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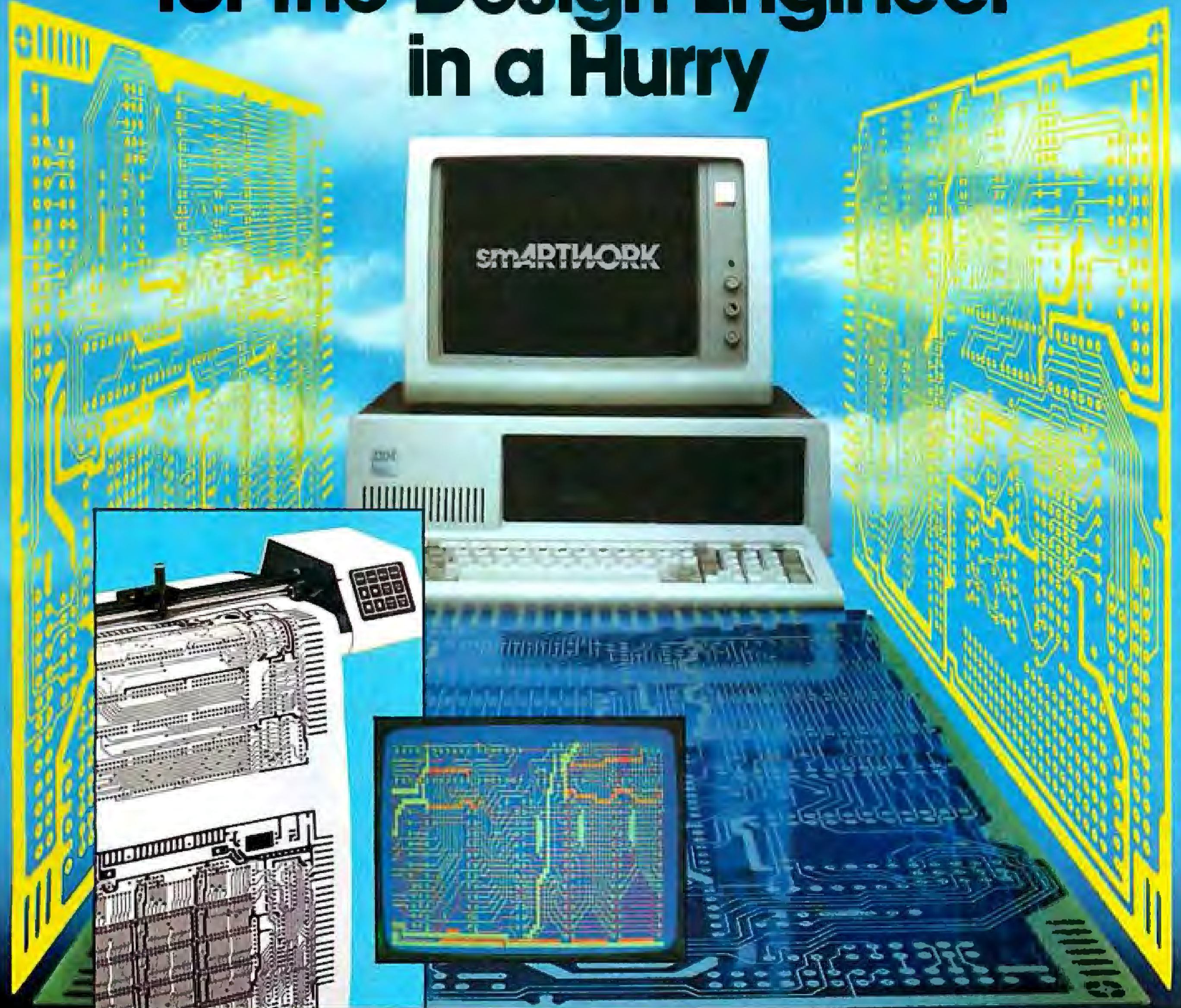

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E·D·I·T·O·R·I·A·L

THE BEST OF BIX COMES TO BYTE

BYTE's readers are always seeking to improve the performance of their personal computers—to expand the memory beyond its supposed limits, to speed up the system clock, to reconfigure the RAM disk, to pop in a more powerful CPU. BYTE's readers are venturesome but not foolhardy. They know a lot themselves but will listen to others who are knowledgeable before proceeding with a radical alteration of a computer system. But other knowledgeable users aren't always handy.

We've been fascinated in the early days of the BYTE Information Exchange (BIX) to see so many readers offering tips and reporting results of various attempts to enhance different kinds of computers.

Atari 520ST users, like Macintosh users, encounter a hard limit on memory expansion at 512K bytes. But the BIX conference on the 520ST gives detailed instructions on expanding the 520ST's memory to 1 megabyte. One pleasant surprise: the operating system recognizes the additional memory.

Have you considered replacing the 8088 in your IBM PC or compatible with the new NEC V20 chip to improve performance? How much improvement could you expect? Would there be technical side effects? In the BIX conferences on IBM PCs and compatibles, readers have already reported their results with IBM PCs and machines made by Seequa, Sanyo, Columbia, and others. Or how about replacing the crystal in your IBM PC AT to make the system operate faster than its usual 6 MHz? Would you see enhanced performance or maddening glitches? AT users discuss their results in the BIX conference on the AT.

If you're installing RAM-disk software on a Macintosh, is it best to use the RAM disk for data, the application program, or the System and Finder? What will future Macintoshes be like and how can today's users write software that will remain compatible? In the BIX conference on the Macintosh, expert users share their experience on these and other topics.

The standard Commodore Amiga has plenty of processing power, but some BIX users have already replaced the 68000 with a 68010 or 68020. Moreover, there's already a 68020 board for the Amiga and the operating system has been revised for upward compatibility to the more powerful chips. Amiga users also exchange tips on how to select and install the best RGB monitor for use with the Amiga. The Sony KV-25XBR monitor comes in for high praise. The BIX Amiga conference covers these and other early experiments with the Amiga.

To give you an idea of the sort of information generated through BIX, we're introducing a new BYTE section this month. Called "Best of BIX," the section will include each month some of the most interesting exchanges from BIX. It was hard deciding which conferences of the more than 100 on BIX to excerpt. There are many conferences in BIX, including good ones on the Apple II family, CP/M machines, LISP, C, Pascal, operating systems, and other topics. But we've chosen examples from the conferences on the Amiga, Atari, IBM PCs, and Macintosh because the interest of most BYTE readers has shifted to 16-bit systems and because these four conferences are among the most lively in the system. We hope in the future to broaden the scope of the Best of BIX section. We would like to be able to provide valuable information in BYTE each month about the specific computers owned by the preponderance of BYTE readers. At the very least, we will continue to include in Best of BIX some of the highlights about Macintosh, the IBM PC family and compatibles, the Commodore Amiga, and the Atari 520ST.

For us, one of the chief attractions of BIX is that there we *can* include coverage of everything. We don't have to make painful decisions about which materials to leave out each month. We can cover your favorite machine, operating system, and programming language. Another major attraction of BIX is the timeliness. BIX members can read first-hand accounts of programming and hardware wizardry only minutes after they are entered.

We do realize that some readers don't participate in telecommunications and don't want to join BIX. The BYTE section introduced this month is an attempt to bring some of BIX's benefits to these readers as well as to broaden the magazine to include regular coverage of several major machines.

HOW YOU CAN JOIN BIX

After one month of commercial operation and one mailing to 50,000 readers, BIX had more than 1000 users with another 40 to 70 signing up each day. Refinements of the software and installation of another MC68000 (bringing the total to 15) improved performance of the Arete computer BIX runs on considerably over what we saw during the test phase. The major technical concern at the moment is UNIX's limited number of i-nodes and the need to supplement them with a database if the user population continues to grow more rapidly than anticipated. UNIX wizards with solutions to this problem should write to Phil Lemmons or George Bond.

Reading more and more about BIX here in the pages of BYTE you are no doubt wondering how and when you can begin using the system. To carefully manage our growth, we're phasing in our promotion of BIX to our readership. We began commercial operation in November and mailed information about BIX to one group of subscribers, primarily in Boston, Chicago, Los Angeles, and San Francisco.

Now the rest of you can join us, and literally within the next few minutes. More information about BIX—including detailed log-on instructions—is on page 246 and 247 of this issue.

If you can't join now but are interested in BIX, circle number 450 on the reader service card, and we'll keep you posted as the system grows.

Some of you have asked whether you can pay for BIX by means other than the credit cards we now honor. We're actively exploring other options and will let you know both on line and in the pages of BYTE as any new payment mechanisms are implemented.

If you have any additional questions, write to BIX, 70 Main St., Peterborough, NH 03458, or call (603) 924-9281 ext. 131, 8:30 a.m. to 4:30 p.m., weekdays, eastern time. We look forward to seeing you soon on BIX.

—*Phil Lemmons*
Editor in Chief

M·I·C·R·O·B·Y·T·E·S

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

Atari's 1040ST: 1 Megabyte for Less Than $1000

The new 1040ST from Atari is a direct successor to the 520ST, but it has 1 megabyte of RAM, an internal power supply, an internal RF modulator, and a built-in double-sided 3½-inch floppy-disk drive. Atari's computer dealers will offer a 1040ST and a monochrome monitor for $995. The TOS operating system has reached final form and will be in ROM inside both the 1040ST and the 520ST. Any 520ST applications that follow TOS and GEM rules will run on the 1040ST.

The 520ST will still be available, but it will be unbundled and sold as a mass-market item. The new prices will be: 520ST, $299; single-sided disk drive, $199; double-sided disk drive, $299; monochrome monitor, $199; color monitor, $399. A 20-megabyte hard-disk drive will be sold for approximately $700.

Apple Adds a Plus to Both Macintosh and LaserWriter

Macintosh Plus has now joined the Macintosh family; LaserWriter Plus joined the LaserWriter in a family of two. The Mac Plus doesn't have any expansion slots and still uses both the 9-inch 512- by 342-pixel screen and 7.8336-MHz 68000 processor. The pluses are 1 megabyte of RAM, 128K bytes of ROM, an 800K-byte double-sided disk drive, an SCSI interface, and a keyboard that includes a numeric keypad and cursor keys. The LaserWriter Plus is faster than the LaserWriter and contains more built-in fonts within a full megabyte of ROM. The RAM in the Mac Plus is contained in four socketed SIMMs (single in-line memory modules), which are small boards with leads on only one side and 256K-bit surface-mount DRAM chips soldered to the top. When 1-megabit surface-mount DRAMs are available, the Mac Plus can be upgraded to 4 megabytes of RAM. The ROM contains a faster QuickDraw and Finder 5.1 with the Hierarchical File System. Other changes include a RAM-disk utility on the pull-down Control Panel. The SCSI interface allows easy connection to industry-standard peripherals like hard disks. The 800K-byte disk drive is a half-height double-sided version of the Fat Mac's Sony drive that is twice as fast. Macintosh Plus will not come bundled with MacWrite and MacPaint.

Apple also announced that any Macintosh can be upgraded to the Mac Plus level. For $299, you can buy a Disk Drive Kit with both an 800K-byte internal disk drive and the new ROMs. For $599 (for Fat Mac owners) or $799 (for 128K-byte Mac owners and Fat Mac owners with unofficial modifications to their machines), you can buy the Logic Board Kit that contains the new digital board and a new rear housing. However, Logic Board Kit buyers must also buy the Disk Drive Kit to get the new ROMs. For $129, you can buy the new keyboard. To protect those who bought Fat Macs in the 60 days prior to the Mac Plus announcement (November 18 to January 16), Apple is offering half-price Disk and Logic upgrade kits. External 800K-byte disk drives will be sold for $499. All of the upgrade prices include the dealer's installation fee.

The LaserWriter Plus carries a $6798 price tag. The $5999 LaserWriter can be transformed into a LaserWriter Plus with the addition of a $799 Font Kit.

Page Scanner for the IBM PC

As evidence of the burgeoning interest in scanning and OCR (optical character recognition), DEST Corporation of Milpitas, CA, has introduced PC Scan, a page scanner for the IBM Personal Computer. The PC Scan box itself costs $1995 and measures 4 by 11½ by 16 inches—about the size of a standard dot-matrix printer. Because the pages are fed in and out of one side of PC Scan, you can put it under a disk drive, printer, or terminal. The PC Scan controller board contains an SCSI interface, costs $195, and plugs into an IBM PC, XT, or AT.

PC Scan automatically scans one sheet at a time. It isn't very picky about what sort of

(continued)

page you feed it, accepting weights from 16 pounds to 30 pounds and sizes from 6 by 6 inches to 8½ by 14 inches. Automatic video thresholding adjusts the scanning contrast for varying paper colors. Pages placed right side up emerge face down to maintain the sequence of multiple-page documents.

Inside PC Scan are the optical-mechanical hardware and a proprietary VLSI OCR processor. Documents are scanned in about 5 seconds at a resolution of 300 dots per inch, and the information is then sent to the attached IBM PC.

To make use of the data, you'll need OCR software, like DEST's software for the PC Scan, called Text Pac. This $595 program contains type style and recognition information that lets PC Scan read all common business documents. A page can be "recognized" in about 25 seconds. Text Pac automatically enters text into the formats of word-processing programs like WordStar and MultiMate. The program even determines the placement of tabs, underscores, and centering instructions and enters these into the file. To use PC Scan, you just insert the page to be scanned and type Alt-S while running your word processor. PC Scan will bring in the text and show you the progress on the PC's screen. DEST is developing other application-specific software for PC Scan and hopes to stimulate third-party developers to do the same.

Chinese Introduce PC Clone

Great Wall, People's Republic of China, offers the 0520A, 0520C-E, and 0520C-H line of IBM PC-compatible microcomputers. The 0520C-H, which is the top of the line, contains a complete set of PC features, including an 8088 processor, 512K bytes of RAM, two 320K-byte floppies, and a 20-megabyte hard disk. The system also boasts a 648- by 504-pixel color display and a monochrome 972- by 700-pixel display, essential for the 16 by 18 and 24 by 28 high-resolution Chinese characters the system can present. Great Wall also offers the GW-NET network, several special display adapters, and is developing a PC AT clone that will support XENIX.

Nanobytes

NEC is sampling its V40 and V50 (μPD70208 and μPD70216) CMOS 16-bit microprocessors. Both chips have a 1-megabyte address space, run all V20 and V30 software—and therefore 8088/86 software—and have integrated many system functions onto the processor chip: a four-channel DMA controller, a serial controller, a DRAM-refresh controller, an interrupt controller, timer/counters, clock generator, and a program wait and bus controller. . . . For those who want to leap past silicon, **TriQuint Semiconductor** of Beaverton, OR, offers the Q-Chip Evaluation Kit for $2500. This kit includes two Q-Chip GaAs (gallium arsenide) MSI (medium-scale integration) cell arrays that run at 2 gigahertz, one high-speed evaluation circuit board, support parts, and documentation. . . . **Award Software**, Los Gatos, CA, is offering three modes of BIOS support for IBM-compatible enhanced graphics adapters. The compatible BIOS supports all alphanumeric and graphics modes and fits in a 16K-byte ROM. . . . **Hunter & Ready**, Palo Alto, CA, has ported its VRTX real-time operating system to **Motorola**'s new VMEmodule board family. This includes the MVME130 single-board microcomputer that employs the 68020 32-bit processor and the 68881 FPU (floating-point unit). . . . **Consulair Corp.** of Portola Valley, CA, announced several new products for Macintosh C programmers. The $80 Consulair Linker is an optimizing linker and librarian for Consulair Mac C and Apple MDS (Macintosh 68000 Development System) programmers. The $100 Consulair Utilities includes SuperMake for determining which files need recompilation, Diff for comparing files, Grep for searching multiple files, and MPA for analyzing performance. Consulair is also selling **ALSoft**'s MacExpress generic application for $495 and **Faircom**'s C-Tree ISAM package for $395. . . . **Borland**'s new $69.95 Turbo Editor Toolbox includes Turbo Pascal source code for construction and customization of editors and word processors as well as a partial adaptation of **MicroPro**'s WordStar word processor. . . . **Softworks Development** in Mountain View, CA, introduced PC-Outline, a shareware outlining program for the IBM PC, XT, or AT. Registration costs $49.95. . . . **Intel** is the first company to put EPROMs into surface-mountable plastic-leaded chip-carrier (PLCC) packages that use less than one-third of the board space of the previous DIP packages. . . . **Advanced Micro Devices** introduced the Am7970 compression/expansion processor chip (CEP) that can compress images by ratios of 30:1. The chip complies with CCITT recommended standards and can expand and compress both text and image data simultaneously using its three processing engines and two-bus architecture. AMD also introduced the Am8177 16-bit Video Data Serializer that converts pixel data from parallel to serial at a 200-MHz shift rate. . . . **Oki Semiconductor**, Sunnyvale, CA, launched the 80C59, a CMOS single-chip 8-bit microcomputer that includes 16K bytes of ROM, 256 bytes of RAM, and three 16-bit timers. The chip uses the same instruction set as the smaller 80C51 and is available in speeds up to 16 MHz.

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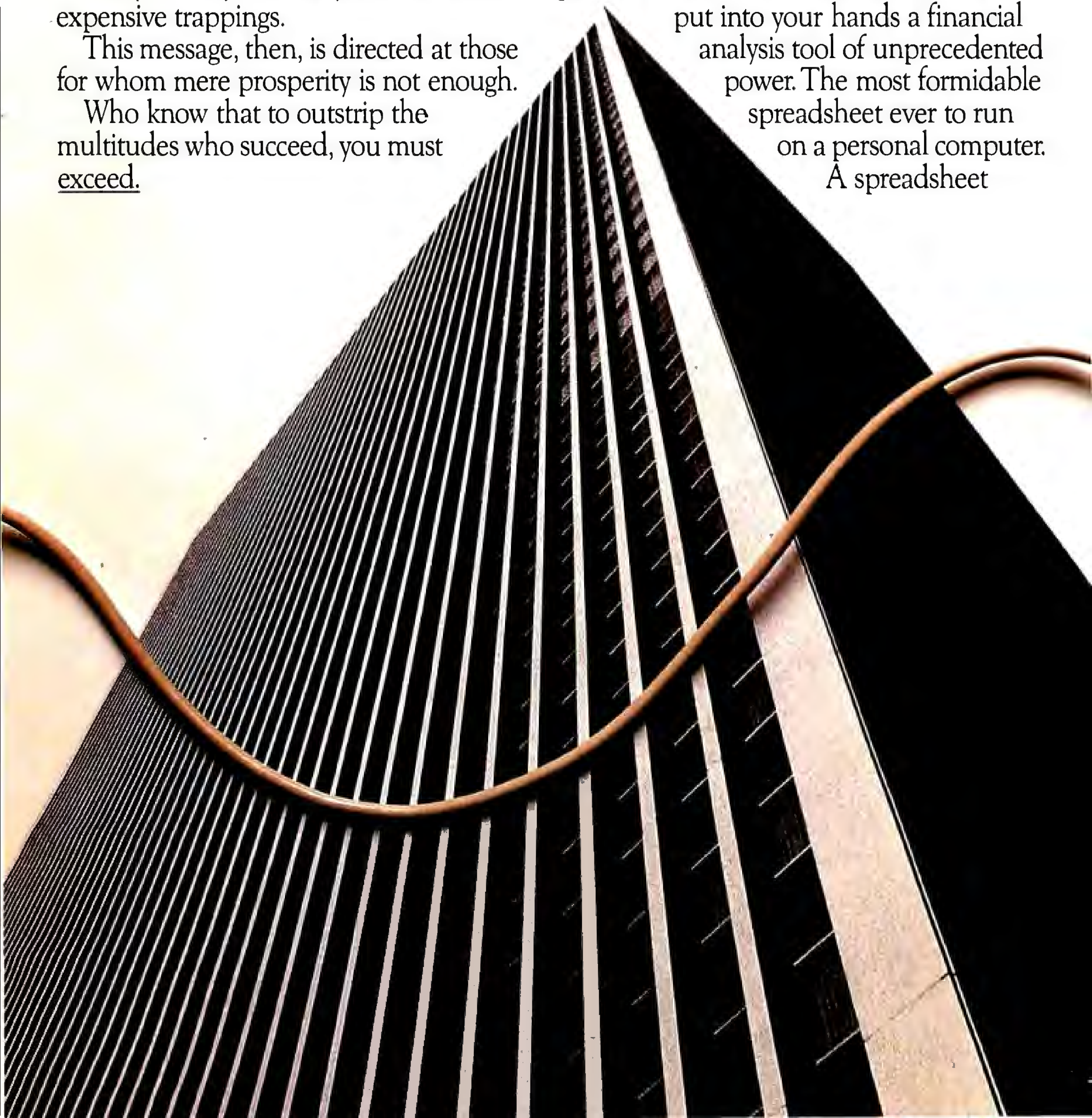

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INTERFACES FOR THE DISABLED

I am currently completing my master's degree in education at Ohio State University. One of my courses is a three-hour independent study project for the director of occupational therapy at Ohio State University Hospitals. The project calls for me to compile a journal/notebook of interface devices that allow handicapped persons to use their computers.

The degree of handicap varies considerably from patient to patient. Some may need merely a utility to convert keyboard keys to toggles in the event that they can use only one hand or some other device to type with.

What I am discovering is that there is a dearth of information available, and I am seeking help from BYTE readers. If anyone out there in computerland (small "c") can assist me with information on various interface devices, I would be appreciative.

I also invite anecdotal experiences from any handicapped persons on their particular computer system, the degree of their handicap, and the methods they use to interface with the computer system.

All of the above information would be placed in a notebook for use by rehabilitation occupational therapists in helping others as the need arises. Information such as copies of magazine articles dealing with this issue will also be appreciated.

ARNIE SKUROW
5760 Crawford Dr.
Columbus, OH 43229

CODING FOR THE 32016

I have been tinkering with a National Semiconductor 32016 processor, and I'm so enthusiastic about the results that I must make other readers more aware of this chip. In the past I hesitated to wander from the Z80 because I'm very fluent in Z80 code and shunned the idea of learning the assembly language of other processors. When I started coding for the 32016, I immediately found it to be very easy, beginning with the very first line of code. Assembly code flows from the pencil much easier than the English language. There is almost no need for a high-level language: the hardware is high-level. Still, I wanted a high-level language but didn't know how to write a compiler, so I wrote a FORTH-83 program for it (that is, it is similar to FORTH-83, but it uses 32-bit signed integers exclusively). I couldn't get its Sieve of Eratosthenes time (10 iterations) any faster than 9.6 seconds because of the awkward syntax of FORTH. In the process of trying to optimize the compilation of FORTH, I realized I could write a compiler for any language. I added BASIC to my FORTH simply by throwing in a parser and adding some BASIC keywords. Don't get the idea that I did any of the programming in FORTH; assembly language is much easier.

Now here's the meat of the story: My BASIC does 10 iterations of the Sieve in 1.78 seconds. The compile time is 0.11 second, so if you have the text in the editor and type RUN, it takes 1.89 seconds to compile and run the Sieve. That is what I call a type I compiler; it is a compiler that completely emulates an interpreter. I call the regular compilers type II compilers; these are the ones that compile modules so that an arbitrary number of precompiled modules can be linked together.

You might be wondering how fast my 32016 (7.16-MHz clock) will do the Sieve in hand-coded assembly language if it does it that fast in BASIC. The answer is that I cannot improve upon the compiled code using assembly language. I'm not sure if you would call this an optimizing compiler, because there is no optimizer. It simply makes one pass through the source code and writes the same kind of machine code that I would write. The 32016 obliterates the dilemma between a high-level language and assembly language in one fell swoop. If this processor performs this way in the hands of a neophyte who has not seen how compilers are written, imagine what it would do in the hands of Microsoft or Borland! You could write every part of your high-speed stuff in the high-level language of your choice with confidence that you could not improve its speed with assembly language. Here are some examples of BASIC statements that compile to a single machine-code instruction:

```
A = A * C
count = count + 5
A = A / C
```

And if *i* and *j* happen to be register variables, these statements will each compile to a single machine-code instruction:

```
A(i) = B(j)
flags(i) = 1
```

I have written some software floating-point routines (IEEE double-precision) for my 32016. It does the square root in 190 microseconds, which is 113 times as fast as BASCOM does it on my Z80 system. I have not integrated my software floating-point routines into my BASIC because of the lure of the hardware math chip, which does a double-precision multiply faster than it can move the operands in and out of memory.

I find coding for the 32016 very easy and a lot of fun, and I recommend it as a form of entertainment even if you don't need one.

NEIL R. KOOZER
Oakland, OR

DATA GENERAL/ONE—A USER'S PERSPECTIVE

Part of what makes the Data General/One work for me is its diminutive presence. I never need to accommodate the machine except to open it where there is adequate light so that its gentle screen can be read comfortably.

I work primarily in programming for fast graphics applications or for fancy vision/robotics installations using machines where the power supplies hum and the screens practically crackle with color and energy. The software is written on the slower, softer, quieter DG/One whenever possible.

I like knowing that I am getting less electronic radiation directly from my worksta-

(continued)

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

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

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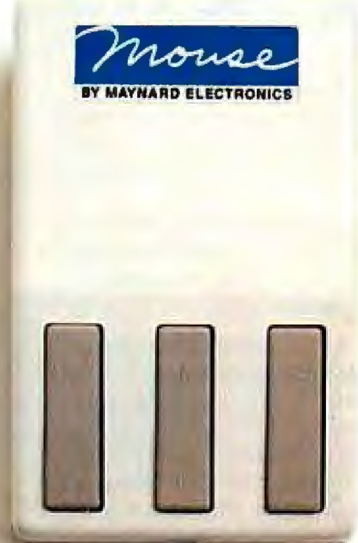

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A Tale Of Three Mice . . .

Compare our Mouse with the others running around and you'll see, there's no comparison! Here are just a few features across the board:

FEATURES	Maynard Mouse	Microsoft	Mouse Systems
# of Button Combinations	7	3	5
Button Auto Repeat	Yes	No	No
Diagnostics	Yes	No	Yes
Dynamic Scaling	Yes	No	No
Cursor Overshoot Control	Yes	No	No
Adjustable Cursor Speed/Up, Dn (while runnin a plication)	Yes	No	No
Adjustab e ursor Speed/Rt, Lft (while runnin a plication)	Yes	No	No
Buttons- e inable (while running application)	Yes	No	No
Macros-Definable (while running application)	Yes	No	No
User-Definable Alternate Cursor Movement	Yes	No	No

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Purchase The Mouse now and receive the popular paint program Telepaint* at no additional cost — a ¶ value!

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tion. The machine is cool; the only heat is from my efforts, amplified impartially by the smoothly running software that I use (EMACS, assemblers, compilers, linkers, debuggers, etc.).

I use 512K bytes and more than four times the disk storage of a regular IBM PC clone. Another virtue of the microdrives: I keep backups of my important work and development environments in my pocket as insurance against the unknown. (I may be unusually sensitive about software security, but having the media on my person at all times tremendously reduces work-related anxiety.)

Frequently I take the DG with me, in a small black backpack, while I cycle to the Swiss Patisserie for a needed change of scenery and a fruit flan with a cappuccino. The waitress knows not to pass liquids over the keys. Since I only unzip the backpack and partly withdraw the machine to open it for working, other patrons have little clue that they are in my software studio.

While the DG/One has been the primary machine in our six-machine firm for the last 11 months, I do not suggest it would be best for every computer user to have a One. It is interesting that afterward I bought a clone with a color monitor and 640K and one drive at the same price and instead of the DG expansion chassis and main board upgrade (to enable my early vintage portable to use the expansion).

I had originally purchased a 5¼-inch drive that attaches easily, so, to test machine-specific software, I move it onto the standard flimsy media for insertion into the noisy clone that bears the truer burden of compliance with the industry standard.

What this all boils down to is that the DG/One supports a gestalt (an ergonomic?) of productivity, where the technology is more transparent than the work being done with it. This is something new, like the feeling of going someplace rather than the task of driving there.

What follows is my wish list for lap portables in order of decreasing short-term possibility:

1. Continuous memory so that booting up the system is an intentional act, not a requirement after closing the lid.
2. Longer battery life; 8 to 12 hours is sometimes less than the length of my work day (though I seldom use just batteries for such a long time).
3. Internal banked memory expansion using Intel Lotus format to 2 megabytes.

(continued)

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LETTERS

4. Color LCD technology.
5. Multiple LCDs (one in color) arranged like a fold-out book, to be used like semivolatile printouts and as alternate touch-sensitive in-use screens. The main problem in portable (clandestine) computing is temporary hard copy; the vanishing that windowing software requires of the occluded data is crippling. Normal screens carry less than a printed page, anyway; when I really get going, my desk has at least four pages of highly relevant information that I randomly refer to as needed. I would suggest a primary-color LCD that, when slipped upward six inches, would expose a secondary black-and-white LCD that could be folded outward and aside to unveil three more subscreens.
6. Physical architecture resembling a bundle of pocket books, so that you could:
   a. snap off the keyboard processor element and unfold a detached keyboard
   b. snap off the display processor element and unfold a multiple touchscreen with integrated stand and auxiliary lighting
   c. switch on the CPU/mass-storage element
   d. optionally snap the elements together into a rigid form while running for least susceptibility to casual interference by innocent passersby
7. A cluster of transputers with a mimic operating-system shell that enable it to emulate other operating systems and read disks of any format.
8. Portable voice and vision and communications subsystems with optional CD-ROMS and CD-RAMS, as miniaturized DMA peripherals.

Okay, Data General, your work is cut out for you. In the meantime, I will continue to click away at the diminutive tan and cream keys beneath a soft gray display panel away from the crackle and (ho)hum of real computers.

JERRY WAESE
Toronto, Ontario, Canada

WHOSE ICON IS IT?

Our family garbage can has served us faithfully and well, transferring without complaint our trash from home to the county dump. Its image was something we shared with people from here to Timbuktu. If we were in Rangoon and didn't speak the lingo, we merely drew a picture, said "Ashcan it, Charley," pointing to the picture, and Charley understood.

(continued)

For those times when 640K memory just doesn't seem to be enough.

AST introduces RAMpage!™ with up to 2 Mb of PC RAM.

Feed your byte-gobbling applications with the expanded memory of RAMpage! And stop wasting valuable time with frustrating "Memory Full" messages.

[illegible] 640K [illegible]

RAMpage! breaks through the PC's 640K-byte barrier delivering up to 2 megabytes of parity checked memory for expanded memory applications. Up to 4 RAMpage! boards can be used in a single PC for a full 8 Mb of memory per system.

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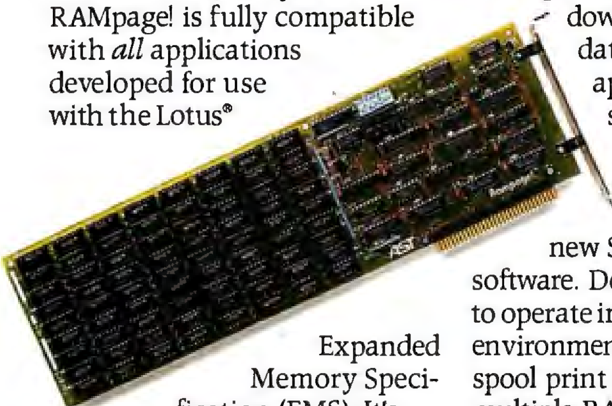
RAMpage! is fully compatible with *all* applications developed for use with the Lotus® Expanded Memory Specification (EMS). It's also supported by Enhanced EMS software—offering more versatility for even greater value and performance.



New software updates of popular applications like Symphony,™ Framework™ and 1-2-3,® designed specifically for use with EMS boards, are now becoming available. And a wide variety of other packages, including windowing, spreadsheet, database and CAD applications, will soon follow.

A [illegible]

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Or write, AST Research, Inc., 2121 Alton Avenue, Irvine, California 92714 TWX: 753699 ASTR UR.

Specifications
- *For use with IBM® PC, PC-XT, 3270 PC and compatibles.*
- *Up to 2.0 Mb expanded memory per board—8.0 Mb total per system.*
- *Socketed and user upgradeable with 256K DRAMS.*
- *Fully compatible with Lotus EMS 3.0.*
- *Enhanced EMS design for greater performance with enhanced EMS software.*
- *AST Expanded Memory Manager software standard.*
- *New SuperPak™ utility software standard.*

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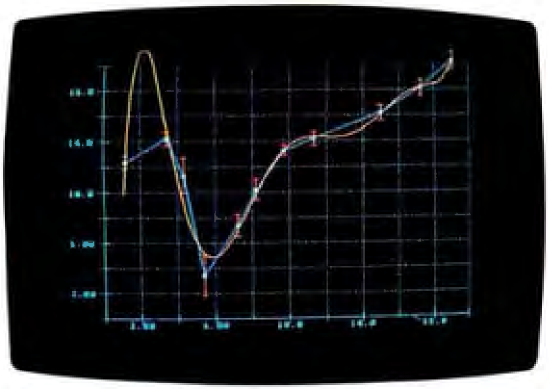

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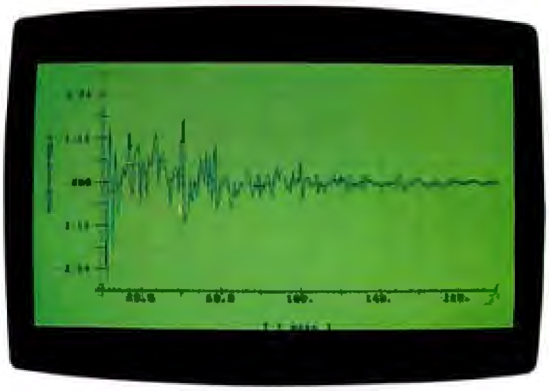
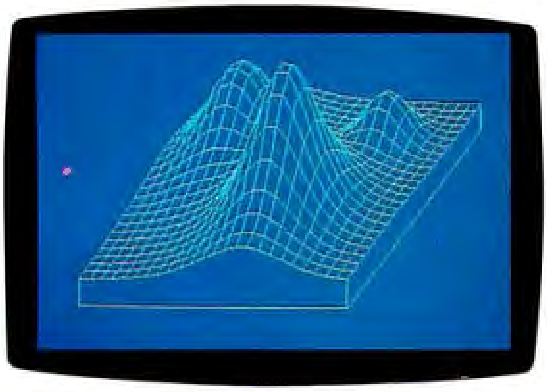
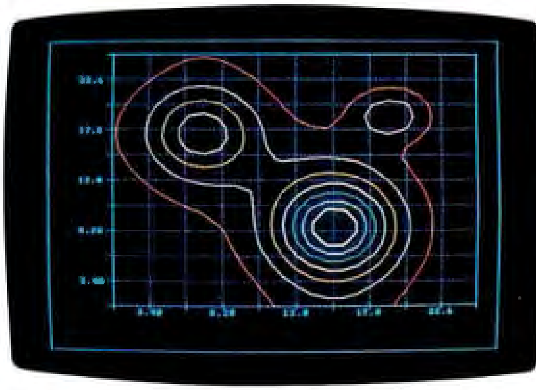


New color graphics enhance comparison of experimental data with filtered data.



ASYST axonometric plots simplify analysis of complicated 3-dimensional surfaces.



Contour plotting adds an alternative approach to meaningful 3-D representation.

ASYST™ adds new muscle.

More hardware support, more analysis capabilities for the IBM PC.

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Minicomputer speed and precision—at a fraction of the cost.

ASYST on an IBM PC does a &g5 FFT in less than 3 seconds (as fast as &5 on some compatibles). For the same task, an optimum performance routine on a DEC &&5 + minicomputer using FPF &&™ took 5 seconds—at 5 times the price!

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Inquiry 200

Our can's image, or "icon," as the fancy dudes have it, together with similar images, offered the potential for a universal language or symbolic system. The day was coming when a local girl in Kathmandu, encountering a new computer for the first time, could scan the images on the screen and have a fighting chance to figure the thing out.

Alas, no longer. Through the legerdemain of Apple Computer's forensic wizards, Apple has taken possession of the family garbage can, or, at least, its image (*InfoWorld*, October 7, 1985, quoting Michael Reichmann, vice-president of development and marketing for software maker Batteries Included of Toronto, in an article entitled "Apple Forces GEM Change"—"Things like the trash can icon, the disk icons. . .are going to have to go. . . .Apple is going after everybody, Commodore and Amiga, Microsoft for Windows. . . .").

Ancient wisdom has it that "Those who do not exercise their rights lose them." One might hope that someone would challenge this blatant image grab.

Alas, the might of Apple's battle-hardened batallions of legal talent is renowned. Before their unsurpassed prowess, legal skills, and unbridled ferocity, huge corporations quake and slink away.

Thus, we envision a world in which every garbage can bears the legend "Visual Image Property of Apple Computer," or, as is inevitable, shortened forms thereof.

The cloud might yet have a silver lining. We might yet have a blessing in disguise if, every time we saw Apple's name on a garbage can, we resolutely undertook to exercise and defend those of our rights remaining.

Be that as it may, we have no alternative but to comply with rights legally appropriated. I am off now to paint the bitter legend on my family garbage can: "Image of Apple Computer."

DICK BELL
Bodega, CA

MULTIBUS II VERSUS VMEBUS

I thought your special edition, *Inside the IBM PCs*, was exceptional. The information contained within the magazine serves as an excellent piece of reference material. I would, however, like to take issue with G. Michael Vose's comments in his editorial "Intel and Future IBM PCs."

Mr. Vose states that the VMEbus is better suited for single-processor applications. Both bus architectures (Multibus II

(continued)

and VME) are capable of multiple bus masters coexisting within one system. In fact, the flexibility afforded to the VME system designer in the choices for bus arbitration between bus masters is greater than that afforded to the Multibus II system designer.

As Mr. Vose notes in his editorial, "Many of the high-end supermicros are MC68010-based machines" with the preferred bus architecture being the VMEbus. Sun, Apollo, and even IBM have introduced products (systems) based on VME. When IBM wants to get some real throughput from a computing system, it, too, relies on the 68000 (the IBM 3270 PC). I invite Mr. Vose to a meeting of the Chicago chapter of the VITA (VME International Trade Association) user group. At the last meeting, a VME system was demonstrated with seven CPU masters all running concurrently.

Last but not least, Mr. Vose compares the architecture of the 68000 to that of the VAX ("partly due to the 68000's similarity to Digital Equipment Corporation's VAX hardware. . ."). Actually, the 68000 architecture more closely resembles that of the DEC PDP-11. The National Semiconductor 32032 architecture is closer to the DEC VAX than the 68000 is.

We have all heard about the problems associated with the Intel 80286 running in the protected mode. To date, I have not seen one operating system that operates in this mode. To this end, Mr. Vose's comment that Motorola design engineers have met their original design goals on the MC68000 family is true. All modes on the 68000 work.

GARY A. SHADE
Elk Grove Village, IL

G. Michael Vose replies:
I thank Mr. Shade for his comments on our IBM special issue.

I did not claim, however, that the VMEbus is "better suited for single-processor applications" (his phrase). I argued that the bus is "nicely suited" to these architectures. My point was that the VMEbus can be used in low-cost, single-processor systems or in multiprocessor systems, while Multibus II is strictly a multiprocessor bus. This VMEbus flexibility characterizes Motorola's approach to hardware/software design, buttressing my contention that Motorola and Intel have distinct corporate mindsets to solving problems.

Look for a two-part article comparing the VME and Intel buses in future issues of BYTE.

Mr. Shade is correct that the 68000 more closely resembles the architecture of the PDP-11 than the VAX, which I was aware of but misstated.

