	65,536 x 4	(150ns) (4464) (41464)	4.95
511000P-10	1,048,576 x 1	(100ns) 1 Meg.	39.95
514256P-10	262,144 x 4	(100ns) 1 Meg.	44.95

STATIC RAMS

2016-12	2048 x 8	(120ns)	1.69
2102-2L	1024 x 1	(250ns) Low Power (91L02)	1.95
2114N	1024 x 4	(450ns)	.99
2114N-2	1024 x 4	(200ns)	1.05
2114N-2L	1024 x 4	(200ns) Low Power	1.49
21C14	1024 x 4	(200ns) (CMOS)	.49
2149	1024 x 4	(45ns)	4.95
5101	256 x 4	(450ns) CMOS	1.95
6116LP-2	2048 x 8	(120ns) Low Power CMOS	2.95
6116P-3	2048 x 8	(150ns) CMOS	1.89
6116LP-3	2048 x 8	(150ns) Low Power	1.95
6264LP-12	8192 x 8	(120ns) Low Power CMOS	4.25
6264P-15	8192 x 8	(150ns) CMOS	3.59
6264LP-15	8192 x 8	(150ns) Low Power CMOS	3.75
6514	1024 x 4	(350ns) CMOS (UPD444C)	4.49
43256-15L	32,768 x 8	(150ns) Low Power	24.95

PROMS/EPROMS

1702A	256 x 8	(1μs)	6.95
TMS2516	2048 x 8	(450ns) 25V	4.95
TMS2532	4096 x 8	(450ns) 25V	5.95
TMS2564	8192 x 8	(450ns) 25V	8.95
2708	1024 x 8	(450ns)	4.95
TMS2716	2048 x 8	(450ns) 3 voltage	9.95
2716	2048 x 8	(450ns)	3.75
2716-1	2048 x 8	(350ns) 25V	4.95
27C16	2048 x 8	(450ns) 25V (CMOS)	6.49
2732	4096 x 8	(450ns)	3.95
2732A-20	4096 x 8	(200ns) 21V	4.25
2732A-25	4096 x 8	(250ns) 21V	3.95
2732A-45	4096 x 8	(450ns) 21V	3.75
27C32	4096 x 8	(450ns) 25V (CMOS)	6.49
2764-20	8192 x 8	(200ns) 21V	4.25
2764-25	8192 x 8	(250ns) 21V	3.75
2764A-25	8192 x 8	(250ns) 12.5V	4.25
2764-45	8192 x 8	(450ns) 21V	3.49
27C64	8192 x 8	(450ns) 21V (CMOS)	5.49
27C64-15	8192 x 8	(150ns) 21V (CMOS)	6.49
27128-20	16,384 x 8	(200ns) 128K 21V	4.95
27128-25	16,384 x 8	(250ns) 128K 21V	4.25
27128A-25	16,384 x 8	(250ns) 12.5V	4.95
27C128-25	16,384 x 8	(250ns) 21V (CMOS)	5.95
27256-20	32,768 x 8	(200ns) 256K (12.5V)	6.95
27256-25	32,768 x 8	(250ns) 256K (12.5V)	5.95
27C256-25	32,768 x 8	(250ns) 256K (CMOS) (12.5V)	8.95
27512-25	65,536 x 8	(250ns) 512K (12.5V)	19.95
68764	8192 x 8	(450ns) 25V	15.95
68766	8192 x 8	(350ns) 25V	16.95
74S387	256 x 4	PROM O.C.	1.29
74S471	256 x 8	PROM T.S.	4.95
N82S123	32 x 8	PROM T.S.	2.49

SATELLITE TV DESCRAMBLER CHIP

The MM5321 is a TV camera sync generator designed to supply the basic sync functions for either color or monochrome 525 line/60Hz interfaced and camera video recorder applications. COLOR BURST GATE & SYNC ALLOW STABLE COLOR OPERATION

MM5321N. $11.95

INTERSIL Also Available!

74HC HI-SPEED CMOS

Part No.	Price	Part No.	Price
74HC00	.25	74HC175	.69
74HC02	.25	74HC221	.99
74HC04	.29	74HC240	.79
74HC08	.29	74HC244	.79
74HC10	.29	74HC245	.89
74HC14	.49	74HC253	.59
74HC30	.29	74HC259	.65
74HC32	.29	74HC273	.79
74HC74	.39	74HC373	.79
74HC75	.39	74HC374	.79
74HC76	.45	74HC393	.75
74HC85	.79	74HC595	1.19
74HC86	.39	74HC688	.79
74HC123	.89	74HC4040	.89
74HC125	.49	74HC4049	.59
74HC132	.49	74HC4050	.59
74HC138	.49	74HC4060	1.09
74HC139	.49	74HC4511	1.29
74HC154	1.19	74HC4514	1.19
74HC163	.65	74HC4538	.89
74HC174	.69	74HC4543	1.19

74HCT — CMOS TTL

74HCT00	.29	74HCT139	.59
74HCT02	.29	74HCT157	.69
74HCT04	.29	74HCT174	.69
74HCT08	.29	74HCT175	.69
74HCT10	.29	74HCT240	.99
74HCT32	.29	74HCT244	.99
74HCT74	.49	74HCT245	1.19
74HCT86	.49	74HCT373	1.19
74HCT138	.59	74HCT374	1.19

74C—CMOS

74C00	.29	74C174	.79
74C02	.29	74C175	.79
74C04	.29	74C221	1.49
74C08	.35	74C240	1.29
74C10	.35	74C244	1.29
74C14	.49	74C373	1.49
74C32	.35	74C374	1.49
74C74	.59	74C912	7.95
74C85	1.39	74C915	1.39
74C86	.35	74C920	9.95
74C89	5.19	74C921	9.95
74C90	.99	74C922	3.95
74C154	2.95	74C923	3.95
74C173	1.05	74C925	5.95

LINEAR

DS0026CN	1.95	LM1458N	.39
TL074CN	.89	LM1488N	.49
TL084CN	.99	DS14C88N (CMOS)	1.19
AF100-ICN	8.95	LM1489N	.49
LM307N	.45	DS14C89N (CMOS)	1.19
LM309K	1.25	LM1496N	.85
LM311N	.45	MC1648P	4.95
LM317T	.79	LM1871N	2.95
LM318N	.99	LM1872N	2.95
LM319N	.99	LM1896N-1	1.59
LM323K	3.95	ULN2003A	.99
LM324N	.39	XR2206	3.95
LM338K	4.95	XR2211	2.95
LM339N	.39	XR2243	1.95
LF347N	1.79	DS26LS29CN	4.49
LM348N	.69	DS26LS31CN	1.19
LM350T	2.95	DS26LS32CN	1.19
LF351N	.39	DS26LS33CN	1.95
LF353N	.49	LM2901N	.49
LF355N	.79	LM2907N	2.49
LF356N	.79	LM2917N (8 pin)	1.55
LF357N	1.09	MC3419CL	9.95
LM358N	.49	MC3446N	2.95
LM360N	2.19	MC3450P	2.95
LM361N	1.79	MC3470P	1.95
LM380N-8	.99	MC3471P	4.95
LM386N-3	.99	MC3479P	4.79
LM387N	.99	MC3486P	1.69
LM393N	.39	MC3487P	1.69
LM399H	2.95	LM3900N	.49
LF411CN	.79	LM3905N	1.19
TL497ACN	2.69	LM3909N	.99
NE540H (C540H)	2.95	LM3914N	1.95
NE555V	.29	LM3916N	1.95
XR-L555	.75	NE5532	.89
LM556N	.49	NE5534	.69
NE558N	.89	7805K (LM340K-5)	1.29
LM565N	.99	7812K (LM340K-12)	1.29
LM567V	.69	7815K (LM340K-15)	1.29
NE592N	.89	7805T (LM340T-5)	.49
LM741CN	.29	7812T (LM340T-12)	.49
LM747CN	.59	7815T (LM340T-15)	.49
MC1350	1.49	7905K (LM320K-5)	1.35
MC1372P	2.49	7905T (LM320T-5)	.59
MC1377P	3.19	75472	.99
MC1398P	8.95	75477	1.29
LM1414N	1.29	76477	5.95
		MC145406P	2.95

IC SOCKETS

Low Profile		Wire Wrap (Gold) Level #3	
8 pin LP	.11	8 pin WW	.59
14 pin LP	.12	14 pin WW	.65
16 pin LP	.13	16 pin WW	.69
24 pin LP	.25	24 pin WW	1.19
28 pin LP	.27	28 pin WW	1.39
40 pin LP	.29	40 pin WW	1.89

Soldertail Standard (Gold & Tin) & Header Plug Sockets Also Available

PARTIAL LISTING • OVER 4000 COMPONENTS AND ACCESSORIES IN STOCK! • CALL FOR QUANTITY DISCOUNTS

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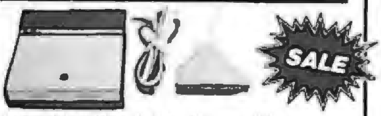
COMMODORE® COMPATIBLE ACCESSORIES



HESWARE 300 Baud Modem
For VIC-20 and C-64

• Connects directly to User Port • Manual Answer/Dial • Function keys defined for convenience • Includes Midwest Micro Associates communication software.