CALCULATING π

I read with interest the recent articles on calculating transcendental numbers. "Computing Pi" by David J. Crawford (May 1985, page 433) contained an algorithm for computing π using an infinite series, or Taylor expansion, that Crawford noted was "virtually useless" because the rate at which it converges on the true value of π declines rapidly. I was interested in seeing how bad this convergence problem was at the extreme, so I converted Crawford's program to FORTRAN (with some modifications) and ran it on a Digital

(continued)

```
 0:10:24 MONTR EXECUTE PI.FOR
 0:10:30 USER [LNKXCT PI execution]
 0:10:31 USER  ITERATION                    PI
 0:59:38 USER   100,000,000   0.31415926435897970D+01
 1:48:45 USER   200,000,000   0.31415926485897915D+01
 3:07:28 USER   300,000,000   0.31415926502564646D+01
 4:04:03 USER   400,000,000   0.31415926510897982D+01
 4:54:16 USER   500,000,000   0.31415926515898004D+01
 6:17:40 USER   600,000,000   0.31415926519231336D+01
 8:08:54 USER   700,000,000   0.31415926521612244D+01
14:38:17 USER   800,000,000   0.31415926523397977D+01
21:16:53 USER   900,000,000   0.31415926524786870D+01
 1:21:55 USER 1,000,000,000   0.31415926525897955D+01
 1:21:55 USER CPU time 7:24:21.59   Elapsed time 25:11:24.33
```

Figure 1: *Reader Hyde's π calculation batch log.*

Equipment Corporation mainframe. I ran it for one billion iterations, which took over 7 hours of CPU time and more than 24 hours to run. I have included the batch log (figure 1). You can see that after one billion iterations, the value of π is accurate to only eight places. I would have to say that this simple, elegant method for calculating π is totally useless for practical calculations, but it is a clearly understandable method on a theoretical level. Thank you for this type of article.

James F. C. Hyde III
Missoula, MT

Where Credit Is Due

It was with great interest that I read "Microcomputers in NASA's SIR-B" by Richard Wilton (July 1985, page 192). The mission design and operations manager of this effort, Henry Harris, was an invited speaker at the 1985 Rochester FORTH Conference, which was held in June. However, I was disappointed to find no mention of Henry in the article, save for two bibliographic references.

I don't wish to downplay Richard Wilton's contribution to this project, but I think that it is important to realize that he was a consultant working under Henry's and others' direction. I appreciate the difficulty in delineating an individual's contribution to a group project, but it is always important to give credit.

Lawrence P. Forsley
Rochester FORTH Conference Chairman
Rochester, NY

Notes on Normal Distribution

I wish to thank the readers of BYTE who took the time to comment on my article ("Simulating the Normal Distribution," October 1985, page 137). The list that follows

(continued)

 Inquiry 322

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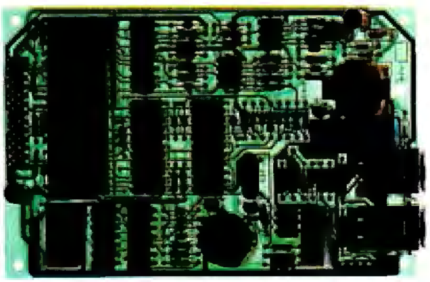

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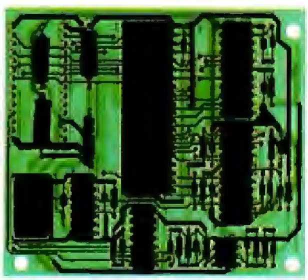

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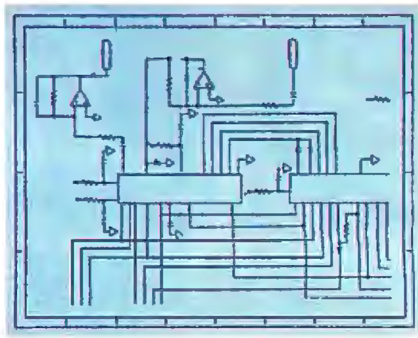

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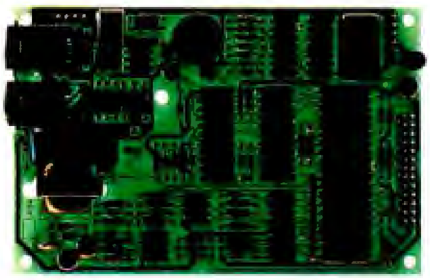

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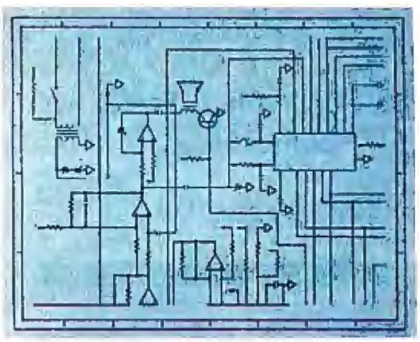

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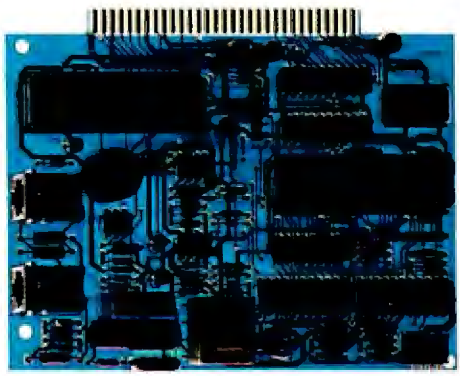

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Inquiry 344

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is in response to the points made by the many readers who wrote to me.

1. Errors. The fourth value in the "Number of Items" heading in table 1 on page 138 should have been 0.144 rather than 0.129.

The variable S3X in line 20 of listing 1 on page 138 should be S3, as in line 50.

2. Novelty. I'm sorry if readers inferred that I claimed to have invented the method. I hadn't seen it in the popular computer literature and thought it might be useful.

3. Tails. The column quote on page 138 says, "There is one thing to watch out for: extreme values." By examining the tabulated values for the normal distribution, and other means, the interested user can determine exactly what is lost by this approximate method.

4. Accuracy. The method does *not* generate a normal distribution. Even with many terms summed, it is but an approximation to it. A question that I have not addressed (because I don't know how to) is, "How can one specify, for a simulation application, the accuracy required of a 'simulated' normal distribution?"

One simple method is to use some chi-squared criterion, but the method of the article yields some pretty good numbers on that score. Perhaps BYTE readers might have suggestions for answers to the "specification" question.

5. Better Methods. Several of these were suggested by readers. The most frequently cited was that of Box and Muller. Daniel Zwillinger provided the BASIC code for its implementation as shown in listing 1.

In his letter, Derek Stubbs suggested two more methods, one of which I simply quote without comment: "In BASIC, M*LOG(RND/RND) will return a normally distributed variable with a mean of zero and a variance of 2*M*M."

Finally, it was not my intent to contribute to the literature of statistics; I just ran into something rather neat and wanted to share it. Nor is it now my intention to become a clearinghouse for information on the subject. But a lot of thoughtful people put considerable effort into drafting their comments, and it would be a shame for their work to be wasted. Therefore, I've got about 20 pages of copies of correspondence on this matter. I make this offer to your readers:

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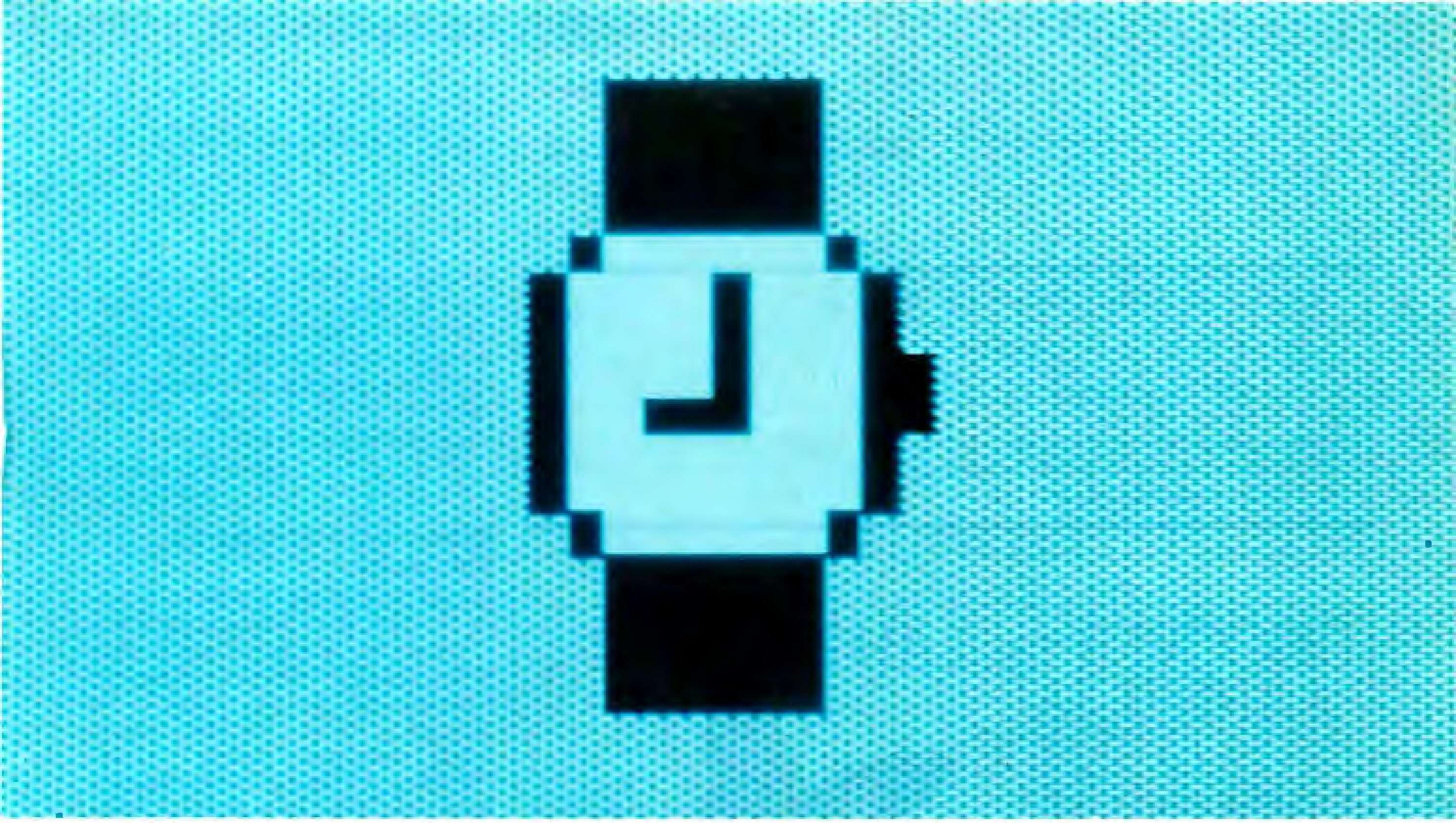
(continued)



Listing 1: *Reader Zwillinger's Box and Muller BASIC code.*

```
10 MN=5 : SD = 1.5 : REM desired parameters
20 X1 = RND(1) : X2 = RND(1)
30 R = SQR( -2 * LOG(X1))
40 T = 2 * 3.14159 *X2
50 R1 = MN + SD *R*SIN(T) : R2 = MN + SD*R*COS(T)
60 REM The mean of R1 and R2 is MN.
70 REM Their standard deviation is SD.
```


copying fees) THEN (I'll send you copies of all the neat stuff) ENDIF.

For their efforts, I wish to thank Louis Baker and Larry Marshall, Joel W. Young and William Satzer, Derek F. Stubbs, Daniel Zwillinger, William J. Coderre, Philip S. Waid, Moshe Braner, and Ed Sarver.

ARTHUR G. HANSEN
Oak Park, IL

DEBUGGING MATHEMATICAL THEOREMS

I would like to thank Dr. John Darlington for his informative and readable article ("Program Transformation," August 1985 BYTE, page 201). However, it contains one statement that certainly needs to be debugged: "No one feels the need to debug a mathematical theorem. . . ." I do. According to Douglas R. Hofstadter's book, *Gödel, Escher, Bach: An Eternal Golden Braid* (Basic Books, 1979, page 91), there are at least 28 published "proofs" stating that Euclid's fifth (parallel) postulate follows from the other four.

In spite of good debugging, it is obviously possible for someone working in one of the most mathematical aspects of computer science to take some things for granted and overlook a statement that sorely misrepresents the way mathematics is really done. Actually, I really assume that John Darlington also feels the need to debug mathematical theorems as well as BYTE articles.

THOMAS LIGON
Munich, West Germany

John Darlington replies:
I agree. There is no guarantee of absolute certainty even in mathematics. Each "proof" needs another proof to establish that the first was conducted correctly, leading to an infinite regress. In practical mathematics this infinite regress is replaced by social review leading to a debugging process that can always show the incorrectness of a proof but never its complete correctness.

In turn, however, I would expect Dr. Ligon to agree that that existence of formal systems enables practical mathematics to be currently vastly more reliable than practical programming. It is this reliability we are aiming for via transformation, not absolute certainty. If the formal manipulations are machine-checked or -generated, then the degree of reliability goes up. Perhaps if we prove our transformation system correct, we would be better off as long as we prove the verification system used and then. . . .

(continued on page 355)

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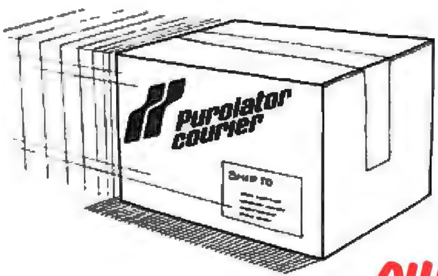

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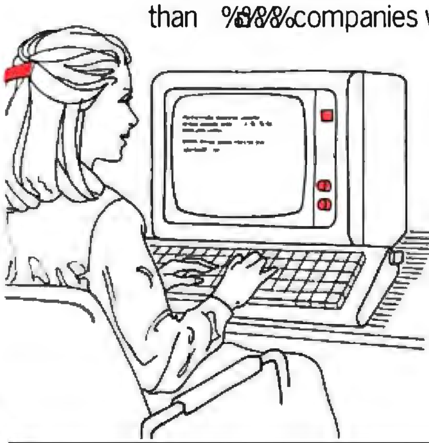

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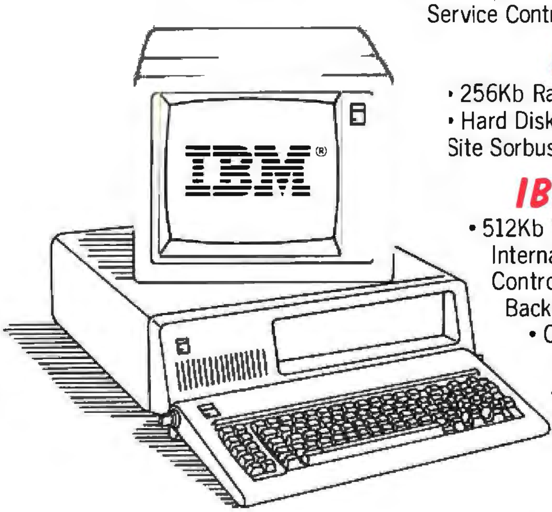

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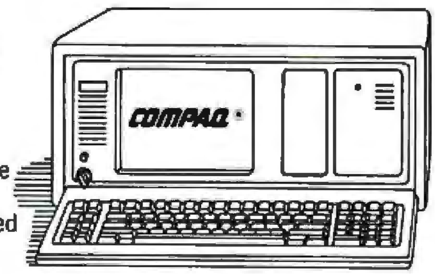

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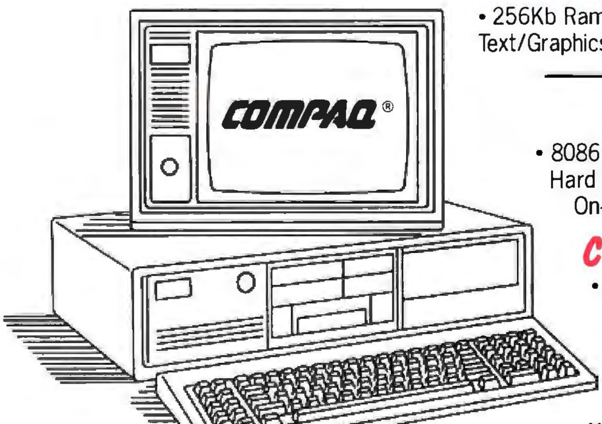

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BYTE's BUGS

More on Quicksort

The QSORT (Quicksort) program in Tim Field's review of five C compilers for the Macintosh (November 1985, page 275) is in error. Source code for the corrected version is in listing 1. This code is also available from BYTEnet Listings; the telephone number is (617) 861-9764.

If you run this Quicksort through the compilers benchmarked by the old version, you will get different timings. However, you won't see a change in their relative standings. The goal of a benchmark is not to test a compiler's ability to generate a program that efficiently executes a specific algorithm; the objective is to test its ability to translate the source-code representation of any algorithm into efficient machine code.

Listing 1: *The corrected version of* BYTE's QSORT.

```
/* sorting benchmark—calls randomly the number of times
   specified by MAXNUM to create an array of long
   integers, then does a quicksort on the array of longs. The
   program does this for the number of times specified by
   COUNT.
*/

#include "stdio.h"

#define MAXNUM 100
#define COUNT 10
#define MODULUS ((long) 0x20000)

#define C 13849L
#define A 25173L

long seed = 7L;

long random ();

long buffer [MAXNUM] = {0};

main ()
     {
     int i, j;
     long temp;
/*
#include "startup.c"
*/
     printf ("Filling array and sorting %d times \n",
     COUNT);
     for (i = 0; i < COUNT; ++i)
          {
          for (j = 0; j < MAXNUM; ++j)
               {
               temp = random (MODULUS);
               if (temp < OL)
                    temp = (-temp);
               buffer[j] = temp;
               }
          printf ("Buffer full, iteration %d \n", i);
          quick (0, MAXNUM, buffer);
          }
/*
#include "done.c"
*/
     }

quick (lo, hi, base)
     int lo, hi;
     long base [ ];
     {
     int i, j;
     long pivot, temp;

     if (lo < hi)
          {
          for (i = lo, j = hi-1, pivot = base [hi]; i < j;)
               {
               while (i < hi && base [i] < = pivot)
                    ++i;
               while (j > lo && base [j] > = pivot)
                    --j;
               if (i < j)
                    {
                    temp = base [i];
                    base [i] = base [j];
                    base [j] = temp;
                    }
               }
          temp = base [i];
          base [i] = base [hi];
          base [hi] = temp;
          quick (lo, i - 1, base);
          quick (i + 1, hi, base);
          }
     }
long random (size)
     long size;
     {
     seed = seed * A + C;
     return (seed % size);
     }
```

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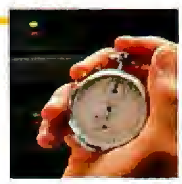

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*The Bernoulli Box for Macintosh is available in a 5-megabyte single-drive version and a 20-megabyte dual-drive version for AppleTalk.™

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Inquiry 170

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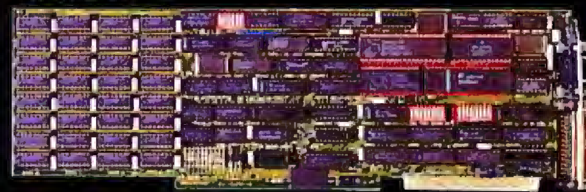

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Painting and Animation for the Amiga

Aegis Development has introduced Aegis Images, a paint program for the Commodore Amiga. The program will produce paintings in either the Amiga's 640- by 200-dot or 320- by 200-dot resolution. In one painting, you can use up to 32 colors from the range of 4096. You can mix colors on the palette or choose those already present. Aegis Images has 20 brushes, including an airbrush, and 16 patterns, all of which can be modified. A tile-draw feature creates 8- by 8-pixel to 16- by 16-pixel patterns.

You can use colors in many ways while painting with Images. The Spread function allows dithering of two or more colors in any area on screen. Wash gives a watercolor effect by blending the colors together at their borders. And Smear simply smears colors together. Another option outlines one color with a corresponding color to create a glowing effect. Finally, two color-cycling features let you have sequences of colors cycle through your painting: Cycle Draw leaves a trail of colors as your brush moves across the screen, and Cycle Colors gives your painting an animated effect by cycling colors through defined areas on the screen.

With Images you can draw freehand, using brushes, or select from a set of shapes that you can customize later. A Rubber-band Arch option lets you "pull" a straight line into an arch. The Frame option lets you take any portion of the screen and rotate it, stretch it, shrink it, or use it as a paintbrush.

Examples of Aegis Images' graphics capability

When creating or editing your painting, you can open a window to show a portion of the screen in fat bits. You can superimpose a grid on paintings to help place objects precisely, and you can use the Pantograph Drawing option to duplicate images already drawn. The Mirror feature is for creating symmetrical designs.

Images is bundled with the Aegis Animator, a real-time metamorphic animation package. It lets you create and manipulate different shapes, colors, sizes, and relative positions of objects on the screen. To facilitate editing objects in different planes, the Animator lets you turn fill patterns on and off so you can work on objects that are currently behind other objects.

Using the Animator, you can change an object's position relative to the current plane of activity, rotate it around an *x*- or *y*-axis or around a point within itself, or combine different motions. You can split the screen into nine separate animations, cut objects from one animation and paste them into another, or splice whole animations together. Objects can be "cloned," enlarged, or shrunk. You can stretch them at existing points or added points. And you can run animations showing the object in its original shape, then growing to the stretched shape.

You can use files produced by Aegis Images (or other paint packages supporting the Interchange File Format) with Aegis Animator. Aegis Images and Aegis Animator use 300K bytes of memory each. The Animator package, including Images, costs $139.95. Images alone costs $79.95.

Contact Aegis Development Inc., 2210 Wilshire Blvd., Suite 277, Santa Monica, CA 90403, (213) 306-0735.

Inquiry 550.

—*Brenda McLaughlin*

Low-Cost UNIX for PCs

Microport Systems has introduced System V/AT, a full adaptation of UNIX System V release 2 for the IBM PC AT. System V/AT is a full implementation of AT&T's UNIX System V iAPX286, which was ported from the VAX version of the UNIX operating system.

(continued)

Like other versions of UNIX release 2, System V/AT has features not found in release 1. These include a faster shell, job control, flexnames, interfunction and multiprocess profiling, user lint libraries, ctrace, terminfo, and curses (ctrace is a utility for tracing a program line by line, terminfo is a database of escape sequences, and curses is a subroutine for manipulating terminal screens). System V/AT adds File System Hardening, which reduces the chances of data loss during an inadvertent shutdown, record-level locking, full use of the iAPX286 protection and task-switching mechanisms, a complete implementation of the symbolic debugger, small- and large-model compilers for C and FORTRAN 77, and 80287 emulation. It is also binary-compatible with UNIX for the AT&T 6300 Plus.

You can purchase System V/AT in three different packages. The Runtime System, with over 40 utilities, costs $139.95. The Software Development System, with C and FORTRAN 77 compilers, make, sccs, sdb, and other tools for large-scale 286 development, costs $99.95. The Text Preparation System, with nroff, troff, spell, and support for output devices ranging from terminals to typesetting equipment, costs $139.95. All three packages can be purchased for $389.95.

Contact Microport Systems Inc., 10096 Soquel Dr., Aptos, CA 95003, (408) 688-0286.

Inquiry 551.

The 80286-based Apricot XEN.

Apricot Introduces 80286 Computer

The Apricot XEN (pronounced "zen") is based on an Intel 80286 running at 7.5 MHz with zero wait states. The system comes equipped with 1 megabyte of RAM, one 720K-byte double-sided 3½-inch microfloppy-disk drive, and an internal 20-megabyte 3½-inch Winchester drive. One parallel Centronics port and one RS-232C serial port are standard.

Of the Apricot's six expansion slots, one is used for a monitor card, one is reserved for future use, and the remaining four can be filled with 1-megabyte RAM expansion boards. Two connectors are provided for expansion, one for Apricot-compatible cards and the other for IBM-compatible cards.

The keyboard layout is similar to that of the IBM PC AT but includes dedicated cursor keys and a backlit 80-character LCD display that you can use to label six additional programmable function keys. A trackball mouse is available as an option.

Software bundled with the system includes MS-DOS 3.1, Microsoft Windows, GW-BASIC, and IBM BIOS emulation software. With the addition of an optional 5¼-inch floppy-disk drive, the XEN can run IBM software off the shelf, including copy-protected programs like Lotus 1-2-3 and Microsoft's Flight Simulator.

System price, not including a monitor, is $3995. For further information, contact Apricot Inc., 47173 Benicia St., Fremont, CA 94538, (415) 659-8500.

Inquiry 552.

Laser Printer for Under $2000

QMS's KISS laser printer produces letter-quality text and graphics with a 300- by 300-dot-per-inch resolution. It has nine resident fonts, two for landscape orientation (including an 18-character-per-inch spreadsheet font) and seven for portrait orientation, allowing up to 40 print combinations. You can mix typefaces and character orientations.

The printer's controller is built around a Motorola 68000 microprocessor. It has an 8K-byte variable input buffer that will store up to four pages of text and 80K bytes of RAM dedicated to holding downloaded fonts. This lets you download fonts such as the IBM 256-character font set, a mosaic character set, or up to eight typefaces. Another 128K bytes of RAM is set aside for the page memory, where page layout and design commands are stored.

The nine resident fonts and the system firmware are in a 256K-byte ROM. This ROM also has Epson FX-80 text and graphics emulation, Diablo 630 emulation, and Qume Sprint emulation. When the KISS printer is in Epson mode, two extra character sets, roman and italic roman, and an additional font are available.

The QMS KISS prints up to six pages per minute on 16- to 21-pound paper and transparencies or manually loaded duplex copies in 16- to 33-pound stock. It costs $1995 with a Centronics parallel interface; an optional RS-232C interface costs an additional $250. Contact QMS Inc., POB 81250, Mobile, AL 36689, (205) 633-4300.

Inquiry 553.

AST Boards for Apple II

Two single-slot, plug-in boards from AST—MegaRamPlus and SprintDisk—improve the Apple IIe's memory. MegaRamPlus lets you add up to 1 megabyte of RAM to an Apple IIe. Because MegaRamPlus is fully socketed, it is simple to add 64K- or 256K-byte RAM chips to the board. MegaRamPlus works

(continued)

NEW FROM BORLAND

Borland Introduces Reflex, The Greatest Analytical Tool Since The Couch

INTRODUCING REFLEX, THE ANALYST.

If you use Lotus 1-2-3™, dBASE® or PFS File™, you need Reflex™—because it's a totally new way to look at your data. It shows you patterns, relationships and interrelationships you didn't know were there, because they were hidden in data and numbers.

Reflex is the first database that separates the trees from the forest. The first database that understands that what you see depends on how you look at it.

The first database that probes relationships—then shows them to you in various graphic forms—scatter, line, bar, stacked bar and pie charts.

The first database to break the bonds of traditional DBMS (Data Base Management Systems) and give a dramatic visual turn to data analysis.

Reflex makes graphic leaps far beyond 1-2-3. With Reflex, when you look, you see.

HOW THE CRITICS REACT TO REFLEX

"The next generation of software has officially arrived."

Peter Norton, PC Week

"Reflex is one of the most powerful database programs on the market; its multiple views; interactive windows and graphics, great report writer, pull-down menus and cross tabulation make this one of the best programs we have seen in a long time...The program is easy to use and not intimidating to the novice...Reflex not only handles the usual database functions such as sorting and searching, but also "what-if" and statistical analysis... it can create interactive graphics with the graphics module. The separate report module is one of the best we've ever seen."

Marc Stern, InfoWorld

"What you see, then, is an interesting hybrid of a database and a spreadsheet that is ideal for analyzing tabular data."

Adam B. Green, InfoWorld

"More flexible than spreadsheets, this easy-to-use database analysis package presents information with visual clarity...Reflex is for you. The flexibility of switching between different views of the data lets you see relationships you may have previously overlooked...Without "what-if" analysis, key variables—such as cost of goods sold or travel expenses—may be out of hand but unnoticed. The type of analysis to uncover such a foible is awkward to do on a spreadsheet; yet, it may mean the difference between success and failure in a competitive situation."

Ira H. Krakow, Business Computer Systems

REFLEX OPENS MULTIPLE WINDOWS WITH NEW VIEWS AND GRAPHIC INSIGHTS.

You use Reflex's Form View to build your database; the List View lets you put data in tabular List form; the Graph View gives you instant interactive graphic representations; the CrossTab View gives you amazing "cross-referenced" pictures of the links and relationships hidden in your data. Report View allows you to import and export data to and from Reflex, 1-2-3, dBASE, PFS File and other applications and prints out information in the formats you want. In fact, Report View is probably the best 1-2-3 report generator you can buy today. It's also the cheapest—and you're getting all the other features free.

The commands for all five Views are consistent—so you're not stuck learning five different ways to get something done. And because Reflex uses advanced windowing techniques, you can see several views on the screen at the same time—without having to switch back and forth. You get the picture—and the pictures—all at once—if that's the way you want to look at things.

Modify a number and all your Views—List, Form and Graph—are immediately updated, on-screen. Changing a number changes the picture—which is mighty handy when you're analyzing (let's say) sales figures by salesperson; or you're in "What-If?" country asking yourself "What if we could add 2.5% in January sales?" "Show me."

"Give me the picture." "Show me what happens when we shift 11% of Nebraska's inventory to the new store in Hawaii." "Show me how many Gizmo 28's we have in every store in every state as of midnight last night and what happens to our East Coast stocks if the shipping strike lasts more than a week." "Show me."

So Reflex shows you. Instant answers. Instant pictures. Instant analysis. Instant understanding.

HOW IN THE WORLD CAN BORLAND SELL A PHENOMENAL PRODUCT LIKE REFLEX FOR ONLY $99.95?

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That's $395.05 off the original price—which is a pretty good return on your toll-free phone call.

We think Reflex should be an "automatic product," a "standard" that every PC owner should own. That's why we priced it at $99.95. Naturally we've added our 60-day money-back guarantee and Borland's Reflex is not copy-protected.

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Inquiry 43 for DEALERS ONLY.

with 80-column displays and also offers an optional RGB interface.

The MegaRamCache utility transparently builds buffers as large as the memory installed in the MegaRamPlus card. The buffers increase program operation speed by reducing the need for the Apple IIe to bring in blocks of code from its disk drives.

MegaRamCache captures blocks of code that would otherwise be dropped from 64K-byte, or extended 128K-byte, CPU-accessible memory and stores them in the MegaRamPlus card's memory. All subsequent disk-drive read requests from the CPU are compared first to the MegaRamPlus memory contents. If the needed block of code is there, it is transferred into CPU-accessible memory at RAM speed. Other software doesn't have to be modified to work with MegaRamCache and MegaRamPlus. Both MegaRam products are compatible with AppleWorks and ProDOS.

Other utilities include AppleWorks Expansion, which lets AppleWorks address a full 1 megabyte of expanded memory; RAM-disk software for disk emulation; and RAM diagnostics.

MegaRamPlus costs $195 with 64K bytes, $295 with 256K bytes, and $745 with 1 megabyte of installed memory.

SprintDisk occupies a single slot, supports up to 1 megabyte of RAM, and will soon offer a piggyback board option to allow expansion to 2 megabytes. The board is fully socketed to make the upgrade to 2 megabytes a simple task. SprintDisk is compatible with ProDOS, DOS 3.3, Pascal 1.3, and Apple's new Apple II Memory Expansion Card.

The Toshiba T-1100 *laptop microcomputer.*

SprintCache is the software distributed with SprintDisk that provides disk caching to speed program operation.

The base model of SprintDisk contains 256K bytes of RAM and sells for $295. Other RAM configurations are available. The 1-megabyte version sells for $745.

Contact AST Research Inc., 2121 Alton Ave., Irvine, CA 92714, (714) 476-3866.
Inquiry 554.

Portable IBM-Compatible from Toshiba

The Toshiba T-1100 is a laptop IBM PC-compatible microcomputer. It offers MS-DOS, 512K bytes of RAM, and an internal 720K-byte 3½-inch floppy-disk drive, yet weighs only 9 pounds. The flat screen produces a 640- by 200-pixel display organized as 80 characters by 25 lines. It can be adjusted for any convenient viewing angle within a 90-degree band.

For I/O, the T-1100 features a parallel printer port, an RGB graphics monitor interface, and a floppy-disk-drive port. The internal disk drive is compatible with the 3½-inch disk drive used on the Data General/One MS-DOS portable computer. The 83-character keyboard includes alphanumeric keys, function keys, and a nonstandard numeric keypad.

The system's power consumption is reduced by the use of CMOS chips and gate arrays. The built-in rechargeable nicad battery will power the computer for four to eight hours. The 12.2- by 12- by 2.6-inch T-1100 also comes with an AC adapter and a carrying case.

External floppy-disk drives (both 3½-inch and 5¼-inch), a printer, and a multifunction card with asynchronous communications port, 300-bps modem, and calendar/clock are available as options.

The T-1100 is priced at $1999. Contact Toshiba America Inc., Information Systems Division, 2441 Michelle Dr., Tustin, CA 92680, (714) 730-5000.
Inquiry 555.

Telecommunications Pop-up Programs

Cygnet Technologies has developed a memory-resident package that automatically accesses electronic mail services and checks for messages without interrupting the program you're using. Get!, which runs on IBM PCs and compatibles, works with host-type services such as MCI Mail, EasyLink, CompuServe Mail, Source Mail, TeleMail, ITT DialComm, and OnTyme.

You can have the software dial the service and check for mail at any time you select. If mail is found, the program flashes a "mail waiting" message in the upper-right corner of your screen. You can then pop out of your application and download your mail or leave it in your electronic mailbox.

Get! sells for $49.95 and is not copy-protected. Contact Cygnet Technologies Inc., 1296 Lawrence Station Rd., Sunnyvale, CA 94089, (800) 621-4292; in California, (800) 331-9113.
Inquiry 556.

Lattice's SideTalk connects you with your modem from inside any application with one keystroke. It provides for multitasking operation, file transfer, text transfer from background to foreground, and DOS commands in background.

SideTalk comes with the SideTalk Communications Language, BASIC-like commands that let you make your own communications processing systems.

The program works with MS-DOS machines and takes up about 64K bytes of memory. SideTalk costs $119.95. Contact Lattice Inc., POB 3072, Glen Ellyn, IL 60138, (312) 858-7950.
Inquiry 557.

NEW FROM BORLAND!

Borland introduces *Turbo* Lightning™ the fastest, most amazing information system since your brain

You can now find out everything in a flash. With instant access to electronic versions of the 83,000 word *Turbo* Lightning™ Random House® Speller & Word List; the 50,000-word *Turbo* Lightning Random House Thesaurus™ and the soon-to-be-released *Turbo* Lightning Encyclopedia™ — and to an astonishing array of electronic reference books which form Borland's new *Turbo* Lightning Library™.

Hitting one key on your IBM® personal computer — taps you into this new electronic age of instant information.

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What we've done has been called "Artificial Intelligence," we simply call it "*Turbo* Lightning." This information revolution — driven by *Turbo* Lightning — means that the way you look things up is definitely looking up.

No matter what program you're running, *Turbo* Lightning instantly checks your spelling *as you type*. You could be running WordStar®, MultiMate™, SideKick®, Microsoft® Word, MCI Mail®, CompuServe®, or whatever, because as you work, as you write, *Turbo* Lightning is waiting in the wings, watching how you spell every word, but not getting in the way of what you're doing.

So how does it work? Let's say the word you meant to type was "RIGHT," but you accidentally typed 'RIHGT,' which is wrong. What happens then?

You immediately *hear* a '*beep*,' so you know there was a boo-boo. You instantly *see* a window, that doesn't list "RIHGT" but it does list 'RIGHT' and its sound-alike words. So your screen looks like this:

```
rihgt
Sound Alike Words
A: r i g h t
B: rights
C: righted
D: rightly
E: relight
F: righter
G. Add word to auxiliary dictionary
PgUp or PgDn for more words
```

So you move your cursor to "A," which is the right "right," hit Return and the spelling mistake is instantly fixed. And the program you were working on has continued to run while you did a little spelling sidetrip with *Turbo* Lightning. *(If you'd rather not remember your Spelling grades in school, the beep might make you nuts, but you can choose the "whole page" option. Which means that when you finish writing the entire page, any spelling mistakes will be highlighted. You go in and straighten things out straight away.)*

Lightning never goes away, is 100% concurrent, reliable, accurate and cannot, does not, will not 'crash & burn.'

Your document, letter, report, spreadsheet is word perfect and no one ever knows that you can't spell for beens.

Tu bo Lightning does a lot more than spell "right" right, it also gives you instant synonyms. Because you also have *Turbo* Lightning's Random House Thesaurus at your fingertips, you can really get to know your 'rights.' So back to the word "Right," but this time in the thesaurus. Type in "Right" and what you see in the on-screen window is:

```
right
Synonyms
-Adjective-
A:straight
B: true
C: accurate
D: s o u n d
E: normal
-Noun-
F: claim
G: title
H: due
I: ownership
PgUp or PgDn for more words
```

So you instantly know more than one way to say, "The Boss is always right," which is handy if you get cornered and have to lie like that.

Introduce yourself to *Turbo* Lightning and it will never ever forget your name. It's conceivable, if unfair, that your name is not in the dictionary already, but you can instantly teach *Turbo* Lightning your name and all the other names and words it needs to know to help run your business or personal life.

Once you've taught *Turbo* Lightning what it needs to know, you'll never blow it with a letter to the *Joint Cheefs of Staff*, the *Raygan White Howse* or mess something up on your IMB PC. (IMB PC is not a trademark of International Business Machine Corp!)

Not $500, not $400, not $300, not $200, not $100, just $99.95 for this instant electronic miracle. Our success is pretty simple. We're not greedy. We believe that it is better to sell hundreds of thousands of software programs at a reasonable price—instead of a few at prices that would make Jesse James blush.

Just $99.95 gets you into the *Turbo* Lightning Library—which is an incredible deal when you look at what you're getting. You're getting the 'access system'—*Turbo* Lightning—which is the "engine" that powers the whole *Turbo* Lightning Library. You're getting the "engine" plus the 83,000-word *Turbo* Lightning Random House Speller and Word List; the 50,000-word *Turbo* Lightning Random House Thesaurus. And you're getting all that for an *incredible* $99.95!

If you ever *write* a word, *think* a word or *say* a word, you need *Turbo* Lightning. We give you a 60-day money-back guarantee and of course there's no copy protection. $99.95 isn't much to pay for a mistake-free life. Not to mention an education. No matter who you are or what you do, you need *Turbo* Lightning. That $99.95 will be the best $99.95 you ever spent on yourself or your company.

Do yourself, your assistants, your secretary, your boss, your readers, your audience and your career a favor, get *Turbo* Lightning today!

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Inquiry 44 for End-Users. Inquiry 45 for DEALERS ONLY.

Color Dot-Matrix Printer from TI

The Texas Instruments Model 857 is a color dot-matrix printer that can produce letter-quality text and graphics. It uses a four-color snap-in ribbon to yield seven printed colors: cyan, magenta, black, yellow, red, blue, and green.

TI's font modules (ROM cartridges) function as electronic daisy wheels during letter-quality printing. Each module has one font style in both draft and letter-quality character sets. The modules are interchangeable, with over 30 font styles and special character sets available. Up to three font modules can be inserted at one time, with font selection made from the keyboard or through software.

The Model 857 will print true descenders and underlines as well as software-selected boldface, shadow printing, superscripts, and subscripts. It comes with a Gothic font module, a full ASCII 96-character set, and a 64 mosaic graphic character set. It also has raster graphics. In draft mode, the Model 857 prints 150 characters per second in a 9- by 9-dot matrix. In letter-quality mode, it prints 35 characters per second in a 15- by 18-dot matrix double pass. Graphics can be produced with horizontal dot densities of 60, 72, 120, and 144 dots per inch and a vertical dot density of 144 dots per inch.

The Model 857 uses standard word- and data-processing escape sequences and has both serial and parallel interfaces. With friction- and tractor-feed mechanisms that will accommodate 3- to 11-inch-wide paper and a screen-dump utility disk, it costs $899. Contact Texas Instruments Inc., Data Systems Group, POB 809063, H-819, Dallas, TX 75380, (800) 527-3500. Inquiry **558.**

The Texas Instruments Model 857 printer.

Leave Spoken Notes in Symphony Files

Lyrics, from Computervoice Corporation, is an add-in product for the IBM PC and compatible computers that lets you annotate Symphony documents with spoken messages. Lyrics records messages onto computer disks and later plays them back using a standard telephone. Messages are noted on your worksheet by a numbered marker, just as a written footnote is.

Lyrics requires 32K bytes of memory in addition to the memory requirements of Symphony. It uses one of your DMA channels and one slot in your IBM PC. Messages use 180K bytes of disk space for each minute of recorded speech.