CM-1 (For VIC-20 and C-64) ~~$34.95~~ **$24.95**

External Power Supply
CPS-10 (For C-64). **$39.95**

Parallel Printer Interface
2K Buffer, Expandable to 10K!

MW-350 (For VIC-20, C-64 & C-128). . . . **$54.95**

TRS-80/TANDY® COMPATIBLE ACCESSORIES

E-X-P-A-N-D TRS-80 MEMORY
All kits come complete with documentation

TRS-80 MODEL 4, 4P, & 4D 64K/128K EXPANSION

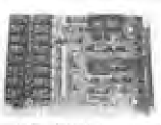
TRS-64K-2. . . . . $7.95
Expands Model 4 from 16K-64K or Model 4 (Gate Array Version), 4P and 4D from 64K-128K

TRS-64K-2PAL. $14.95
Expands Model 4 (Non-Gate Array Version) from 64K to 128K

TRS-80 MODEL 100 8K EXPANSION

M1008K. . . . . $19.95 ea. or 3 for $54.95

ZUCKERBOARD



TANDY 1000 Expansion Memory Half Card

Expand the memory of your Tandy 1000 (128K Version) to as much as 640K. Also includes DMA controller chip.

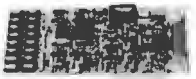
TAN-EM256K	Includes 256K RAM.	$ 99.95
TAN-EM512K	Includes 512K RAM.	$119.95

Options for TAN-EM256K/512K

TAN-C	Plug-in Clock option chip (only).	$39.95
TAN-D	RAM Disk Printer Spooler Software (only)	$39.95

NEW! Expansion Memory *NEW!* Half Card for TANDY 1000SX

TSX256K Includes 256K RAM. . . . **$119.95**



TANDY 1000 Multifunction Board with Clock Calendar

Expand the memory on your Tandy 1000 (128K Version) to as much as 640K. Complete with an RS232 port, clock/calendar, RAM Disk Printer Spooler and on-board DMA controller chip.

MTAN-256K	Includes 256K RAM.	$179.95
MTAN-512K	Includes 512K RAM.	$199.95

NEW! Multifunction *NEW!* Board for TANDY 1000SX

M256K Includes 256K RAM. **$189.95**

UV-EPROM ERASER

Erases all EPROMs. Erases up to 8 chips within 21 minutes (1 chip in 15 minutes). Maintains constant exposure distance of 1". Special conductive foam liner eliminates static build-up. Built-in safety lock to prevent UV exposure. Compact - 9.00"L x 3.70"W x 2.60"H. Complete with holding tray for 8 chips.

DE-4	UV-EPROM Eraser. . . .	$69.95
UVS-11EL	Replacement Bulb. . . .	$19.95
NCF-2	Cond. Foam 12x24x¼ Hard Blk.	$ 8.95

NOW YOU CAN BUILD AN IBM PC/XT COMPATIBLE!

IBM Compatible Kit

IBM-64K(2)	64K RAM Chips (18). .	$ 19.90
KB83	83-Key Keyboard	$ 29.95
IBM-FCC	Floppy Controller Card	$ 34.95
IBM-Case	Case.	$ 39.95
IBM-MCC	Monochrome Card . .	$ 59.95
IBM-PS	Power Supply.	$ 69.95
FD55B	Disk Drive.	$109.95
IBM-MON	Monochrome Monitor	$ 99.95
IBM-MB	Motherboard.	$109.95

FREE! QUICKSOFT PC WRITE WORD PROCESSING SOFTWARE INCLUDED!

Weight: 48 lbs. *Regular List $574.50*

IBM-Special (Includes 9 items above) **$499.95**

IBM Special No. 2

NEW

Includes IBM AT style keyboard with tactile touch (KB5160, see below) and all the above items (except KB83) *Regular List $604.50*
Weight: 48 lbs.

IBMSP2. . . . . **$529.95**

ADDITIONAL ADD-ONS AVAILABLE!

IBM-KB	83-Key Keyboard.	$ 59.95
IBM-ENH	Enhanced Keyboard.	$ 79.95
IBM-ICB	Integrated Color Board w/Printer Port.	$ 99.95
IBM-EGA	Enhanced Graphics 256K RAM . . . ~~$249.95~~	$229.95
IBM-20MBK	20MB Hard Disk Drive, Controller & Cable. . . .	$429.95
IMFC	Multifunction 0-384K RAM (without RAM). . . .	$109.95
EM-100	Expansion Memory Half Card (without RAM) . .	$ 59.95
RS232HC	RS232 Serial Half Card.	$ 29.95
TTX-1410	14" RGB Color Monitor. . . . . . . ~~$299.95~~	$289.95
PM1200B-2	1200/300 Baud Half Card Modem without software. . .	$129.95
PM1200B-2S	1200/300 Baud Half Card Modem with Mirror Software . .	$159.95

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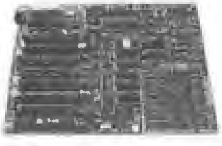
NEW PRODUCTS!

Turbo 4.77/8MHz Motherboard



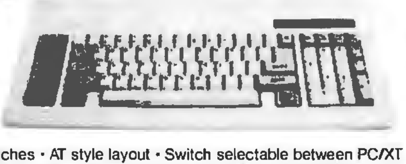
IBM PC/XT Compatible

• 75% faster than the IBM PC while in the turbo mode • Turbo Mode selectable through either software or hardware • Expandable to 640K (comes w/zero-K) • DTK/ERSO BIOS included

TURBO. . . . . ***NEW!*** **$129.95**

IBM PC/XT/AT Compatible Keyboard

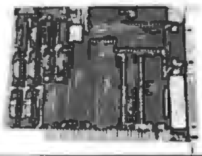
NEW! **AT Style Layout**



• Tactile touch keyswitches • AT style layout • Switch selectable between PC/XT or AT • Illuminated Caps Lock, Num Lock and Scroll Lock indicators • Low profile design • 8½ foot cord • Manual included

KB5160. . . . . **$59.95**

ZUCKERBOARD Monochrome Graphics Half Card



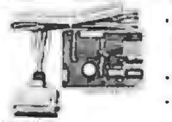
with Printer Port for IBM PC/XT/AT and Compatible Computers

• Full Hercules™ compatibility • Printer port adapter • High resolution graphics 720 x 348 pixels • Diagnostics program included • Fast refresh rate • 2-yr. warranty • Manual included

MG201... *NEW!* ...$89.95

APPLE COMPATIBLE ACCESSORIES

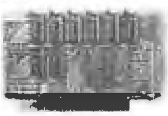
Jameco ELECTRONICS Parallel Printer Card for Apple II, II+ and *IIe*



• Intelligent interface to most dot matrix graphics printers
• Centronics standard
• Advanced text printing

JE880	Parallel Printer Card.	$49.95
JE883	64K Buffer for JE880 ~~$69.95~~	$59.95
JE8803	JE880 and JE883 ~~$109.90~~	$99.95

Jameco ELECTRONICS Extended 80-Column Card for Apple *IIe*



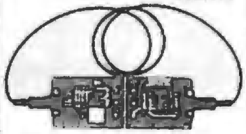
• 80 Col./64K RAM • Doubles amount of data your Apple IIe can display as well as its memory capacity • Ideal for word processing • Complete with instructions

JE864 $59.95

Additional Apple Compatible Products Available

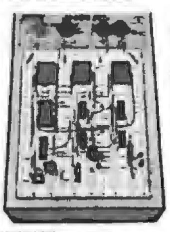
Jameco ELECTRONICS JE310 Fiber Optics Experimenter Kit

NEW! • Educational device gives students and engineers hands-on experience with fiber optic technology • Step by step instructions • Includes transmitter & receiver circuits boards, as well as all nec. IC's, cables & connectors



JE310 Fiber Optic Kit. **$19.95**

Jameco ELECTRONICS JE450 Solderless Proto-Type Builder



• Provides user with quick and efficient system for breadboarding electronic circuits • Components & wire leads can be quickly inserted and removed without soldering or desoldering • 3 regulated power supplies: 5V @ 1A, +5V to +15V @ .5A, −5V to −15V @ .5A • Power: 120VAC, 60Hz fused

NEW!