The Lyrics software and add-in card cost $139. Contact ompütervoice Corp., POB 352, Newton Highlands, MA 02161, (617) 244-4233. Inquiry **559.**

Socketed Prototyping Board

Ajida Technologies' Personal Protosystem is a complete interface system for the IBM PC. You can design and build a circuit on the Protosystem, connect it to the signal lines provided on the console, and test it using your PC. The Protosystem software lets you change the input signal levels and monitor the resulting outputs so you can test your design, find the optimal input levels for your goals, and change the hardware settings using the software.

The 7- by 8- by 3-inch console provides 32 bits of buffered digital I/O, two channels of 8-bit A/D, two channels of 8-bit D/A, three programmable 5-MHz counter/timers, a 4-MHz clock, 5-volt and 12-volt power supplies, and breadboard space for 24 14-pin DIPs. It connects to your IBM PC via the parallel port.

The Personal Protosystem comes with setup software and a BASIC driver for $425; FORTH and C drivers are also available. Contact Ajida Technologies Inc., POB 40178, Berkeley, CA 94704, (415) 548-6434. Inquiry **560.**

Keyboard Shorthand

PRD+ (for Productivity Plus) is memory-resident software that lets you design your own shorthand for use in a word-processing, database-management, spreadsheet, or graphics program. You can use fewer keystrokes by substituting abbreviations for words, phrases, programming commands, and formulas. Each abbreviation can replace as many as 240 characters. You define the abbreviations, which are stored with their long forms in an on-line dictionary.

Suppose you often write the phrase "Have a nice day." While using your word processor, you could abbreviate this as "hnd." When you activate PRD+ by pressing the space bar, carriage return, or punctuation symbol, it replaces each abbreviation with the long form.

You can define as many abbreviations as your computer's memory will allow. Each word list can contain 40,000 characters. PRD+ contains a list of abbreviations for common items—month, street, state, etc.—and a list of commonly misspelled words. Another feature calculates the number of keystrokes saved during a writing or data-entry session.

PRD+ runs on the IBM PC and compatibles. It uses 64K bytes of memory. Suggested retail price is $195. Contact Productivity Software International, 1220 Broadway, New York, NY 10001, (212) 967-8666. Inquiry **561.**

(continued on page 395)

New for SideKick Users!

Borland introduces Traveling SideKick™, it's your SideKick's™ sidekick!

Traveling SideKick is the organizer for the Computer Age!

Traveling SideKick is *both* a binder you take with you when you travel — *and* a software program — which includes a Report Generator — that *generates* and *prints out* all the information you'll need to take with you. Information like your phone list, your client list, your address book, your calendar, and your appointments. (The Appointment Schedule or Calendar you're already using in your SideKick is automatically used by your Traveling SideKick. You don't waste time and effort re-entering information that's already there.)

One keystroke generates and prints out a form like your Address Book. (You don't need to change printer paper.) You simply use a standard 3-hole punch — which you can steal from someone else's desk — punch out the holes, fold and clip the form into your Traveling SideKick binder — and you're on your way. Because Traveling SideKick's binder and software are CAD (Computer Age Designed), you don't fool around with low-tech tools like scissors, tape, or staples. Just one keystroke, 3 holes and you're on your way.

You don't have a SideKick? You must be kidding.

More than half a million people already use Borland's desk top organizer, SideKick (Winner of InfoWorld's "Product of the Year" award, it is also the #1 best-seller for the IBM PC™). Anyway, if you don't have one already you need one now and we'll give you a special price break. Buy Traveling SideKick *and* SideKick for *only* $125.00 (Sold separately they add up to $154.90, so you save $29.90—which we hope you don't have to spend on cabs which take you the *long way* to the airport).

What the software program and its Report Generator do for you before you go — and when you get back.

Before you go:

- Prints out your Calendar, Appointments, Addresses, Phone Directory, and whatever other information you need from your data files.

It can also:

- Sort your address files by name, zip code, or company name
- Print mailing labels
- Print information selectively
- Search files for existing addresses or calendar engagements

When you return:

- Lets you quickly and easily enter all the new names and numbers, facts and figures you learned while you were away—into your SideKick data files.
- Traveling SideKick does all of the above and more without needing special computer paper.

If you use SideKick, you need Traveling SideKick.

Since you use SideKick, you already know how incredible and invaluable it is. And you now know that Traveling SideKick uses all the information you already have in your SideKick. No retyping. No re-entry. It's that easy.

Sold separately, Traveling SideKick is only $69.95 which is a lot less than many 'dumb' organizers that are nothing more than printed books that can't generate anything except dust. (Because Traveling SideKick is electronic, it works *this* year, *next* year, and all the *"next years"* after that. Old-fashioned low-tech organizers are history in 365 days.) You'll be proud of your Traveling SideKick binder on planes and boats and trains. It's stylish, professional, and practical. It belongs — with you — in the Computer Age — and for only $69.95, it belongs to you.

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Inquiry 46 for End-Users. Inquiry 47 for DEALERS ONLY.

Conducted by Steve Ciarcia

COMMODORE 64 TAPE BUFFER

Dear Steve,

How would I bypass the buffer on a Commodore 64 so that I can have a 30-minute graphics program play directly from the tape in real time? Also, can you think of any problems I might have recording it?

RANDY MAULE
Santa Monica, CA

It is not necessary to bypass the tape buffer in order to display graphics directly from tape. The amount of time required by the Kernal to maintain the tape buffer is small compared to the time required to read a few bytes from a tape. The speed at which the image on the screen can be changed is, therefore, limited to the speed that data is read from a tape.

An image can be saved and later restored on tape in two ways. One way is an adaptation of a technique described in the April 1984 issue of Compute! *magazine on page 152. The article "Qwikload/save for VIC and 64" by Richard L. Witkover describes how to use the Kernal routines SETLFS, SETNAM, LOAD, and SAVE to load and save blocks of memory. In your case, you could save the 8K-byte block of bit-map memory used in the bit-map graphics mode, but in 30 minutes the screen could be redrawn only a few times.*

There is a second way. If you are clever, you could save only those parts of the image that are changing. But this would require saving not only the byte of memory being changed but also its address within the 8K-byte block of memory. Each byte saved would, therefore, take three times as much time to restore as in the first method. If only small parts of the image are being changed, however, this method may prove to be fast enough.—Steve

BUS CONVERSION

Dear Steve,

What I need is an article describing the common microcomputer buses (Apple II, IBM PC, Commodore 64, S-100, etc.) with instructions for converting projects from any one to any other. I understand that there are big differences between the 6502-based Apple II and the 8080/8088-based S-100 and IBM PC buses, but A0–A15 and D0–D7 should be common enough, and I would guess that some support chips and a PAL or two could take care of the rest. The only big limitation would seem to be the small size of the Apple cards. Apple owners may never be able to fit an S-100 project onto one card, but two cards connected by a ribbon cable is always a possibility. The other problem is software, but I don't see that as anywhere near the obstacle that hardware imposes, and future articles could provide software documentation with conversion in mind. Am I all wet, or is this possible? I would appreciate the help.

RICK DOWNER
Seattle, WA

I have no immediate plans for projects to provide conversion from IBM PC to Apple, Commodore, or S-100 buses, or the reverse, but it does seem like a useful idea. I'll keep it in mind for the future.

Meanwhile, you can get instructions for building a converter to interface IBM PC-compatible boards to your S-100 bus from the article "Build an S-100 to PC Bus Converter" by John Monohan in the May/June 1985 issue of Micro/Systems Journal.

The S-100 and Other Micro Buses *by Elmer C. Poe and James C. Goodwin (Howard W. Sams, 1981) also provides information on Apple, S-100, and a number of other buses, but, unfortunately, not all you need to interface between them.*

Interfacing Apple cards to the Commodore 64 and some other 6502 machines should be fairly easy. However, in the case of Apple to IBM or S-100, it would probably be easier and more reliable to redesign the I/O section than to try to make an adapter.—Steve

HIGH-QUALITY SOUND SYNTHESIS

Dear Steve,

I am a researcher in the field of auditory function. In our laboratory, we use an Apple II to control the contingencies of a behavioral apparatus used to test the hearing of different species of animals. We use a collection of waveform-shaping devices, attenuators, filters, amplifiers, and function generators to produce our auditory stimuli. These devices are controlled manually. Our computer, via mechanical relays, can only turn devices on and off. It would be convenient to be able to control all aspects of sound generation with the computer.

I am looking for an IC, or better yet, a complete board, that would provide high-quality sound synthesis and be IBM-compatible (we are presently considering the purchase of an IBM PC AT). I would like the device to have the following characteristics: variable intensity (attenuation) over a 120-dB dynamic range in 1-dB steps; generation of white noise and pure tones over a wide frequency range (20 Hz to 40 or 60 kHz); at least 2 independent output channels, although I would prefer 8 to 16 channels; and all functions fully programmable.

I have been told that the Texas Instruments signal-processing IC (the TMS32010) would be suitable for such an application. However, I lack the software-development environment and the engineering skills necessary to support this IC. I know that some devices like the one I have described exist in the $10,000 price range, but as well as being expensive, these devices often have only a single channel.

Is there an IC or a complete board for high-quality sound synthesis that can be programmed simply by setting bits in certain registers, in much the same way as some of the 8-bit sound-synthesis ICs that you have described in past articles?

PETER W. JUDGE
Ottawa, Ontario, Canada

Apart from the 120-dB output range requirement, nearly any music-synthesis system could generate the signals you need. Assuming you want a 120-dB power range, the voltage range is 1,000,000 to 1—from 100 volts to 100 microvolts, in practical units. Few devices have that range and allow programmability in 1-dB steps; none are inexpensive, as you point out in your letter.

Hewlett-Packard recently introduced a series of laboratory devices, called PC Instruments, which feature complete pro-

(continued)

grammability and relatively low cost. Up to eight instruments can be controlled by a single plug-in card for an IBM or HP PC. Prices range from $650 to $1500; the controller and software cost $500. The attraction of this system is that you can set up a complete stimulus-response experiment using a building-block approach.

The 61014AA Function Generator has only a 62-dB power range (10 V to 8 mV), but you could build a 60-dB attenuator using the 61011AA Relay Multiplexer and some precision resistors. For two channels, you would need two 61014AAs. You might also want a Universal Counter/Timer (61015AA) that could be used to measure response times and a Digital I/O unit (61010AA) to read switches and turn on lights. The overall cost of the system would be about $6000, plus a small breadboard for the attenuator.

Although not as inexpensive as a single-board synthesizer, these instruments are designed for laboratory use and can be reconfigured easily as your needs change, in addition to being completely programmable.—Steve

DATAMASTER

Dear Steve,

We have been running an IBM System/23 computer (also known as the Datamaster) and would like to write some assembly-language programs. Do you know where we can get instruction manuals for assembly-language programming on the System/23?

Also, we would like to purchase a hard disk for the Datamaster. IBM's hard disk is 30 megabytes and is too expensive. Do you know of any disk units that can attach to this machine?

IRWIN J. MATTEN
Chicago, IL

Everyone was surprised when IBM adopted an open architecture for the PC: The documentation for the hardware, ROMs, operating-system interfaces, and so forth is readily available. Unfortunately, the System/23 isn't an open system. If IBM doesn't provide the information you need, it simply isn't available. If your local IBM branch office will provide you with a list of the System/23 manuals, you may be able to pick out the right one from its title.

Adding an "alien" hard disk to your system faces similar obstacles; the disk supplier must get the interface specifications from IBM before designing the disk-controller card. In the case of the DisplayWriter (another closed system), IBM recently introduced an adapter cable that connects a DisplayWriter to a PC, letting the DisplayWriter operator send and receive files from the PC's hard disk.

The DisplayWriter option is called the DW/PC Attachment Convenience Kit and sells for $495. It includes a 25-foot cable, an 8-inch DW disk, and a 5¼-inch PC disk. While I doubt that this particular device will work as is on a System/23, it is possible that IBM has a similar kit for your system.

While not as fast or as convenient as an integrated hard disk (program files must be on the DisplayWriter's floppies), the overall cost of the kit and a PC XT is quite comparable to the official IBM hard-disk system. If you already have a PC with a fixed disk, it's unbeatable. Check with your branch office to see if such a kit is available for the System/23.
—Steve

GRADING HELP

Dear Steve,

I have been wondering if there is a card reader available for the IBM PC that could be used to read students' multiple-choice test cards. I haven't seen an ad or article about such a device in BYTE. I would be grateful for any information you could provide.

FATIH GORMAN
Mersin, Turkey

The Sentry 3000 Optical Mark Reader from National Computer Systems is designed for education and human-resources work. Its advertising claims that it reads and analyzes marks on specially designed forms. Apparently, it is useful for grading tests and compiling statistics. The price is $2700. Contact National Computer Systems, 4401 West 76th St., Edina, MN 55435.

If you want to do more work and spend less money, you might consider adapting a bar code reader to read the marked test forms line by line. This would require writing some software, however. Bar code readers are available for $500 to $1000. Some of them are the PCScanner Model 240 from Caere Corporation, 100 Cooper Court, Los Gatos, CA 95030, (408) 395-7000; the CYC-48 bar code reader from New Wave Systems, 12123 Washington Pl., Los Angeles, CA 94303, (213) 475-8545; and the BCR 232 bar code reader from Comtec Information Systems, Digitronics Div., 53 John St., Cumberland, RI 02864, (401) 724-8500.

I suggest you query these companies

(continued)

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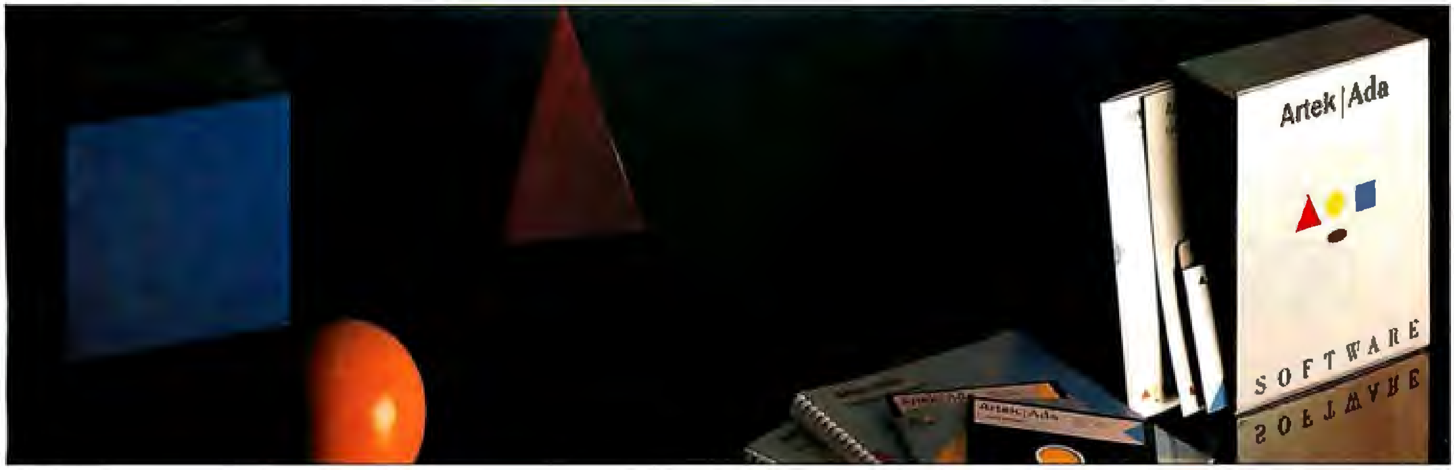

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Artek Corporation 100 Seaview Drive
Secaucus, NJ 07094

ASK BYTE

about the feasibility of modification to read your test sheets.—Steve

Atari I/O Bus

Dear Steve,

Do you know where I can get information on the Atari 800XL's parallel I/O bus? It is accessible on the back of the XL through a 50-pin edge connector. I can't seem to find anything on it anywhere.

Alak Kumar Deb
Sunnyvale, CA

Antic *magazine ran a four-part article entitled "Parallel Bus Revealed" by Earl Rice; it contains pin-out information as well as software and hardware examples. Part I begins in the January 1985 issue.*

Also, one source of circuit diagrams for the more popular microcomputers, including Atari, is Sams Computerfacts, *which is available from*

Howard W. Sams & Company Inc.
4300 West 62nd St.
POB 7092
Indianapolis, IN 46206

The one for the Atari 800XL (product number 008951, set number CC11) sells for $19.95.

Sams Computerfacts *are technical service manuals. There are no explanations of the circuits, and the price may be high, but if you already have some knowledge of interfacing, they may be sufficient.*—Steve

German Characters

Dear Steve,

I have an IBM PC XT and want to use Framework on it. However, I have much writing to do in German, and this requires special characters (such as umlauts). A couple of months ago I read how to emulate a German keyboard so that the special characters I need appear on the screen. (Unfortunately, I didn't keep that BYTE issue.) I have contacted Ashton-Tate about my problem, but they had no answer except that I should wait until a German version becomes available.

I have a daisy-wheel printer, so I can easily switch the print wheels. Any ideas about how I can solve my problem?

Karl H. Mauritz
Cleveland, OH

It appears that the IBM PC has all the characters you need in its extended character set, so all you need is a program to make some key combinations (e.g., Alt-A, Alt-B) display German characters.

(continued)

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There have been some published programs for changing the PC's key definitions, and they are usually good programming examples useful in limited applications. You may find one of the commercial keyboard-redefinition programs more useful and easier to use, though. They provide the keyboard-customization features you need and have other worthwhile functions.

ProKey from RoseSoft, SuperKey from Borland International, and Keyworks from Alpha Software Corporation are available from most computer stores as well as several companies that advertise in BYTE. One of these will allow you to redefine keys or enable shifted-key combinations using Alt and Ctrl keys in conjunction with letter keys.—Steve

IRON-OXIDE SENSORS

Dear Steve,

Can you tell me who makes iron-oxide sensors for detecting propane and natural gas?

DAVID SMITH
Milford, IA

Panasonic makes two iron-oxide solid-state sensors, one for detecting liquid propane (LP) and one for detecting liquid natural gas (LNG). The LP sensor is type EGS-S130P02; the LNG sensor is type EGS-N02C. These devices have a sensitivity of 50 parts per million and can be used as gas-leak detectors.

The address of Panasonic is

Panasonic
Matsushita Electric Corporation
Industrial Division
1 Panasonic Way
Secaucus, NJ 07094
(201) 348-7275

—Steve ■

IN ASK BYTE, *Steve Ciarcia answers questions on any area of microcomputing. The most representative questions received each month will be answered and published. Do you have a nagging problem? Send your inquiry to*

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

The Ask BYTE staff includes manager Harv Weiner and researchers Larry Bregoli, Bill Curlew, Jeannette Dojan, Jon Elson, Roger James, Frank Kuechmann, Edward Nisley, Dick Sawyer, Andy Siska, and Robert Stek.

MICROSOFT LANGUAGES NEWSLETTER Vol. 1-2

News about the Microsoft Language Family

New Microsoft® LISP Offers a Complete LISP Programming Environment

Microsoft has extended its six-year relationship with Soft Warehouse, Inc. of Hawaii by renewing the licensing agreements for muLISP™ and muMATH™ products. Microsoft LISP, the newly updated release of Microsoft muLISP, is the most powerful LISP development environment available for MS-DOS® today. Not only is Microsoft LISP three times faster than its competitors, it also allows larger artificial intelligence programs and expert systems to be developed. The new LISP provides over 400 Common LISP functions, macros, special forms, and control variables. Microsoft LISP comes with an integrated window-oriented LISP editor and debugger, tutorial lessons, and several demonstration LISP programs.

Mixed Memory Model Dynamic Allocation [illegible] Microsoft C—[illegible]

The standard method of dynamic heap allocation in C is provided by the [illegible] and *free* library routines. In Microsoft C this has been extended to allow mixed memory model dynamic allocation and deallocation in both *near* and *far* heaps for all memory models by using the undocumented routines below:

```
extern char near* _nmalloc(unsigned int);     /*near heap*/
extern void _nfree(char near*);               /*near heap*/
extern char far* _fmalloc(unsigned int);      /*far heap*
extern void _ffree(char far*);                /*far heap*/
```

For example, a small memory model C program can be written that can dynamically allocate and access more than 64K of data by using far heap allocation and far pointers. Similarly, the efficiency of large model programs can be improved by using near pointers and the near heap. However, with mixed model programming, care must be taken when accessing library routines that take pointers for parameters.

Part II to follow next month.

Microrim's R:BASE™ Developed in Microsoft FORTRAN and C

The core R:BASE 5000 database management system product contains about 40,000 lines of Microsoft FORTRAN code. New modules for R:BASE were developed in Microsoft C. Fred Gray, Microrim's Director of Development said, "Interlanguage calling allows us to migrate our code from FORTRAN to C without having to rewrite the entire product at once."

Microrim also provides the R:BASE Program Interface, which is a library of relocatable FORTRAN routines for accessing R:BASE databases. The interlanguage calling support in Microsoft FORTRAN, Pascal, and C allows application developers to call any routine in the Program Interface.

Write to: MICROSOFT Languages Newsletter
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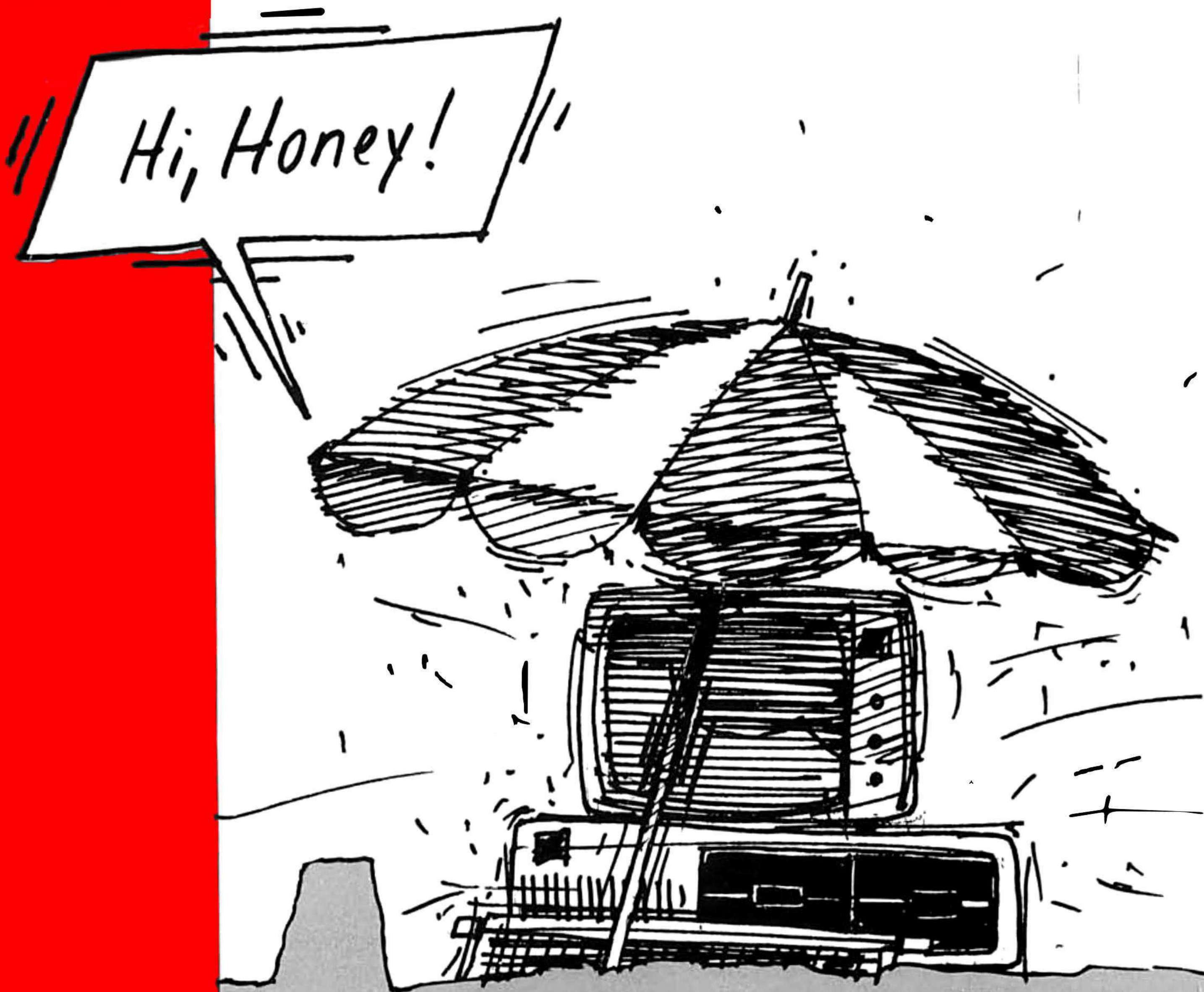
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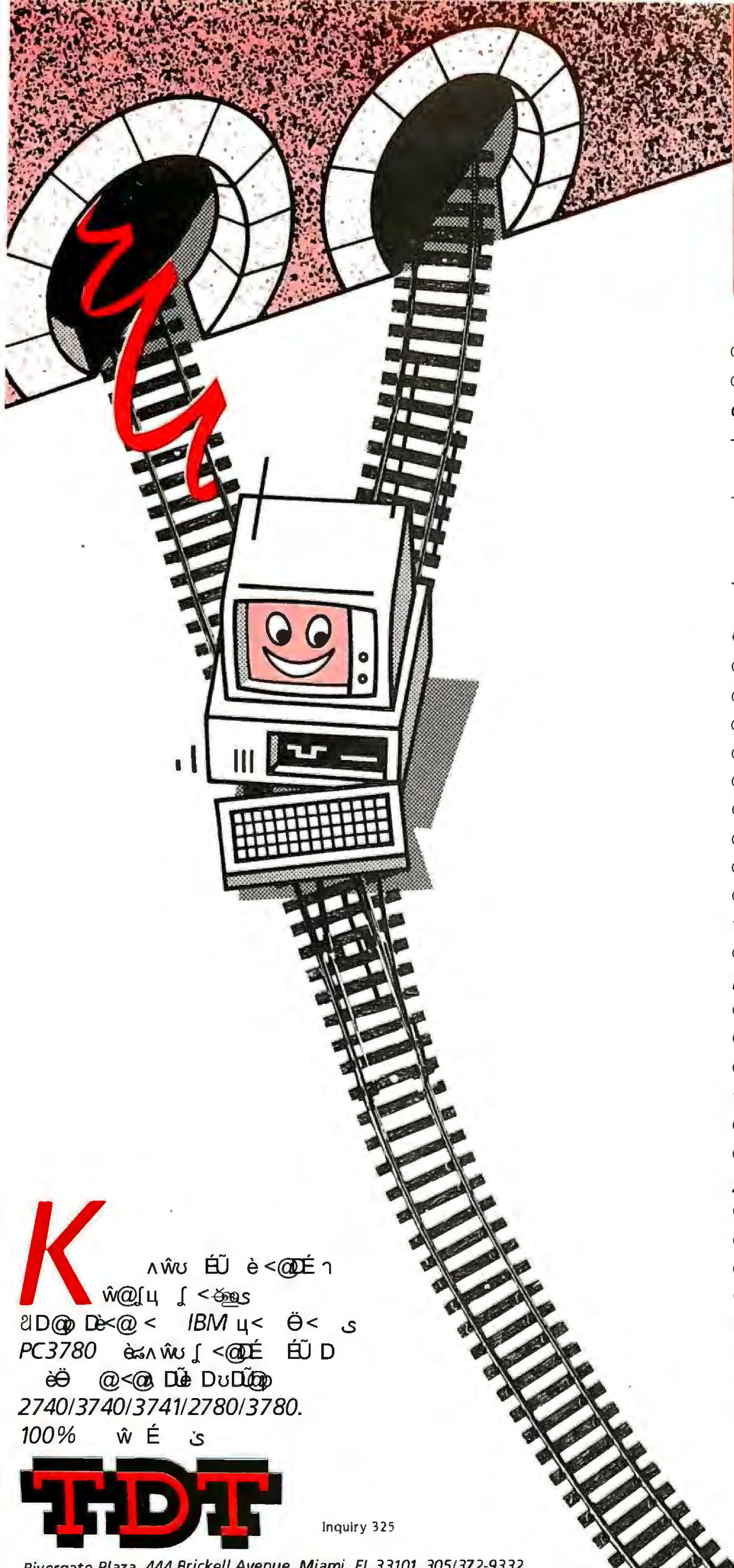

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AMERICAN CRYPTOGRAM ASSOCIATION (ACA), Mike Barlow, 12317 Dalewood Dr., Wheaton, MD 20902, (514) 485-5381. Newsletter. Annual fee: $15.

THE NATIONAL ASSOCIATION OF MACINTOSH USERS, John Allen, POB 40045, Portland, OR 97204-0045. Newsletter, BBS, public-domain library. Users groups join for free by sending newsletter.

THE PRINCETON (NJ) IBM-PC USERS GROUP, POB 291, Rocky Hill, NJ 08553. Monthly meetings and newsletter, public-domain software library.

THE APPLEWORKS USERS GROUP, Jim Willis, 1300 Hinton St., West Monroe, LA 71291. Disk exchange. No dues.

THE CLEVELAND COUNTY BULLETIN BOARD, Dan Wise, Shelby, NC 28150. Free 24-hour BBS at (704) 482-8012. 45 sections on CP/M, S-100, UNIX/XENIX, and AI.

M300 AND PC REPORT, Meckler Publishing, 11 Ferry Lane W, Westport, CT 06880, (203) 226-6967. Library applications for M300 workstations and IBM PCs. 11 issues: $29.

CAD/CIM ALERT, Management Roundtable Inc., 824 Boylston St., Chestnut Hill, MA 02167. Newsletter for advanced automation professionals. 12 issues: $148.

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68796 HACKER'S NEWSLETTER, Victor Frank, 12450 Skyline Blvd., Woodside, CA 94062, (415) 851-7031. 10 issues: $20.

COMPUTER NOTES, Bill White, Box 1735, Twin Falls, ID 83303, (208) 734-0746. Newsletter of programs and tips. 6 issues: $3.60.

CHICAGO AREA NORTH STAR USER GROUP (CANSUG), Edgar Coudal, POB 9, Park Ridge, IL 60068. Meetings, newsletter.

THE ADIRONDACK COLOR COMPUTER CLUB, Greene County Chapter, Peter Chast, POB 61, Athens, NY 12015. Meetings, chapters.

PLUS/4 USERS' GROUP (PLUG), Calvin Demmon, Box 1001, Monterey, CA 93940. Commodore Plus/4 user-written software exchange, newsletter.

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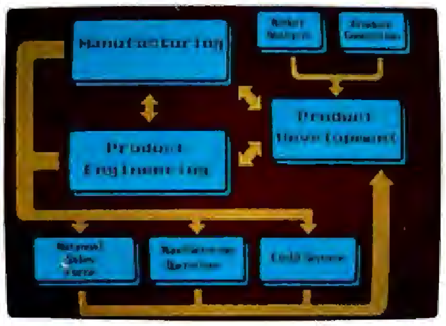

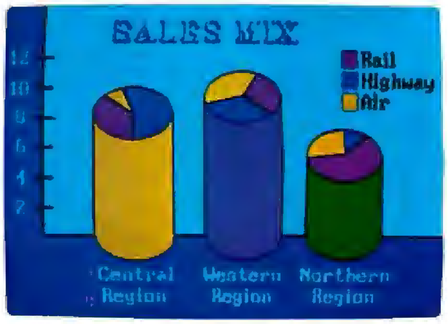

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B·O·O·K R·E·V·I·E·W·S

VIDEOTEX/TELETEXT:
PRINCIPLES AND
PRACTICES
Antone F. Alber
McGraw-Hill
New York: 1985
512 pages, $32.95

TELECONFERENCING:
LINKING PEOPLE
TOGETHER
Kathleen Kelleher and
Thomas B. Cross
Prentice-Hall
Englewood Cliffs, NJ: 1985
303 pages, $32.95

PASCAL PRIMER
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Dan Shafer
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New American Library
New York: 1985
318 pages, $19.95

SILICONNECTIONS:
COMING OF AGE IN
THE ELECTRONIC ERA
Forrest M. Mims III
McGraw-Hill
New York: 1985
240 pages, $16.95

VIDEOTEX/TELETEXT: PRINCIPLES AND PRACTICES

Reviewed by Wayne W. Shearer Jr.

Videotex has not found its way into many American homes. Why? Well, that's just one of the subjects in Antone F. Alber's excellent reference text, *Videotex/Teletext: Principles and Practices*. I call this book a reference text because that should be its position in your technical library. The book is definitely designed for professionals in the field, or those who want to become professionals. It covers the gamut from videotex history to distribution-system design to the corporate structure necessary to operate a successful videotex service. And if it leaves anything out, you need only refer to any of the source materials listed at the end of each chapter.

While I could hardly classify this book as easy reading, neither can it be called dry. Explanations of videotex principles are enhanced by examples, illustrations, diagrams, and pictures, including four color pages of sample videotex displays. The back of the book contains a glossary of industry terms and an appendix defining acronyms and abbreviations. By the time you have finished this text, you have a burning desire to see videotex arrive in your neighborhood; you can also acquire the sobering knowledge to understand the difficulties and obstacles involved in implementing such an information network on a large, profitable scale.

The beginning of this book introduces and explains the basics of videotex systems. In addition to describing the history of videotex through a discussion of such systems as Britain's Prestel and France's Teletel, Alber precisely defines the terms used in the industry and differentiates the meanings of several misused terms. The most important of these confusing labels are the terms *videotex*, *teletext*, and *teletex*.

Videotex, according to Alber, is the more generic term referring to any system that allows the user to access data from a remote computer by means of a modified TV set or specially designed video-display terminal. The more common form of videotex, used by CompuServe and The Source, is called *interactive* videotex. In this system, the user may request a frame of data for display, and that frame will be transmitted specifically to the requesting user. This form of videotex requires a two-way flow of information

(continued)

ILLUSTRATED BY BLAIR THORNLEY

between the user and the computer system. This data is usually carried over the phone lines, although in some areas coaxial cable and fiber optics are used.

In broadcast videotex, what the author refers to as teletext, frames are constantly broadcast to all users on the system. When a specific frame is requested, the receiver selects that frame of data from the sequential stream being received and displays it on the video terminal. This data is usually broadcast as part of a regular TV signal, either over the air or on a cable system. The one-way nature of the signal requires that the data available be repeatedly broadcast and that the receiving terminal be "smart" enough to select the specific frame of data requested. Teletex (notice the lack of the final *t*) is an upgraded form of telex service that allows telex machines, personal computers, word processors, and terminals to transmit messages worldwide by way of a compatible message system.

PROTOCOLS

Coverage of the basics is followed by a detailed discussion of the North American Presentation-Level-Protocol Syntax (NAPLPS) and the Videotex Presentation-Layer Protocol (VPLP), two competing videotex coding and control standards. Alber provides a thorough description of the various aspects of the two protocols, including alphanumeric coding, mosaic characters, and picture graphics. This is complemented by code charts and structure diagrams. Also, the seven-layer Open Systems Interconnection (OSI) model for providing compatible data transmission between varying types of computer systems is explored. Again, the author provides a detailed but concise explanation of these technical subjects.

THE BUSINESS

Alber describes the commercial aspects of a videotex system. Finding information providers, selling the videotex service, and marketing and advertising are covered in a minicourse on business management. He discusses financial alternatives of different approaches to providing the service, as well as employee requirements and cost analysis. The information in these chapters is highly detailed, including even an organizational chart and job descriptions for upper management. Alber covers pricing comparisons for some existing and hypothetical systems so precisely that the book must have been written for use as a college text.

The end of the book wraps up some loose ends not covered in other chapters, such as legal considerations and governmental regulations. Social implications are given a once-over, as are the possible security problems in a public videotex system. Alber uses the last chapter to do some reading of the tea leaves about the potential and evolution of videotex.

I cannot recommend this book as an introduction to videotex and teletex systems; that was not the author's

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intention. What he attempted was a detailed discussion of all the major aspects of the videotex industry. What he produced is a compendium of information on an industry just beginning to surface as a major contender in influencing the world of our future. If you have a professional interest in the videotex industry, you'll want to save this book. It may be describing tomorrow.

Wayne W. Shearer Jr. (1143 South University Blvd., Denver, CO 80210) is a senior field engineer for NEC Information Systems. He has worked in the computer industry for 15 years.

TELECONFERENCING: LINKING PEOPLE TOGETHER ELECTRONICALLY

Reviewed by David L. Salahi

Here is a book to introduce the reader to teleconferencing, a fast-moving new technology that will increasingly shape the way human beings interact in the coming decade. The subtitle of this book, *Linking People Together Electronically*, reflects a theme that runs through the book: Teleconferencing is about facilitating communication between people. The authors look at their topic from this perspective.

Kathleen Kelleher and Thomas B. Cross write that the attraction of teleconferencing is that it lets us "move ideas, not people or paper." And ideas can be moved much more quickly and less expensively than people. They discuss other advantages of teleconferencing, including the synergy of people working together, reduced need for travel, elimination of geographical and temporal barriers, and fewer problems scheduling meetings between busy people. It's more democratic, they say, because it gives access to people who wouldn't be able to attend certain meetings, and it gives the vocally quiet person more of a chance to be heard. Another benefit they cite is reduction of time lag in communications. All of these advantages can be summed up as increased access to people and information.

TECHNOLOGIES

Kelleher and Cross cover four types of teleconferencing technologies: audio (telephone), audiographic (audio plus still pictures), full-motion video, and computerized. Each type is explored in some detail, and advantages and disadvantages are discussed. Audio teleconferencing is the easiest and least expensive to use, requiring no special equipment in many cases. In addition, it is accessible nearly anywhere through the worldwide dial-up network. For more sophisticated users, the book covers specialized services that can give the participants greater access to the system as well as more control over it. Equipment such as speakers, microphones, and audio-bridging devices is discussed.

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With audiographic teleconferencing technology, users can transmit images as well as words. This can provide a necessary extra dimension for technical discussions or it can be used to convey pictures of the participants as each one speaks in turn. Depending on resolution, an image can be transmitted in about 30 to 90 seconds. The authors list a variety of source devices that can be used to send images to conference participants: microfiche, facsimile, slide projectors, computer graphics, slow-scan TV, and telewriting systems. This last category includes light pens, electromechanical pens, electronic tablets, and electronic blackboards.

To understand the application of full-motion video teleconferencing, consider the adage "A picture is worth a thousand words and a feeling is worth a million facts." For certain types of communication, the feedback and visual cues provided by this technology are indispensable. These include applications involving motivation, negotiation, and other instances where the emotionality, urgency, or intensity of the participants must be conveyed.

This technology commands a high price, however, and is not for everyone. The prices are attributable to the high capital costs of equipment, the high bandwidth required for transmission, and the host of production and technical personnel required. The authors go into considerable detail about each area, outlining the types of equipment available and the roles of the different people needed to make a full-motion video teleconference work.

Kelleher and Cross describe computer teleconferencing systems, which are essentially high-powered versions of the bulletin-board systems that have become so popular among computer users. Computer conferencing can be conducted either in real time, in which all participants are on line simultaneously, or asynchronously. In an asynchronous conference, the users access the conference whenever they want to read comments left by other participants and add their own. In this way, the comments of the entire group are collected in one place to provide a transcript of the group's proceedings. Any number of conferences and subconferences can be available for access by the users of the service. In addition, electronic mail is almost always a part of such systems.

The book points out that the structure of the communication in a computer teleconference is quite different from a face-to-face meeting. The structure is dictated in part by the hardware (keyboard and monitor) but also to a large extent by the software. Thus, a well-designed system can build in cues to shape the interactions of the participants. The authors mention some of the parameters of communication that can be influenced by the system, including the roles of the participants, the topics under discussion and the order of presentation, the tempo of the discussion, appropriate types of responses to be elicited, and the expected level of technicality of the discussion.