JE450 Solderless Proto-Type Builder . . . **$119.95**

IBM Compatible! DISK DRIVES
Documentation Included

FD55B	Teac 5¼" DS ½-H (IBM PC/XT) . . .	$109.95
JU-455	Panasonic 5¼" DS ½-H (IBM PC/XT)	$109.95
JU-475	Panasonic 5¼"DS ½-H (IBM AT) . .	$119.95

DATA BOOKS

30003	National Linear Data Book (82).	$14.95
30009	Intersil Data Book (86).	$ 9.95
30013	Zilog Data Book (85).	$14.95
30032	National Linear Supplement (84).	$ 6.95
210830	Intel Memory Handbook (87).	$17.95
230843	Intel Microsystem Hndbk. Set (87). . . .	$24.95

MUFFIN/SPRITE-STYLE FANS

MUF60. . . . . $9.95
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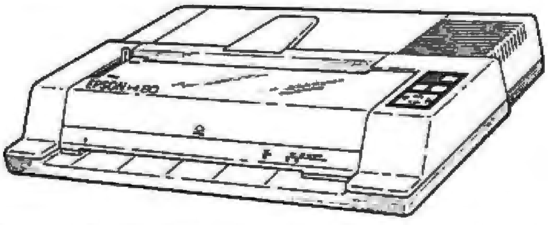

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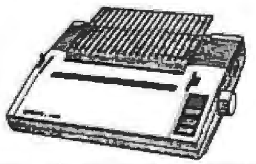

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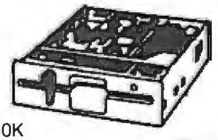

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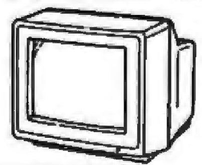

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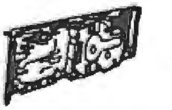

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74LS12	.22	74LS195	.69
74LS13	.26	74LS196	.59
74LS14	.39	74LS197	.59
74LS15	.26	74LS221	.59
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74HCT139	1.15	74HCT373	2.49
74HCT154	2.99	74HCT374	2.49
74HCT157	.99	74HCT393	1.59
74HCT158	.99	74HCT4017	2.19
74HCT161	1.29	74HCT4040	1.59
74HCT164	1.39	74HCT4060	1.49

74F00

74F00	.69	74F74	.79	74F251	1.69
74F02	.69	74F86	.99	74F253	1.69
74F04	.79	74F138	1.69	74F257	1.69
74F08	.69	74F139	1.69	74F280	1.79
74F10	.69	74F157	1.69	74F283	3.95
74F32	.69	74F240	3.29	74F373	4.29
74F64	.89	74F244	3.29	74F374	4.29

Visit our retail store located at 1256 S. Bascom Ave. in San Jose, (408) 947-8881

JDR Microdevices

110 Knowles Drive, Los Gatos, CA 95030
Toll Free 800-538-5000 • (408) 866-6200
FAX (408) 378-8927 • Telex 171-110

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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 applicable sales tax. 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.

Inquiry 162

EGA CARD AND MONITOR NOW ONLY $569!

CMOS

4001	.19	14419	4.95
4011	.19	14433	14.95
4012	.25	4503	.49
4013	.35	4511	.69
4015	.29	4516	.79
4016	.29	4518	.85
4017	.49	4522	.79
4018	.69	4526	.79
4020	.59	4527	1.95
4021	.69	4528	.79
4024	.49	4529	2.95
4025	.25	4532	1.95
4027	.39	4538	.95
4028	.65	4541	1.29
4035	.69	4553	5.79
4040	.69	4585	.75
4041	.75	4702	12.95
4042	.59	74C00	.29
4043	.85	74C14	.59
4044	.69	74C74	.59
4045	1.98	74C83	1.95
4046	.69	74C85	1.49
4047	.69	74C95	.99
4049	.29	74C150	5.75
4050	.29	74C151	2.25
4051	.69	74C161	.99
4052	.69	74C163	.99
4053	.69	74C164	1.39
4056	2.19	74C192	1.49
4060	.69	74C193	1.49
4066	.29	74C221	2.49
4069	.19	74C240	1.89
4076	.59	74C244	1.89
4077	.29	74C374	1.99
4081	.22	74C905	10.95
4085	.79	74C911	8.95
4086	.89	74C917	12.95
4093	.49	74C922	4.49
4094	2.49	74C923	4.95
14411	9.95	74C926	7.95
14412	6.95	80C97	.95

7400/9000

7400	.19	74147	2.49
7402	.19	74148	1.20
7404	.19	74150	1.35
7406	.29	74151	.55
7407	.29	74153	.55
7408	.24	74154	1.49
7410	.19	74155	.75
7411	.25	74157	.55
7414	.49	74159	1.65
7416	.25	74161	.69
7417	.25	74163	.69
7420	.19	74164	.85
7423	.29	74165	.85
7430	.19	74166	1.00
7432	.29	74175	.89
7438	.29	74177	.75
7442	.49	74178	1.15
7445	.69	74181	2.25
7447	.89	74182	.75
7470	.35	74184	2.00
7473	.34	74191	1.15
7474	.33	74192	.79
7475	.45	74194	.85
7476	.35	74196	.79
7483	.50	74197	.75
7485	.59	74199	1.35
7486	.35	74221	1.35
7489	2.15	74246	1.35
7490	.39	74247	1.25
7492	.50	74248	1.85
7493	.35	74249	1.95
7495	.55	74251	.75
7497	2.75	74265	1.35
74100	2.29	74273	1.95
74121	.29	74278	3.11
74123	.49	74367	.65
74125	.45	74368	.65
74141	.65	9368	3.95
74143	5.95	9602	1.50
74144	2.95	9637	2.95
74145	.60	96S02	1.95

74S00

74S00	.29	74S163	1.29
74S02	.29	74S168	3.95
74S03	.29	74S174	.79
74S04	.29	74S175	.79
74S05	.29	74S188	1.95
74S08	.35	74S189	1.95
74S10	.29	74S195	1.49
74S15	.49	74S196	2.49
74S30	.29	74S197	2.95
74S32	.35	74S226	3.99
74S37	.69	74S240	1.49
74S38	.69	74S241	1.49
74S74	.49	74S244	1.49
74S85	.95	74S257	.79
74S86	.35	74S253	.79
74S112	.50	74S258	.95
74S124	2.75	74S280	1.95
74S138	.79	74S287	1.69
74S140	.55	74S288	1.69
74S151	.79	74S299	2.95
74S153	.79	74S373	1.69
74S157	.79	74S374	1.69
74S158	.95	74S471	4.95
74S161	1.29	74S571	2.95

DATA ACQ / INTERFACE

DATA ACQ		INTERFACE	
ADC0800	15.55	8T26	1.29
ADC0804	3.49	8T28	1.29
ADC0809	4.49	8T95	.89
ADC0816	14.95	8T96	.89
ADC0817	9.95	8T97	.59
ADC0831	8.95	8T98	.89
DAC0800	4.49	DM8131	2.95
DAC0806	1.95	DP8304	2.29
DAC0808	2.95	DS8833	2.25
DAC1020	8.25	DS8835	1.99
DAC1022	5.95	DS8836	.99
MC1408L8	2.95	DS8837	1.65

VOLTAGE REGULATORS

TO-220 CASE

7805T	.49	7905T	.59
7808T	.49	7908T	.59
7812T	.49	7912T	.59
7815T	.49	7915T	.59

TO-3 CASE

7805K	1.59	7905K	1.69
7812K	1.39	7912K	1.49

TO-93 CASE

78L05	.49	79L05	.69
78L12	.49	79L12	1.49

OTHER VOLTAGE REGS

LM323K	5V	3A	TO-3	4.79
LM338K	Adj.	5A	TO-3	6.95
78H12K	12V	5A	TO-3	8.95

IC SOCKETS

	1-99	100+
8 PIN ST	.11	.10
14 PIN ST	.11	.09
16 PIN ST	.12	.10
18 PIN ST	.15	.13
20 PIN ST	.18	.15
22 PIN ST	.15	.12
24 PIN ST	.20	.15
28 PIN ST	.22	.16
40 PIN ST	.30	.22
64 PIN ST	1.95	1.49
ST=SDLDERTAIL		
8 PIN WW	.59	.69
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		
16 PIN ZIF	4.95	CALL
24 PIN ZIF	5.95	CALL
28 PIN ZIF	6.95	CALL
40 PIN ZIF	9.95	CALL

ZIF=TEXTOOL
(ZERO INSERTION FORCE)