The authors profile several large computer teleconferencing systems such as EIES, Notepad, Genie, Matrix,

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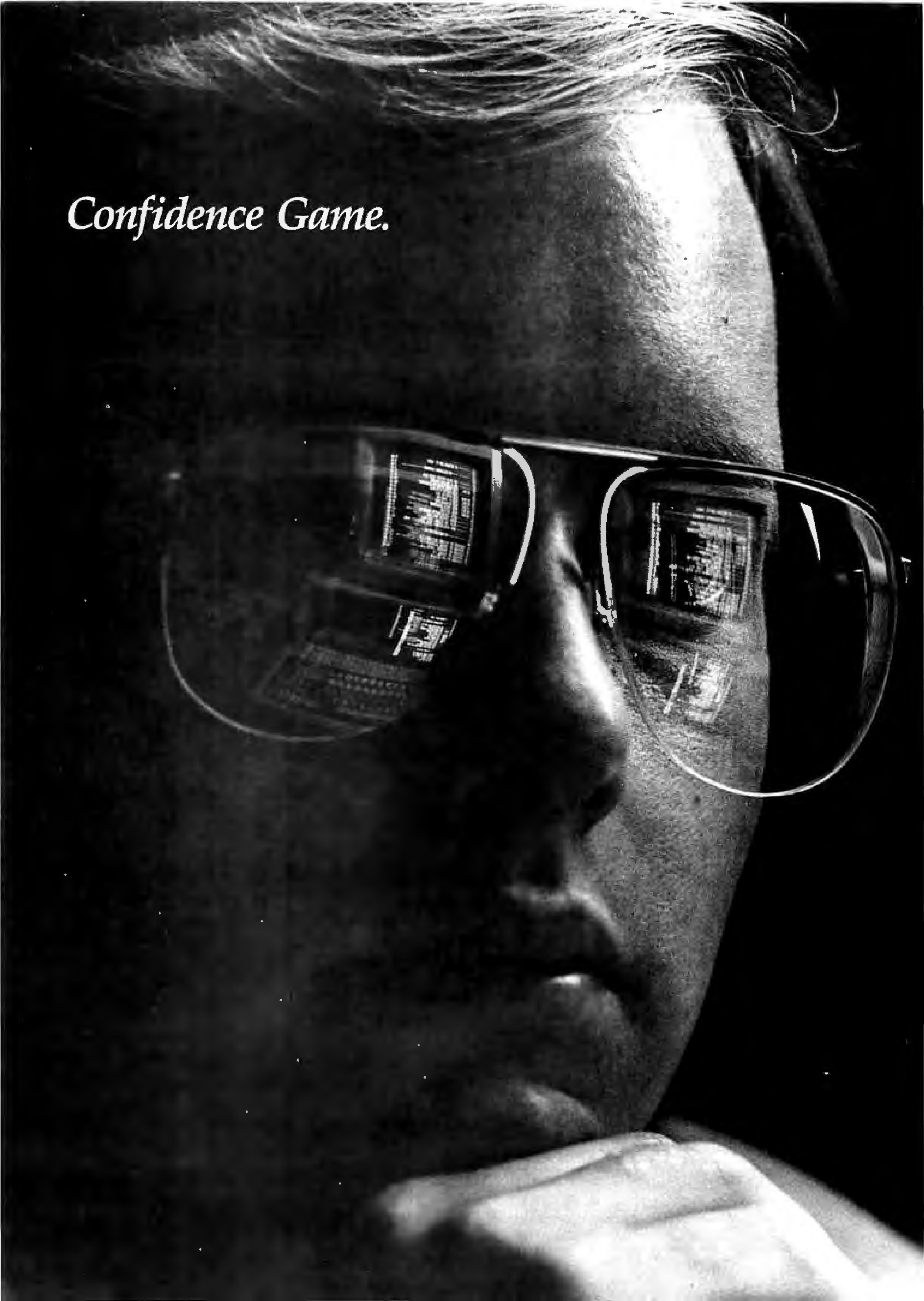
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and Augment. These systems are very powerful but very expensive and run on minicomputers or mainframes. I would have liked to see discussions of some smaller systems such as MIST CONEXUS, which runs on the IBM Personal Computer. Furthermore, these systems almost all represent the first generation of such software. In a new and rapidly evolving field such as this, it would be nice to see where the technology is and where it's going.

SOCIAL DIMENSIONS

As stated previously, the authors recognize that teleconferencing must mesh with the existing social and organizational structure of a company. Implementors of any such system must take the existing channels of communication into careful account. However, the book covers systems analysis and group communications almost as much as teleconferencing. (More than 100 pages is given to the discussion of topics related to management of human resources, meetings, and the implementation of a system.) This concern for the human element is laudable, but much of this information exists elsewhere already. In a book on teleconferencing, I would have expected more on the technology and its future directions. While the human element is important, perhaps the authors could have limited this discussion to only those aspects that are directly affected by teleconferencing technology.

Kelleher and Cross have done a good deal of research and have presented a thoughtful treatment of all aspects of teleconferencing. The book gives the reader a solid grounding in the basics of each of the technologies and in the dynamics of human interaction. Of course, actually implementing a teleconferencing system entails a good deal more learning, a process that can be started by contacting some of the numerous companies listed in the resource reference at the back of the book.

Though the price of the book might discourage the casual reader, it should not give pause to anyone seriously contemplating the use of this technology. In addition to providing an introduction to the world of teleconferencing, the book serves to expand the reader's awareness to include options for doing business you would never have thought of or would have dismissed as impossible. My horizons have certainly been broadened, and I now know where to look for more information if I need it.

David L. Salahi (90 Streamwood, Irvine, CA 92714) is a computer programmer interested in music, graphics, surveying, and telecommunications.

PASCAL PRIMER FOR THE MACINTOSH

Reviewed by Scott L. Norman

Dan Shafer's *Pascal Primer for the Macintosh* is by no stretch of the imagination a textbook, and it makes

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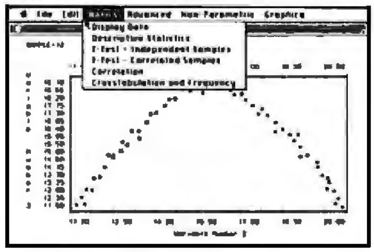

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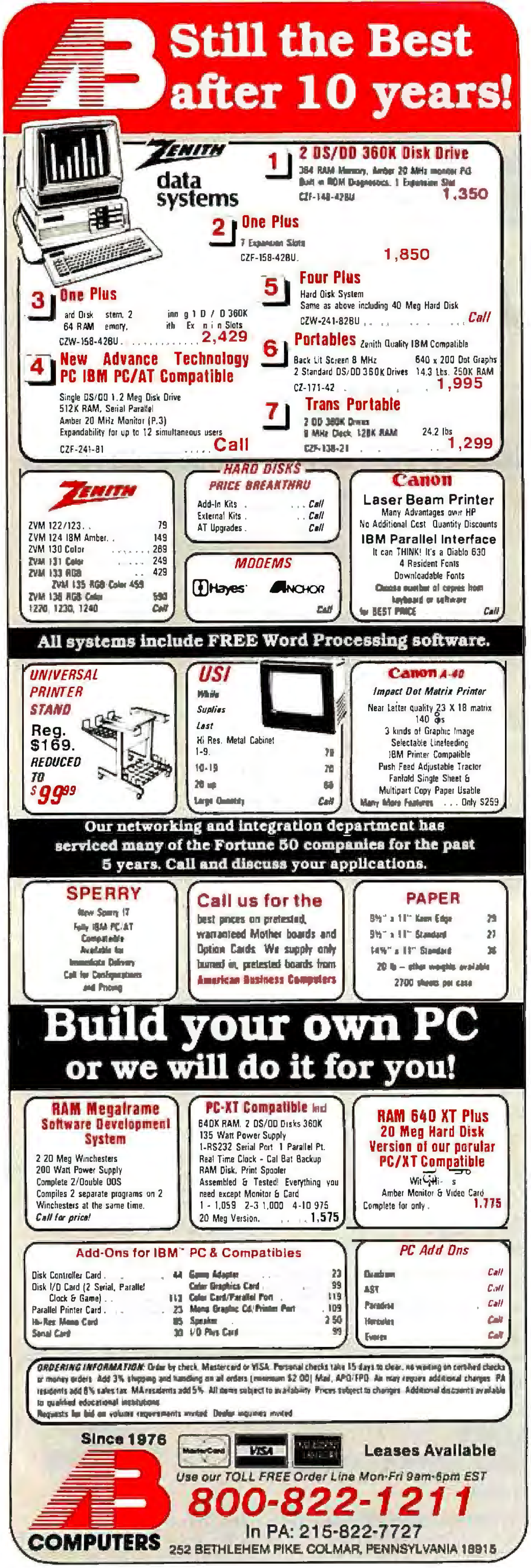

no pretense of dwelling on the theoretical principles of its subject. There is very little discussion of structured programming in general, and this may be the only Pascal book in existence that is totally devoid of the language's syntax diagrams.

Pascal Primer fills another need. It might be the one book to read if you are a novice who wants to be able to write nontrivial Macintosh Pascal programs in the shortest possible time. The book captures the style and pace of the most successful teach-yourself efforts I have seen, and perhaps too much BASIC really does spoil you for the newer languages.

Thus this primer seems best suited to the aspiring Mac programmer who functions outside a formal computer science setting. Shafer mentions another potential audience: experienced Pascal programmers who want a quick briefing on the special features of the Mac dialect. Its appeal to that group is questionable. While Pascal initiates can certainly pick up useful information here, the *Reference Manual* and *Technical Appendix* furnished with the language are probably more appropriate for them to use.

INTRODUCTORY MATERIAL

Pascal as implemented on the Macintosh is an interactive, interpreted language (see the preview by G. Michael Vose in the June 1984 BYTE, page 136). Feedback from the interpreter and the insight provided by the special windows that can be opened to monitor a running program encourage the student to experiment.

Pascal Primer supports this approach. The book is liberally laced with routines that you are encouraged to enter, check, run, and modify. Most of them are short so as not to induce typing fatigue. The blue ink and small sans serif type used for the program code can be difficult to read, however. Most chapters end with a summary and exercises. Possible answers to many of them (most are programming problems without unique answers) appear in an appendix.

The book introduces Macintosh Pascal's menus, windows, and editing and debugging features. The automatic formatter (which indents the source code, puts reserved words in boldface, and generally deals with matters of program legibility) is briefly described. In my opinion, this feature makes the built-in editor much more attractive than a separate text processor for preparing code.

After describing the structure of the Pascal program, Shafer introduces the concepts of variable types and then defines the principal types of control statements. He does this with plenty of consideration for the novice; for example, he provides a good explanation of how the WHILE and REPEAT. . .UNTIL constructs differ in treating a loop that should execute just once—or not at all—in a given program.

At this point, Shafer introduces QuickDraw graphics. Topics include the control of pen size and pattern, the use of MoveTo and LineTo commands to write high-speed

(continued)

 Inquiry 4

Shafer's handling of the concept of the scope of a variable is a painless introduction to the subject.

drawing programs, and the manipulation of some predefined shapes. The reader is introduced to the Frame, Paint, Fill, Erase, and Invert operations. The tools for surprisingly complex graphics are now in hand.

Subsequent discussions cover string manipulations, the types of numbers in Pascal (emphasizing reals and integers but with at least a hint of the more specialized types that are available), and procedures and functions. Shafer's handling of the concept of the scope of a variable is one of the most painless introductions to the topic I have seen. Most of the space is devoted to the use of procedures, with a summary of the similarities and differences between them and functions.

ADVANCED TOPICS

The last 100 pages or so are devoted to topics that most readers will need if they want to write programs of real substance. There is no obvious dividing line in the book at this point, but rather a subtle change in the impression it leaves. Many of the remaining topics are more abstract and simply require closer study than the material that has gone before.

A readable introduction to structured data types—arrays, sets, and records—gets things under way. In keeping with the orientation of the book, only one- and two-dimensional arrays are discussed, using the typical examples of lists and tables. Shafer writes about subrange data types and enumerated user-defined types as well as sets and the programming tools for manipulating them.

There is some danger that the reader will begin to suffer from data-structure overload at this point. My best advice is to try and remember that you don't have to use every single tool in every program.

The remainder of *Pascal Primer* treats matters that could be difficult for the novice. The topics deserve a place in the book, however; they can be important when writing programs of any practical level of complexity. They include the Event Manager, which helps handle keyboard and mouse inputs to a running program; disk files (restricted to numerical files here); dynamic data structures, used when you lack a priori knowledge of the quantity of information with which you will deal; and advanced graphics and sound techniques. The book ends with three sample programs that pull together many of these techniques.

USEFUL AND READABLE

I think that *Pascal Primer for the Macintosh* continues the Waite Group's track record of conveying useful information in

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BOOK REVIEWS

highly readable form. It is pleasant to find a Macintosh software book that deals with the same version of a product that the consumer can actually buy.

I found only a few misprints, which seemed to be confined to program listings. Some of the demonstration routines will crash if run as listed; interpreting the resulting Macintosh Pascal error messages is not too difficult and can be considered part of the learning process. One error that comes to mind is in the "Flying Circles" graphics program on page 112; as it stands, a second constant (ymax) must be declared in order to set the boundary of the drawing area.

Shafer's style leans on frequent asides to the reader and minor-league puns, and it does get a bit tiresome.

But these are minor matters. I recommend the book to Macintosh Pascal beginners learning to write useful programs. Some ex-novices (especially those with BASIC experience) will be able to go straight from the *Pascal Primer* to Apple's own Macintosh documentation, while others may find a more traditional Pascal text a worthwhile investment.

Scott L. Norman (8 Doris Rd., Framingham, MA 01701) is a frequent contributor to computer magazines.

SILICONNECTIONS: COMING OF AGE IN THE ELECTRONIC ERA
Reviewed by William Barden Jr.

Forrest M. Mims III is one of the world's best-selling electronics and computer authors. His Radio Shack *Engineer's Notebooks* are down-to-earth guides for hardware hackers on how to use integrated circuits. His column in *Computers and Electronics* magazine, covering lasers, optics, computers, and electronics, was the mainstay of that magazine for years. Mims started his career in electronics about the time of large-scale use of integrated circuits and therefore has an excellent perspective about the era of silicon chips and microcomputers.

Mims's new book *Siliconnections: Coming of Age in the Electronic Era* spans 15 years. Mims has some spellbinding stories to tell that will be of great interest to computer users, hardware hackers, and anyone else interested in "high tech."

There's a story of how Mims helped found MITS, long before Apple (at least in measurement of time in the microcomputer era). With the Altair 8800, MITS became the first successful microcomputer company. Those were the days of iron men and silicon machines; it took a dedicated computer hobbyist to build the system from a kit and then program it in machine language. The Altair 8800 was sold at first in kit form, coming complete with 256 bytes of RAM (random-access read/write memory). The Altair 8800 was incredibly successful and was the

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basis for the microcomputer industry. It spawned a host of imitators: Sphere, IMSAI, Southwest Technologies, and Apple. This is the true story of the birth of the microcomputer industry from an insider's point of view that moves the birthplace of the infant industry from Silicon Valley to Silicon Valley Southwest—Albuquerque.

Then there's the story of Mims versus Bell Laboratories, a David-and-Goliath scenario that pits an independent inventor of an electronics device against the power of Bell Labs. Mims raises several questions. Do large companies steal ideas? Does the "little guy" have any recourse if it happens? As it goes according to the author, Mims had invented an infrared-emitting diode device that acted as both a laser emitter and detector. In a proposal to Bell Labs, he described the device and suggested that Bell might like to use the invention in a fiber-optics two-way communications link. Bell rejected the proposal, saying that it "has negligible value to Bell Labs." However, five years later Mims learned that Bell Labs had developed a new device that doubled as detector and light source, "greatly simplifying the problem of coupling separate detector and transmitter devices to the same end of a hair-thin fiber." A legal battle ensued.

LASERS AND HOWARD HUGHES

There's intrigue in this book, too. In 1975 Mims was contacted by the *National Enquirer* for a feature article on lasers. In the course of the preliminary discussion, Mims casually verified that laser devices could indeed be used to intercept conversations in closed rooms by bouncing the beam off the window panes. Conversations in the room would make the panes vibrate, and this vibration could be used to modulate the returning beam. The *Enquirer* staff was excited because they had been trying to get copy on Howard Hughes, even offering as much as $100,000 for a full-face photo of the billionaire. Could Mims make such a device they could use? The resulting story is an interesting insight into the operations of the *Enquirer* and an individual's right to privacy.

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February

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LOCAL AREA NETWORKS; THE INFORMATION CENTER; FINANCIAL ANALYSIS AND PROBLEM SOLVING USING LOTUS 1-2-3, various sites throughout the U.S. Data-Tech Institute, Lakeview Plaza, POB 2429, Clifton, NJ 07015, (201) 478-5400. *February*

PERSONAL COMPUTER SEMINARS, New York, NY. Personal Computer Education, Training, and Consulting, 450 Seventh Ave., New York, NY 10123, (212) 736-5870. *February*

C PROGRAMMING; UNIX; MICROCOMPUTER SYSTEMS IN GOVERNMENT, various sites throughout the U.S. Conference Manager, U.S. Professional Development Institute, 1620 Elton Rd., Silver Spring, MD 20903, (301) 445-4400. *February–March*

DIAL-UP COMMUNICATIONS: SOLVING YOUR APPLICATIONS PUZZLES, various sites throughout the U.S. Microcom, 1400A Providence Highway, Norwood, MA 02062, (617) 762-9310. *February–March*

DIGITAL CONTROL SYSTEMS; DIGITAL IMAGE PROCESSING; AUTOMATED RECOGNITION SYSTEMS, various sites throughout the U.S. and Canada. Integrated Computer Systems, 6305 Arizona Place, POB 45405, Los Angeles, CA 90045, (213) 417-8888. *February–March*

COMPUTER RELATED SEMINARS FOR PROFESSIONAL DEVELOPMENT, Worcester and Boston, MA, area. Kathy Shaw, Office of Continuing Education, Higgins House, Worcester Polytechnic Institute, Worcester, MA 01609, (617) 793-5517. *February–April*

SYMPHONY SEMINARS, various sites throughout the U.S. Automated Digital Offices, 4555 MacArthur Blvd., Washington, DC 20007, (202) 337-1393. *February–April*

VOICE AND DATA COMMUNICATIONS COURSES, various sites throughout the U.S. Datapro Research Corp., 1805 Underwood Blvd., Delran, NJ 08075, (800) 328-2776. *February–April*

MICROCOMPUTER AND SOFTWARE SEMINARS FROM DIGITAL CONSULTING ASSOCIATES INC., various sites throughout the U.S. and Toronto, Ontario, Canada. Software Institute of America Inc., 8 Windsor St., Andover, MA 01810, (617) 470-3880. *February–May*

UNIX PUBLIC TRAINING SEMINARS, Edison, NJ. Cynthia Capria, Auxton Computer Enterprises Inc. (AUXCO), 2 Kilmer Rd., Edison, NJ 08817, (201) 572-5075. *February–June*

UNIFORUM 1986, Anaheim, CA. UniForum 1986, 2400 East Devon Ave., Suite 205, Des Plaines, IL 60018, (312) 299-3131, or /usr/group, 4655 Old Ironsides Dr., Suite 200, Santa Clara, CA 95054, (408) 986-8840. *February* 4–7

PERSONAL COMPUTER NETWORKS, Milwaukee, WI. Peter Tocups, University of Wisconsin-Milwaukee, 929 North Sixth St., Milwaukee, WI 53203, (414) 224-3952. *February* 5–7

FIFTEENTH ANNUAL NORTHWEST COUNCIL FOR COMPUTERS IN EDUCATION CONFERENCE, Seattle, WA. Sue Collins, S.P.I., NCCE, Old Capitol Building, Olympia, WA 98504. *February* 6–8

THE COMMODORE SHOW II, San Francisco, CA. West Coast Commodore Association, POB 210638, San Francisco, CA 94121, (415) 982-1040. *February* 8–9

THE ROLE OF THE COMPUTER IN EDUCATION VI, Arlington Heights, IL. Rick Nelson, Micro-Ideas, 2701 Central Rd., Glenview, IL 60025, (312) 998-5065. *February* 12–14

1986 NORTH AMERICAN COMPUTER OTHELLO CHAMPIONSHIP, California State University, Northridge. North American Computer Othello Championship, CSUN Computer Science Association, School of Engineering, Box 31, 18111 Nordhoff St. Northridge, CA 91330, (213) 852-5096. *February* 15–16

DESKTOP COMPUTERS IN ENGINEERING AND ARCHITECTURE, Austin, TX. DCEA Conference, CLE Program, University of Texas Law School, 727 East 26th St., Austin, TX 78705. *February* 16–19

NINTH ANNUAL PERSONAL COMPUTER FORUM—THE PC MARKETPLACE: EXPLOITING THE STANDARDS, Phoenix, AZ. Release 1.0, Ziff-Davis Publishing Co., One Park Ave., New York, NY 10016, (212) 503-5500. *February* 16–19

VISION GUIDANCE FOR INDUSTRIAL ROBOTS, Dearborn, MI. Joanne Rogers, Special Programs Division, Society of Manufacturing Engineers, One SME Dr., POB 930, Dearborn, MI 48121, (313) 271-1500, ext. 399. *February* 18–20

AI AND EXPERT SYSTEMS: CONCEPTS AND WORKSHOP, Princeton, NJ. Sperry Corp., POB 2191, Princeton, NJ 08540, (800) 222-0966; in New Jersey, (201) 329-3899. *February* 19–20

AUTOCADCON, Rosemont, IL. Cad Design Systems Inc., 1305 Remington Rd., Suite D, Schaumburg, IL 60195, (312) 882-0114. *February* 20–21

FIFTH INTERNATIONAL HOBBY COMPUTER CLUB FAIR, Venlo, The Netherlands. J. Peeters, Molenstraat 8, 5993 ZB Maasbree, The Netherlands; telephone: 4765-1693. *February* 22 ■

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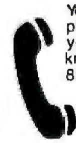

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Features

As Steve Ciarcia explains is often the case, this month's Circuit Cellar project came about because of a dilemma he faced. The problem is that he's living in a half-computerized house. The audio-visual systems, which are really important to him, haven't even been touched. Steve therefore embarked on a project to develop a switching/multiplexing/amplifying system, which is called the AVMUX. It was designed both to provide a solution to the wiring maze around his house and to facilitate a point-to-point switching system for audio and video signals.

This month's Programming Project is the final part of Jonathan Amsterdam's article on his SIMPL compiler. In this concluding section, he discusses how to handle user-defined types, arrays, strings, Ada-style parameter modes, and open-array parameters. These extensions are not really difficult to implement, but designing them so they don't interact in harmful ways can be difficult. Jonathan hopes that his explanations of the design choices involved will help you better understand programming languages.

The creator of Intuition, Robert J. Mical's first version of "Introduction to the Amiga ROM Kernel" ran in three parts on BIX (BYTE Information Exchange) in October 1985. The parts have now been combined into one article that introduces the building blocks of the Amiga ROM Kernel software, examines the ROM Kernel, and looks at the hardware and special features of the ROM Kernel.

LISP's unnatural syntax can be simplified with the Visual Syntax editor. "Visual Programming" by Raph Levien describes a program that is an editor for LISP. It displays programs as pictures, with all data paths marked with arrows, and it allows you to edit functions and expressions and view them in typical LISP syntax.

We have received several program submissions in response to the article "Viewing Molecules with the Macintosh" by Earl J. Kirkland, which ran in February 1985. We feel that this month's Programming Insight, "Molecules in Color" by John J. Farrell, is the best of the submissions. The BASIC program COLOR3D.BAS is a program for the IBM PC and has many of the features of the original MODEL3D.BAS, except that this program displays molecules on an RGB monitor and each type of atom can be easily identified by its different color or pattern.

There are many CP/M utilities that were designed to help users correct bad disks or tracks; however, most fail to identify the names and locations of those files. The Programming Insight "Badfile: CP/M System Programming in C" is an exception. The utility described was written in C and can be useful to CP/M users, as it offers the valuable information that can help you salvage information from your disks.

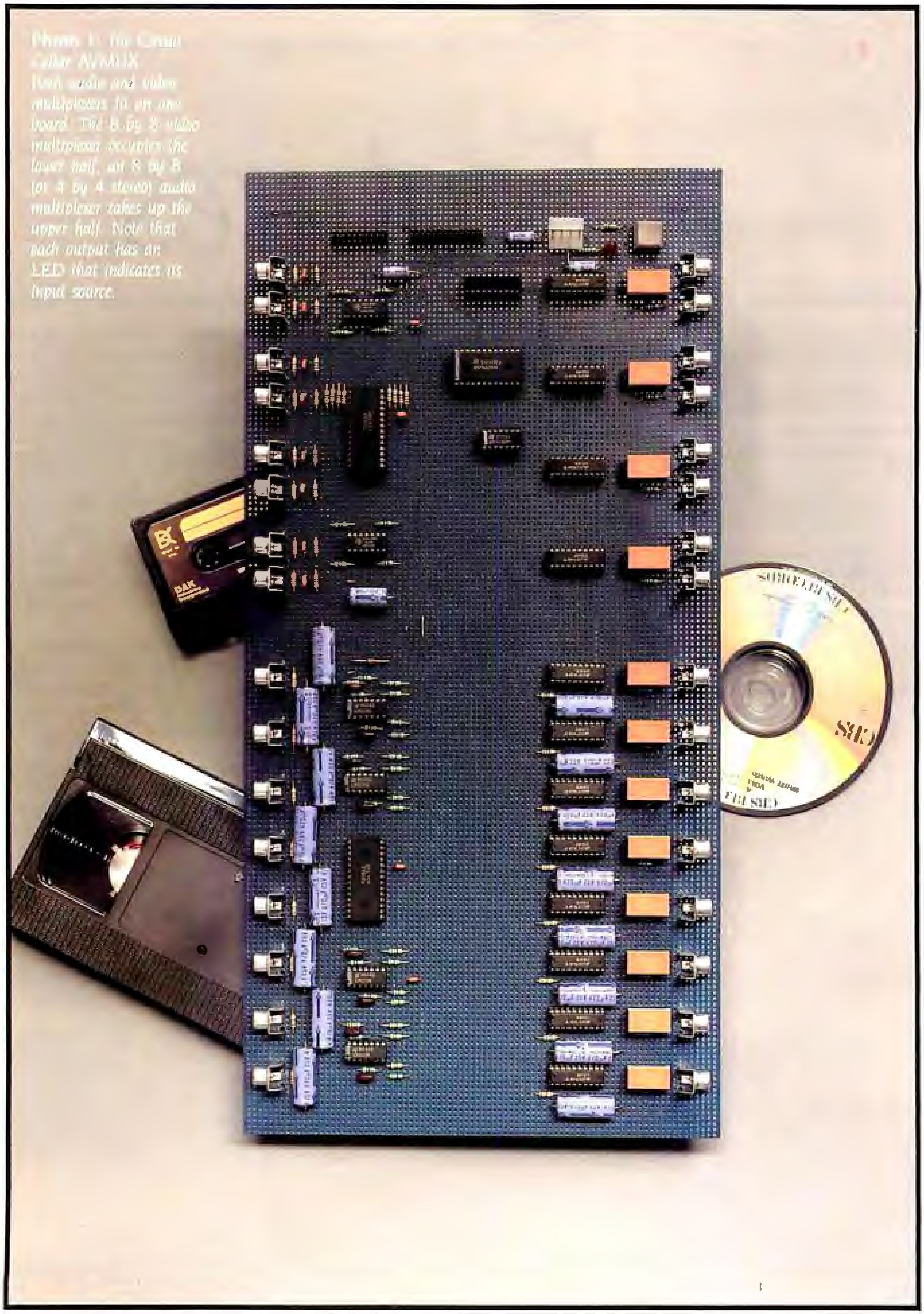

Photo 1: *The Circuit Cellar AVMUX. Both audio and video multiplexers fit on one board. The 8 by 8 video multiplexer occupies the lower half; an 8 by 8 (or 4 by 4 stereo) audio multiplexer takes up the upper half. Note that each output has an LED that indicates its input source.*

PHOTOGRAPHED BY PAUL AVIS

BUILD AN AUDIO-AND-VIDEO MULTIPLEXER

BY STEVE CIARCIA

The AVMUX is a computer-controlled high-performance router

When I was disenchanted with the lack of timeliness of commercial weather forecasts, I built my own weather station; when the world worried about the cost and availability of oil, I built a computer-controlled central-heating wood stove; when I got tired of waiting for slow interpretive BASICs to crunch through my programs, I built a fast BASIC "engine" and did it in hardware; when I got frustrated hunting for light switches in the dark, I built a home-control system and installed computerized lighting.

It should be apparent to you by now that I don't hesitate to present ambitious solutions where I perceive inadequacies. I seriously believe in the old adage that "Necessity is the mother of invention." Unfortunately, in my case "necessity" has been broadly redefined to include "convenience," and the unbridled application of this "invention" has led to interesting responses from others.

There are the housekeepers ("from the old country") who cross themselves before beginning work because they have no concept of automatic lighting or automatically answered phones and really think my place is haunted. There are the neighbors who picked up broadcasts from my automatic voice-synthesized weather station and called NASA to see if they had lost anything. There are the zoning-board officials who don't believe that my 15-foot satellite dish looks quite enough like an umbrella next to the picnic table. And, if things weren't bad enough, there are the eight state and local policemen who surrounded my house after the security system reported a burglary in progress that turned out to be my Scotties in the dog-biscuit barrel.

All right, I'll admit that some people don't understand the true gravity of the projects I present, but it is a weighty issue. For me, it is a process of recognizing a need, formulating an approach, and embarking on a solution. Frequently, I come up with BASIC-52 and SB180 projects, but when it really gets down to the basics, convenient living is facilitated more by the design of Whimsi-Bells and talking weather stations. Remember, if Ben Franklin already had an AC outlet to plug in his electric shaver, he never would have flown a kite in a thunderstorm.

This brings me to my latest dilemma. The problem is that I'm living in a half-com-

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puterized house. That's right, half. The security system, inside and outside lighting, and HVAC (heating, ventilating, and air conditioning) systems are automated. Unfortunately, the really important things—the stereo, television, and other audiovisuals—haven't even been touched. When I am in the kitchen cooking some wild Italian delicacy and watching *The Muppet Show* and leave to go into the bedroom or bathroom momentarily, I have to turn on the television in that room (don't you have one in your bathroom?) and switch to the correct channel.

How humiliating to be so manual. With a control system intelligent enough to turn the light on in any room I enter, and even announce when someone arrives in the driveway, why can't it tune the television or stereo to the right station or switch the output of a driveway camera to where I am?

I'm not talking about some new form of audiovisual background music à la piped-in MTV (you know, background music is that absolutely awful radio station selected by some grocery-store manager who believes the definition of culture is the green stuff on bread). It's just that I have many separate video and audio sources but few connections among them. For example, the satellite receiver is in the Circuit Cellar with a remote control and color monitor in the bedroom. Unfortunately, it doesn't go anywhere else. If I want to watch something on Satcom F3 while preparing a snack, I'd better plan on lots of crumbs in the bed.

The HCS (Home Run Control System) and the outside television cameras each have their own monitors. (Remember, the Circuit Cellar is underground, and it's easy to miss visitors who don't pound hard on the door or bring a bullhorn. Forget my dogs, Scotties bark at falling leaves. You'd install a television camera on the driveway too after running upstairs only to find it was some dumb squirrel they saw.) Unfortunately, all the monitors, television sets, and stereos are starting to get a bit messy. Every new system I seem to add around here has a video output requiring a display, and, since I'm not always in the Circuit Cellar, I start

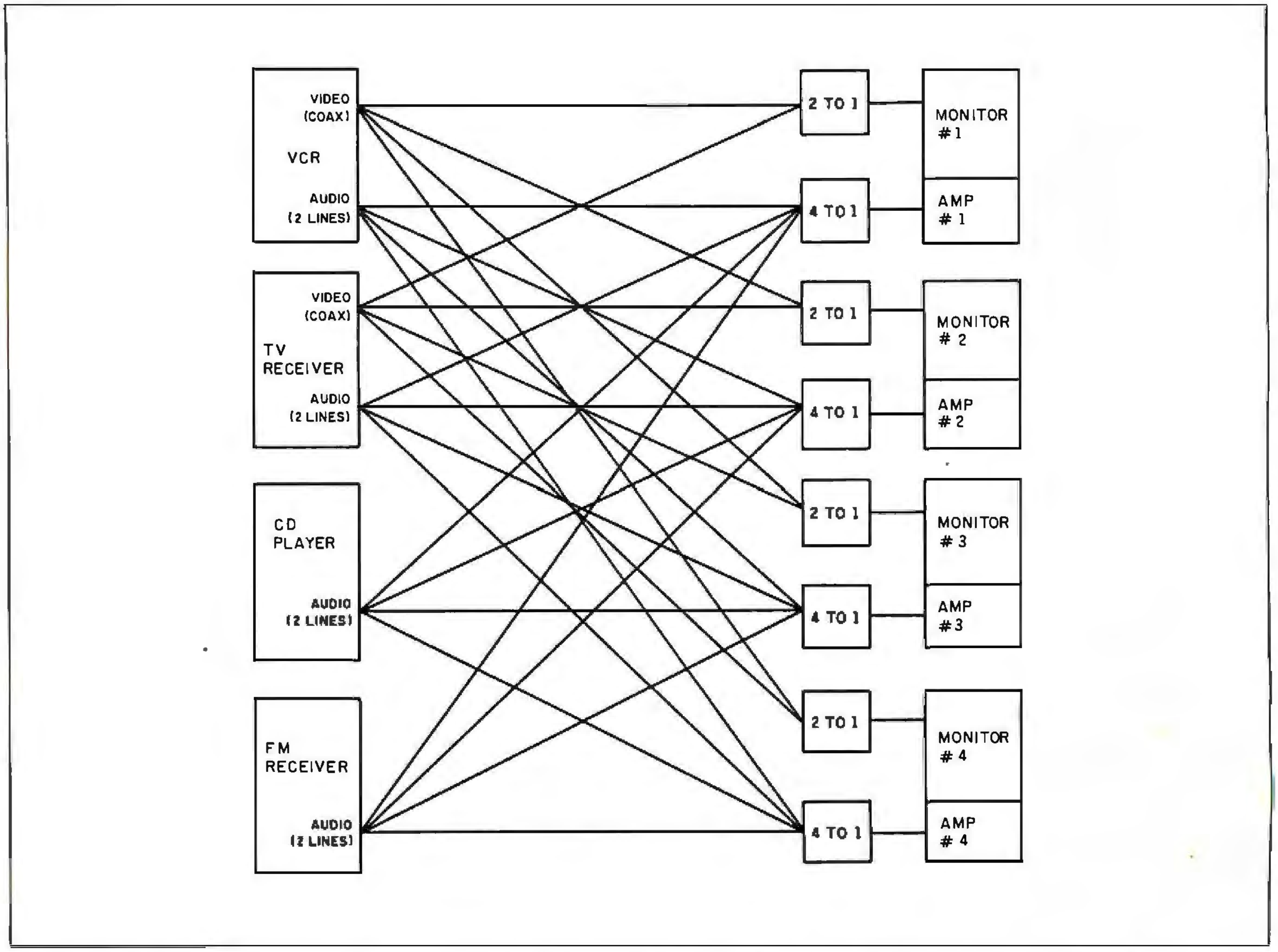

Figure 1: *A diagram for connecting audio/video sources to various outputs via brute-force point-to-point wiring. This scheme requires 8 coax and 32 shielded-conductor cables, along with a set of selector switches at the receiving end.*

stringing and installing . . . I'm sure you get the picture.

In point of fact, the Circuit Cellar is fairly neat. The storage area behind it, where you find all the wiring for the various control and display systems, is another story entirely. Looking like something halfway between the telephone company's switching office and the scrap pile at some wire and cable company, the walls behind the Circuit Cellar office are going to cave in from all the holes drilled for routing cables. Recently, I went out back to see how much trouble it would be to add another monitor from the satellite receiver. On one 2- by 10-inch beam I counted four 16-conductor cables, two 12-conductor shielded cables, four twisted-pair shielded wires, eleven twisted-pair wires, two 4-conductor telephone cables, three RG-58 coaxial cables, and six shielded-conductor cables. Believe me, I haven't the slightest idea where most of this stuff terminates. When I built the Circuit Cellar I prewired it to some extent, but I never could find that list of what went where.

CLEANING UP THE WIRING MAZE

Frankly speaking, this place needs a little organization—computerized, that is. Until now, every audio or video source has been treated as a separate system with dedicated extensions. While it's nice to see what's happening with the HCS and important to view the outside cameras when someone arrives, these requirements rarely occur simultaneously. Thus, it seems extravagant to have monitors stacked all over the place. At the very least, video sources from control systems and cameras should be multiplexed and displayed on a single monitor. Television, satellite, and videocassette recorder (VCR) video can be multiplexed and sent to color monitors, etc. In the end, I'd not only neaten the wiring but have all the elements of the convenient automatic audiovisual system I alluded to earlier.

Directing an audio or video source to multiple outputs is easier than it sounds. Adding a remote set of speakers to a stereo system is relatively easy. The ease is not because the connection is electrically inconsequential but because the necessary function has been provided for by the manufacturer. The typical stereo has an A and B speaker switch with connectors on the rear of the case where two separate sets of stereo speakers are attached. If you are listening to music in the living room and go to the bedroom, you can press the B remote switch to turn on speakers there. The connection and speaker impedances have already been accounted for by the manufacturer, and both the A and B speaker systems perform together without overstressing the amplifier. Adding a third set of speakers is an entirely different matter. If they are attached in parallel with a pair of the existing speakers, the power consumption will double. If added in series, there will be a large difference in volume levels between the A and B speaker pairs.

Beyond the two pairs of speakers designed to be accommodated by the amplifier, trying to simultaneously power many remote sets of speakers directly is a game of impedance matching. Realize that with speakers, especially, we are driving low-impedance loads with relatively high power. While eight sets of speakers could be successfully multiplexed through an external switch attached to the A and B outputs (only two speaker pairs enabled at once), the switches would probably have to be

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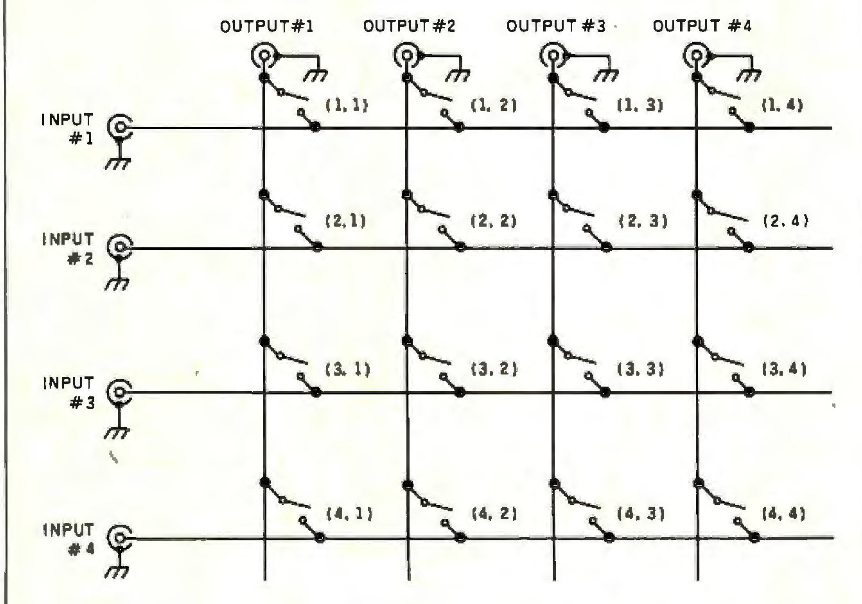

Figure 2: A 4 *by* 4 *crosspoint matrix.*

mechanical for best price/performance. (Driving 20 watts continuous into an 8-ohm speaker load is almost 3 amperes. It's much more when it hits a bass note!) Another consideration is the connecting wire. If the load is only 4 or 8 ohms and you attach them through thin wire, you will be dissipating more audio power in the cabling than in the speakers. Even #14 or #16 wire may be inadequate if you are used to high listening levels. Often, the only solution is thick "monster" cable. The last time I bought some it was $475 a roll.

You can still string speaker cable if you wish, but the preferred solution is to do a little distributed processing. Instead of using low-impedance outputs connected directly to the speakers, we use high-impedance (1- to 10-kilohm) audio signals from the tape or auxiliary outputs and send them to independent amplifiers at each speaker pair (I never said the solution was cheap, only that it was the way I as an engineer would do it). By dealing with low current and high impedances, you can use relatively inexpensive solid-state CMOS (complementary metal-oxide semiconductor) switches as multiplexers.

With each speaker pair no longer dependent on a single amplification source, many separate and distinct audio programs can be sent to each amplifier and speaker set. For example, the output of a speech synthesizer could greet guests in the foyer, Mahler could be playing in the kitchen as you prepare dinner, and the full stereo accompaniment to a videotaped presentation of *Flashdance* could be on the projection television (via monitor and auxiliary inputs) in the family room. All these sources would, of course, be coming from a little room downstairs where the master audio-and-video multiplexer sat next to all the program sources.

The need for a video-switching system can be justified on the same grounds. With video, however, it is not a simple matter of stringing miles of coaxial cable from the monitor output of your new television and switching in remote sets. The signal degradation from long lines and poorly matched impedances mandates the need for dedicated amplifiers for each video monitor, especially when driven from a single source. The switch used for video must also be different since

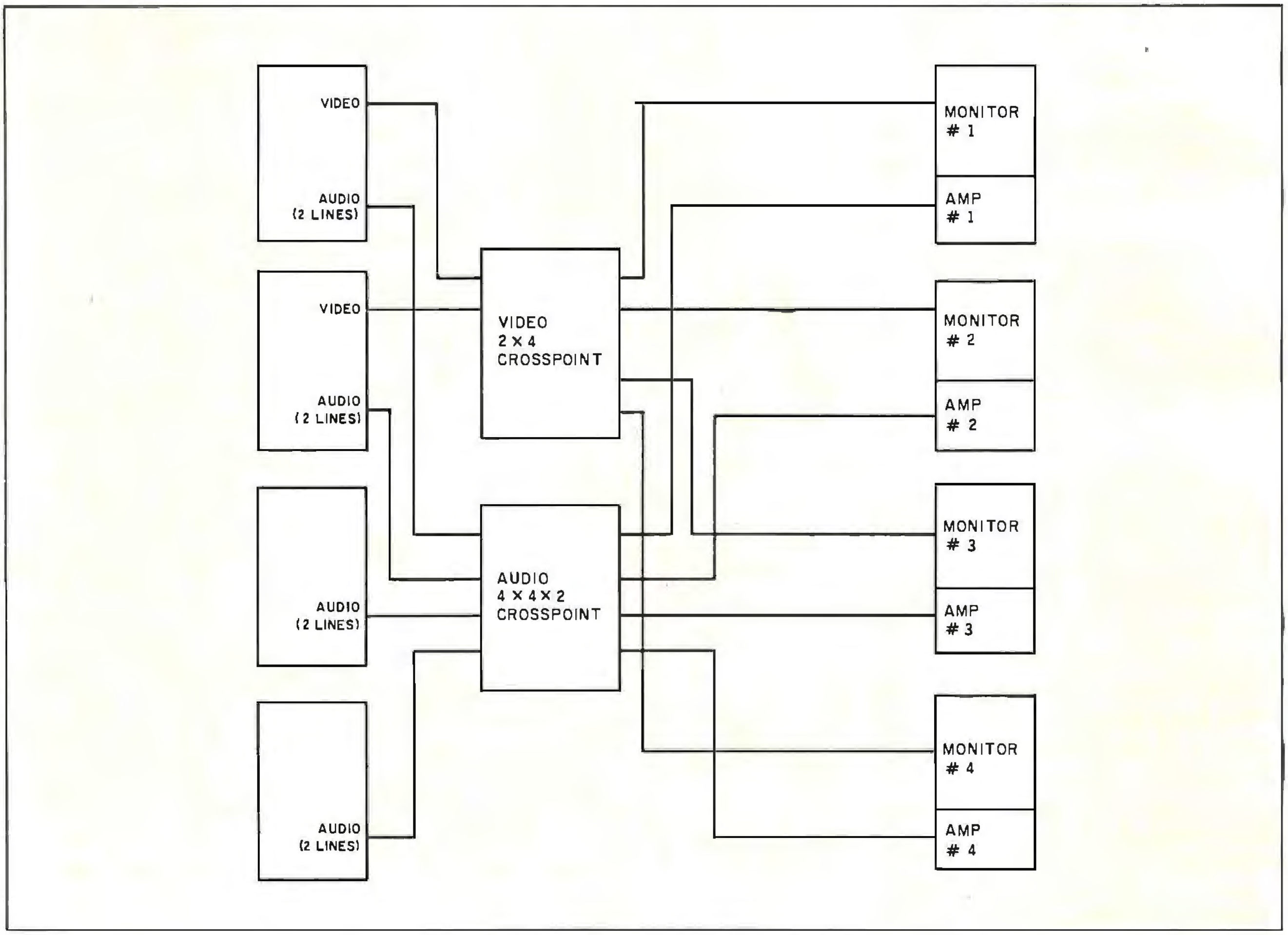

Figure 3: *The wiring in figure 1 can be simplified considerably by using a pair of crosspoint switches, one for video signals and one for audio signals.*

it has to handle the higher frequencies associated with these signals.

This switching/multiplexing/amplifying system is this month's project. Dubbed the Circuit Cellar AVMUX (audio-video multiplexer), it was designed both to provide a solution to the wiring maze around my house and to facilitate a truly functional computerized point-to-point switching system for audio and video signals. Totally automatic and easily connected to virtually any computer system or controller, I envision it as the central element in my pie-in-the-sky voice-activated home-control system. For today, however, it's just a local/remote computer-controlled crosspoint switch.

While some similar switching systems are on the consumer market, none in my opinion offers as many channels or the potential programming flexibility afforded in the AVMUX. Briefly, the AVMUX has eight input and eight output channels each for audio and video signals. Each output has its own amplifier and can derive its signal source from any input. This means that all eight outputs can reflect the program content of a single input or eight distinctly separate outputs. I designed it as a state-of-the-art solution to a particular problem while documenting it so that you can duplicate it. You might think this is all "much ado about nothing" if you haven't tried to do more than add a remote set of speakers to the stereo in the den, but I assure you there is much more to it than that.

Assume you have these sources: stereo television set with monitor outputs, VCR with stereo outputs, stereo compact-disc player, and FM stereo receiver; there are four locations in the house other than the den where you might want to selectively view or listen to any one of these program sources. At first, you might consider simply running wires from each source output with wires to the separate rooms (8 coax and 32 shielded-conductor cables, as shown in figure 1). At the receiving end, a 4 to 1 rotary or push-button selector switch would choose the appropriate source and route it to the display or amplifier input. Of course, this technique ignores the fact that we are driving signals into unterminated cables most of the time, and it is

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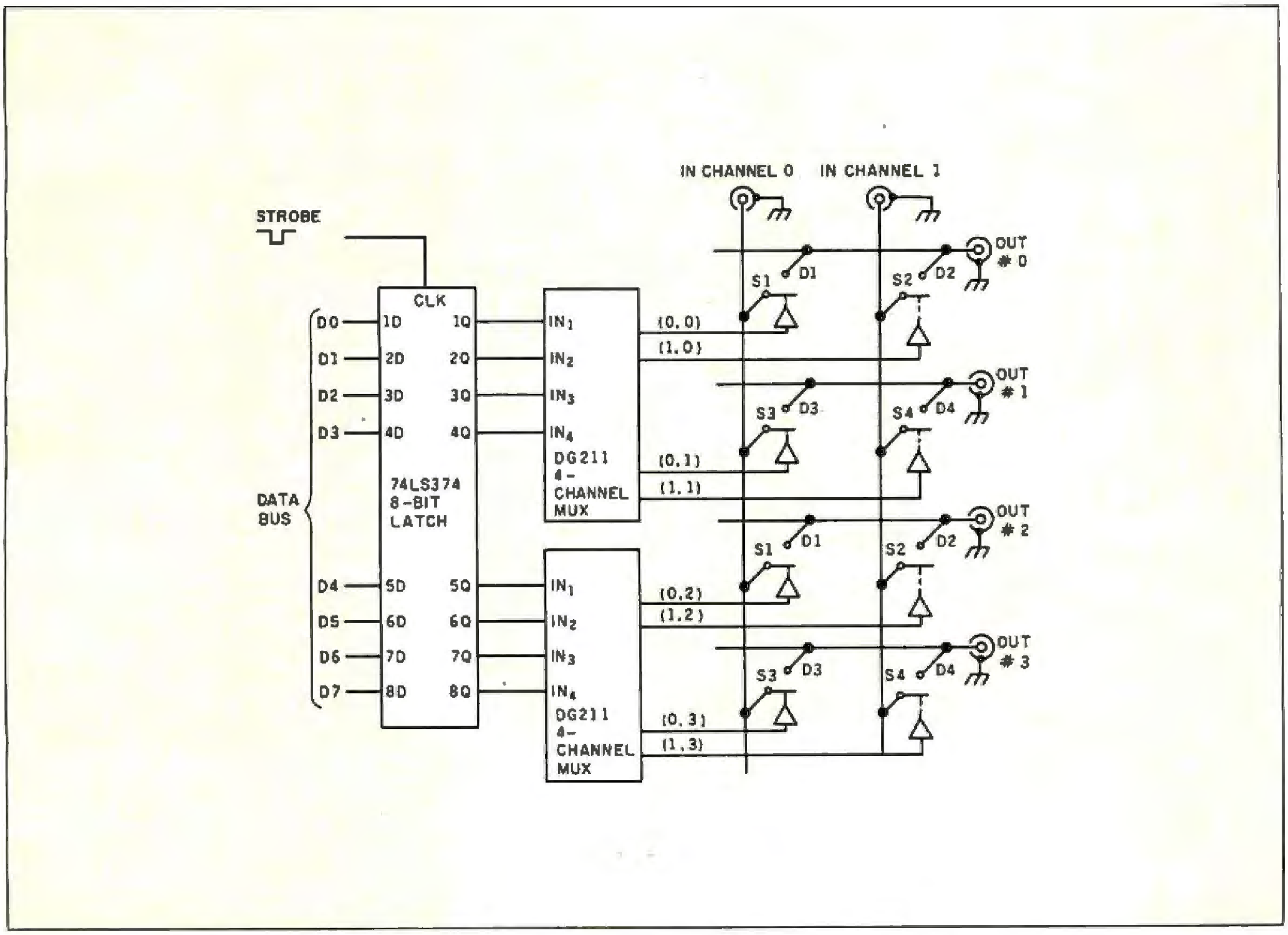

Figure 4: A *block diagram of a 2 by 4 crosspoint switch constructed using traditional* IC *technology.*

possible for all four receiving video monitors to be tuned to the VCR, for example. If that were the case, the video signal would be severely degraded unless sufficiently amplified along the way (matching impedances again).

What Is a Crosspoint Switch?

The previous technique, while electrically sound, requires a prodigious wiring effort and a large pocketbook for potentially less-than-acceptable results. A more state-of-the-art solution uses a crosspoint switch. As the name implies, the crosspoint switch is actually a matrix of independently controlled switches. A 4 by 4 crosspoint switch is diagramed in figure 2.

The 4 rows on the left are the signal inputs, and the 4 columns down from the top are the outputs (a common ground is assumed). The switch connection across each matrix crosspoint is a CMOS switch called a transmission gate. These switches can all be integrated into a single LSI (large-scale integration) package or be separate switches, like those provided in a CD4066 or DG211 multiplexer (the choice of switches is primarily dependent on frequency).

To route input #2 to output #1, simply close the switch at crosspoint location (2,1). Similarly, input #4 to output #3 is facilitated by closing the switch at (4,3). Finally, all four outputs can have the same input, for example, input #1, by closing switches at (1,1), (1,2), (1,3), and (1,4). (Note: Care must be taken not to close switches that will short inputs together.) If we apply this technique using 2 by 4 and 4 by 2 crosspoint switches to the house-wiring situation described before, we can see that the wiring is greatly simplified (figure 3). Rather than 40

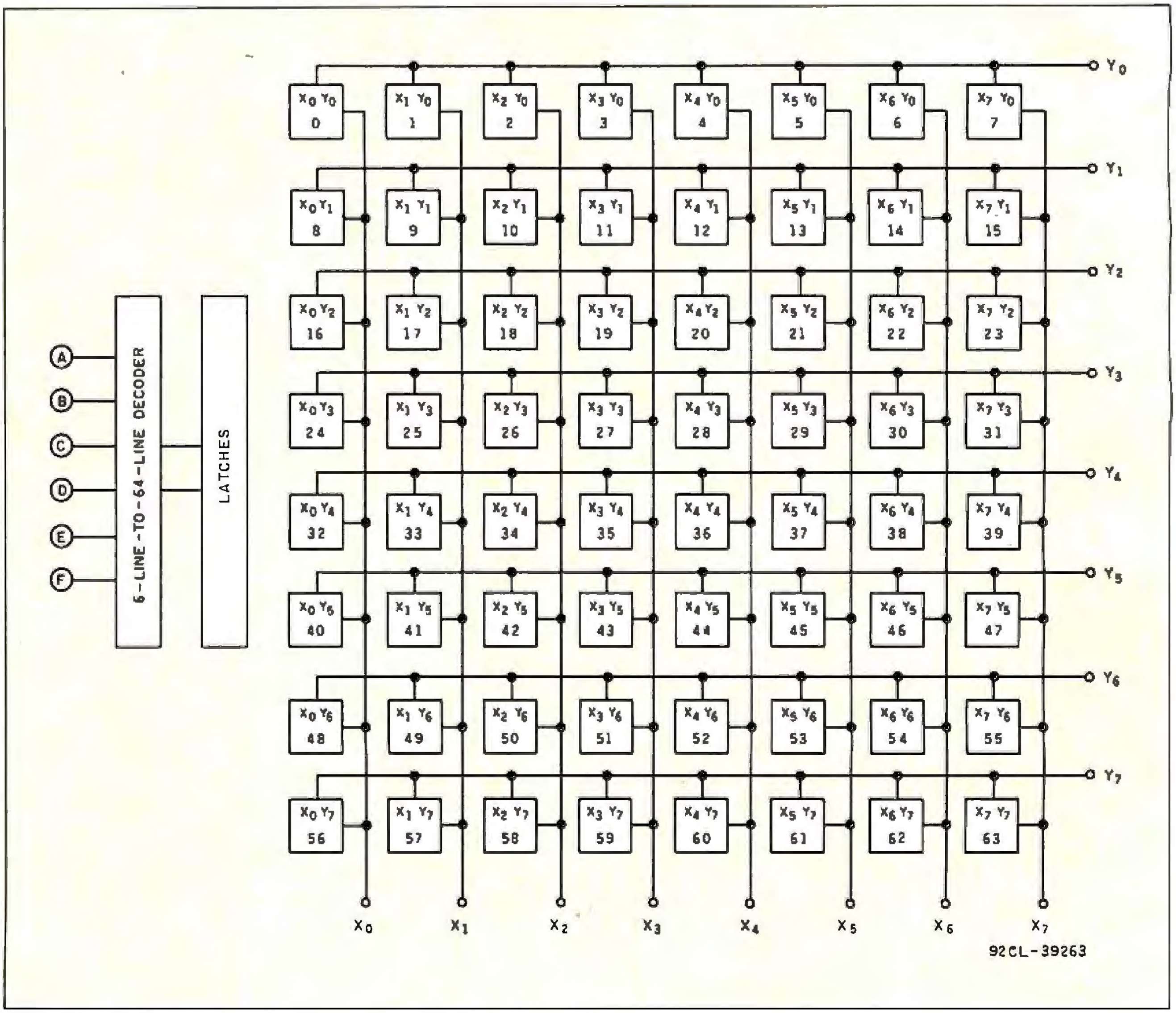

Figure 5a: *A block diagram of the* 74HC22106 8 *by* 8 *crosspoint-switch* IC.

long cables, we have to run only 4 coax and 8 shielded-conductor cables.

As is always the case, if it were this simple we'd all be doing it already. The stumbling blocks to this have been the expense of high-quality CMOS switches, the voluminous support circuitry necessary to physically build the crosspoint matrix, and lack of a reasonably priced intelligent local/remote control system.

CMOS switches like the CD4016 and 4066 are adequate for audio frequencies but don't have the bandwidth or transfer characteristics for high-quality video (you can use them if you don't mind some fuzziness). One switch that has all the right characteristics, however, is the Siliconix DG211 4-channel multiplexer (four separate SPST |single-pole single-throw| switches, just like the CD4066).

To give you an idea of present technology, figure 4 outlines the schematic of a typical 2 by 4 crosspoint switch (eight crosspoints) configured with two DG211s. One problem with this approach, however, is that DG211s (or CD4066s) are not latching switches and must have a constant signal applied to their control line if a switch is to stay closed. To facilitate this, a separate 8-bit latch is required with its outputs connected to the control inputs of the DG211s. The 8-bit latch in turn is loaded and controlled directly from a computer bus. Routing input #1 to output #3 (closing switch point 1,3) is simply a matter of loading 80 hexadecimal (128 decimal) into the latch.

This 2 by 4 matrix is not particularly difficult to build, since it requires only 3 ICs (integrated circuits). A 4 by 4 matrix, by comparison, would require 6 chips, and, unfortunately, the 8 by 8 configuration I want would take at least 12 chips. So much for present technology.

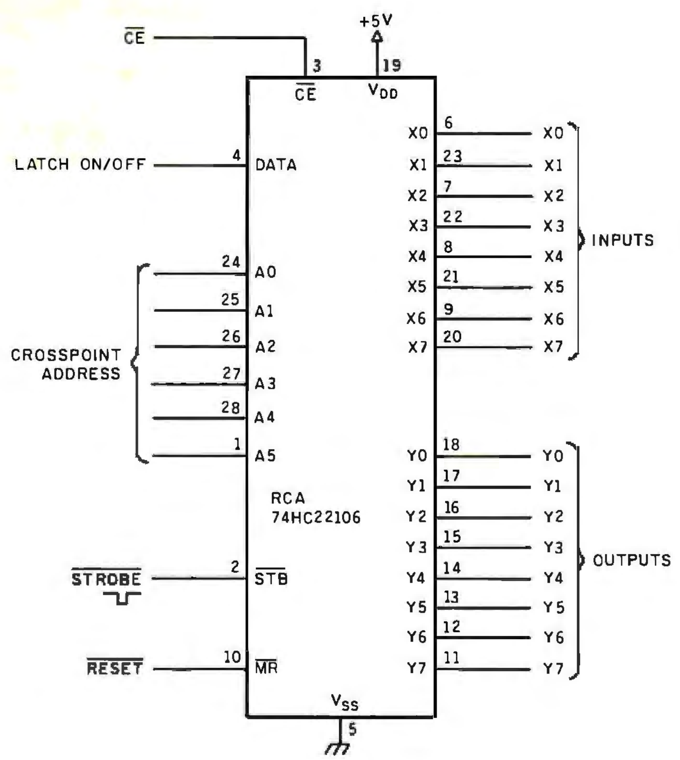

Figure 5b: A *pin-out diagram of the* 74HC22106.

THE RCA 74HC22106

Of course, I wouldn't be going through all this unless I planned on pulling something new out of the hat. RCA has just introduced a new chip called the 74HC22106. Shown in detail in figures 5a–5c, it is a full 8 by 8 crosspoint switch complete with addressable on-chip latches. Instead of using 12 ICs, we can configure a full 8 by 8 crosspoint multiplexer with a single chip!

The 74HC22106 uses silicon-gate CMOS technology that results in input-level compatibility with LSTTL (low-power Schottky transistor-transistor logic) yet the low power consumption typical of CMOS (it has 2- to 10-volt operation). At 5 V, typical switch resistance (Ron) is 95 ohms and bandwidth is 5 megahertz (9 MHz at 9 V). Operation of the 74HC22106 is straightforward. Each of the 64 crosspoint latch/switches can be uniquely addressed through six crosspoint address lines, A0–A5. If the transmission gate at that point is to be turned on, the $\overline{\text{STROBE}}$ input is pulsed to a logic low while chip enable $\overline{\text{CE}}$ is low and DATA is high. To turn off a transmission gate, the process is repeated with DATA low. $\overline{\text{RESET}}$ clears all the latches and opens all matrix crosspoints.

Using the 74HC22106, it is easy for me to implement the automated audio-video switching system described earlier. With a 5-MHz band-

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width, it is a natural for video signals, and 8 by 8 is perfect for all the sources I have. But what about audio?

Generally speaking, if the switch works well at high frequencies, it works better at low frequencies. And, being a true crosspoint switch, under program control it can be configured to look like a 4 by 4 by 2 for stereo inputs rather than an 8 by 8 orientation. Stereo signals connected to two adjacent inputs, inputs #2 and #3, for example, are switched as a pair to two adjacent outputs like #6 and #7. In actuality, the switch is still 8 by 8, but the software thinks of it as a 4 by 4 with two transmission-gate set points each time. Of course, you can selectively multiplex monaural and stereo signals as well as connect one monaural signal to both channels of a stereo amplifier.

The Circuit Cellar AVMUX

Figure 6 is the block diagram of the Circuit Cellar AVMUX. The same basic circuit is used for both audio and video. If used for video, the configuration is 8 by 8, and the input impedance-matching resistors are 150 ohms. When used for stereo audio, it becomes a 4 by 4 by 2 multiplexer with an input resistor of 10 kilohms (see photo 1).

One new item not previously described is an amplifier on each output. As I mentioned earlier, with a crosspoint switch it is possible to have all eight outputs coming from one input. By using separate amplifiers with high input impedances, this signal is not loaded down, and each destination monitor receives a clean, powerful level, even through 50 or 100 feet of coax. Figure 7a is the circuit of the video amplifier I used. It is an LM359 noninverting amplifier with a ×2 adjustable gain (more gain is needed for

FILE No. 1719 ——— CD54/74HC22106, CD54/74HCT22106

TRUTH TABLE

A_5	A_4	A_3	A_2	A_1	A_0	SWITCH SELECT	A_5	A_4	A_3	A_2	A_1	A_0	SWITCH SELECT
0	0	0	0	0	0	X_0 Y_0	1	0	0	0	0	0	X_0 Y_4
0	0	0	0	0	1	X_1 Y_0	1	0	0	0	0	1	X_1 Y_4
0	0	0	0	1	0	X_2 Y_0	1	0	0	0	1	0	X_2 Y_4
0	0	0	0	1	1	X_3 Y_0	1	0	0	0	1	1	X_3 Y_4
0	0	0	1	0	0	X_4 Y_0	1	0	0	1	0	0	X_4 Y_4
0	0	0	1	0	1	X_5 Y_0	1	0	0	1	0	1	X_5 Y_4
0	0	0	1	1	0	X_6 Y_0	1	0	0	1	1	0	X_6 Y_4
0	0	0	1	1	1	X_7 Y_0	1	0	0	1	1	1	X_7 Y_4
0	0	1	0	0	0	X_0 Y_1	1	0	1	0	0	0	X_0 Y_5
0	0	1	0	0	1	X_1 Y_1	1	0	1	0	0	1	X_1 Y_5
0	0	1	0	1	0	X_2 Y_1	1	0	1	0	1	0	X_2 Y_5
0	0	1	0	1	1	X_3 Y_1	1	0	1	0	1	1	X_3 Y_5
0	0	1	1	0	0	X_4 Y_1	1	0	1	1	0	0	X_4 Y_5
0	0	1	1	0	1	X_5 Y_1	1	0	1	1	0	1	X_5 Y_5
0	0	1	1	1	0	X_6 Y_1	1	0	1	1	1	0	X_6 Y_5
0	0	1	1	1	1	X_7 Y_1	1	0	1	1	1	1	X_7 Y_5
0	1	0	0	0	0	X_0 Y_2	1	1	0	0	0	0	X_0 Y_6
0	1	0	0	0	1	X_1 Y_2	1	1	0	0	0	1	X_1 Y_6
0	1	0	0	1	0	X_2 Y_2	1	1	0	0	1	0	X_2 Y_6
0	1	0	0	1	1	X_3 Y_2	1	1	0	0	1	1	X_3 Y_6
0	1	0	1	0	0	X_4 Y_2	1	1	0	1	0	0	X_4 Y_6
0	1	0	1	0	1	X_5 Y_2	1	1	0	1	0	1	X_5 Y_6
0	1	0	1	1	0	X_6 Y_2	1	1	0	1	1	0	X_6 Y_6
0	1	0	1	1	1	X_7 Y_2	1	1	0	1	1	1	X_7 Y_6
0	1	1	0	0	0	X_0 Y_3	1	1	1	0	0	0	X_0 Y_7
0	1	1	0	0	1	X_1 Y_3	1	1	1	0	0	1	X_1 Y_7
0	1	1	0	1	0	X_2 Y_3	1	1	1	0	1	0	X_2 Y_7
0	1	1	0	1	1	X_3 Y_3	1	1	1	0	1	1	X_3 Y_7
0	1	1	1	0	0	X_4 Y_3	1	1	1	1	0	0	X_4 Y_7
0	1	1	1	0	1	X_5 Y_3	1	1	1	1	0	1	X_5 Y_7
0	1	1	1	1	0	X_6 Y_3	1	1	1	1	1	0	X_6 Y_7
0	1	1	1	1	1	X_7 Y_3	1	1	1	1	1	1	X_7 Y_7

Figure 5c: *The switch-selection table for the 74HC22106. The selected switch is opened or closed based on the state of the* DATA *input line (see figure 5b).*

longer cables). It is designed primarily for impedance matching rather than pure voltage gain. As such, it will be most often set as a ×1 buffer. Power required is +12 V.

The audio amplifiers shown in figure 7b are considerably less complicated and consist merely of noninverting high-impedance ×1 buffers. This is acceptable because the inputs they will be connected to are themselves gain-adjustable, and it is unnecessary to provide it twice. Power required is ±12 V.

Figure 8 is the schematic of the switching-and-amplification portion of the Circuit Cellar AVMUX (only 8 chips are needed for both crosspoint switches and all the amplifiers). Figure 9 is the microcomputer interface that controls everything. I haven't mentioned it up to this point. I felt doing so would muddy the water since it is needed more to coordinate the bells and whistles (like seven-segment LEDs [light-emitting diodes] and a video presentation of the chosen crosspoints on a BCC-22 Term-Mite smart-terminal board—all I needed was another video source!) than to control the multiplexers themselves.

A computer is really only required to set or reset the gates in the crosspoint matrices. While I intend to dedicate one of my BCC-52 BASIC controllers to the task, we shouldn't have to have a video monitor to know what channel is going where. I will presume we already know the sources of the inputs and that they can't change unless we physically move the wires. Only an output's source is in question.

To solve this dilemma, I added a seven-segment LED at each output connector. If input #2 is channeled to output #7, the LED at #7 would dis-

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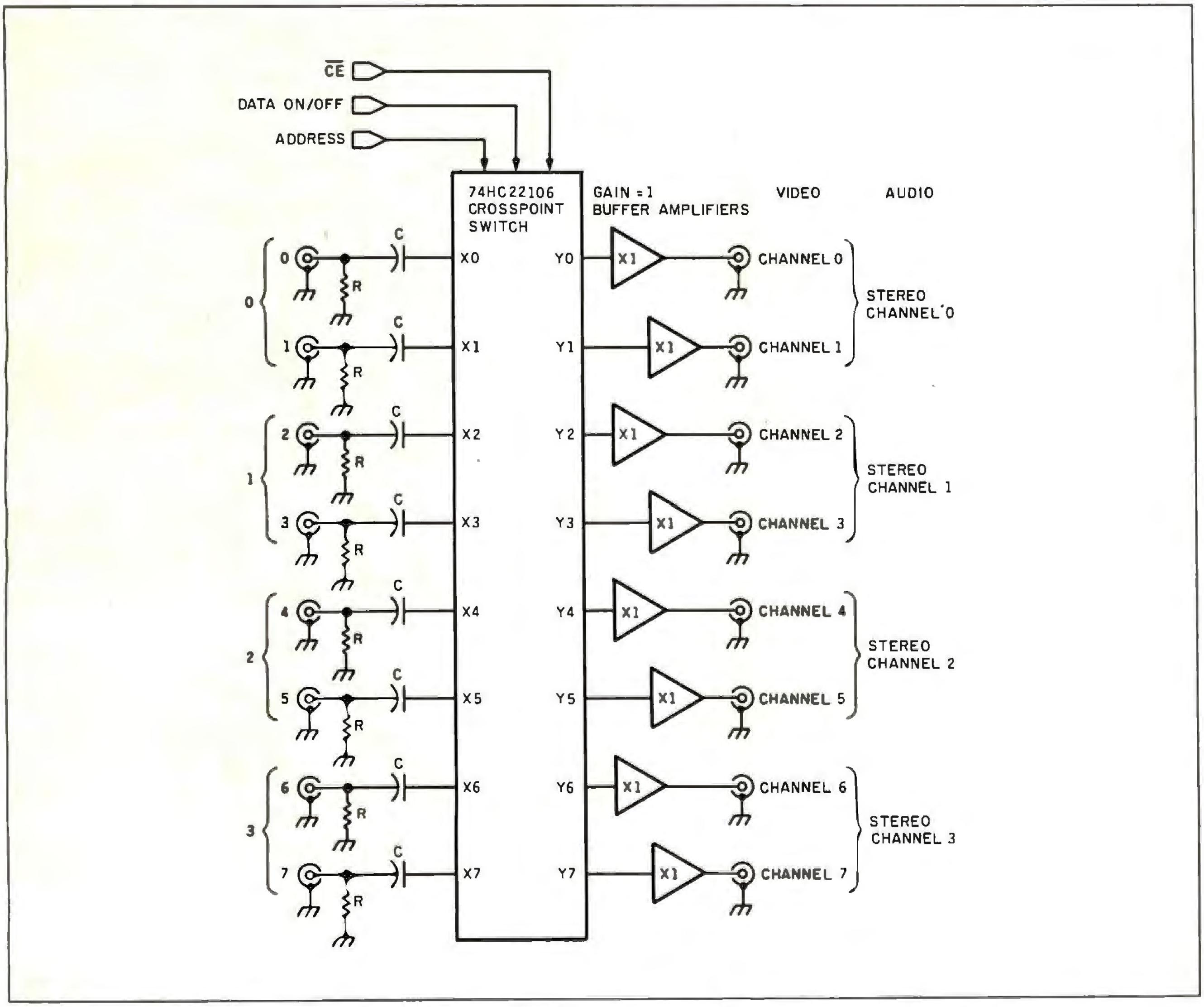


Figure 6: *A block diagram of the Circuit Cellar AVMUX. This same basic circuit works for both audio and video signals. Details of the support components (buffers, capacitors, etc.) vary accordingly.*

play the number 2. Similarly, if #6 goes to #1, the LED at #1 would indicate a 6. If no output is programmed, the LED is off. Unfortunately, the LED displays involve more circuitry than the crosspoint switches, but I thought they were necessary.

To limit the number of components, I did take some poetic license in the design of the LED driver (or non-driver), however. As shown in figure 10, each LED is connected to an 8-bit latch. Rather than use a 4-bit BCD (binary-coded decimal)-to-decimal decoder driver connected to a latch, I directly drive the LED with the segment data in the latch. For example, to display the number 1, we have to light segments B and C. This is accomplished by loading 06 hexadecimal (6 decimal) in the latch. The complete list of displayed numbers and their corresponding values is given in table 1.

One caution. This is not the most foolproof-engineered LED driver circuit. I used it only because I was getting tired of wiring. For it to be successful, the current supplied to the LED should be within the operating limits of the 74LS374 latch, and total package power dissipation should not be exceeded. By using high-efficiency LEDs, bright displays are obtained with only 5 milliamperes per segment. While the schematic shows inexpensive MAN74A LEDs, I used MAN3640A LEDs that barely heat the LS374 and are very bright (both will work, but giving part numbers that no one will ever find on schematics is counterproductive).

The AVMUX connects to a computer through a bus of sorts. Two of the three on-board parallel ports from a BCC-52 BASIC computer/controller (August 1985, page 104) synthesize an address/data-and-control bus (see figure 9). Port A is the address/data bus; port B is the control bus. To connect video input #2 to output #5, merely set the transmission-gate number of the 74HC22106 on port A with its MSB (most significant bit) set high for ON, set bit 6 of port B high to enable the video crosspoint-switches' $\overline{CE}$, and make a high-low-high transition on the MSB of port B. To reset (turn off) the #2-to-#5 connection, the sequence is repeated with the MSB of port A set low. The transmission-gate number of input #2 and output #5 is simply calculated as

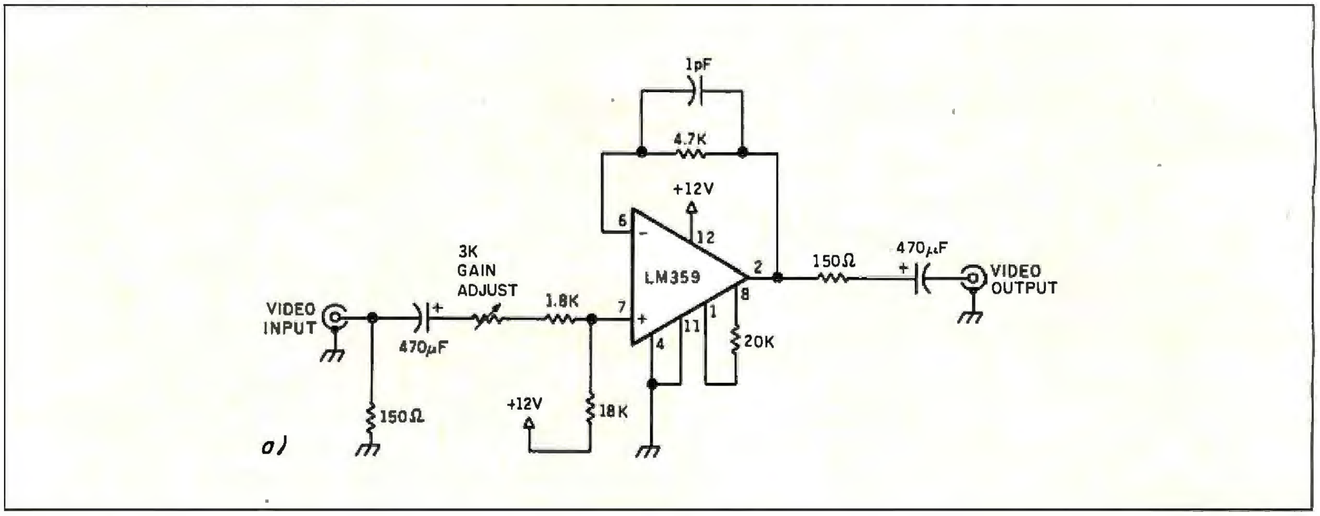


Figure 7a: A *schematic of the amplifier circuit used in the* AVMUX's *video-output stage.*

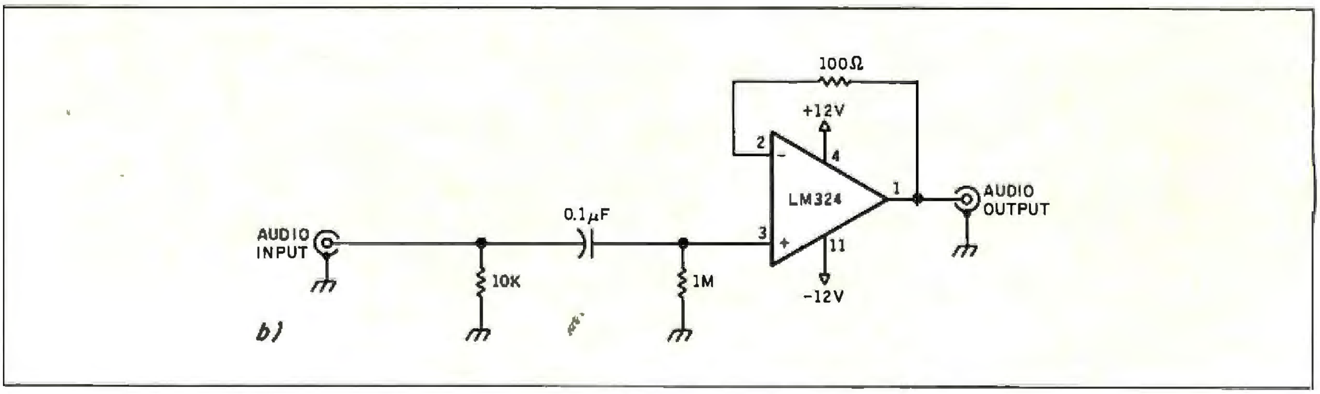


Figure 7b: A *schematic diagram of the amplifier circuit used in the* AVMUX's *audio-output stage.*

(out*8)+in or (5*8)+2, which is gate 42 on the 74HC22106.

Audio set points are calculated and passed by a similar sequence. The only difference is that the audio multiplexer is enabled by bit 5 instead of bit 6 on port B. For stereo channels, two gates would be closed.

Once the crosspoint switches are set, the appropriate segment data must be latched to LEDs. The 12 LEDs (8 video and 4 audio) are controlled through a 4- to 16-line 74LS154 decoder chip. With the segment data as described above set on port A, and the 1–12 address code (they are physically connected as LED1–LED12 rather than 0–11 so as not to accidentally enable an LED at address 0) set on the 4 least significant bits of port B, to latch the segment data into the addressed register, you toggle bit 4 on port B low then high again. Listings 1 and 2 are simple BASIC-52 programs that exercise the AVMUX.

The AVMUX can be remotely or locally controlled. Since the controller is a BCC-52 computer, we are not talking dumb. Even with its connections to the AVMUX, the BCC-52 still has a serial I/O (input/output) port and another parallel port. Multiplexer control information can be transmitted to it serially from the other side of the house (or country) or through a small keypad connected to the extra parallel port. If we use a hexadecimal keyboard-encoder chip, we not only can have multiple keypads but are left with a few extra bits that could be connected to direct outputs from the HCS.

The HCS, sensing a particular series of events, like walking from one room to another, could then direct the BCC-52 to execute a preprogrammed event sequence. The typical action might simply be to switch the stereo into the room I entered. Fortunately, now that I have an operational AVMUX, HCS, and BCC-52, such thoughts are becoming closer to reality. (See photo 2.)

In Conclusion

Since the BCC-52 is versatile enough that software slowpokes like me can easily program it in BASIC, I'm well on my way to the automated audio-video switching system I wanted. As it stands, I may have to build another AVMUX because the present one is already full, with the satellite receiver, two VCRs, the laser disk, projection television, two outside cameras, HCS, and the AVMUX itself.

(continued)

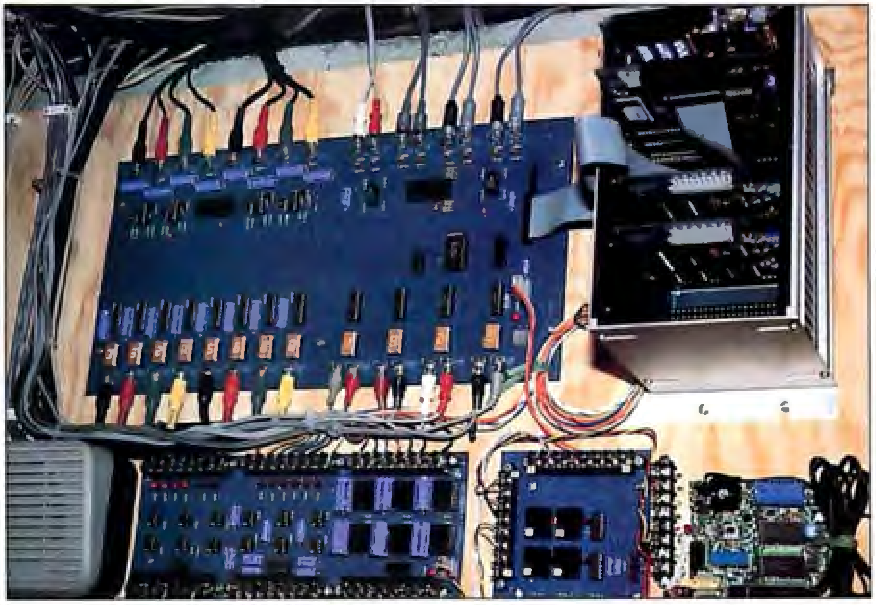


Photo 2: *The finished* AVMUX *joins the* HCS *in the Circuit Cellar storage area. The card cage to the right contains the* BCC-52, *a Term-Mite video-display board, and a couple of analog-to-digital converter boards.*

Photo 3: *Using the* BCC-52 *and a video-display controller, a display of the* AVMUX's *configuration by location and source is easier to read than* LEDs.