LINEAR

TL066	.99	LM733	.98
TL071	.69	LM741	.29
TL072	1.09	LM747	.69
TL074	1.95	LM748	.59
TL081	.59	MC1330	1.69
TL082	.99	MC1350	1.19
TL084	1.49	MC1372	6.95
LM301	.34	LM1414	1.59
LM309K	1.25	LM1458	.49
LM311	.59	LM1488	.49
LM311H	.89	LM1489	.49
LM317K	3.49	LM1496	.85
LM317T	.95	LM1812	8.25
LM318	1.49	LM1889	1.95
LM319	1.25	ULN2003	.79
LM320	see7900	XR2206	3.95
LM322	1.95	XR2211	2.95
LM323K	4.79	XR2240	1.95
LM324	.49	MPQ2907	1.95
LM331	3.95	LM2917	1.95
LM334	1.19	CA3046	.89
LM335	1.79	CA3081	.99
LM336	1.75	CA3082	.99
LM337K	3.95	CA3086	.80
LM338K	6.95	CA3089	1.95
LM339	.59	CA3130E	.99
LM340	see7800	CA3146	1.29
LM350T	4.60	CA3160	1.19
LF353	.59	MC3470	1.95
LF356	.99	MC3480	8.95
LF357	.99	MC3487	2.95
LM358	.59	LM3900	.49
LM380	.89	LM3909	.98
LM383	1.95	LM3911	2.25
LM386	.89	LM3914	2.39
LM393	.45	MC4024	3.49
LM394H	5.95	MC4044	3.99
TL494	4.20	RC4136	1.25
TL497	3.25	RC4558	.69
NE555	.29	LM13600	1.49
NE556	.49	75107	1.49
NE558	1.29	75110	1.95
NE564	1.95	75150	1.95
LM565	.95	75154	1.95
LM566	1.49	75188	1.25
LM567	.79	75189	1.25
NE570	2.95	75451	.39
NE590	2.50	75452	.39
NE592	.98	75453	.39
LM710	.75	75477	1.29
LM723	.49	75492	.79

H=TO-5 CAN, K=TO-3, T=TO-220

EDGECARD CONNECTORS

100 PIN ST	S-100	.125	3.95
100 PIN WW	S-100	.125	4.95
62 PIN ST	IBM PC	.100	1.95
50 PIN ST	APPLE	.100	2.95
44 PIN ST	STD	.156	1.95
44 PIN WW	STD	.156	4.95

36 PIN CENTRONICS

MALE

IDCEN36	RIBBON CABLE	6.95
CEN36	SOLDER CUP	4.95

FEMALE

IDCEN36/F	RIBBON CABLE	7.95
CEN36PC	RT ANGLE PC MOUNT	4.95

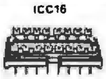
INTERSIL

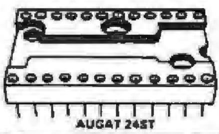
ICL7106	9.95
ICL7107	12.95
ICL7660	2.95
ICL8038	4.95
ICM7207A	5.95
ICM7208	15.95

DIP CONNECTORS

DESCRIPTION	ORDER BY	CONTACTS								
		8	14	16	18	20	22	24	28	40
HIGH RELIABILITY TOOLED ST IC SOCKETS	AUGATxxST	.62	.79	.89	1.09	1.29	1.39	1.49	1.69	2.49
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)	IOPxx	---	.95	.95	---	---	---	1.75	---	2.95

FOR ORDERING INSTRUCTIONS SEE D-SUBMINIATURE BELOW





DIODES/OPTO/TRANSISTORS

1N751	.25	4N26	.69
1N759	.25	4N27	.69
1N4148	25/1.00	4N28	.69
1N4004	10/1.00	4N33	.69
1N6402	.25	4N37	1.19
KBP02	.55	MCT-2	.59
KBU8A	.95	MCT-6	1.29
MDA990-2	.35	TIL-111	2.25
N2222	.25	2N3906	.10
PN2222	.10	2N4401	.25
2N2905	.50	2N4402	.25
2N2907	.25	2N4403	.25
2N3055	.79	2N6045	1.75
2N3904	.10	TIP31	.49

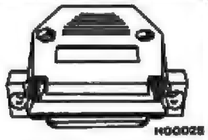
D-SUBMINIATURE

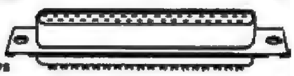
DESCRIPTION		ORDER BY	CONTACTS					
			9	15	19	25	37	50
SOLDER CUP	MALE	DBxxP	.82	.90	1.25	1.25	1.80	3.48
	FEMALE	DBxxS	.95	1.15	1.50	1.50	2.35	4.32
RIGHT ANGLE PC SOLDER	MALE	DBxxPR	1.20	1.49	—	1.95	2.65	—
	FEMALE	DBxxSR	1.25	1.55	—	2.00	2.79	—
WIRE WRAP	MALE	DBxxPWW	1.69	2.56	—	3.89	5.60	—
	FEMALE	DBxxSWW	2.76	4.27	—	6.84	9.95	—
IDC RIBBON CABLE	MALE	IDBxxP	2.70	2.95	—	3.98	5.70	—
	FEMALE	IDBxxS	2.92	3.20	—	4.33	6.76	—
HOODS	METAL	MHOODxx	1.25	1.25	1.30	1.30	—	—
	GREY	HOODxx	.65	.65	—	.65	.75	.95

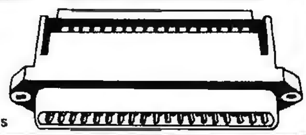
ORDERING INSTRUCTIONS: INSERT THE NUMBER OF CONTACTS IN THE POSITION MARKED "xx" OF THE "ORDER BY" PART NUMBER LISTED.

EXAMPLE: A 15 PIN RIGHT ANGLE MALE PC SOLDER WOULD BE DB15PR.

MOUNTING HARDWARE $1.00







LED DISPLAYS

FND-357(359)	COM CATHODE	.362"	1.25
FND-500(503)	COM CATHODE	.5"	1.49
FND-507(510)	COM ANODE	.5"	1.49
MAN-72	COM ANODE	.3"	.99
MAN-74	COM CATHODE	.3"	.99
MAN-8940	COM CATHODE	.8"	1.99
TIL-313	COM CATHODE	.3"	.45
TIL-311	4x7 HEX W/LOGIC	.270"	9.95

DIFFUSED LEOS

		1-99	100-UP
JUMBO RED	T1¾	.10	.09
JUMBO GREEN	T1¾	.14	.12
JUMBO YELLOW	T1¾	.14	.12
MOUNTING HDW	T1¾	.10	.09
MINI RED	T1	.10	.09

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 OUTPUT 10 POSITION 6 PIN DIP		1.95

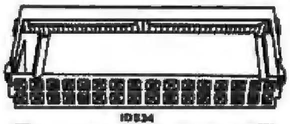
DIP SWITCHES

4 POSITION	.85	7 POSITION	.95
5 POSITION	.90	8 POSITION	.95
6 POSITION	.90	10 POSITION	1.25

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	2.25
RIBBON HEADER	IDMxx	---	5.50	6.25	7.00	7.50	8.50
RIBBON EDGE CARD	IOExx	1.75	2.25	2.65	2.75	3.80	3.95

FOR ORDERING INSTRUCTIONS SEE D-SUBMINIATURE ABOVE



RIBBON CABLE

CONTACTS	SINGLE COLOR		COLOR CODED	
	1'	10'	1'	10'
10	.18	1.60	.30	2.75
16	.28	2.50	.48	4.40
20	.36	3.20	.60	5.50
25	.45	4.00	.75	6.85
26	.46	4.10	.78	7.15
34	.61	5.40	1.07	9.35
40	.72	6.40	1.20	11.00
50	.89	7.50	1.50	13.25

HARD TO FIND "SNAPABLE" HEADERS

CAN BE SNAPPED APART TO MAKE ANY SIZE HEADER, ALL WITH .1" CENTERS

1x40	STRAIGHT LEAD	.99
1x40	RIGHT ANGLE	1.49
2x40	STRAIGHT LEAD	2.49
2x40	RIGHT ANGLE	2.99

SHORTING BLOCKS

GOLD CONTACTS SPACED AT .1" CENTERS

5/$1.00

When I called JDR, the operator was super friendly and patient, not to mention very helpful In addition, the delivery was made very quickly. On top of all that, I am most happy with the merchandise itself. It's quality, price and warranty are most impressive. Thanks again and keep up the good work.

Scott Feickert

CALL FOR VOLUME QUOTES

Inquiry 162

1200B MODEM $99⁹⁵ FOR IBM W/ SOFTWARE 2400B MODEM $199⁹⁵

BARGAIN HUNTERS CORNER

KEY TRONIC™ $49⁹⁵

5150 STYLE OEM KEYBOARD

- IMPROVED KEYBOARD LAYOUT
- 83 KEYS, FULLY IBM COMPATIBLE
- LED INDICATORS FOR CAPS & NUMBER LOCK

NEW!