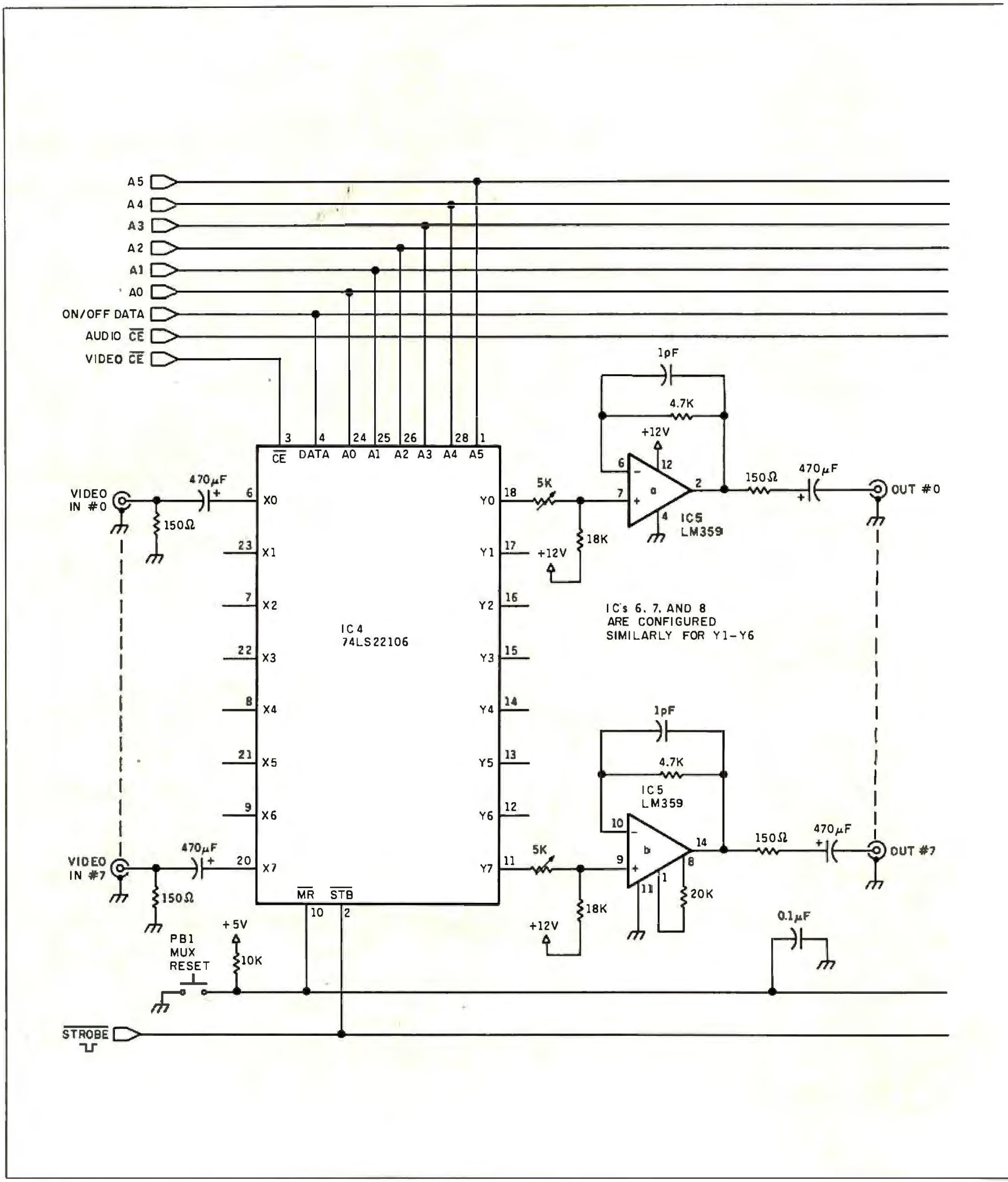
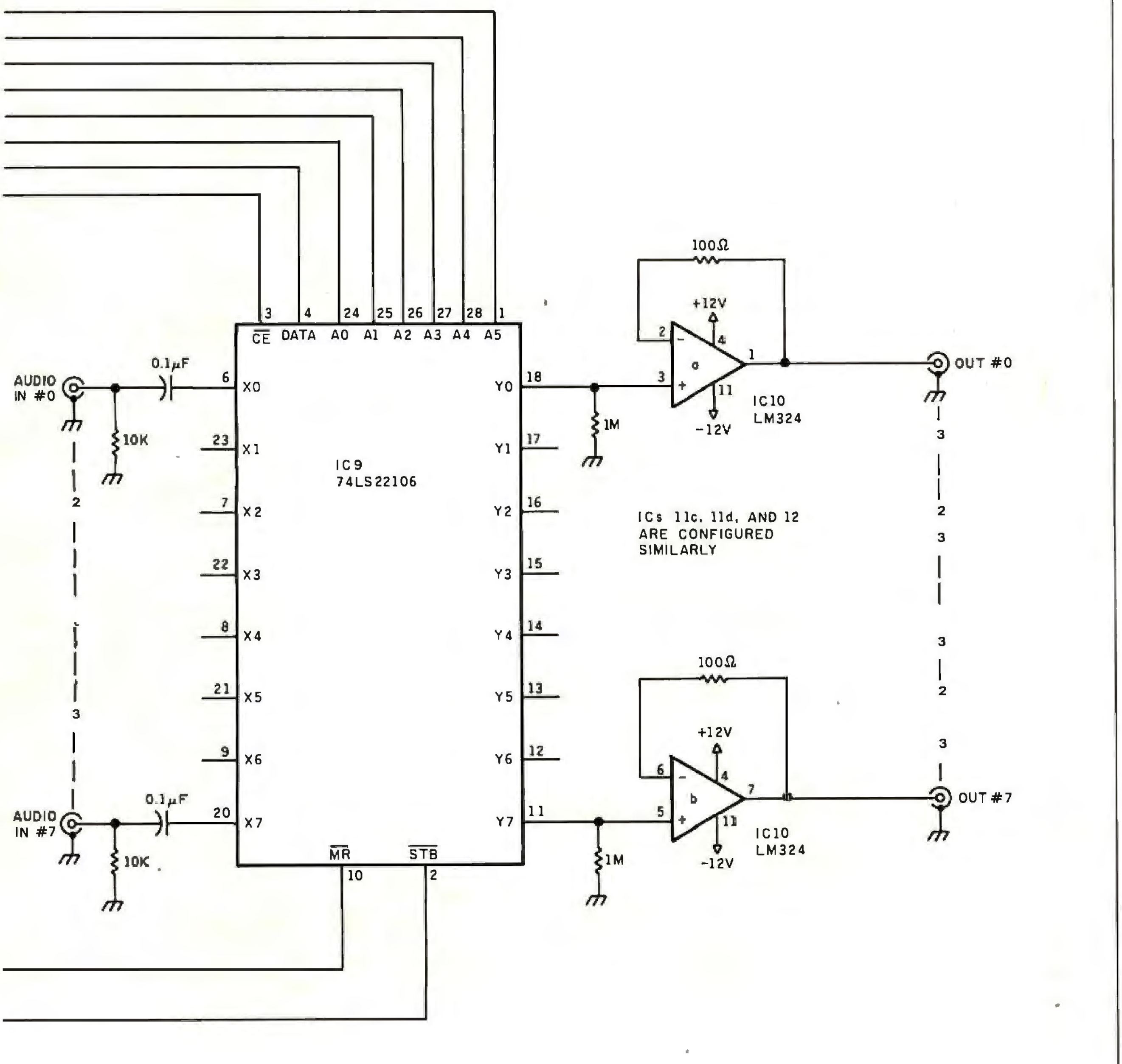


Figure 8: A *circuit diagram of the switching-and-amplification portion of the* AVMUX.


AUDIO IN #0
0.1μF
10K
AUDIO IN #7
0.1μF
10K
IC9
74LS22106
CE DATA A0 A1 A2 A3 A4 A5
X0 X1 X2 X3 X4 X5 X6 X7
Y0 Y1 Y2 Y3 Y4 Y5 Y6 Y7
MR STB
1M
100Ω
+12V
-12V
IC10
LM324
ICs 11c, 11d, AND 12
ARE CONFIGURED
SIMILARLY
OUT #0
OUT #7

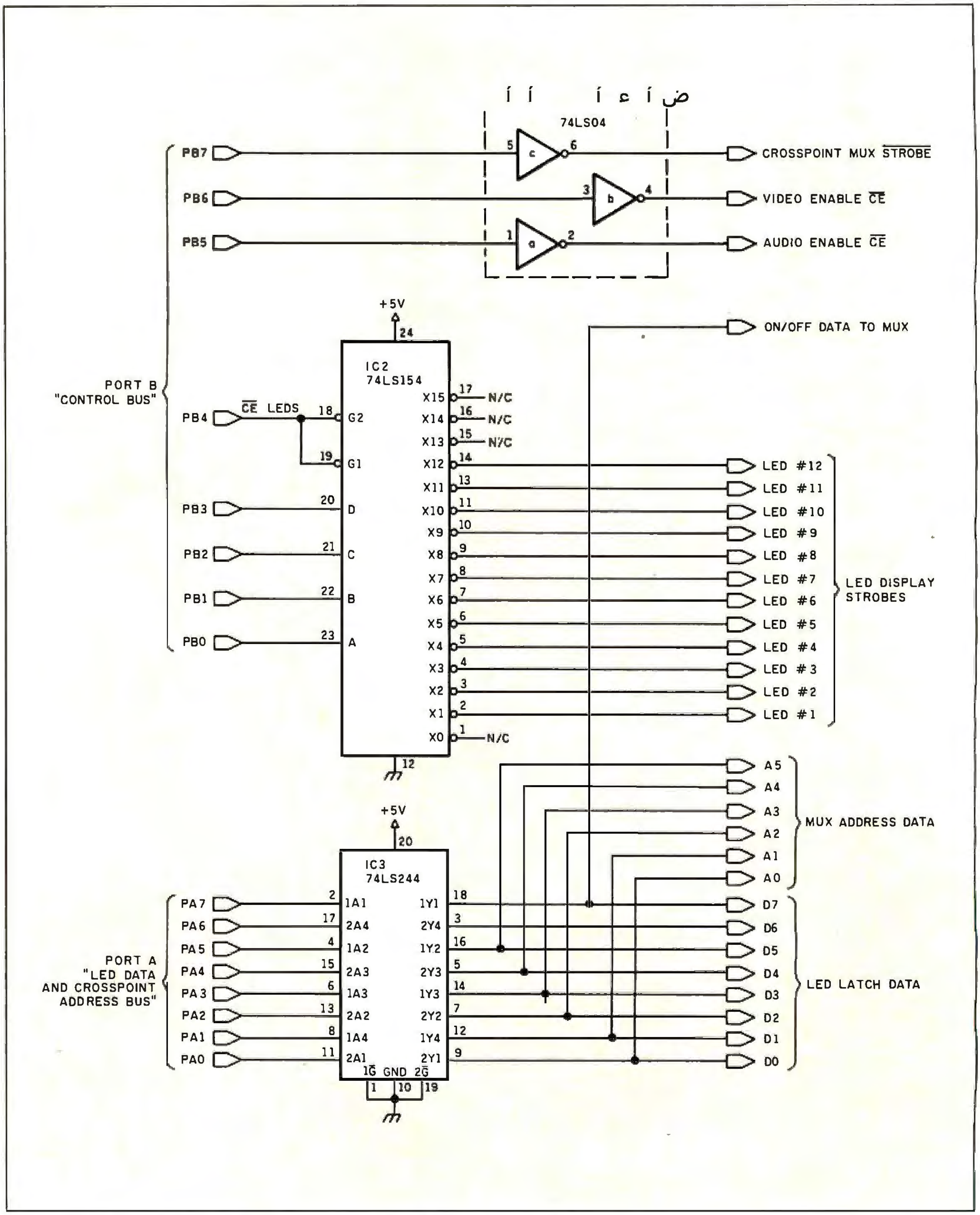


Figure 9: *A circuit diagram of the microcomputer interface for the* AVMUX.

Listing 1: A *simple* BASIC-52 *program to exercise the* AVMUX.

```
80    REM  PROGRAM TO SPECIFY DIRECT INPUT/OUTPUT AUDIO CHANNEL
85    REM  INPUT AS IN#,OUT#,I/O ON/OFF —— AUDIO 0-7 CHANNELS
90    INPUT A,B,C
95    IF C=1 THEN Q=128
100   P1=51200 : P2=51201 : P3=51202 : P4=51203
110   XBY(P4)=137 : REM  SET A&B AS OUTPUT AND C AS INPUT
115   REM  PORT A IS ADDRESS AND PORT B IS CONTROL BUS
117   XBY(P2)=32
120   S=(B*8)+A : REM  CALCULATE MUX SWITCH NUMBER
122   PRINT S,Q
125   XBY(P1)=S+Q : REM  SET ADDRESS AND ON/OFF BIT
135   XBY(P2)=32 : XBY(P2)=160 : XBY(P2)=32
150   GOTO 90
```

Table 1: *The values loaded into the 8-bit latch to produce a given number on the* LED *display.*

Display	Latch Value in Decimal
0	63
1	6
2	91
3	79
4	102
5	109
6	124
7	7
8	127
9	103
OFF	0

Listing 2: *Another program like the one in listing* 1.

```
80    REM  PROGRAM TO SPECIFY DIRECT INPUT/OUTPUT VIDEO CHANNEL
85    REM  INPUT AS IN#,OUT#,I/O ON/OFF —— VIDEO 0-7 CHANNELS
90    INPUT A,B,C
95    IF C=1 THEN C=128
100   P1=51200 : P2=51201 : P3=51202 : P4=51203
110   XBY(P4)=137 : REM  SET A&B AS OUTPUT AND C AS INPUT
115   REM  PORT A IS ADDRESS AND PORT B IS CONTROL BUS
117   XBY(P2)=64
120   S=(B*8)+A : REM  CALCULATE MUX SWITCH NUMBER
125   XBY(P1)=S+C : REM  SET CHANNEL ADDRESS AND ON/OFF BIT
135   XBY(P2)=64 : XBY(P2)=192 : XBY(P2)=64
150   GOTO 90
```

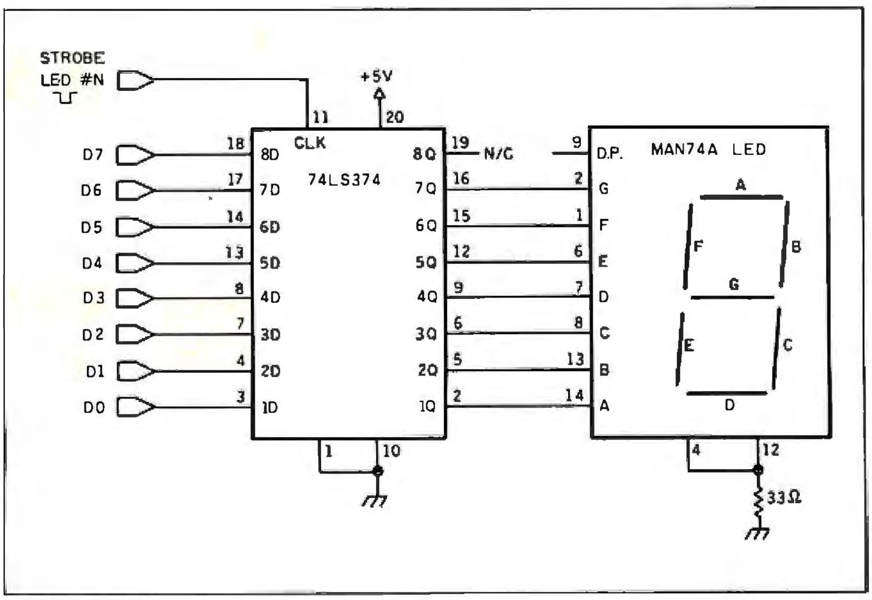


Figure 10: A *diagram of one of the* AVMUX's LED *circuits. There is one of these for each of the output lines (eight video and four stereo audio).*

After wiring up all those blasted LEDs for a local display, I wondered how I was going to see the results of crosspoint entries made via one of the remote-entry keypads. The obvious solution was to attach a BCC-22 Term-Mite 80-character by 24-line smart-terminal board (January and February 1984) to the BCC-52's serial port. As the controller makes decisions and transmission-gate changes, it displays them on the terminal board in the form of a matrix or chart that is easily read. The video output of the BCC-22 board is then connected to one of the eight inputs of the video crosspoint switch. With the BCC-52 programmed to accept a specific key press as a default command, the AVMUX display could then be directed to any or all video monitors while remote programming is in process. (See photo 3.)

Circuit Cellar Feedback

This month's feedback is on page 346.

Next Month

I'll build a real-time clock. ■

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, POB 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.

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Inquiry 259

ILLUSTRATED BY PAUL MOCK

A SIMPL COMPILER PART 3: EXTENSIONS

BY JONATHAN AMSTERDAM

Designing extensions that don't interact in harmful ways

Last month, I talked about how to implement procedures and functions for SIMPL—the high-level language whose compiler I have been describing in these pages. This month, I will discuss how to handle user-defined types, arrays, strings, Ada-style parameter modes, and open-array parameters. Although these extensions do not pose terribly challenging implementation problems, designing features so that they don't interact in harmful and unexpected ways can be difficult. I hope that my explanations of the design choices involved will give you a better understanding of existing progr mming languages and will help you design your own.

USER-DEFINED TYPES

SIMPL has three built-in types: INTEGER, CHAR, and BOOLEAN. Until now, the programmer had no way to construct other types. The modifications I've made permit the programmer to construct new types and name them. I'll discuss the naming apparatus first.

The syntax for type declarations is shown in figure 1a. It is identical to Pascal's. The type-declaration section begins with the keyword TYPE and consists of declarations of the form identifier = type. After a type name is declared, it can be used in further declarations of types or variables.

The ability to name types raises some important questions: When are two types considered equal? What operations are permitted on new types? For example, consider the declaration TYPE T = INTEGER. To what extent can variables of type T be treated as integers? Can we add or compare them to each other or to integers?

One solution is to treat T as identical to INTEGER; in this case, a type declaration like the one above serves merely as documentation. A second solution is to consider T a completely different type. Although T variables could be assigned to and tested for equality with each other (since these operations can be defined for variables of any type), integers could not be assigned to or compared with them, nor would operations defined for other types be defined for type T variables. This would render declarations like the above utterly useless unless some sort of coercion function were provided to convert values of type T to type INTEGER. Modula-2's solution of using the type name as the coercion function lets you add two variables *x* and *y* of type T by

(continued)

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writing INTEGER(x) + INTEGER(y) and to assign an integer value to a T variable by writing x := T(3).

My solution falls in between the two just outlined. It is based on the idea that what is meant by a declaration like TYPE T = INTEGER is that values of type T behave like integers but are logically distinct from them. Any operation that can be done on integers is valid on values of type T, but you must use a coercion function to mix types. So the addition above could be written simply as x + y, but the assignment would have to remain as y := T(3).

Compiling with User-Defined Types

Several modifications have to be made in the current SIMPL compiler to handle user-defined types. Most important, the way the compiler represents types must be changed. The current compiler uses three values to represent the three possible types: INTEGER, CHAR, and BOOLEAN. These values are defined by using a Modula-2 enumerated type: TYPE typeType = (tInteger, tChar, tBoolean). (This is probably one of the more confusing statements in the compiler. It defines a Modula-2 type used by the compiler to represent SIMPL types.) This scheme won't do now that users can define their own types, because it's not possible to add to this list of values when the compiler is running. Instead, it makes more sense to put types into the symbol table along with other declarations. SIMPL's three built-in types are inserted into the symbol table when the compiler is initialized. These special symbol-table entries, which I'll call type objects, uniquely identify the types used in the program. The symbol-table entries of variables and functions contain a pointer to the appropriate type object instead of containing a type value of tInteger, tChar, or tBoolean. Two variables are of the same type if and only if they point to the same type object.

What information should a type object contain? The type's name is essential for looking it up in the symbol table. Types can be defined as local to routines, so the lexical level at which the definition occurred is also important. (INTEGER, CHAR, and BOOLEAN can be considered to be at lexical level 0.) The type's size—that is, the amount of storage in VM2 words occupied by a variable of that type—will prove useful. Finally, all user-defined types must contain a pointer to the base type, the type they were defined in terms of. After compilation of the declaration TYPE T = INTEGER, the type object for T points to the type object for INTEGER as its base type.

Some straightforward changes must be made to the parser to handle type declarations. The declarations themselves must be parsed and should result in the creation of new type objects. When a type name is parsed during a variable or function declaration, the corresponding type object must be looked up in the symbol table and a pointer to it inserted in the variable's or function's symbol-table entry. The parsing of function calls has to be changed so that coercion functions are recognized: If the name of the function being called is actually a type name, the argument expression is parsed as usual, but its type is changed to that of the function name if the two types are compatible (i.e., the same size).

The final changes required to implement user-defined types occur in the compiler's type-checking module; it is here that the type-equivalence rules I described above are actually put into practice. To determine whether two types are the same, the type checker compares the type objects to see if they are the same object. It needs to make this sameness test for operands of every binary operation, including Boolean and relational operators, and for assignment as well.

For testing of equality or inequality and for assignment, it is sufficient that

```
(a)
types       ::= TYPE  typeList
typeList    ::= typeDecl |  typeDecl typeList
typeDecl    ::= typeName = type ;
typeName    ::= id

(b)
type        ::= INTEGER | CHAR | BOOLEAN | typeName |
                  ARRAY [ bounds ] OF type
bounds      ::= integer .. integer
idOrIndex   ::= id  |  idOrIndex [ expr ]
assignStmt  ::= idOrIndex := expr
factor      ::= ... | idOrIndex

(c)
bounds      ::= integer .. integer  |  integer .. integer , bounds
idOrIndex   ::= id | idOrIndex [ exprList ]
exprList    ::= expr | expr , exprList

(d)
formals     ::= ( formList )
formList    ::= formDecl | formDecl ; formList
formDecl    ::= modes idList : formType
modes       ::= empty | IN  |  OUT  |  IN OUT
idList      ::= id  |  id , idList
formType    ::= typeName  |  ARRAY OF typeName
```

Figure 1: *The syntax of some extensions to* SIMPL: (*a*) *types,* (*b*) *arrays,* (*c*) *syntactic sugar for arrays, and* (*d*) *formal declarations. The* | *means an "or." An ellipsis indicates that other parts of the rule are omitted.*

the two types be the same. All other operations have the additional requirement that the operands be appropriate to the operation. For example, the arithmetic operators are defined only for integers; the Boolean operators AND, OR, and NOT for Boolean values only; and the WRITE and READ statements can be used only with integers or characters. The type checker uses a type's base type to determine if the type is appropriate to an operation. To find the base type, the type checker follows the type field of the type object until it reaches one of the built-in types. The type checker may have to follow more than one pointer because types can be declared in terms of one another to arbitrary depth, as the following declarations illustrate:

```
TYPE
    T = INTEGER;
    U = T;
    V = U;
```

The type-naming facility I've described doesn't let you do any more than rename existing types. This ability can still be useful; for instance, if you are programming a banking system, you may want to have dollar values that behave like integers but cannot be indiscriminately combined with integers. Still, it would be nice to be able to create completely new types out of the built-in ones. Types like arrays, for example.

Listing 1: *The Sieve of Eratosthenes benchmark coded in* SIMPL *as an illustration of the use of* SIMPL *arrays.*

```
PROGRAM sieve;
{ Sieve of Eratosthenes program for computing prime numbers. }

VAR flags: ARRAY[0..500] OF BOOLEAN;
    count, k, prime, iter, i:INTEGER;

BEGIN
    iter := 1;
    WHILE iter <= 3 DO
        count := 0;
        i := 0;
        WHILE i <= 500 DO
            flags[i] := TRUE;
            i := i + 1;
        END;
        i := 0;
        WHILE i <= 500 DO
            IF flags[i] THEN
                prime := i + i + 3;
                k := i + prime;
                WHILE k <= 500 DO
                    flags[k] := FALSE;
                    k := k + prime;
                END;
                count := count + 1;
                WRITE(prime); WRITE('\n');
            END;
            i := i + 1;
        END;
        WRITE(count); WRITE('\n'); WRITE('\n');
        iter := iter + 1;
    END;
END.
```

ARRAYS

Absolutely essential for most programming jobs is some sort of aggregate data structure, like an array or a list. I have extended SIMPL to include arrays of arbitrary dimension. The array indices must be integers, and the bounds of the array must be known at compile time. SIMPL arrays are identical to Pascal arrays, except that Pascal permits arrays to have indices that range over any scalar type except reals. The syntax for SIMPL arrays is presented in figure 1b, and listing 1 shows the Sieve of Eratosthenes benchmark coded in SIMPL as an example of the use of arrays. [*Editor's note: The Modula-2 source code for the listings in this article is available from* BYTE*net Listings at* (617) 861-9764.] As in Pascal, SIMPL functions cannot return arrays.

IMPLEMENTATION OF ARRAYS

Although a SIMPL array can have any number of dimensions, I'll begin by considering the implementation of one-dimensional arrays. A one-dimensional array is stored as a contiguous sequence of memory locations. The starting address of the array is the address of its first element. If the array's lower bound is zero, accessing an array element is done by multiplying the element's index by the size of the element (that is, the number of VM2 words it occupies) and adding the result to the starting address. If the array's lower bound is other than zero, it must be subtracted from the index before doing the multiplication.

I've packaged all this computation in a new VM2 instruction, AREF, which takes as an argument the size of an array element (measured in VM2 words). It expects four words on the stack, starting at the top: the index, the upper bound, the lower bound, and the starting address of the array. AREF removes the four items from the stack and checks that the index is between the upper and lower bounds, signaling an error if it isn't. It then carries out the index calculation by subtracting the lower bound from the index, multiplying the result by the element size, and adding in the

(continued)

starting address. The resulting value—the address of the desired array element—is then pushed onto the stack.

COMPILING ONE-DIMENSIONAL ARRAYS

Array types can be named in the type-declaration section of a program:

TYPE alpha = ARRAY[1..10] OF CHAR;

or can be used directly in a variable declaration:

VAR beta:ARRAY[1..10] OF CHAR;

In both cases, the compiler creates a type object when it sees the declaration. In the first case, the type object has a name; in the second case, it is anonymous. The base type of an array is the type of the array's elements; in both cases above, it would be CHAR. The size of the array is the product of the size of its base type (that is, the number of words occupied by a variable of that type) and the number of elements in the array. The type object for an array also holds the array's upper and lower bounds.

When anonymous declarations like the one above are permitted, the issue of type equivalence again rears its ugly head. As I will describe below, arrays can be assigned to one another and passed as arguments. The types involved must be compatible for these operations to be legal. Is the variable beta compatible with variables declared to be of type alpha? Proponents of so-called structure equivalence hold that it should be, since both types have the same structure: a one-dimensional array of 10 characters. Those, like myself, who favor the policy known as name equivalence believe that two types are distinct unless they have the same name or, more precisely, refer to the same type object. Since two different type objects are involved in the above declarations, the types are distinct. In the following declarations:

VAR *a*, *b*: ARRAY[1..10] OF CHAR;
c: ARRAY[1..10] OF CHAR;

a and *b* share the same type object, so they are compatible, but *c* is compatible with neither *a* nor *b*.

When an array declaration is parsed, the compiler has to generate code to allocate space for the array at run time. For globally declared arrays, the compiler outputs the variable name as a label, followed by a BLOCK directive with the number of words required for the array. For example, since the array named *c* above occupies 10 VM2 words, the assembler code generated for it would be *c*: .BLOCK 10.

When an array is declared local to a routine, the compiler must arrange for its storage to be allocated when the routine is called. The obvious place for the array is on the stack with the other local variables. You may recall that I allocate space for a local variable on the stack with a PUSHC 0 instruction. Allocating an array in this way would be quite inefficient because it would take as many PUSHC instructions as there are words in the array. Instead, I will introduce a new VM2 instruction, SETSP (for set stack pointer), that takes an integer argument that it uses to decrement the stack pointer. Now, a 20-word space on the stack can be allocated with the instruction SETSP 20.

You can use array elements either in an expression or on the left-hand side of an assignment statement. Both occur in the statement *a*[*i*]: = *a*[*i* + 1]. In both cases, the code generator begins by producing code to push the array's starting address and its bounds. It then generates the code to compute the index. An AREF instruction, which will put the array element's address onto the stack, is then output. At this point, the code for the two cases differs. When an array element appears in an expression, a CONTENTS instruction is generated to retrieve its value. When the array element appears on the left-hand side of an assignment statement, a POP statement is generated to pop the second word on the stack into the address on top of the stack.

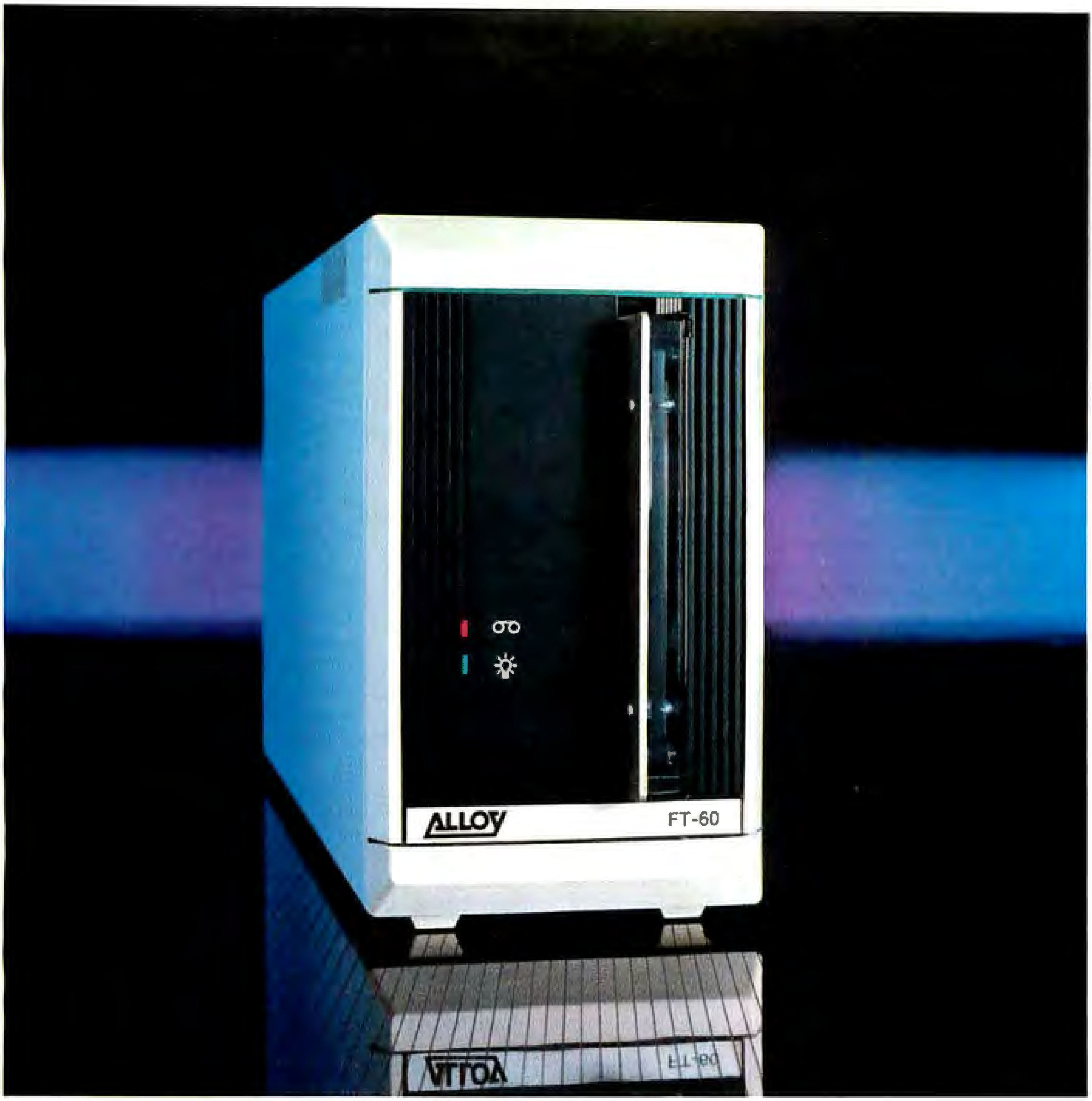
For global arrays, the variable name is used to label the beginning of the array in the compiler's assembly-language output, so the name serves as the array's starting address; if the array *a* were declared globally as ARRAY[1..10] OF INTEGER, the code for *a*[*i*] : = *a*[*i* + 1] would be as shown in listing 2.

If *a* were declared locally to a routine, the compiler couldn't use the array name to get its starting address because local arrays are allocated on the stack at run time. Instead, the compiler uses another new instruction, ADDRL (address of local), to compute the starting address of the array. Given a difference in lexical levels and a local variable's frame-pointer offset as arguments, ADDRL

(continued)

Listing 2: *Code generated for the statement* *a*[*i*] : = *a*[*i* + 1], *where a is defined as an* ARRAY[1..10] OF INTEGER.

```
PUSHC    a     ; starting address
PUSHC    1     ; lower bound
PUSHC    10    ; upper bound
PUSH     i     ; compute index
PUSHC    1
ADD
AREF     1     ; compute address of a[i+1]
CONTENTS       ; get the contents of a[i+1]
PUSHC    a     ; starting address
PUSHC    1     ; lower bound
PUSHC    10    ; upper bound
PUSH     i     ; index
AREF     1     ; compute address of a[i]
POP            ; put a[i+1] into a[i]
```



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You can copy whole arrays with a single assignment statement.

calculates the address of the local and puts it onto the stack. It computes the address just as PUSHL and POPL do: by following the static-pointer chain for a number of times equal to the lexical-level difference and then adding the offset to the resulting frame-pointer value. If array *a* were declared locally, each of the two PUSHC *a* instructions in listing 2 would be replaced by an ADDRL instruction.

An array name can be used in only two places in the program to stand for the entire array: in an assignment statement and as an argument to a routine. In all other cases, the array must be accessed element by element.

It is possible to copy whole arrays with a single assignment statement. If the statement *a* := *b* occurs, and *a* and *b* are arrays of the same type, the compiler generates code to copy all the elements of *b* into *a*. I will once again add a VM2 instruction, COPY, to do this. COPY is actually a very general instruction. It expects the top of the stack to contain the number of words to be moved, the next value on the stack to be the destination address, and the third stack value to be the source address. It copies the specified number of words from source to destination. Since the SIMPL compiler needs to move only nonoverlapping areas of memory, COPY does not check for or correctly handle overlapping regions.

An entire array can be passed as an argument to a routine if the types of the argument and the routine's formal parameter are the same. Because of the way I defined type equality above, you can't declare a formal parameter like

PROCEDURE P(*a*:ARRAY[1..10] OF INTEGER);

because the array declaration results in the creation of a new type object, so no variable has the same type as *a*. Since the types of corresponding formal and actual parameters must be identical, it would be impossible to make a legal call to procedure P. You have to use a type name to declare the formal, *a*:

TYPE intArray = ARRAY[1..10] OF INTEGER;
PROCEDURE P(*a*:intArray);

Now, any variable of type intArray can be passed to procedure P.

This is an interesting demonstration of how seemingly separate features can interact. My definition of type equality, the ability to pass arrays as parameters to routines, and the ability to name types are three separate aspects of the language, but you can't have the first two without the third.

MULTIDIMENSIONAL ARRAYS

It may seem that, with only one-dimensional arrays covered, there is much yet to be done to handle the general case of arrays of many dimensions. Somewhat remarkably, all the array machinery I've been discussing will work just fine with arrays of more than one dimension. A look at the array syntax in figure 1b shows it is possible to declare a two-dimensional array of characters by writing

VAR window: ARRAY[1..10] OF ARRAY [1..10] OF CHAR;

since ARRAY[1..10] OF CHAR is a valid type declaration and can appear after the OF. The array syntax lets you access array elements by writing the indices one after the other, each enclosed in square brackets, like window[3][4]. It remains only to add some syntactic sugar to sweeten the pill of having to write arrays of arrays of arrays. . . My compiler accepts the usual syntax for multidimensional arrays, as shown in figure 1c, but the parser just treats it as an abbreviation for the above syntax. For instance, the array window could be defined by VAR window: ARRAY[1..10,1..10] OF CHAR and accessed with window[3, 4]. It's always a joy to discover that what appeared at first to be a new and complex feature is nothing more than a syntactic variant of what you already have.

STRINGS

With arrays in place, you can implement character strings as arrays of characters. It's a straightforward matter to write routines to read and write strings from the terminal, and you can embed strings within your program by assigning one character at a time to an array:

s[1] := 't'; *s*[2] := 'e'; *s*[3] := 'd';
s[4] := 'i'; *s*[5] := 'o'; *s*[6] := 'u';
s[7] := 's';

But this last operation is unforgivably tedious. It would be helpful to endow the language with facilities for string manipulation. As a first step in this direction, I have added string constants to SIMPL, which are sequences of characters enclosed in double quotes; they can be assigned to character arrays or passed directly as arguments to routines.

IMPLEMENTATION OF STRINGS

String constants are fairly easy to implement for the SIMPL language because the VM2 assembler accepts string constants with exactly the same syntax; so the constants can be compiled without change. The compiler outputs a string constant preceded by a label, which can be used to refer to the string, and followed by a zero to terminate the string with an ASCII NUL. Routines can use this NUL to determine when they have reached the string's end. A string assignment like *s* := "better", where *s* is a character array, is implemented with COPY. The compiler must determine if the array is shorter than the string constant; if so, it should signal an error. Also, the string constants are kept separate from the routine's executable code, so the machine will not try to execute the string constants.

Passing a string constant as an argument is similar to passing an array. If the type of the corresponding formal parameter is an array of the same size as or larger than the string constant,

(continued)

the call is valid. I now turn to the parameter-passing mechanism itself.

Ins and Outs of Parameter Passing

Entire arrays (as well as string constants, which can be treated as arrays in this context) can be passed as arguments to routines. Should an array argument be copied, or should a pointer to the array be passed instead? These two choices correspond to the two most common parameter-passing schemes: call-by-value and call-by-reference. In the call-by-value scheme, only the value of the argument is passed, not a reference to the actual argument, so any modification of the argument by the callee will not affect the original.

When a variable is passed using call-by-reference, the callee gets a pointer to that variable, so the variable's contents can be modified. Now, here's the rub: Call-by-reference should be used when you plan to modify a variable inside a routine. But if you aren't doing this, call-by-value is the right choice since it ensures that what is being passed won't accidentally be modified. Call-by-value is much less efficient for large objects like arrays because it requires a copy of the entire array to be made. The practical result is that arrays are almost never passed by value. Neither method seems a satisfactory choice of calling mechanism. Indeed, it looks like a classic trade-off between considerations of efficiency and good programming style: Either write good code and take your lumps with the copies or be fast and a little dirty.

The designers of the Ada programming language provide a solution to this dilemma. It involves separating the implementation of the parameter-passing mechanism from the way it appears to the programmer. The terms call-by-reference and call-by-value describe implementations. As a programmer, you have three ways in which you might want to treat an argument to a routine: you want the routine to use the argument's value but not to modify it; you want the routine to transmit a value back to the caller through the argument, but it is not necessary to examine its value; or you want the routine to both examine and modify the argument. In Ada, if a formal parameter is followed by the keyword IN, its value can be examined but not altered; if it is followed by the keyword OUT, it can be assigned to but not examined; and the keywords IN OUT allow both. The default is IN. A formal is said to have a mode of IN, OUT, or IN OUT. The Ada-style parameter-passing mechanism can now always pass arrays and string constants by reference and leave it to the compiler to check for their proper use inside the routine.

The designers of Ada's parameter-passing mechanism have made splendid use of a powerful idea: Let the compiler do the work. Call-by-value for a large structure is little more than expensive run-time protection against modifying the structure. By performing the checks for modification at compile time instead, you can eliminate a great deal of inefficiency.