TOSHIBA 3½" FDD KIT

360K, DOUBLE SIDED/DOUBLE DENSITY

- MOUNTING HARDWARE FOR 5¼" SLOT
- FACEPLATES FOR BOTH AT & XT MACHINES

$149⁹⁵

SPECIALS ENDS 6/30/87

PAGE WIRE WRAP WIRE

PRECUT ASSORTMENT

IN ASSORTED COLORS $27.50

100ea: 5.5", 6.0", 6.5", 7.0"
250ea: 2.5", 4.5", 5.0"
500ea: 3.0", 3.5", 4.0"

SPOOLS

100 feet	$4.30	250 feet	$7.25
500 feet	$13.25	1000 feet	$21.95

Please specify color:
Blue, Black, Yellow or Red

EXTENDER CARDS

IBM-PC	$29.95
IBM-AT	$39.95

WIRE WRAP PROTOTYPE CARDS

FR-4 EPOXY GLASS LAMINATE
WITH GOLD-PLATED EDGE-CARD FINGERS

IBM-PR2

IBM

BOTH CARDS HAVE SILK SCREENED LEGENDS AND INCLUDES MOUNTING BRACKET

IBM-PR1	WITH +5V AND GROUND PLANE	$27.95
IBM-PR2	AS ABOVE WITH DECODING LAYOUT	$29.95

S-100

P100-1	BARE - NO FOIL PADS	$15.15
P100-2	HORIZONTAL BUS	$21.80
P100-3	VERTICAL BUS	$21.80
P100-4	SINGLE FOIL PADS PER HOLE	$22.75

APPLE

P500-1	BARE - NO FOILPADS	$15.15
P500-3	HORIZONTAL BUS	$22.75
P500-4	SINGLE FOIL PADS PER HOLE	$21.80
7060-45	FOR APPLE IIe AUX SLOT	$30.00

SOCKET-WRAP I.D.™

- SLIPS OVER WIRE WRAP PINS
- IDENTIFIES PIN NUMBERS ON WRAP SIDE OF BOARD
- CAN WRITE ON PLASTIC; SUCH AS IC #

PINS	PART#	PCK. OF	PRICE
8	IDWRAP 08	10	1.95
14	IDWRAP 14	10	1.95
16	IDWRAP 16	10	1.95
18	IDWRAP 18	5	1.95
20	IDWRAP 20	5	1.95
22	IDWRAP 22	5	1.95
24	IDWRAP 24	5	1.95
28	IDWRAP 28	5	1.95
40	IDWRAP 40	5	1.95

PLEASE ORDER BY NUMBER OF PACKAGES (PCK. OF)

ID WRAP 24

FRAME STYLE TRANSFORMERS

12.6V AC CT	2 AMP	5.95
12.6V AC CT	4 AMP	7.95
12.6V AC CT	8 AMP	10.95
25.2V AC CT	2 AMP	7.95

25 PIN D-SUB GENDER CHANGERS

$7.95

SWITCHING POWER SUPPLIES

PS-IBM $69.95

- FOR IBM PC-XTCOMPATIBLE
- 135 WATTS
- +5V @ 15A, +12V @ 4.2A
  -5V @ .5A, -12V @ .5A
- ONE YEAR WARRANTY

PS-IBM/150

PS-IBM-150 $79.95

- FOR IBM PC-XTCOMPATIBLE
- 150 WATTS
- +12V @ 5.2A, +5V @ 16A
  -12V @ .5A, -5V @ .5A
- ONE YEAR WARRANTY

PS-130

PS-130 $99.95

- 130 WATTS
- SWITCH ON REAR
- FOR USE IN OTHER IBM TYPE MACHINES
- 90 DAY WARRANTY

PS-A $49.95

- USE TO POWER APPLE TYPE SYSTEMS, 79.5 WATTS
- +5V @ 7A, +12V @ 3A
  -5V @ .5A, -12V @ .5A
- APPLE POWER CONNECTOR

PS-A

PS-1558 $34.95

- 75 WATTS, UL APPROVED
- +5V @ 7A, +12V @ 3A
  -12V @ 250ma, -5V @ 300ma

PS-1558

CAPACITORS

TANTALUM

1.0µf	15V	.35	.47µf	35V	.45
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	680	50V	.05
22	50V	.05	.001µf	50V	.05
27	50V	.05	.0022	50V	.05
33	50V	.05	.005	50V	.05
47	50V	.05	.01	50V	.07
68	50V	.05	.02	50V	.07
100	50V	.05	.05	50V	.07
220	50V	.05	.1	12V	.10
560	50V	.05	.1	50V	.12

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	10	50V	.16
4.7	50V	.15	22	16V	.14
10	50V	.15	47	50V	.20
47	35V	.18	100	35V	.25
100	16V	.18	220	25V	.30
220	35V	.20	470	50V	.50
470	25V	.30	1000	16V	.60
2200	16V	.70	2200	16V	.70
4700	25V	1.45	4700	16V	1.25

DATARASE EPROM ERASER $34.95

- ERASES 2 IN 10 MINUTES
- COMPACT-NO DRAWER
- THIN METAL SHUTTER PREVENTS UV LIGHT FROM ESCAPING

¼ WATT RESISTORS

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FROM 1 OHM TO 10 MEG. OHM

10 PCS	same value	.05	100 PCS	same value	.02
50 PCS	same value	.025	1000 PCS	same value	.015

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SIP	10 PIN	9 RESISTOR	.69
SIP	8 PIN	7 RESISTOR	.59
DIP	16 PIN	8 RESISTOR	1.09
DIP	16 PIN	15 RESISTOR	1.09
DIP	14 PIN	7 RESISTOR	.99
DIP	14 PIN	13 RESISTOR	.99

SPECIALS ON BYPASS CAPACITORS

.01 µf CERAMIC DISC	100/$5.00
.01 µf MONOLITHIC	100/$10.00
.1 µf CERAMIC DISC	100/$6.50
.1 µf MONOLITHIC	100/$12.50

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WBU-T	1.38 x 6.50"	—	—	1	630	—	6.95
WBU-204-3	3.94 x 8.45"	1	100	2	1260	2	17.95
WBU-204	5.13 x 8.45"	4	400	2	1260	3	24.95
WBU-206	6.88 x 9.06"	5	500	3	1890	4	29.95
WBU-208	8.25 x 9.45"	7	700	4	2520	4	39.95

WBU-208

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AS USED IN CLOCK CIRCUITS

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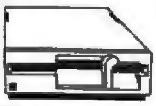
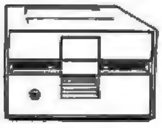
EGA CARD AND MONITOR NOW ONLY $569!

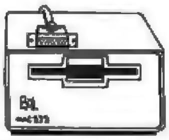
DISK DRIVES
FOR APPLE COMPUTERS



AP-150
$99.95
- ½ HT, DIRECT DRIVE
- 100% APPLE COMPATIBLE
- SIX MONTH WARRANTY



AP-135
$129.95
- FULL HT SHUGART MECHANISM
- DIRECT REPLACEMENT FOR APPLE DISK II
- SIX MONTH WARRANTY



DOUBLE SIDED!

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$249.95
- 3.5" ADD-ON DISK DRIVE
- 100% MACINTOSH COMPATABLE
- DOUBLE SIDED 800K BYTE STORAGE
- HIGH RELIABILITY DRIVE HAS AUTO-EJECT MECHANISM
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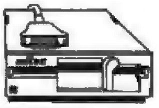

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IIc ADAPTOR CABLE	$19.95

ADAPTS STANDARD APPLE DRIVES FOR USE WITH APPLE IIc

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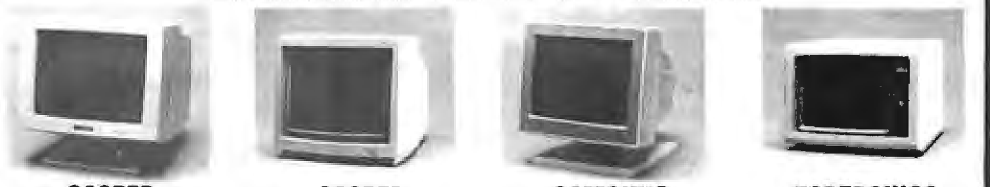

CASPER
EGA MONITOR
- EGA & CGA COMPATIBLE
- SCANNING FREQUENCIES: 15.75 / 21.85 KHz
- RES: 640 x 200 / 350
- .31mm DOT PITCH, 25 MHz
- 16 COLORS OUT OF 64
- 14", BLACK MATRIX SCREEN

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RGB MONITOR
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MONOCHROME
- IBM COMPATIBLE TTL INPUT
- 12" NON-GLARE AMBER, LOW DISTORTION SCREEN
- RESOLUTION: 720H x 350V
- ATTRACTIVE CASE WITH SWIVEL BASE
- ONE YEAR WARRANTY

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MONOCHROME
- IBM COMPATIBLE TTL INPUT
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AMBER OR GREEN AVAILABLE

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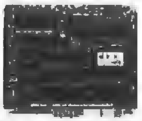
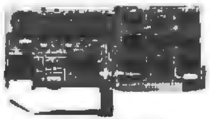
TILT & SWIVEL MONITOR STAND $12.95 WITH POWER CENTER $39.95

APPLE COMPATIBLE INTERFACE CARDS



EPROM PROGRAMMER
- DUPLICATE OR BURN ANY 27xx SERIES EPROM (2716 TO 27128)
- MENU-DRIVEN SOFTWARE
- HIGH SPEED WRITE ALGORITHM

RP-525 $59.95



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- CAN BE USED IN PLACE OF THE APPLE LANGUAGE CARD

RAM-CARD $39.95

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IC-TESTER $129.95

MOLDED INTERFACE CABLES
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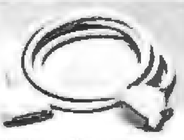