Implementing Parameter Passing

Only a few modifications need to be made to the compiler to handle the IN-OUT parameter-passing mechanism. The parser must deal with the

A. To pass an argument A to a formal parameter F:
1. If A is an array:
   a. If F is an open-array parameter, push the HIGH and LOW bounds of A;
   b. Push A's starting address.
2. If A is a scalar:
   a. If F has mode IN, push the value of A;
   b. Otherwise, push the address of A.

B. To store the top of the stack into a variable V:
1. If V is an array element:
   a. Push the address of the array containing V;
   b. Push the array's bounds;
   c. Push the value of the index expression;
   d. Use an AREF instruction to put the address of V on the stack;
   e. Use a POP instruction.
2. If V is a scalar variable:
   a. If V is a global variable, use a POPC instruction;
   b. If V is a local variable, use a POPL instruction;
   c. If V is an OUT or IN OUT formal:
      (1) Push V's address;
      (2) Use a POP instruction.

C. To put the contents of a variable V on the stack:
1. If V is an array element:
   a. Use an AREF sequence, as in B.1.a–B.1.d above;
   b. Use a CONTENTS instruction.
2. If V is a global variable, use a PUSH instruction;
3. If V is a local variable or IN formal, use a PUSHL instruction;
4. If V is an IN OUT formal:
   a. Push V's address;
   b. Use a CONTENTS instruction.

D. To push the address of a variable V (including arrays) onto the stack:
1. If V is a global variable, use a PUSHC instruction;
2. If V is a local variable, use an ADDRL instruction;
3. If V is a scalar formal with mode IN, use an ADDRL instruction;
4. If V is any other kind of formal, use a PUSHL instruction.

Figure 2: *Rules for manipulating variables in* SIMPL. *These rules are used by the code generator. They assume that mode-compatibility errors (such as an attempt to store into a formal of mode* IN*) have been caught by the type checker.*

occurrence of IN and OUT keywords in the list of formal parameters (see figure 1d), and a field must be added to symbol-table entries to record the mode of formal parameters. Each occurrence of a formal must be checked to make sure it conforms to the formal's mode. The rules are simple: IN formals cannot occur on the left-hand side of an assignment statement or as arguments to a routine whose corresponding formal has modes OUT or IN OUT. (This includes the built-in READ procedure, whose formals are considered to have mode OUT.) OUT formals cannot occur in expressions or as arguments to a routine whose corresponding formal has modes IN or IN OUT (including WRITE, whose formals are IN). Formals of mode IN OUT can occur anywhere.

The code generator needs to be changed so that the right code sequences are generated for accessing variables and passing arguments. The code generator's rules are summarized in figure 2. It may help you to wade through the confusing mass of instructions if you remember that everything is passed by reference (i.e., a pointer is passed) except expressions and scalar (nonarray) variables passed to IN formals, which are passed by value.

Open-Array Parameters

Users of Pascal quickly discovered that language's inflexibility with array parameters. Pascal insists that the types of the formal and actual parameters match. If a Pascal sort routine were defined to sort arrays of 10 integers, it could accept only such arrays and no others; the same routine could not be used to sort an array of 11 integers, even though the sorting algorithm itself might pose no limitations on the length of the array to be sorted. In Pascal, it is impossible to write general-purpose routines that can work with arrays of arbitrary size. Writing general-purpose string-handling routines is likewise impossible in Pascal: strings longer than the size of the routine's formal parameter cannot be handled.

(continued)

Listing 3: (a) A SIMPL *program illustrating the use of strings, parameter modes, and open-array parameters.* (b) VM2 *assembly-language code produced by the compiler from the program in* (a).

(a)
```
PROGRAM censor;

TYPE string = ARRAY[1..80] OF CHAR;

VAR a:string;

PROCEDURE xout(s:IN OUT ARRAY OF CHAR);
{ Replaces all characters in s with xs. String terminated by end of array or an
  ASCII NUL (character code zero) }
VAR i:INTEGER;
BEGIN
    i := LOW(s);
    WHILE i <= HIGH(s) AND s[i] <> CHAR(0) DO
        s[i] := 'x';
        i := i + 1;
    END;
END;

BEGIN
    a := "This is a string";
    xout(a);
END.
```

(b)
```
        BRANCH    censor
a:      .BLOCK 80
xout:
        SETSP     1
        PUSHL     0, 4      ; LOW
        POPL      0, -1     ; i
L1:
        PUSHL     0, -1     ; i
        PUSHL     0, 5      ; HIGH
        LSSEQL
        BREQL     L3
        PUSHL     0, 3      ; s
        PUSHL     0, 4      ; LOW
        PUSHL     0, 5      ; HIGH
        PUSHL     0, -1     ; i
        AREF      1
        CONTENTS
        PUSHC     0
        NOTEQL
        BRANCH    L4
L3:
        PUSHC     0
L4:
        BREQL     L2
        PUSHC     'x
        PUSHL     0, 3      ; s
        PUSHL     0, 4      ; LOW
        PUSHL     0, 5      ; HIGH
        PUSHL     0, -1     ; i
        AREF      1
        POP
        PUSHL     0, -1     ; i
        PUSHC     1
        ADD
        POPL      0, -1     ; i
        BRANCH    L1
L2:
        RETURN    3
censor:
        PUSHC     L5
        PUSHC     a
        PUSHC     17
        COPY
        PUSHC     80
        PUSHC     1
        PUSHC     a
        CALL      xout, 0
        HALT
L5:
        "This is a string" 0
```

Open-array parameters are so easy to implement, it's a wonder that more languages don't use them; two extra pushes are all you need.

Modula-2's open-array parameters corrected the deficiency. If the words ARRAY OF CHAR, for example, occur in a formal-parameter declaration, that formal can be bound to an array of any size, provided it is a one-dimensional array of characters. The ARRAY OF... construct can be used with any type name, even one that the programmer previously defined. If a Modula-2 formal parameter is declared with ARRAY OF, then whatever the lower bound of the actual parameter, the formal parameter's lower bound is zero; its upper bound is available by using the built-in function HIGH applied to the formal parameter. I will adopt Modula-2's syntax for open-array parameter declarations, but I don't like the way Modula-2 alters the bounds. So in SIMPL, the bounds of the formal parameter are identical to those of the actual and can be accessed with the built-in functions LOW and HIGH.

Implementation of Open-Array Parameters

Open-array parameters are so easy to implement, it's a wonder more languages don't use them. When an array is passed to a formal declared as an open array, the bounds of the array are pushed onto the stack in addition to the array's starting address. When compiling a formal-parameter declaration, the compiler assigns frame-pointer offsets to the two bounds as well as to the array's starting address. Any time a bound is needed inside the routine, the compiler uses a PUSHL instruction to put it on the top of the stack. The built-in functions LOW and HIGH merely compile directly into the appropriate PUSHL instructions. A minor interaction occurs with the whole-array-assignment feature. If an array assignment involves an open array, the compiler can't know the array's size at compile time. Yet it must generate a COPY instruction and push the number of words to copy onto the stack. The solution is for the compiler to generate code that computes the minimum of the two arrays' sizes at run time. For this purpose, I've added a new VM2 instruction, MIN, that pops the top two integers off the stack and pushes their minimum back onto the stack.

Conclusion

To give you an idea of what the compiled code looks like for the features I've been discussing, I have provided in listing 3 a SIMPL program that uses strings, parameter modes, and open-array parameters.

When I chose the extensions to include in this project, I picked what seemed to me to be the most essential and easiest to implement of hundreds of possible features. If you've understood the project up to now, it shouldn't be difficult for you to add other common programming-language features to SIMPL, like real numbers, records, FOR loops, and so on. However, there may be some advanced features whose implementation gives you pause. Hence the following offer.

Think of your favorite high-level-language feature. It may already be a part of a programming language, or it may be some creature bred of your own imagination; no matter. Send it to me, either on BIX (BYTE Information Exchange) or by U.S. Mail. In a future article, I will examine a handful of the most interesting suggestions. For each feature, I will either describe an implementation or explain why, in my opinion, no decent programming language should provide the feature. ■

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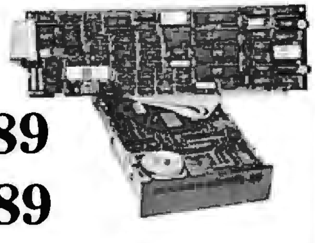

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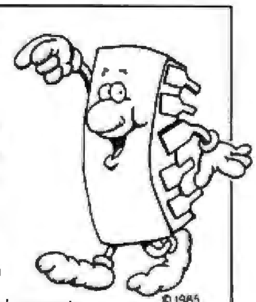

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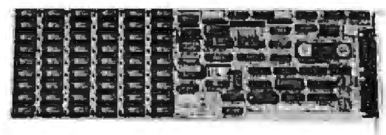

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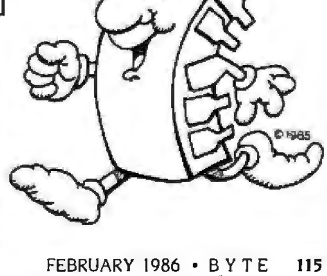

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INTRODUCTION TO THE AMIGA ROM KERNEL

A look inside the Amiga by the creator of Intuition

Editor's note: The first version of this article appeared on BIX (BYTE *Information Exchange) on October* 10, 1985.

This article introduces the building blocks of the Amiga ROM (read-only memory) Kernel software. I will examine the ROM Kernel, including AmigaDOS and the disk-based libraries and devices, and present examples of translating code from other machines to the Amiga. Finally, I'll look at the hardware and special features of the ROM Kernel, describing how to use these directly in a system-integrated fashion. |*Editor's note: For an overview of the Amiga from Commodore, see "The Amiga Personal Computer" by Gregg Williams, Jon Edwards, and Phillip Robinson, August* 1985 BYTE, *page* 83.|

SYSTEM OVERVIEW

It is rare for software and hardware groups to work as closely together as we did at Amiga. We exchanged and debated ideas continuously during the creation of the Amiga. The close relationship influenced the design, bringing new features to the hardware and allowing the software to take full advantage of the hardware.

The Amiga's greatest strengths lie in its modularity and the interconnections among its system components, both hardware and software. The design teams designed and developed simultaneously, and from the start they were intended to complement one another. Even though we designed the hardware ieces to fit tightly together, you can use any subset of the features without the necessity of controlling the entire machine. It's the same with the ROM software, where the pieces work closely together but each can stand alone.

The hardware and software combine efforts in many ways to achieve the Amiga's performance. For instance, the hardware includes a special coprocessor, the Copper, which synchronizes itself to the display position of the video beam without tying up the bus or the processor. The Copper can move data to one of the many hardware registers or it can cause a 68000 interrupt, which the Amiga's multitasking Exec (also known as Executive) then processes. This makes the Copper a powerful, unobtrusive auxiliary tool. It is used by the Graphics Support library for display-oriented changes and by the audio device for time-critical audio-channel manipulations. You can use the Copper for time-critical operations because it's tied to the display, which is guaranteed to run at 60 Hz (the display processors start from the top of the screen 60 times a second).

The way the Amiga handles communications with its peripherals is another example of the union of hardware and software. The signals that pass between the Amiga and its peripherals are interrupt-driven. Peripherals, therefore, do not disturb the system or require monitoring until information needs to be communicated. The Amiga Exec works with the interrupt-driven communication by managing a complete interrupt-processing mechanism, providing a convenient, interleaved, prioritized processing of interrupts.

The multitasking Exec forms the core of the system software; it is a compact collection of routines that underlies the rest of the Amiga ROM software. The developers attempted to optimize the Exec for space, performance, clarity of usage, and the creation and management of lists, which are the primary components of Exec. All of the other pieces of the Exec are built on lists and, therefore, provide performance with a minimum of system overhead. You will be able to use even the more esoteric Exec functions once you learn the concept of the Exec list.

Exec is the starting point for all the other pieces of ROM software, mostly because it is the controller of tasks and interrupts. Each of the ROM Kernel software components is designed to stand alone as much as possible; programmers can choose which components to use. But at the

(continued)

Robert J. Mical, Director of Intuition for Commodore-Amiga, created Intuition and the Amiga's GELS system. He can be reached at Commodore-Amiga Inc., 983 University Ave., #D, Los Gatos, CA 95030.

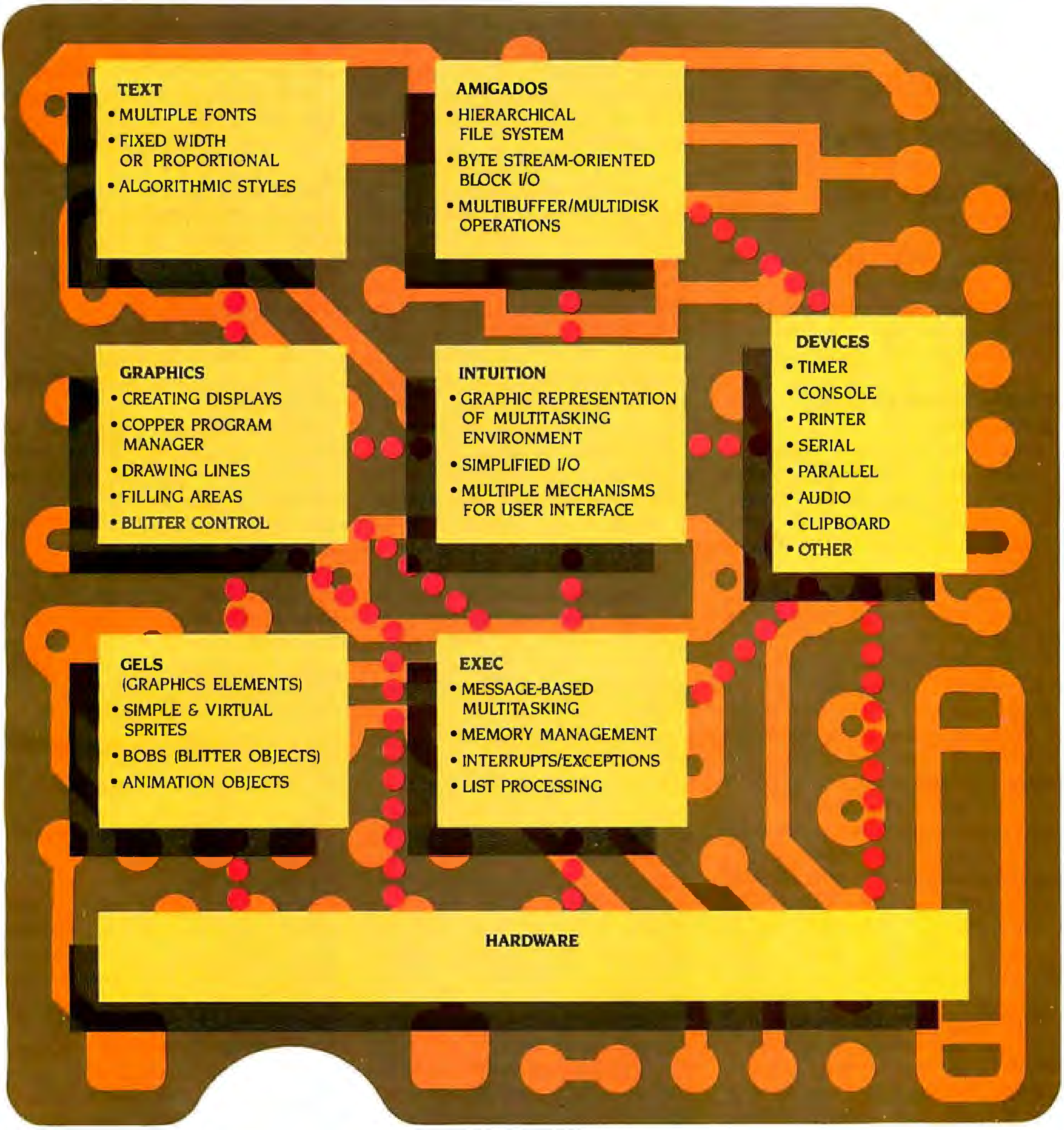

Figure 1: ROM *Kernel overview.*

Tasks are the most elemental executable component under Exec.

same time, the components were designed to share resources and a common interface as much as possible, to aid the programmer's understanding of the system as a whole.

PRIMARY ROM KERNEL SOFTWARE

Figure 1 summarizes the many components of the Amiga ROM Kernel and their interrelationships. This section briefly introduces the components that I will describe in more detail.

First and foremost is the multitasking Exec. Its primary responsibility is to manage the Amiga environment and resources for the many tasks that can reside simultaneously in the Amiga, with each free to make any request of the system at any time. It also provides a common interface between applications and many of the ROM software mechanisms.

Almost all code that executes in the Amiga is, at its lowest system level, a task. Each task has its own execution environment; in other words, each task appears to control the entire machine, except for memory that Exec won't allow the task to allocate.

Exec also manages the available memory and provides routines that allow an application to allocate a block of memory and do its own memory management within that block. Finally, Exec supplies routines that enable uniform access to Amiga devices and libraries.

A device is a special I/O (input/output) mechanism that uses tasks to create systematic access to some hardware component. For example, by using the Amiga timer device you can receive an interrupt or be awakened from a wait state after a period of time that you specify. By using the console device, which is described later, your application can receive input and write text output in the simplest fashion possible, as if it were connected to a normal computer terminal.

A library is a collection of related routines that reside in ROM or that you load from disk. The routines have no fixed address, and you call them indirectly. Applications, therefore, don't need to know the absolute address of any library routine when you compile the program. More significantly, except for the one address that contains the pointer to the Exec database, there is no need for absolute addresses anywhere in the system.

The Graphics Support library, another important component of the Amiga ROM Kernel and an example of an Exec library, provides a shell of software between the programmer and the Amiga graphics hardware. The graphics hardware is extremely complex, but the graphics routines eliminate much of the complexity by translating simple rendering requests into systematic writes to the hardware registers. The routines also program the Amiga's special coprocessor. Applications can use the Graphics library simply to draw lines and fill areas or to do more complex things such as gaining systematic access to the special hardware mechanisms like the coprocessor and the block-transfer device. An application knows the graphics routines only as offsets in a table, and the application doesn't know about the table until it opens the library at run time.

Intuition is another example of a library. It is a collection of routines that support and provide convenient access to Exec's multitasking capabilities. It also provides mechanisms that enable users to interact easily with applications. Intuition uses the Graphics library to create display environments in which many applications can coexist. Intuition also provides an alternate source of input for applications that don't want to use the console device for preprocessed data.

MULTITASKING

Each executing unit (except the program executed by the coprocessor) gets its own environment; in effect, it gets a complete machine. The task gets its own registers, stack, and process state, and it can access I/O devices (including the disk device and the graphics display) without worrying about other tasks that may be out there competing for the same resources.

Tasks are very simple. They are the most elemental executable component under Exec. Everything is built on top of the task, including simple task programs, devices, and AmigaDOS processes.

Programmers can, if they wish, ignore the Amiga's multitasking capabilities for the most part. If you are writing a simple program to run on the Amiga, you don't have to care about other programs that may be sharing memory and the hardware resources. For your program to be well-behaved in the multitasking environment, you only have to remember to always relinquish control of the processor and resources whenever possible to allow other tasks to run. For instance, when you are waiting for an event like a keystroke from the user, you should use the Exec function Wait(), which provides a convenient mechanism for standing aside and letting other programs run until the event occurs.

Because the Amiga has only one microprocessor (the 68000), and tasks share the CPU, only one task can be active at a time. Each task has a priority number, which is an indicator of how important it is for that task to run. The numbers range from −128 to 127; most tasks run at priority 0. The task with the highest priority gets to run whenever it's ready, even if this requires interrupting the work of a lower-priority task. If two tasks share the same priority and both are ready to run, they share the processor (time-slicing) by running for a given amount of time (64 milliseconds) before transferring control to the other task. When a task is finished with its work and is willing to "go to sleep" temporarily and relinquish control of the system, it calls the Exec function Wait(). The

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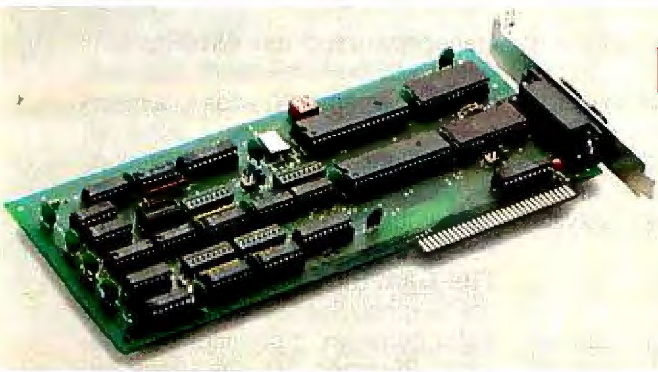

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IBM is a registered trademark of International Business Machines Corporation function call includes instructions describing the event that will awaken the task. (See table 1 for the sequence of events required to set up and start a simple task.) Usually the function call is some external event, heralded by the arrival of a message or signal. When a task "waits," the next task of equal priority will start to run. When all tasks of the highest priority are waiting, the next-lowest-priority task is allowed to run. This sleeping and waking of tasks, called task switching, is managed by Exec.

MESSAGES AND SIGNALS

Tasks communicate with each other using messages and signals. The signal, the simplest form of intertask communication, is physically 1 bit in a 32-bit word (called the signal-bits word). Each task gets 32 signal bits. Some of the low bits are reserved for system use. The argument to the Wait() function is a long word (32 bits) with bit settings corresponding to the signals for which the task wants to wait. When the task calls Wait(), it is saying to the Exec that it wants to wait for one or more events to occur. When the task "wakes up," the Wait() function returns an argument. The argument is a long word with the signal bits (more than one is possible) that were sent back to the task in order to wake it up again.

Using the Exec function AllocSignal(), the task allocates its signal bits to identify the types of information that are being transmitted. It can attach the signal to a message it sends out so that it can readily identify the reply. Also, tasks can make the signal globally available to other tasks, either as a global variable in a program of many tasks or as information in a message being passed via the message structure. Tasks can communicate with one another by using signals and the Exec function Signal().

Alternatively, tasks can use messages to communicate. Tasks know about each other's ports either through a globally declared variable or a prearranged name for the ports. There are several Exec functions for managing ports. A task creates a message port by using the Exec function CreatePort() and can assign a text name to that port. Then other tasks can find the port by using the FindPort() function. The CreatePor () function allocates and initializes memory and a signal bit for a message port and then calls AddPort() to install the new message into the system.

PutMsg() sends a message to another port. Once you have sent a message, you can choose to wait for a reply (synchronous I/O) or continue processing and check back later for a reply (asynchronous I/O). A task receives messages by using GetMsg(), which returns the address of a message or zero if no message is available.

MEMORY ALLOCATION

Several Exec and Intuition routines manage RAM (random-access read/write memory) allocation and deallocation. The basic functions are Exec's AllocMem() and FreeMem(). Use AllocMem() to specify how much and what type you want (low address, high address, and whether it should be cleared to zeros for you). FreeMem() returns your piece of memory to the available pool.

Other Exec memory-allocation routines allow you to control memory management yourself. First, you allocate a block of memory using the AllocMem() function. Then you do memory management within the memory block by using the Exec functions Allocate() and Deallocate().

Tasks can use Exec's list capability to allocate memory in a fashion such that the memory will be automatically freed when the task is exiting. To do this, you can allocate memory blocks using the AllocEntry() function and then attach the memory list returned by AllocEntry() to the MemList field of the task's block of control data. When the task is closing, Exec deallocates any memory list it finds in the task's control block.

Intuition provides a pair of memory-management routines, AllocRemember() and FreeRemember(). Each call to AllocRemember() adds to a memory list of the calling task. A single call to FreeRemember() frees all memory allocated by repeated calls to AllocRemember().

THE GRAPHICS LIBRARY

The Graphics Support library has two major purposes. It provides a simplifying interface to the complex mechanics of the Amiga display hardware, and it supplies procedural access to the rendering functions of the Amiga chips. I shall describe here only the basic rendering functions of the Graphics library.

The Graphics library supplies several data structures for defining and manipulating display memory. Display memory is RAM that is organized in planes of pixel information. Each plane contains a single bit of information for each pixel in the display. A normal display contains from one to five planes of pixel data. This means that each pixel can be defined using 1 to 5 significant bits (see figure 3 in the August 1985 BYTE article). The

(continued)

Table 1: *The sequence of events to open a task.*

- Initialize a task-control block
    - Allocate stack space for the task
    - Initialize the stack variables SPUpper, SPLower, and SPRegister.
      All procedure calls made by this task need task space, which comes from here. The programmer is obliged to make sure stack is large enough and to check for stack overflow. Minimum stack is 66 bytes.
    - Initialize the priority (optional)
    - Set the name of the task (optional, suggested)
- Create a port (optional) using CreatePort()
- Add the task to the system by calling AddTask()

Table 2: *The main components of a* RastPort *structure.*

PRIMARY RENDERING PEN
FgPen (ForegroundPen, or PrimaryPen) is the primary drawing pen.
When only one pen is being used (simple line draws and rectangular area fills), this is it.

SECONDARY RENDERING PEN
BgPen (BackgroundPen, or SecondaryPen) is the pen that's used when a second pen is required, for instance, when drawing text.

DRAW MODE
DrawMode is the variable that describes how the rendering should take place, for example, using the topics covered below:

Line Drawing

JAM1	Draw the line in the value of FgPen.
JAM2	As with JAM1, draw the line in the value of FgPen.
COMPLEMENT	Ignore the pen colors, and binary complement every bit where the line is drawn.

Filling Rectangular Areas

JAM1	Fill the area in the value of FgPen.
JAM2	As with JAM1, fill the area in the value of FgPen.
COMPLEMENT	Ignore the pen colors, and binary complement every bit of the defined area.

Printing Text

JAM1	Print the character information of the text in the value of FgPen, leaving the background undisturbed where the character is surrounded by "white space."
JAM2	Print the character information of the text in the value of FgPen, and where the character is surrounded by "white space" use the BgPen.
COMPLEMENT	Invert the bit-plane data of the pixels overstruck by the character imagery.
INVERSEVID	This flag works in conjunction with JAM1 and JAM2. The most typical use is to combine INVERSEVID and JAM2 to switch the values of FgPen and BgPen when writing the character, thereby "inverting" the normal character rendering.

Listing 1: *The following C-language procedure illustrates the steps for drawing a line.*

```
DrawLine(RPort, Pen, Mode, StartX, StartY, EndX, EndY)
struct RastPort *RPort;
UBYTE Pen, Mode;
SHORT StartX, StartY, EndX, EndY;
{

        SetAPen(RPort, Pen);

        SetDrMd(RPort, Mode);

        Move(RPort, StartX, StartY);

        Draw(RPort, EndX, EndY);

}
```

combination of bits in the pixel constitutes a value that can range from 0 to 31, depending on how many bit planes are used in the display memory. This value corresponds to one of the Amiga's 32 color registers. The value of a pixel is used by the display hardware as an index into the hardware color registers. Each color register is 12 bits wide, so each color register can describe one of 4096 values. The net result is that the Amiga can display up to 32 colors on the display at one time, and each of these colors can be one of 4096 possible tints.

The most basic structures in the Graphics library are the BitMap and the RastPort (raster port). The BitMap structure defines how bit planes are grouped together to form display memory. The RastPort structure is a compendium of parameters required for rendering into the BitMap's display memory. This rendering is done by the graphics routines, the text routines, and the animation objects. Table 2 describes the most important components of the RastPort structure.

THE GRAPHICS PEN

When the Graphics library performs rendering, it often uses the RastPort "pen," which describes both the color register and display position used when drawing lines, writing text, and doing simple rectangular area fills. The primary pen used for rendering graphics is the foreground pen, known as pen A. You use the background pen, or pen B, to do more elaborate rendering, such as patterned lines and rendering both the foreground and background of text characters.

The routine SetApen() sets the pen's value, which specifies one of the hardware color registers. The pen also has a specified coordinate in a RastPort. You use Move() to set the position of the pen, the starting point for lines, and the baseline for text characters.

DRAWING LINES AND FILLING RECTANGLES

Drawing a line requires only four steps (see listing 1). First, you set the pen

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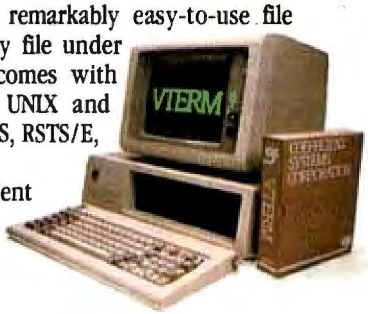

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Intuition takes many complex aspects of the system and reduces them to simple procedure calls.

color for the line. The pen numbers available depend on how many bit planes you have in your BitMap. Next, you set the drawing mode for the line you want to draw. Typically, you will select the drawing mode JAM1 for simple lines. Finally, move the pen to the starting position of the line and draw to the end position.

Therefore, the statement DrawLine(RPort, 1, JAM1, 10, 10, 15, 25); draws a line in color 1 from position (10,10) to position (15,25). In effect, the Draw() function drags the pen to the new location, leaving a trail to show where it moved. In line-plotter terminology, Move() is equivalent to "move with pen up," and Draw() is equivilent to "move with pen down."

Once set, the drawing-mode and pen-color variables retain their values until you change them. You do not need to set the drawing mode and pen color each time you draw a line.

The Graphics library also has a routine for filling rectangles that are parallel to the horizontal and vertical axes with a given color. The function RectFill() uses the drawing pen and mode that were set up by previous calls to the RastPort operators. The routine accepts two coordinates, the top-left and bottom-right corners of a rectangle. It then uses the Amiga hardware to draw the rectangles. In an unencumbered system, the Graphics library can create approximately one thousand 96- by 96-pixel single bitplane rectangles per second.

PRINTING TEXT

You also use the graphics pens to print text. The position of the graphics pen describes the position in which the text will be rendered. The x-coordinate specifies the pixel position for the first character. The y-coordinate describes the characters' "baseline," like the lines on lined paper. The bottoms of the characters will rest on the baseline; descenders will extend below it.

You use the foreground pen to draw the characters. The drawing mode JAM1 draws the characters' images over the background in the color of the foreground pen, and the BitMap shows through the blank space around the character imagery. Drawing mode JAM2 uses both the foreground and background pens. As in JAM1, the foreground pen renders the character imagery, but the blank space that surrounds the character is now rendered in the background pen color, thereby obliterating any BitMap information beneath the character. The INVERSEVID (inverse video) drawing mode combines both drawing modes to reverse the meanings of the pens.

To set up pens and drawing modes to write text, you use the same routines you used to draw lines. You establish the pen values and drawing mode with SetAPen(), SetBPen(), and SetDrMd(). You move the pen to a given position with Move(). You then call Text() to render your text into the RastPort (see listing 2). As in line drawing, you need not reset the pens, the drawing mode, or move the pen position before you render text. If you call Text() twice, the second line of text will follow, correctly spaced, on the same baseline as the first.

INTUITION

Intuition is called the Amiga User Interface, but it also provides simple mechanisms for creating displays that support multitasking. Intuition takes many complex aspects of the system and reduces them to simple procedure calls. You don't even need to understand the calls to use them. One of the primary goals of Intuition was to ease the effort of programmers by simplifying the interface to the ROM Kernel software as much as possible. Intuition provides tools for creating an environment that is intuitive for the user and convenient for the application designer. Designers are free to take advantage of any combination of the tools and constructs that Intuition provides and manages.

The screen is the basic unit of the Intuition display. A screen is a combination of display memory and instructions to the Amiga graphics hardware about how to translate that display memory into the video display. The screen's display memory is used for all of the Graphics library functions, and all of the Intuition display components are ultimately rendered in screen display memory.

You use Graphics library calls to create the screen display. When you first create screens, they normally fill the entire video display. The graphic aspect of the screen is actually a

(continued)

Listing 2: A C *procedure illustrating the steps for printing text.*

```
PrintText(RPort, String, StringLength, FrontPen, BackPen, TextMode, X, Y) struct
RastPort *RPort;
BYTE *String;
UBYTE FrontPen, BackPen;
SHORT TextMode;
SHORT X, Y, StringLength;
{
        SetAPen(RPort, FrontPen);
        SetBPen(RPort, BackPen);
        SetDrMd(RPort, TextMode);
        Move(RPort, X, Y);
        Text(RPort, String, StringLength);
}
```

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superset of the Graphics library's ViewPort. The Graphics library sets up the Amiga hardware to create the desired display, as specified in the fields of the screen data structure.

You can create displays by going to the Graphics library directly, without using Intuition. Designers interested in taking over the entire machine will do this, but it is more difficult than using Intuition. Creating a display involves many steps and requires that you make the correct procedure calls with the correct arguments. Intuition helps you by doing the grunt work, reducing the creation of a display to two steps: the initialization of a NewScreen data structure, and a single procedure call to the Intuition function OpenScreen().

An application designer can create any Amiga display possible by defining and opening an Intuition screen. All screens are rectangular; you decide the width and height of the screen, as well as the number of colors that will appear. You also decide on the display type (low- or high-resolution, interlaced or noninterlaced, etc.). Also, if you create the display as an Intuition screen, it can coexist on the video display with other Intuition screens, giving users the ability to choose (by dragging them up and down or by depth-arranging them) from multiple tasks even when each task requires its own display.

WINDOWS

Windows are distinct display-output areas that open within screens; output written to one window never affects any of the other windows, regardless of their relative positions. Windows are flexible and easy to create; undoubtedly, most applications will exploit them (although the screen's display memory can be used directly, without opening a window). Windows can be sized, moved, and depth-arranged, either by the user or programmatically by the application. When a user manipulates a window, it can react to the changes or ignore them. The programmer will decide. The user will decide which window will be active for input at any time, but you can even ignore whether or not your window is active for input. You can write into any window at any time, regardless of what else is happening in the system.

Because the application can entirely ignore the shape, position, and state of the window, each window can act as a "virtual terminal" for the application program. The application can, in fact, learn nothing more about Intuition than how to open and close a window, and then open the Console Device and do I/O, as if it were connected to a normal ANSI (American National Standards Institute) terminal. You open a window, like a screen, by initializing a data structure, NewWindow, and calling a single procedure, OpenWindow(). You also need to select a window type (see table 3).

Intuition provides special control mechanisms called gadgets, which you can attach to a window. There are four types of system-defined gadgets: the sizing gadget, which allows users to size the window; the depth-arrangement gadget, with which users can arrange the window from front to back with respect to other windows; the drag gadget, which allows users to drag the window around the screen; and the window-close gadget, which sends a message specifying that a user wishes to close the window.

In addition to the system gadgets, you can create many different types of custom gadgets for your windows. There are four basic classes of gadgets from which to choose: Boolean, for true or false selects; proportional, which returns a range from 0 to 65535; string, which allows a user to enter a text string; and integer, for integer-only strings.

You can also use simple procedure calls to write text to Intuition windows. Before you write text, you can move the cursor to a specific location. You can also bypass the standard fonts that are built into the ROM by opening one of the disk-based system fonts or designing and opening a font of your own. Fonts also have special al-

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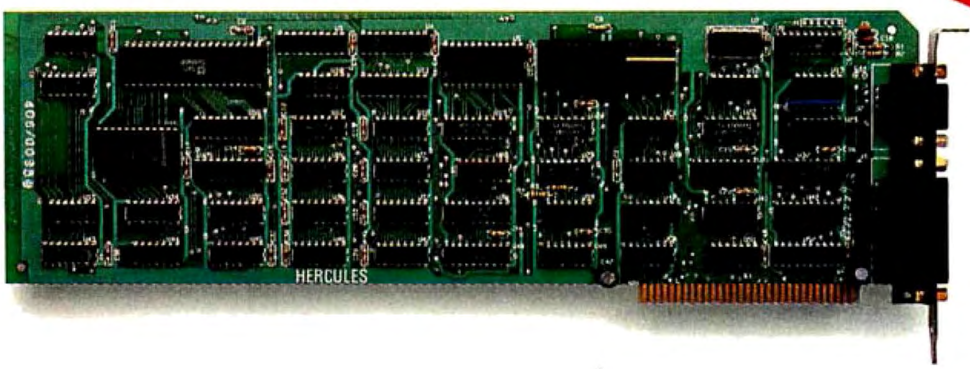

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Table 3: *A list of the more important window features.*

SPECIAL WINDOW TYPES

These aren't mutually exclusive. You can combine special window types.

Backdrop—This window opens up behind and stays behind all other windows.
Gimmezerozero—This is a two-layer window, where the Intuition border and gadgets are kept out of your way in a separate layer.
Borderless—This window has no default Intuition borders.
SuperBitMap—You can supply your own display memory for a window using the SuperBitMap type of window.

WINDOW DISPLAY PRESERVATION

Simple Refresh—When part of this window is concealed, the data is discarded. When the window is revealed, you must redraw those discarded sections.
Smart Refresh—The concealed portions of the screen are saved in off-screen buffers and restored automatically when the window is later revealed.
SuperBitMap—The display memory for this window is entirely off-screen in your own private buffer, except for the revealed portions of the window.

SYSTEM GADGETS

Sizing gadget—This system gadget enables the user to change the size of the window.
Depth-arrangement gadget—This system gadget enables the user to change the front-to-back ordering of the windows.
Drag gadget—This system gadget enables the user to drag the window around the screen.
Close gadget—The user can select this gadget and cause a special message to be sent to your task.

gorithmically generated variations, such as bold and italics.

MENUS AND THE IDCMP

The Intuition menu system enables you to group together and display the functions and options that your application offers. Menu items can be graphic images or text, and you can position them in any way. You can select one or two menu levels to present the items. Users can select menu items with the mouse or with command-key shortcuts.

The typical application finds out about the selection of a menu option through IDCMPs (Intuition Direct Communications Message Ports), standard Exec message ports and message passing simplified for developers. When Intuition sets up an IDCMP, it allocates and initializes the two ports that message passing requires (one to receive the message and the other to receive the reply). You don't need to learn about the many mechanisms for creating and maintaining ports; you only need to learn how to receive messages.

You receive messages about keyboard events, mouse movement and mouse buttons, disk events, and Intuition events all through the IDCMP. The other avenue for getting input is through the Console Device, which does terminal-like preprocessing of the data to create ASCII code and ANSI escape sequences. Applications that want to rely heavily on the Amiga's virtual-terminal capability will use the Console Device rather than the IDCMP.

SUMMARY

What started out as a high-powered game machine three years ago has evolved into a full-system computer. This article introduces three system components: Exec, Graphics, and Intuition. But other aspects of the system are as useful and powerful; such is the Amiga. ■

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BY RAPH LEVIEN

VISUAL PROGRAMMING

A LISP *editor that lets you create* LISP *programs visually*

Many people are interested in LISP but are put off by the unnatural syntax. Visual Syntax is an editor for LISP that displays programs as pictures with all data paths marked with arrows. It allows you to create, modify, and edit functions and expressions and view them in typical LISP syntax.

With Visual Syntax, you can scan through the entire library of LISP functions and see intuitively how the functions work. When you are finished, you will have a much better understanding of LISP.

THE REASONING BEHIND VISUAL SYNTAX

All programming is essentially breaking up a large problem into smaller and smaller functions until the steps are built-in steps of the programming language.

With ordinary sequential programming, two steps are put together by a rule: First do this step, then do the next step. A sequential program also needs some way of repeating some steps.

Functional programming allows you to put two steps together *with* the rule: Use the value of the first step to give the value of the second. For example, if the first step is "two plus three" and the second step is "multiply by four," then you can put them together to make "multiply two plus three by four." The value of the first step is 5. This is given to the second step to make 20.

In the programming language LISP, the first step above would be broken into three steps: 2, which is a number, 3, which is also a number, and the built-in function +. The second step would be broken into two steps: 4 and the built-in function *.

A diagram of this is shown in figure 1. Notice that the arrow takes the value on the left to the function on the right. Also, functions are in boxes, values are not.

This sort of diagram works best with functional programming because sequential programming does not have the direct movement of data that functional programming features. However, sequential programming has an easy method for input and out-

(continued)

Raph Levien (Levien Instrument Company, POB 31, McDowell, VA 24458) is the author of BYSO LISP. *He also holds a patent on a software-protection scheme.*

put, which functional programming lacks. LISP allows both functional and sequential programming.

Figure 1 should be read as "the product of the sum of 2 and 3, and 4." Similarly, figure 2a should be read "the car of the list (John is a good boy)," and figure 2b should be read "the cdr of the list (John is a good boy)." [*Editor's note: For an introduction to* LISP *and an explanation of the functions* car, cdr, *and others, see* "An XLISP Tutorial" *by* David Betz, *March* 1985 BYTE, *page* 221.]