IBM PARALLEL PRINTER CABLE	9.95
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ALL LINES SWITCHED, GOLD PLATED CONNECTORS, QUALITY SWITCHES

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- CONNECTS 2 PRINTERS TO 1 COMPUTER OR VICE VERSA

AB-P *(CENTRONICS PARALLEL)*
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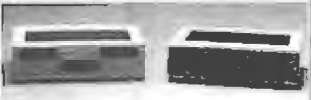

3 WAY $99.95
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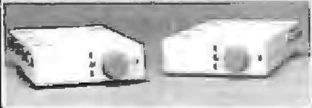
SWITCH-3P *(CENTRONICS PARALLEL)*
SWITCH-3S *(RS232 SERIAL)*



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FOR APPLE OR IBM
INCLUDES ASCII PRO-EZ SOFTWARE
- FCC APPROVED
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- INCLUDES AC ADAPTOR
- AUTO-DIAL
- DIRECT CONNECT

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- 160 CPS DRAFT, 32 CPS NLQ
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NASHUA DISKETTES WERE JUDGED TO HAVE THE HIGHEST POLISH AND RECORDED AMPLITUDE OF ANY DISKETTES TESTED (COMPARING FLOPPY DISKS, BYTE 9/84)

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5¼" SOFT SECTOR, DS/DD
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HOLDS 40
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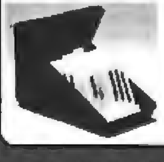

Seagate
5¼" HARD DISK DRIVES

ST-225	HALF HT 20MB 65ms	$275
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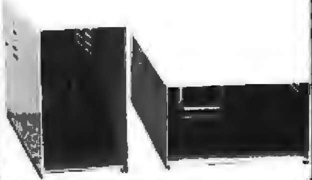

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AS SEEN IN BYTE, OCT. 86
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ONLY $199

KIT INCLUDES PCB AND ALL COMPONENTS EXCEPT CASE & POWER SUPPLY

CALL FOR VOLUME QUOTES

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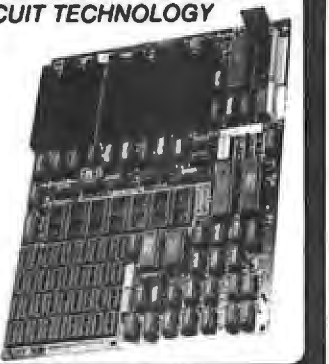
EGA CARD AND MONITOR NOW ONLY $569!

QUALITY IBM COMPATIBLE MOTHERBOARDS

FROM MODULAR CIRCUIT TECHNOLOGY



TURBO 4.77 / 8 MHz $129.95

JDR PART #: MCT-TURBO

- 4.77 OR 8 MHz OPERATION WITH 8088-2 & OPTIONAL 8087-2 CO-PROCESSOR
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BOTH WITH FREE MCT BIOS!

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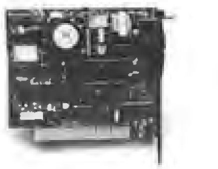
All models feature auto-dial/answer/redial on busy, Hayes compatible, power up self test, touchtone or pulse dialing, built-in speaker, PC Talk III Communications software, Bell Systems 103 & 212A full or half duplex and more.



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EASYDATA-12H $99.95
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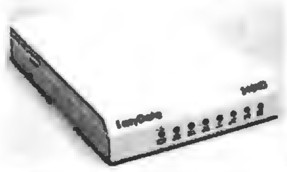

EXTERNAL

NO SOFTWARE INCLUDED

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JDR PART #: FAR-FDD

- SUPPORTS UP TO 4 INTERNALLY MOUNTED FDDs
- IBM COMPATIBLE, INTERFACES TO 360K OR 720K USING DOS 3.20
- INCLUDES CABLE FOR 2 DISK DRIVES

$24.95

IBM COMPATIBLE FLOPPY DISK DRIVE

JDR PART #: FDD-360

GOOD QUALITY DRIVES BY MAJOR MANUFACTURERS SUCH AS QUME, TANDON & CDC

- 5¼" HALF HEIGHT
- 360K STORAGE CAPACITY
- DS/DD
- 48 TPI

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IBM STYLE COMPUTER CASE

AN ATTRACTIVE STEEL CASE WITH A HINGED LID FITS THE POPULAR PC/XT COMPATIBLE MOTHERBOARDS

- SWITCH CUT-OUT ON SIDE FOR PC/XT STYLE POWER SUPPLY
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- ALL HARDWARE INCLUDED

$34.95

SLIDE TYPE CASE $39.95

BUILD YOUR OWN 256K XT COMPATIBLE SYSTEM

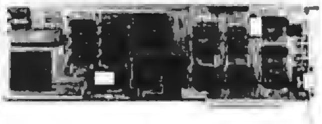
XT MOTHERBOARD	$109.95
PRO-BIOS (A $20 VALUE)	FREE!
256K RAM	$26.55
130 WATT POWER SUPPLY	$69.95
FLIP-TOP CASE	$34.95
KEY TRONIC™ KEYBOARD	$49.95
360K DRIVE	$69.95
FARADAY CONTROLLER	$24.95
MONOCHROME ADAPTOR	$49.95
FORTRONICS MONITOR	$99.95
TOTAL:	$536.15

DISPLAY CARDS

FROM MODULAR CIRCUIT TECHNOLOGY

MCT-EGA $179.95

100% IBM COMPATIBLE, PASSES IBM EGA DIAGNOSTICS



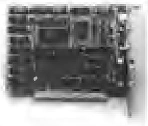
- COMPATIBLE WITH IBM EGA, COLOR GRAPHICS AND MONOCHROME ADAPTORS
- TRIPLE SCANNING FREQUENCY FOR DISPLAY ON EGA, STANDARD RGB OR HIGH RESOLUTION MONOCHROME MONITOR
- FULL 256K OF VIDEO RAM ALLOWS 640 x 350 PIXELS IN 16 OF 64 COLORS
- LIGHT PEN INTERFACE

MCT-CG $49.95

COMPATIBLE WITH IBM COLOR GRAPHICS STANDARD

- SHORT SLOT CARD USES VLSI CHIPS TO INSURE RELIABILITY
- SUPPORTS RGB, COMPOSITE MONOCHROME & COLOR AND AN RF MODULATOR OUTPUT
- 320 x 200 COLOR GRAPHICS MODE
- 640 x 200 MONOGRAPHICS MODE
- LIGHT PEN INTERFACE

SHORT SLOT

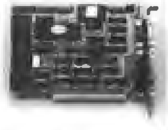


MCT-MGP $59.95

COMPATIBLE WITH IBM MONOCHROME AND HERCULES GRAPHICS STANDARDS

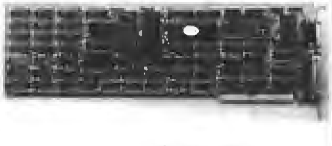
- SHORT SLOT CARD USES VLSI CHIPS TO INSURE RELIABILITY
- PARALLEL PRINTER PORT, CONFIGURABLE AS LPT1 OR LPT2
- 720 x 348 GRAPHICS MODE
- LOTUS COMPATIBLE
- CAN RUN WITH COLOR GRAPHICS CARD IN THE SAME SYSTEM

SHORT SLOT



MCT-MG $79.95

COMPATIBLE WITH IBM MONOCHROME AND HERCULES GRAPHICS STANDARDS



- SERIAL PORT OPTION
- PARALLEL PRINTER PORT
- 720 x 348 GRAPHICS MODE
- 80 x 25 TEXT MODE
- LOTUS COMPATIBLE
- SELECTABLE TO RUN ALONG WITH COLOR GRAPHICS CARD IN THE SAME SYSTEM

MG-SERIAL OPTIONAL SERIAL PORT $19.95

MCT-MONO $49.95

ANOTHER FANTASTIC VALUE FROM JDR!

- IBM COMPATIBLE TTL INPUT
- 720 x 348 PIXEL DISPLAY

PLEASE NOTE: THIS CARD WILL NOT RUN LOTUS GRAPHICS AND DOES NOT INCLUDE A PARALLEL PORT

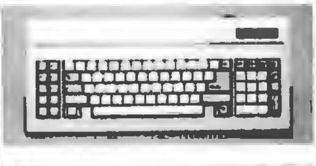
IBM COMPATIBLE KEYBOARDS

MCT-5150 $59.95

- "5150" STYLE KEYBOARD
- FULLY IBM COMPATIBLE
- LED STATUS INDICATORS FOR CAPS & NUMBER LOCK
- LARGE, EASY TO REACH SHIFT & RETURN KEYS
- 83 KEY TYPEWRITER LAYOUT

MCT-5151 $79.95

- REPLACEMENT FOR KEY TRONIC™ KB-5151 KEYBOARD
- SEPARATE CURSOR & NUMERIC KEYPAD
- CAPS LOCK & NUMBER LOCK INDICATORS
- IMPROVED KEYBOARD LAYOUT



MCT-5060 $59.95

- IBM AT STYLE LAYOUT
- SOFTWARE AUTOSENSE FOR XT OR AT COMPATIBLES
- EXTRA LARGE SHIFT & RETURN KEYS
- LED INDICATORS FOR SCROLL, CAPS & NUMBER LOCK
- AUTO REPEAT FEATURE

MCT-5339 $89.95

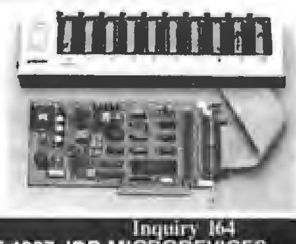
- IBM ENHANCED STYLE LAYOUT
- SOFTWARE AUTOSENSE FOR XT OR AT COMPATIBLES
- 12 FUNCTION KEYS
- EXTRA LARGE SHIFT & RETURN KEYS
- LED INDICATORS FOR SCROLL, CAPS & NUMBER LOCK
- AUTO REPEAT FEATURE
- SEPARATE CURSOR PAD

EPROM PROGRAMMERS

FROM MODULAR CIRCUIT TECHNOLOGY

MCT-EPROM $129.95

PROGRAMS 27xx AND 27xxx SERIES EPROMS UP TO 27512



- SUPPROTS VARIUOS MANUFACTURERS FORMATS WITH 12.5, 21 AND 25 VOLT PROGRAMMIMG
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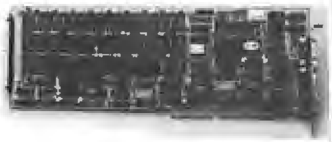

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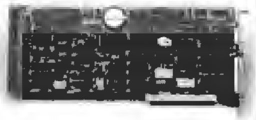

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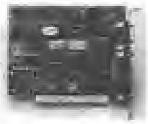

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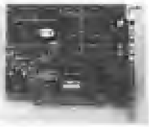

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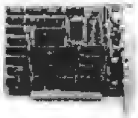

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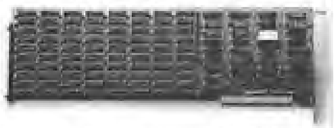

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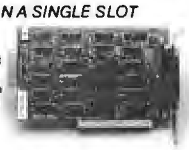

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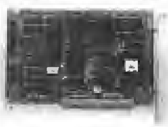

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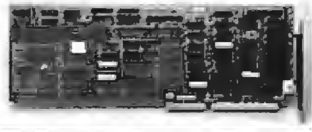

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BOMB

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BOMB RESULTS

Top billing for February goes to What's New, written by BYTE staffers. This is followed by Jerry Pournelle's Computing at Chaos Manor column, entitled "A Confederation of Hackers." In third place is Steve Ciarcia's Circuit Cellar project, "Build an Infrared Remote Controller." In fourth and the winner of $100 is John Unger for his review of "Four Portable Computers." Rene Stolk and George Ettershank will split the $50 second-place prize for their Programming Insight: "Calculating the Area of an Irregular Shape." Winner of the $50 award for quality goes to Dennis Dykstra for his review of "Microsoft QuickBASIC 2.0." Congratulations everyone.

COMING UP IN BYTE

Features:

A special advance look at a major new software development. We also have articles on Conrec, which is a contouring subroutine; storing maps on CD-ROMs; and Karmarkar's algorithm.

Theme:

Computer-aided design will include the following topics: data structures of CAD, shareware CAD, computer-aided routing of PC boards, the IEGS data interchange format, and silicon compilers.

Circuit Cellar:

Part 2 of Steve Ciarcia's video digitizer.

Programming Insights:

Articles on complex math in Pascal and a polynomial curve fitter in BASIC.

Reviews:

Two 12-MHz IBM PC AT compatibles, the IBM PC XT 286, the Amiga Turbo Chassis, a group review of Mice, three C interpreters for the IBM PC, Microsoft's Windows, Smalltalk/V, Turbo Prolog and Chalcedony Prolog, an expert system tool called Acquaint, and a filer called Zoomracks.

Kernel:

Jerry Pournelle's Chaos Manor, According to Webster, Dick Pountain's new Algorithms column, and Ezra Shapiro's Applications Only.

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Index of companies covered in articles, columns, or news stories in this issue.
Each reference is to the first page of the article or section in which the company name appears.

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State ____________ Zip ____________

Telephone ______________________

A. What is your principal occupation? (Please check one only.)
1. ☐ Business Owner
2. ☐ Manager/Administrator
3. ☐ Professional (law, medicine, architecture, etc.)
4. ☐ Computer Programmer/Analyst
5. ☐ DP/MIS
6. ☐ Engineer
7. ☐ Scientist
8. ☐ Educator/Student
9. ☐ Other (please specify)

B. How many people does your company employ?
1. ☐ 1–49
2. ☐ 50–999
3. ☐ 1,000 or more

C. Information requested for:
1. ☐ Business use
2. ☐ Personal use
3. ☐ Both

D. Do you plan to purchase items inquired about within:
1. ☐ Next 3 months?
2. ☐ Next 6 months?
3. ☐ Next 12 months?

E. Please check the statement that best describes your involvement in your company's purchasing decisions. (Check all that apply.)
1. ☐ I determine the need
2. ☐ I evaluate products/systems
3. ☐ I select/recommend the vendor
4. ☐ I approve/authorize the purchase

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MAY 1987
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1	23	45	67	89	111	133	155	177	199	221	243	265	287	309	331	353	375	397	419	441	463	485	507	529	551	573	595	617	639	661	683	705	727	749	771	793
2	24	46	68	90	112	134	156	178	200	222	244	266	288	310	332	354	376	398	420	442	464	486	508	530	552	574	596	618	640	662	684	706	728	750	772	794
3	25	47	69	91	113	135	157	179	201	223	245	267	289	311	333	355	377	399	421	443	465	487	509	531	553	575	597	619	641	663	685	707	729	751	773	795
4	26	48	70	92	114	136	158	180	202	224	246	268	290	312	334	356	378	400	422	444	466	488	510	532	554	576	598	620	642	664	686	708	730	752	774	796
5	27	49	71	93	115	137	159	181	203	225	247	269	291	313	335	357	379	401	423	445	467	489	511	533	555	577	599	621	643	665	687	709	731	753	775	797
6	28	50	72	94	116	138	160	182	204	226	248	270	292	314	336	358	380	402	424	446	468	490	512	534	556	578	600	622	644	666	688	710	732	754	776	798
7	29	51	73	95	117	139	161	183	205	227	249	271	293	315	337	359	381	403	425	447	469	491	513	535	557	579	601	623	645	667	689	711	733	755	777	799
8	30	52	74	96	118	140	162	184	206	228	250	272	294	316	338	360	382	404	426	448	470	492	514	536	558	580	602	624	646	668	690	712	734	756	778	800
9	31	53	75	97	119	141	163	185	207	229	251	273	295	317	339	361	383	405	427	449	471	493	515	537	559	581	603	625	647	669	691	713	735	757	779	801
10	32	54	76	98	120	142	164	186	208	230	252	274	296	318	340	362	384	406	428	450	472	494	516	538	560	582	604	626	648	670	692	714	736	758	780	802
11	33	55	77	99	121	143	165	187	209	231	253	275	297	319	341	363	385	407	429	451	473	495	517	539	561	583	605	627	649	671	693	715	737	759	781	803
12	34	56	78	100	122	144	166	188	210	232	254	276	298	320	342	364	386	408	430	452	474	496	518	540	562	584	606	628	650	672	694	716	738	760	782	804
13	35	57	79	101	123	145	167	189	211	233	255	277	299	321	343	365	387	409	431	453	475	497	519	541	563	585	607	629	651	673	695	717	739	761	783	805
14	36	58	80	102	124	146	168	190	212	234	256	278	300	322	344	366	388	410	432	454	476	498	520	542	564	586	608	630	652	674	696	718	740	762	784	806
15	37	59	81	103	125	147	169	191	213	235	257	279	301	323	345	367	389	411	433	455	477	499	521	543	565	587	609	631	653	675	697	719	741	763	785	807
16	38	60	82	104	126	148	170	192	214	236	258	280	302	324	346	368	390	412	434	456	478	500	522	544	566	588	610	632	654	676	698	720	742	764	786	808
17	39	61	83	105	127	149	171	193	215	237	259	281	303	325	347	369	391	413	435	457	479	501	523	545	567	589	611	633	655	677	699	721	743	765	787	809
18	40	62	84	106	128	150	172	194	216	238	260	282	304	326	348	370	392	414	436	458	480	502	524	546	568	590	612	634	656	678	700	722	744	766	788	810
19	41	63	85	107	129	151	173	195	217	239	261	283	305	327	349	371	393	415	437	459	481	503	525	547	569	591	613	635	657	679	701	723	745	767	789	811
20	42	64	86	108	130	152	174	196	218	240	262	284	306	328	350	372	394	416	438	460	482	504	526	548	570	592	614	636	658	680	702	724	746	768	790	812
21	43	65	87	109	131	153	175	197	219	241	263	285	307	329	351	373	395	417	439	461	483	505	527	549	571	593	615	637	659	681	703	725	747	769	791	813
22	44	66	88	110	132	154	176	198	220	242	264	286	308	330	352	374	396	418	440	462	484	506	528	550	572	594	616	638	660	682	704	726	748	770	792	814

BYTE's ongoing monitor box (BOMB) lets you rate each article you've read in BYTE as excellent, good, fair, or poor. Each month, you can mail in the BOMB card found at the back of each issue. We tally your votes, total the points, tell you who won, and award the two top-rated nonstaff authors $100 and $50, respectively. An additional $50 award for quality goes to the nonstaff author with the best average score (total points divided by the number of voters). If you prefer, you can use BIX as your method of voting. We welcome your participation.

Article No.*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Excellent	1	5	9	13	17	21	25	29	33	37	41	45	49	53	57	61	65	69	73	77	81	85	89	93	97
Good	2	6	10	14	18	22	26	30	34	38	42	46	50	54	58	62	66	70	74	78	82	86	90	94	98
Fair	3	7	11	15	19	23	27	31	35	39	43	47	51	55	59	63	67	71	75	79	83	87	91	95	99
Poor	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84	88	92	96	100

Article No.*	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Excellent	101	105	109	113	117	121	125	129	133	137	141	145	149	153	157	161	165	169	173	177	181	185	189	193	197
Good	102	106	110	114	118	122	126	130	134	138	142	146	150	154	158	162	166	170	174	178	182	186	190	194	198
Fair	103	107	111	115	119	123	127	131	135	139	143	147	151	155	159	163	167	171	175	179	183	187	191	195	199
Poor	104	108	112	116	120	124	128	132	136	140	144	148	152	156	160	164	168	172	176	180	184	188	192	196	200

* To determine this month's Article No., see BOMB as listed in Table of Contents under Departments.

Name ______________________

Title ______________________

Company ______________________

Address ______________________

City ______________________

State ____________ Zip ____________

Telephone ______________________

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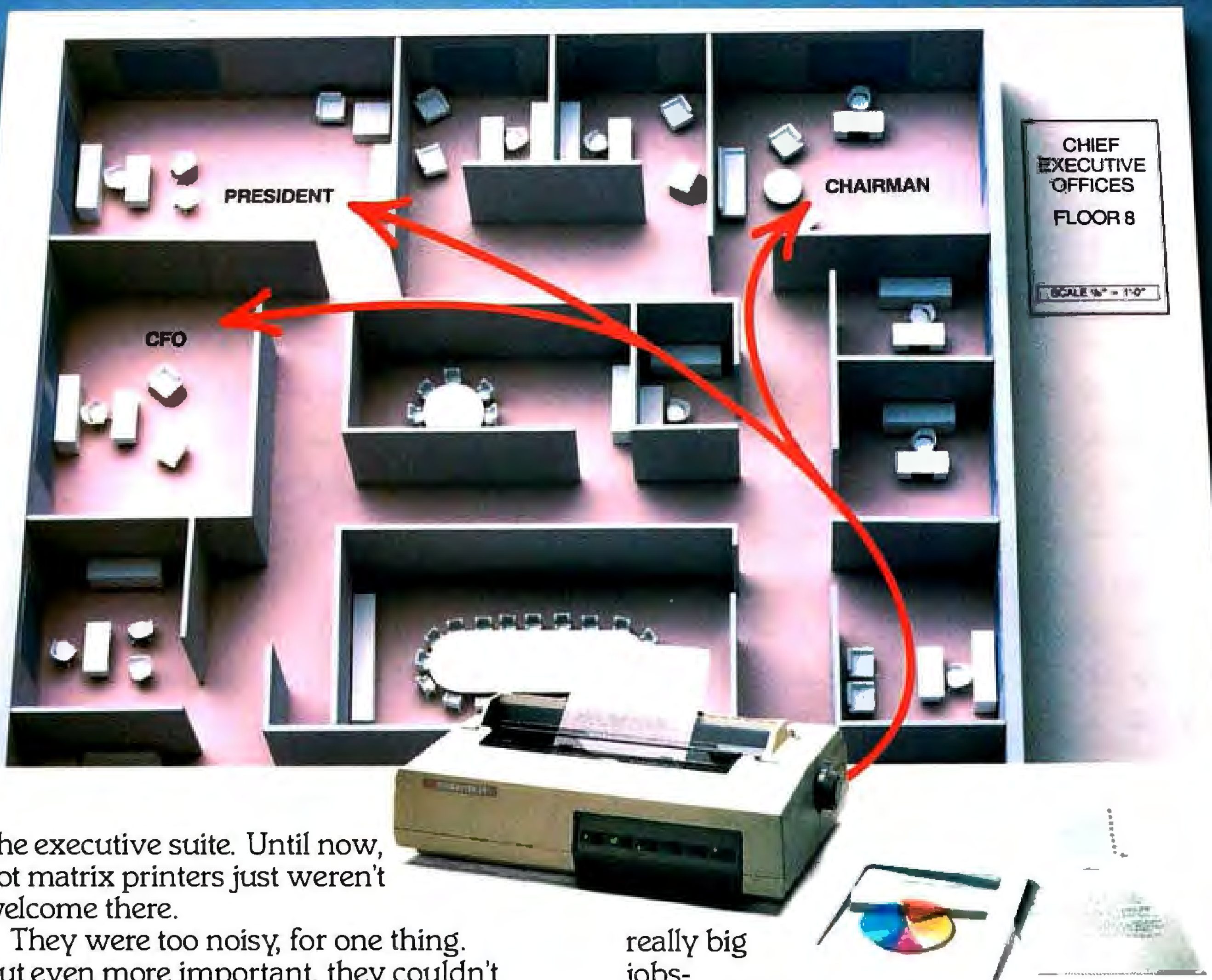
OUR NEW PINWRITER XL SERIES BOLDLY GOES WHERE NO OTHER MATRIX PRINTERS HAVE GONE BEFORE.



The executive suite. Until now, dot matrix printers just weren't welcome there.

They were too noisy, for one thing. But even more important, they couldn't deliver the quality top executives demand.

But now there's the XL series from NEC.

Our Pinwriter® XL series printers have multistrike film ribbons that produce true letter-quality documents—the kind any executive would be proud to sign. They print in 8 different colors—on paper or transparencies—to make charts, graphs and executive presentations more impressive. And they're the quietest matrix printers you've never heard.

`Dear Stockholder:`

Actual print sample from a Pinwriter P9XL printer.

They're also fast. Take our new Pinwriter P9XL, for example. It's over 30% faster than most other printers in its price range, with nearly twice as much memory to handle the really big jobs-including payroll, invoices, continuous forms, and multi-page reports.

Executives will also be pleased to learn that the Pinwriter XL printers, like all NEC printers, are built to run an average of 5 years before they might need a repair. In fact, they have the highest reliability ratings in the industry.

So make an executive decision. Call 1-800-343-4418 (in MA 617-264-8635) and ask for the name of the NEC dealer nearest you. Or write to NEC Information Systems, Dept. 1610, 1414 Massachusetts Ave., Boxborough, MA 01719.

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C&C Computers and Communications

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NEC Information Systems, Inc.

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Next to your computer,

nothing beats a Tandy® printer

IBM® PC compatible

For the best value and selection in top-quality printers, shop your local Radio Shack Computer Center. We've got what you need, whatever your printing requirements.

Versatile business printer

The DMP 2200 (26-1279, $1695) provides dot-matrix printing at up to 380 characters per second. Efficient, fast printing means no long delays for reports—and that saves your business money. Supports elongated, double-high, bold, underline, super/subscripts, italics, double strike and bit-image graphics.

Customized type styles

Use the Font Editing Packages (sold separately) to load different type styles for print quality that rivals a daisy wheel. In the draft mode, the DMP 2110 (26-2810, $1295) prints up to 240 characters per second. Includes data-processing, word-processing and graphics modes.

Low-cost business printer

The DMP 430 (26-1277, $699) features an 18-wire print head and allows a choice of micro, italic and double-high fonts, as well as bit-image graphics. Prints up to 180 characters per second.

Letter-quality daisy-wheel printers

Give your correspondence, reports and memos that clean, crisp "electric-typewriter look." The DWP 520 daisy-wheel printer (26-2800, $995) produces up to 500 words per minute and supports bold-face, strike-through, double-underline, super and subscripts.

And for letter-quality printing under $400, the DWP 230 (26-2812, $399.95) is the clear choice. Prints up to 200 words per minute.

Stop by your local Radio Shack and see our complete selection of printers and accessories today.

TANDY COMPUTERS: In Business . . . for Business™

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