Figure 3 shows a more complicated LISP program as displayed in Visual Syntax. This program defines the Fibonacci function. The Fibonacci function is more well known as the Fibonacci sequence, of which the first two elements are 1 and the rest of the elements are the sum of the previous two elements. The sequence is 1, 1, 2, 3, 5, 8, 13, 21, and so on. The Fibonacci function of *n* is simply the *n*th value in the Fibonacci sequence (where you begin counting from zero). Thus, (fib 4) equals 5.

The LISP program for the Fibonacci function is (defun fib (x) (if (< x 2) 1 (+ (fib – x [illegible](fib (– x 2))))). That is, the value of the Fibonacci function is 1 if the argument is less than 2. Otherwise, it is the sum of the Fibonacci function for the argument minus 1 and the Fibonacci function for the argument minus 2.

In this program, defun is used to define a function. The new function is called fib and has one argument, x. The if function returns the value of the second argument if the value of the first argument is true (not nil); otherwise, it returns the value of the third argument. Therefore, in the fib function, if (< x 2) is true, then the result is 1; otherwise the result is (+ (fib – x 1)) (fib – x 2))).

THE VISUAL SYNTAX EDITOR

The Visual Syntax editor allows you to edit, create, and modify LISP programs using structures like those in figures 1, 2, and 3. A small version of the Visual Syntax editor is available via BYTEnet Listings, as explained at the end of this article, and on disk, as explained on page 350.

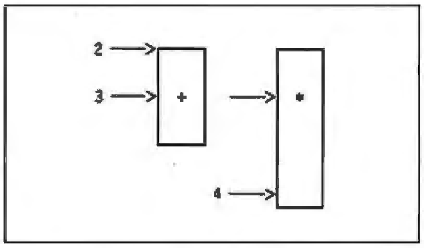

Figure 1: *A diagram of the* LISP *expression* (* + 2 3) 4), *as displayed by the* Visual Syntax *editor.*

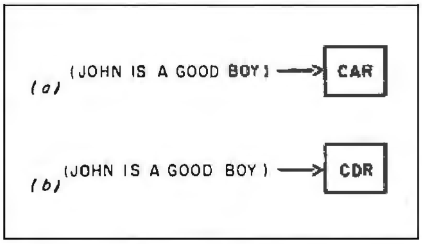

Figure 2: *(a) A diagram of the expression "the* car *of the list (John is a good boy)." (b) A diagram of the expression "the* cdr *of the list (John is a good boy)."*

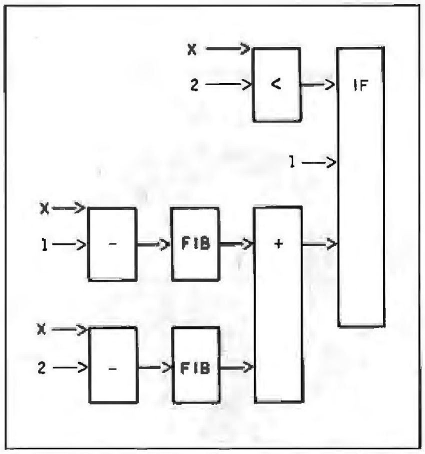

Figure 3: *The* fib *function, as displayed by the* Visual Syntax *editor.*

To use the Visual Syntax editor, you must first enter LISP, then type (load 'smallvsd). After a minute or two, LISP will respond with the message Value is. . . nil, alerting you that the editor is now ready for you to use.

You enter the Visual Syntax editor by typing (edv [illegible] This displays the expression in Visual Syntax. For example, to see the expression in figure 1, you would type (edv ':* (+ 2 3) 4)). (Note that the apostrophe before the expression is important. Without it, LISP will evaluate the expression and the Visual Syntax editor will display its *value,* in this case, 20.)

When you start the editor, the whole expression is highlighted. Highlighting indicates which part of the expression is being acted upon. You can highlight different parts of the expression by using the arrow keys.

The left arrow key highlights the first argument of the rightmost function in the previously highlighted area.

The down arrow key highlights the expression directly below the currently highlighted area. For example, if the first argument were highlighted before, the second argument would be highlighted afterward.

The up arrow key highlights the expression directly above the currently highlighted area. For example, if the second argument were highlighted before, the first argument would be highlighted afterward.

The right arrow key highlights the function to the right of the old highlighted area, along with its arguments.

Figure 4 shows the Fibonacci function, as displayed by the Visual Syntax editor, after pressing the left arrow key once and the down arrow key twice. The + function and its arguments are highlighted.

EDITING COMMANDS

Once you have highlighted part of an expression in the Visual Syntax editor, you can enter the following one-letter commands to act upon it.

- C—change current highlighted area. You can change the current highlighted area to an atom or a function. An atom can be either a number or a variable. When you use a function in Visual Syntax, it can be any function, built-in or user-defined.
- A—add argument to function. You can add either an atom or a function as an argument to the currently highlighted area.

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- D—delete highlighted area. Deletes the currently highlighted argument from a function.
- I—insert argument to function. You can insert a new argument between two arguments by highlighting the bottom one and inserting either an atom or a function.
- T—test expression. This evaluates either just the highlighted area or the whole screen and prints the value.
- Escape—escape from editor. This asks you if you really want to exit, and if you do, takes you back to the LISP interpreter, which displays the data in normal LISP notation.

Often, the Visual Syntax editor makes no distinction between the highlighted area and the rightmost function in the highlighted area because the function is the really important part.

Also, the editor will often ask questions that you should answer with one keypress. For example, Add argument a)tom or f)unction?. You should answer this by pressing either the A or F key.

An Example

As an example of using the editing commands, here are the steps you would follow to create the expression in figure 1 within the editor (as opposed to typing it in typical LISP notation and then seeing it displayed in Visual Syntax, as described above).

To begin, type (edv nil) to the LISP interpreter to start with a blank slate. (Here, "type" means press Enter at the end.) You will see the word nil highlighted in the upper right corner of your screen. Now press C to change the blank slate into the first function. The editor will respond: Change to a)tom or f)unction? Press F, which tells the computer that you want to change nil into a function. The editor will ask to which function you want to change it. Type * to indicate the multiplication function. Now press A to add an argument to the * function. At the prompt, press F to tell the computer that you want to add a function, and type + to indicate the addition function. Now press the left arrow key. This will highlight the + function only. Press A to add an argument to +. At the prompt, press A to indicate that you are adding an atom, and type 2. Now press A to add another argument to +. Press A to indicate that you are adding an atom, and type 3. Now press the right arrow. This will highlight the whole expression. Press A to add another argument to *. Press A to indicate that you are adding an atom, and type 4. You should now see the entire expression on your screen. You can then test this expression by pressing T, to which the editor should respond

Value: 20
Press any key to return to editor:

To get the LISP notation of programs that you have entered with Visual Syntax, press the Escape key. The editor will ask: Are you sure you want to exit the editor? Then you press Y, and the LISP interpreter will display the data that you edited with Visual Syntax in normal LISP notation, with all the parentheses.

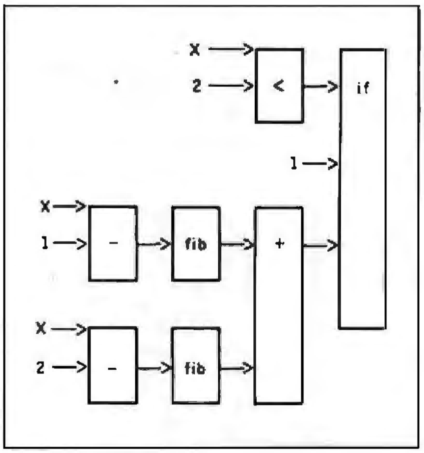

Figure 4: *Using the cursor keys, you can highlight (and thereafter edit) specific parts of an expression or function. Here, the + function and its two arguments, part of the larger* fib *function, are highlighted.*

Creating Functions

If you want to define a new function with the Visual Syntax editor, then type (edv '(defun [illegible] nil)). The editor will display the name of the function and the variables in the upper left corner, and the present value of the function, nil, in the upper right corner. For example, to create the fib function, you would type (edv '(defun fib (x) nil)) and use the editing commands as described above.

You can also use the Visual Syntax editor to edit previously defined functions. For example, if you had already defined the fib function in ordinary LISP syntax, you could edit it in the Visual Syntax editor by typing (edv '(grindef 'fib)), which would display the value of fib, as shown in figure 3, in the upper right corner of your screen.

How the Visual Syntax Editor Works

The most important thing in the source code for the Visual Syntax editor is the cursor location. This is simply a list of numbers. For example, if the cursor location is (1 2 3), that means "the first argument of the second argument of the third argument of the function on the right side of the screen." In this case, if the screen contained the Fibonacci function (figure 3), then the cursor would highlight (– x 2).

This method for locating the cursor is well suited to the cursor keys. For example, if the cursor location were (1 2 3) and pointing to (– x 2), then if you pressed the left arrow key the cursor would highlight x, which is the first argument of the first argument of the second argument of the third argument of if, the rightmost function. This means that the new cursor location should be (1 1 2 3). The left arrow always means insert a 1 at the beginning of the list. This is neatly accomplished by the LISP function cons, which adds a new element to the front of a list. The expression that performs this, (setq curs (cons 1 curs)), occurs in the edv function (edv is the main body of the editor) in the source-code listing.

Similarly, the right arrow removes the first element from the list, which is handled by the convenient LISP function cdr. For example, the cdr of

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Inquiry 161

(1 2 3) is (2 3).

Also, the up and down arrows subtract or add 1 to the first element of the list, respectively.

The in function, shown in figure 5, is used to determine what the highlighted area is. It is a simple function and a good example of recursion in LISP.

However, the in function can also be used with the setf function. The setf function changes parts of lists and arrays and is used similarly to setq, except that setq assigns values only to variables. An example of setf is (setf (car curs) (– (car curs 1))), which means set the first element of curs to the old first element of curs minus one, or subtract one from the first element in curs. This is the program for the up arrow key.

When in is used with setf, this means you can change the highlighted area to another expression. You can see the use of this in the chel function, described below.

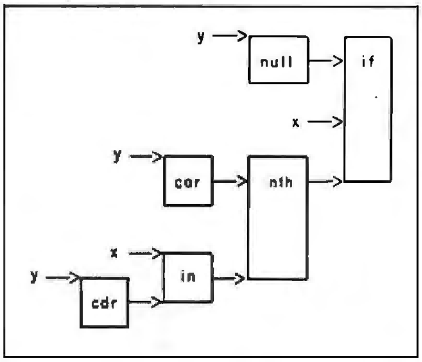

Figure 5: A *Visual Syntax diagram of the* in *function, used by the editor to determine which is the highlighted area.*

What happens is that setf decides that in is not a built-in function; therefore it must be a user-defined function and must have a user-defined setf program. Notice that this is defined with the defsetf function near the top of the listing.

The user-defined setf program is called ins and is nearly as simple as in.

THE VISUAL-DISPLAY ROUTINES

The visual-display routines vsd1, vsd2, vsd3, vsd4 and adj are used to display the programs on the screen. The routine vsd1 decides if a box is needed or not; vsd2 displays numbers and variables without a box; vsd3 displays a function in a box; and vsd4 displays the arguments to the function, with arrows pointing to the function. The routine adj makes the box large enough so that there is room for all the arrows. These routines are described below.

The main function, vsd1, will display the entire program by calling the other routines. The routine vsd1 is called by edv, the main body of the editor, to display the program being edited.

The visual-display routines use a

(continued)

MAKING VISUAL SYNTAX WORK ON OTHER LISPS

Visual Syntax was written in BYSO LISP. To use Visual Syntax on other LISPs, you must adapt some BYSO-specific parts of the program.

Visual Syntax requires the variables of one function to be accessible from another function. This is because the expression being edited is stored in the variable x by the function edv. This variable is used in several other functions that are called by edv, such as ins, chel, addarg, inel, delel, testel, and stoped. If your LISP does not allow this, there are two possible solutions. You could make x a global variable by changing the argument of edv to another variable, say *x*, and write (setq x *x*) directly after (prog (curs com)). The other solution is to pass x as an argument to the functions listed above.

Not all LISPs have the setf function. This allows you to assign values to parts of data structures as if they were variables. The functions that use this are edv, chel, addarg, inel, delel, and ins. These will have to be changed to use rplaca and rplacd. In addition, several functions use (setf (in . . .) . . .). These will have to be changed to calls to ins.

The input and output functions of other LISPs are obviously going to be different. The following are the input and output functions that BYSO uses.

The tyo function takes an ASCII code and displays it at the current cursor position, then moves the cursor one character to the right. Most LISPs will have either this function or another function that does the same thing.

The tyk function, defined in Visual Syntax, returns the next key from the keyboard. The low byte of the returned value is the ASCII value, which is zero for arrow and function keys. The high byte is the IBM scan code. References to the tyk function are made in edv, readel, testexp, and stoped.

The msg function prints out its arguments without much formatting. For example, there are no quotes printed around strings. In addition, (msg t) prints a newline. This function is used in defund, chel, readel, inel, testexp, and ask. Split the msg into several other function calls, using pstring for strings, terpri for newlines, and print for ordinary LISP expressions.

The setc function is used to set the cursor position. Its argument is the address of the cursor, which is two times the *x* position plus 160 times the *y* position. Most LISPs should have similar functions.

For LISPs not implemented on the IBM PC, Visual Syntax uses extended codes to draw the boxes, lines, arrows, etc. These characters are used in vsd1 through vsd4 and adj. The characters are shown in table 1. It should not be hard converting Visual Syntax to work on other LISPs running on terminals with direct cursor addressing, but on systems with teletypes and dumb terminals, it is more of a challenge.

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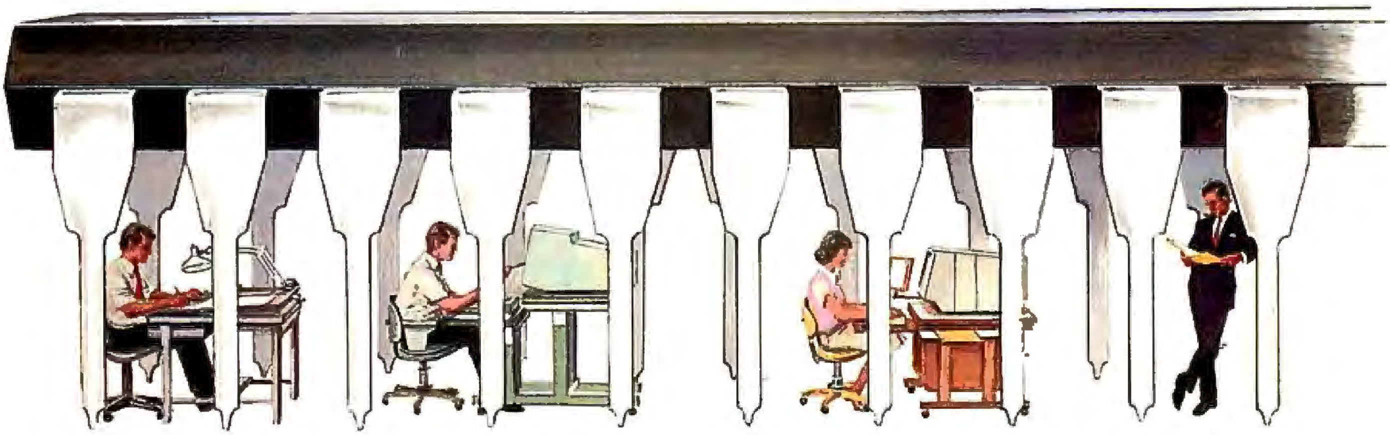

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XASM48	8048/8041	200.00	250.00
XASM51	8051	200.00	250.00
XASM65	6502/65C02	200.00	250.00
XASM68	6800/01,6301	200.00	250.00
XASM75	NEC 7500	500.00	500.00
XASM85	8085	250.00	250.00
XASM400	COP400	300.00	300.00
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significant number of nonstandard functions to display pictures at various locations on the screen and to print the boxes and arrows. These functions come from BYSO LISP, although they could be adapted to other LISP dialects quite easily (see the text box "Making Visual Syntax Work on Other LISPs"). However, Visual Syntax makes heavy use of dynamic binding, so on LISPs without dynamic binding, it would require a lot of work.

As the main routine, vsd1 decides which of the other routines should handle the argument. The routine vsd1 is also a good example of data-driven programming. There are two functions in Visual Syntax that are not displayed in the normal manner: defun and quote. The display functions for these are called defund and quoted. These functions are entered into the property list of defun and quote. When vsd1 recognizes a display function in the property list, it will call that display function rather than the standard display function. This is superior to comparing for defun or quote because it makes it easier to modify and also keeps the program much more modular.

The routine vsd1 returns a screen address of the lower left corner of the displayed object. This is so vsd4 knows where to put the next argument without overwriting part of the screen.

The routine vsd2 is a very simple function that takes an atom to display and the screen address of the upper right corner and displays the atom. It returns the lower left corner.

The routine vsd3 takes a function to display and the screen address of the upper right corner. It displays the function in a box and returns the screen address of the place to put an arrow in (for vsd4).

The function vsd4 does most of the work. It takes a list of arguments to display and the value returned by vsd3. It displays all arguments in the list, with arrows pointing into the box to the right. It returns screen addresses for the size of the box to the right and the lower left corner of the list of arguments.

Table 1: *ASCII codes used by the Visual Syntax editor to generate lines, arrows, and boxes.*

Character	ASCII code
->	26
│	179
┐	191
└	192
├	195
─	196
┘	217
┌	218

Adj simply adjusts the size of a box to make sure the box is big enough to accept all arrows pointing in from the left. It returns the lower left corner of the displayed function along with all its arguments.

Highlighting is handled by the function highlt.

A screen address is computed by $2*(x+80*y)$. The command (setc adr) will move the blinking underline (as opposed to the cursor described below) to the screen address. Also, the built-in function tyo prints one character. It takes one argument: the ASCII code of the character. The ASCII codes for some of the characters used by Visual Syntax are shown in table 1.

Editing Command Routines

The main body of the editor is handled by the edv function. Frankly, the edv function is not an example of good programming style, as it is too large. Most of the body of the function is just (if (= (low com) xxx) yyy) repeated over and over. This could be replaced by a list. However, edv works, and it is reasonably fast.

The editing commands c, i, d, a, and t are handled by the functions chel, inel, delel, addarg, and testel, respectively. These functions are fairly straightforward, and they work by list surgery when it is necessary to change anything.

The functions chel, inel, and addarg must have either an atom or a function to complete their particular editing tasks. To do this, they call

(continued)

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readel, which asks the user Change to a)tom or f)unction? and uses read to input a value.

All editing commands use tyk for input from the keyboard. This calls the BIOS (basic input/output system) to receive one key from the keyboard. It returns 256 times the scan code, plus the ASCII code. The ASCII code is used only for letters, numbers, and symbols (plus a few special functions such as space, backspace, tab, escape, and enter) where the scan code is unimportant. The ASCII code is not used for arrows, function keys, etc., so the scan code is used. The LISP functions high and low pick out the scan code and ASCII code, respectively.

THE FUTURE OF PICTURE PROGRAMS

As mentioned earlier, picture programs work best for functional-style programming as in LISP. Picture programs would also be very interesting for a logic programming style similar to Prolog's. However, this has not been done yet, to my knowledge.

It would be very exciting to be able to click function icons with a mouse and have a very simple user interface. This would combine the ease of use of menu-driven software with the power of a real programming language. It would be especially exciting if you could access control structures from icons, too.

This may be the real future of software, since it addresses the two major needs of users at the same time: clarity and power.

[*Editor's note: The source code for two versions of the Visual Syntax editor are available for downloading from* BYTEnet Listings. *The first is* SMALLVSD, *which requires an* IBM PC *and the* BYSO LISP *interpreter and is described in this article. The second,* XLISPVSD, *is an adaptation of the Visual Syntax editor for an* IBM PC *with* XLISP 1.5c, *a public-domain* LISP *interpreter also available on* BYTEnet Listings. *The number is* (617) 861-9764. FIB, *the source code for the Fibanacci function, is also available.*

The complete Visual Syntax editor is included with BYSO LISP, *a* LISP *interpreter available from Levien Instrument Company.*] ■


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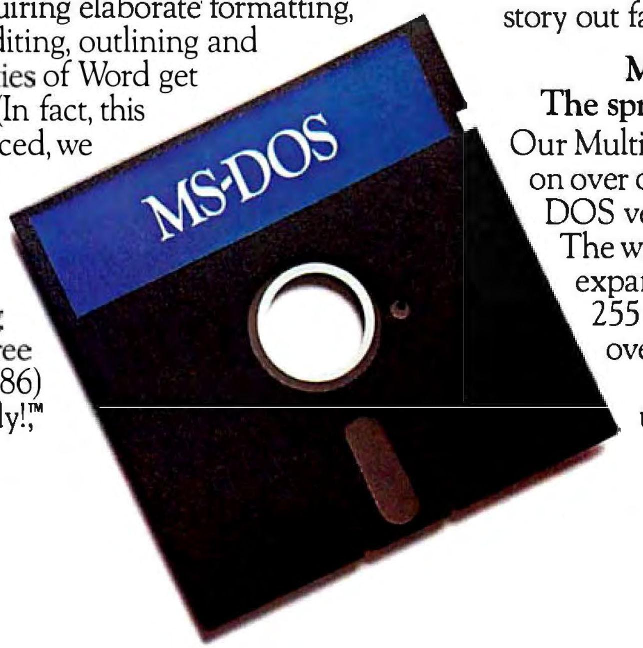

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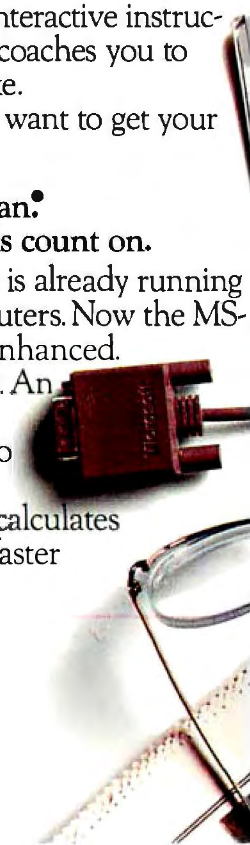

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MOLECULES IN COLOR

BY JOHN J. FARRELL

A program that displays molecules on an RGB monitor

Editor's note: In response to the article "Viewing Molecules with the Macintosh" by Earl J. Kirkland (February 1985, page 251), we have received a number of program submissions. Several of these were adaptations of the MODEL3D program for the IBM Personal Computer, while others used different types of notation, added color, or added special effects. The following piece is, in our opinion, the best of the submissions.

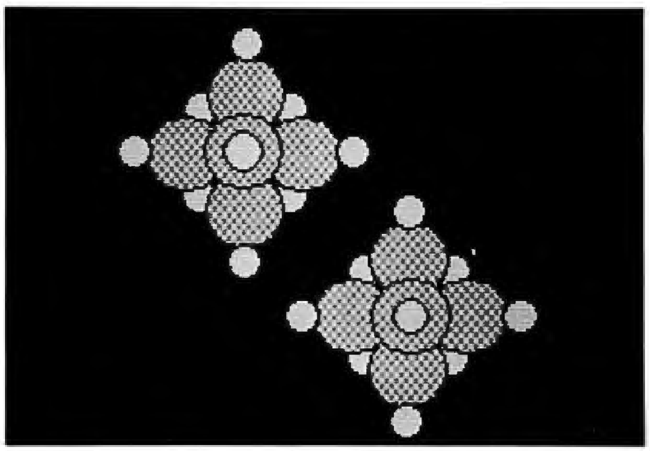


Photo 1: *Two molecules of pentaborane,* B_5H_9*. Hydrogen is white; boron is magenta-and-white checked.*

COLOR3D.BAS is a BASIC program for the IBM PC. It has most of the features of the original MODEL3D.BAS by Earl J. Kirkland. However, it displays molecules on an RGB (red-green-blue) monitor as collections of colored disks that represent the individual atoms of the molecules.

Like MODEL3D.BAS, COLOR3D.BAS has a three-dimensional perspective—atoms closer to you appear larger than atoms that are farther away. The program displays molecules in the *xz* plane (*x* is horizontal, *z* is vertical), and you can rotate molecules about the *z*-axis (azimuthal rotation) or about the *x*-axis (polar rotation).

Photo 1, for example, shows a screen shot of two molecules of pentaborane, B_5H_9, that were drawn by COLOR3D.BAS. The top molecule is closer to you than the lower one.

Photo 2 shows another example, tricarbonyl(benzene)chromium(0), $Cr(C_6H_6)(CO)_3$. Photo 3 is sodium chloride, NaCl (table salt). Finally, photo 4 shows para-aminobenzoic acid, $NH_2C_6H_4COOH$ (PABA—a sunscreen agent). In these photos, hydrogen atoms are white, carbon is cyan, oxygen is magenta, chromium is magenta-and-cyan checked, nitrogen is a mixture of cyan and magenta dots that appears blue, and boron atoms are magenta-and-white checked.

THE PROGRAM

Although the SCREEN 1 command in IBM PC BASICA limits the number of colors to four (including the background color), an infinite number of patterns are available by using BASICA's tiling capabilities (in DOS 2.0 or later). COLOR3D.BAS has 24 colors built into it, as shown in photo 5. You can change or add to these patterns as desired.

To use COLOR3D.BAS, you must first write a data file, which will be called by the program. Figure 1 shows the data file for tricarbonyl(benzene)

(continued)

John J. Farrell, Ph.D. (Chemistry Department, Franklin and Marshall College, Lancaster, PA 17604), is chairman of the chemistry department and associate professor of chemistry.

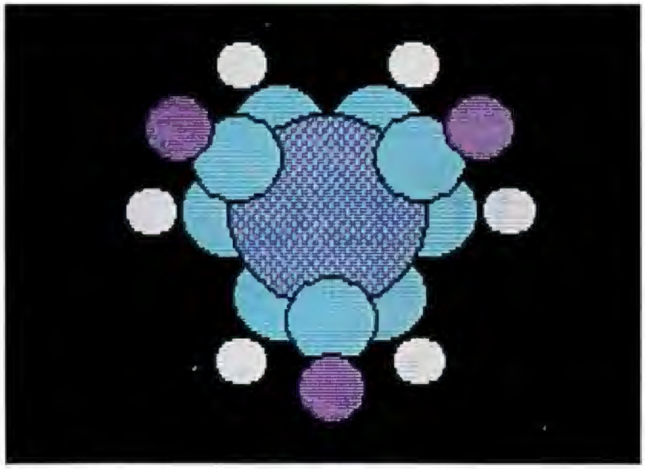


Photo 2: *One molecule of tricarbonyl(benzene)chromium(0),* $Cr(C_6H_6)(CO)_3$. *Hydrogen is white, carbon is cyan, oxygen is magenta, and chromium is magenta-and-cyan checked.*

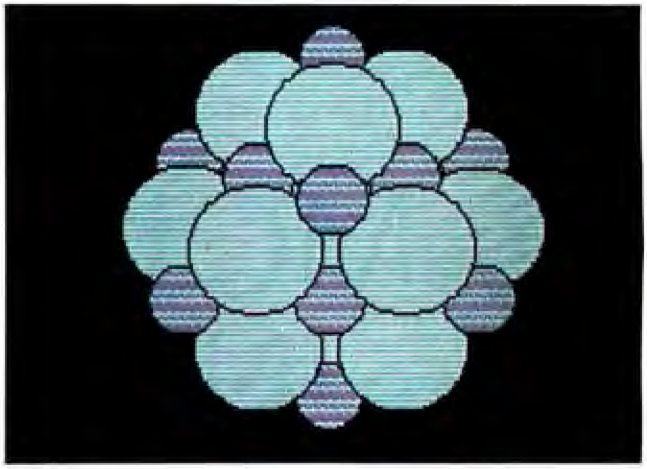


Photo 3: *Common table salt, sodium chloride, NaCl. Sodium is Easter-egg pattern, and chlorine is cyan-and-white striped.*

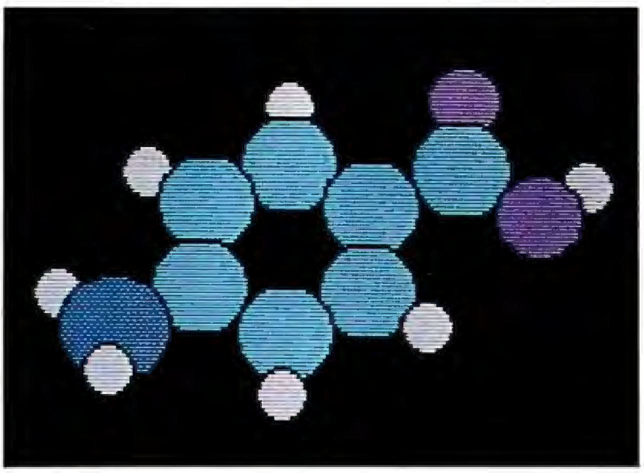


Photo 4: A *sunscreen agent, para-aminobenzoic acid,* $NH_2C_6H_4COOH$ (PABA). *Hydrogen, carbon, and oxygen are colored as in photo 2; nitrogen is cyan and magenta dots.*

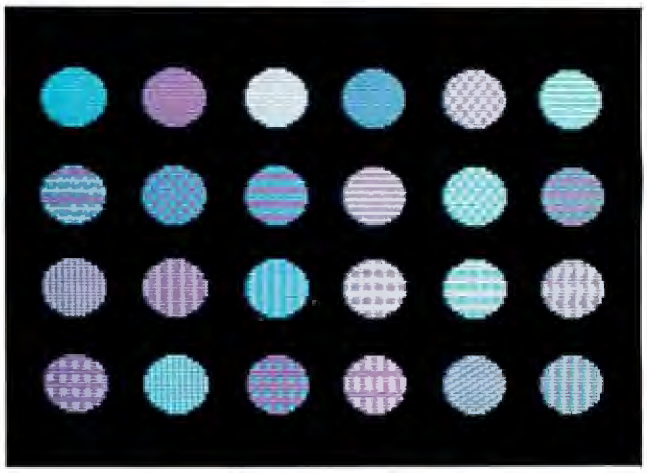


Photo 5: *The 24 colors and patterns available with program* COLOR3D.BAS. *The patterns are numbered from 1 to 24 proceeding left to right, top to bottom row.*

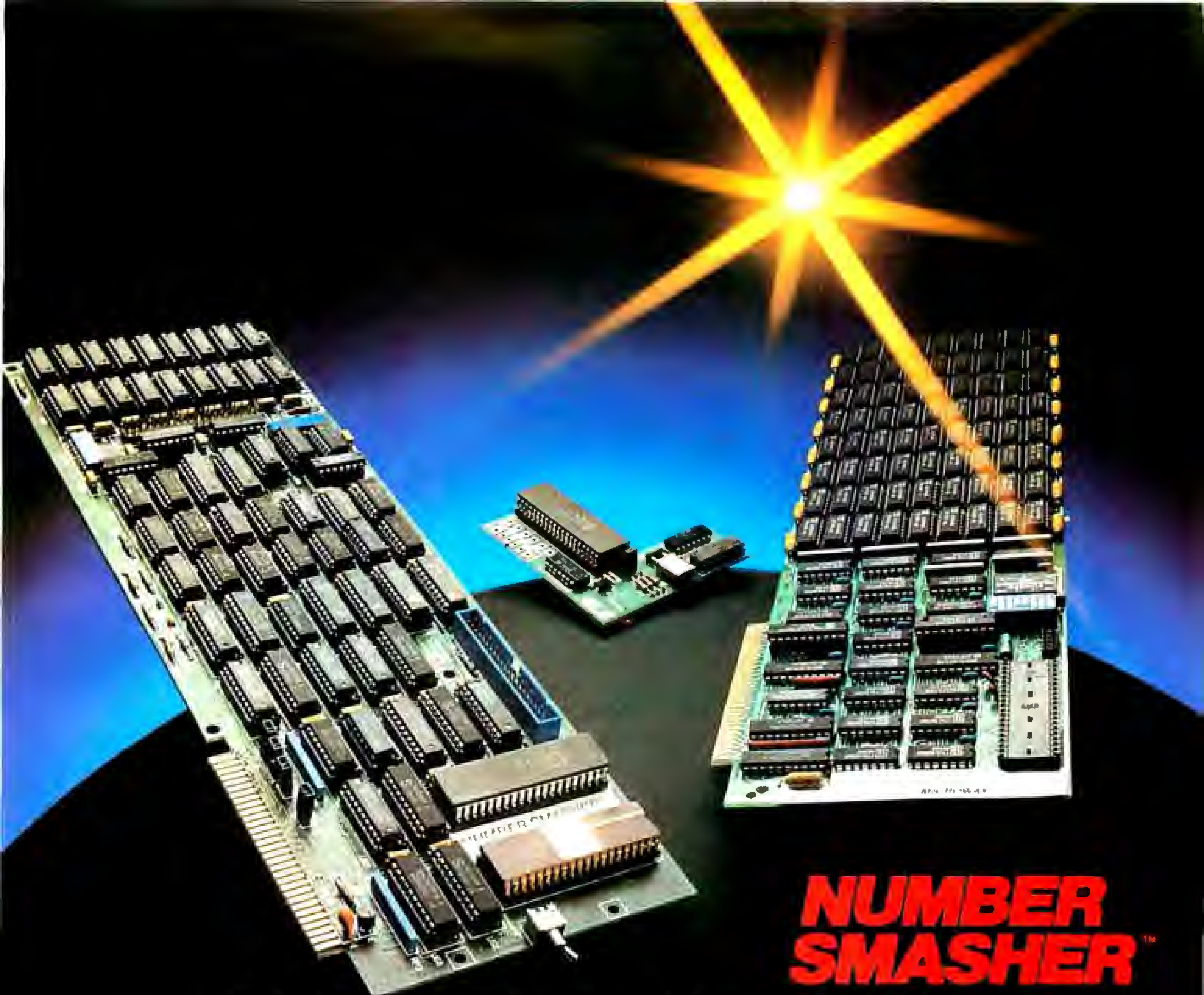
chromium(0). Each line of the data file represents a different atom, and the data includes color ′ to 24); *x*, *y*, and *z* coordinates (in angstroms); and atomic radius (in angstroms). Coordinate data may be found in a number of sources, including *Crystal Structures* by R. W. G. Wyckoff (volumes 1–6, John Wiley & Sons, 1951) and the journal *Acta Crystallographica*. In writing your data files, you may choose whatever colors you like for the atoms, using photo 5 as a guide.

You can write data files for molecules using any word processor, or you can write a BASIC program to generate them. Listing 1, for example, is DATAGEN.BAS, a BASIC program that I used to generate the data file in figure 1. A generator program lets you make changes in the data file (such as the color of a particular element) more readily, by changing the appropriate parameters in the generator file.

COLOR3D.BAS begins by asking you to supply the name of the data file, the rotation angles, the viewing distance, and the magnitude of the atoms. An error message will result if the viewing distance is too small (inside the crystal). If this happens, rerun the program with a larger viewing distance. If the atomic coordinates and radii are in angstroms, a magnitude of 1 will give touching spheres.

The program uses a rather complex sequence of painting and repainting to avoid two problems. First, it indicates the edge of each atom by a black circle; these lines must be painted over when the atom is hidden or partially hidden. Second, colored

(continued)



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Listing 1: *The* BASIC *program used to generate the data file in figure* 1. *The unit cell is monoclinic.*

```
100 ' Program to generate a data file for Cr(C6H6)(CO)3.
105 ' Page 5 of Vol 6 of Crystal Structures by Wyckoff.
107 ' Unit cell is monoclinic.
110 INPUT "Output file name:"; FILE$
120 OPEN FILE$ FOR OUTPUT AS #1
130 SIZ=1.4 : COL = 8
140 A = 6.17 : B = 11.07 : C = 6.57 : BETA = 101.5
150 X = .3319 : Y=.25 : Z = .0225
160 GOSUB 1000
200 SIZ= .7 : COL = 1             'ring carbons
210 X = .1804 : Y=.3119 : Z =-.2973
220 GOSUB 2000
230 X = .3761 : Y=.3769 : Z =-.2273
240 GOSUB 2000
250 X = .5738 : Y=.3142 : Z =-.1598
260 GOSUB 2000
270 SIZ= .64                      'carbonyl carbons
280 X = .5538 : Y=.25 : Z =+.2557
290 GOSUB 1000
300 X = .1827 : Y=.3642 : Z =+.1453
310 GOSUB 2000
320 SIZ= .49: COL = 2             'carbonyl oxygens
330 X = .6899 : Y=.25 : Z =+.4002
340 GOSUB 1000
350 X = .0894 : Y=.4341 : Z =+.2248
360 GOSUB 2000
400 SIZ= .38: COL = 3             'hydrogens
410 X = .028  : Y=.361  : Z =-.35
420 GOSUB 2000
430 X = .376  : Y=.474  : Z =-.227
440 GOSUB 2000
450 X = .728  : Y=.363  : Z =-.107
460 GOSUB 2000
999 GOTO 5000
1000 WRITE #1, COL, (X - Z*SIN((BETA - 90)*3.14159/180))
*A,Y*B,(Z*COS((BETA - 90)*3.14159/180))*C,SIZ
1020 RETURN
2000 WRITE #1, COL, (X - Z*SIN((BETA - 90)*3.14159/180))
*A,Y*B,(Z*COS((BETA - 90)*3.14159/180))*C,SIZ
2020 WRITE #1, COL, (X - Z*SIN((BETA - 90)*3.14159/180))
*A,(.5-Y)*B,(Z*COS((BETA - 90)*3.14159/180))*C,SIZ
2040 RETURN
5000 CLOSE #1: END
```

```
8,2.020146,2.7675,.1448574,1.4
1,1.478777,3.452733,-1.914049,.7
1,1.478777,2.082267,-1.914049,.7
1,2.600139,4.172283,-1.463382,.7
1,2.600139,1.362717,-1.463382,.7
1,3.736916,3.478194,-1.028809,.7
1,3.736916,2.056806,-1.028809,.7
1,3.102409,2.7675,1.646224,.64
1,.9485256,4.031694,.9354568,.64
1,.9485256,1.503306,.9354568,.64
2,3.764398,2.7675,2.57653,.49
2,.2750717,4.805487,1.447286,.49
2,.2750717,.729513,1.447286,.49
3,.6032948,3.99627,-2.253337,.38
3,.6032948,1.53873,-2.253337,.38
3,2.599153,5.24718,-1.46145,.38
3,2.599153,.2878199,-1.46145,.38
3,4.62338,4.01841,-.6888774,.38
3,4.62338,1.51659,-.6888774,.38
```

Figure 1: *The data file for* $Cr(C_6H_6)(CO)_3$, *tricarbonyl(benzene)chromium(0).*

patterns from previously tiled patterns must not supply a terminating condition for tiling atoms that are closer to the viewer. I have not, as yet, encountered a situation in which the program has failed to avoid these problems. The program takes 20 to 40 seconds to draw a molecule.

CONCLUSION

COLOR3D.BAS lets you generate displays of molecules in color on the IBM PC or compatibles. Each type of atom is easily identified because it has a difference in color or pattern than other types of atoms. This program should be helpful to scientists and students who wish to understand the relationship between molecular structure and chemical behavior. [*Editor's note:* COLOR3D.BAS *and* DATAGEN.BAS *are available for downloading from* BYTEnet Listings *at* (617) 861-9764. *Also, a number of data files are available for individual molecules, along with a data file that produces the patterns in photo 5, all of which have names with a* .DAT *extension, such as* BENZENE.DAT. *You will need an* IBM PC *or compatible with* BASICA *and an* RGB *monitor to run the program. You can also obtain these listings on disk.* *See page* 350 *for details.*] ■

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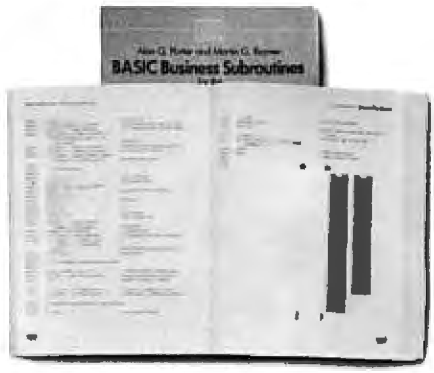

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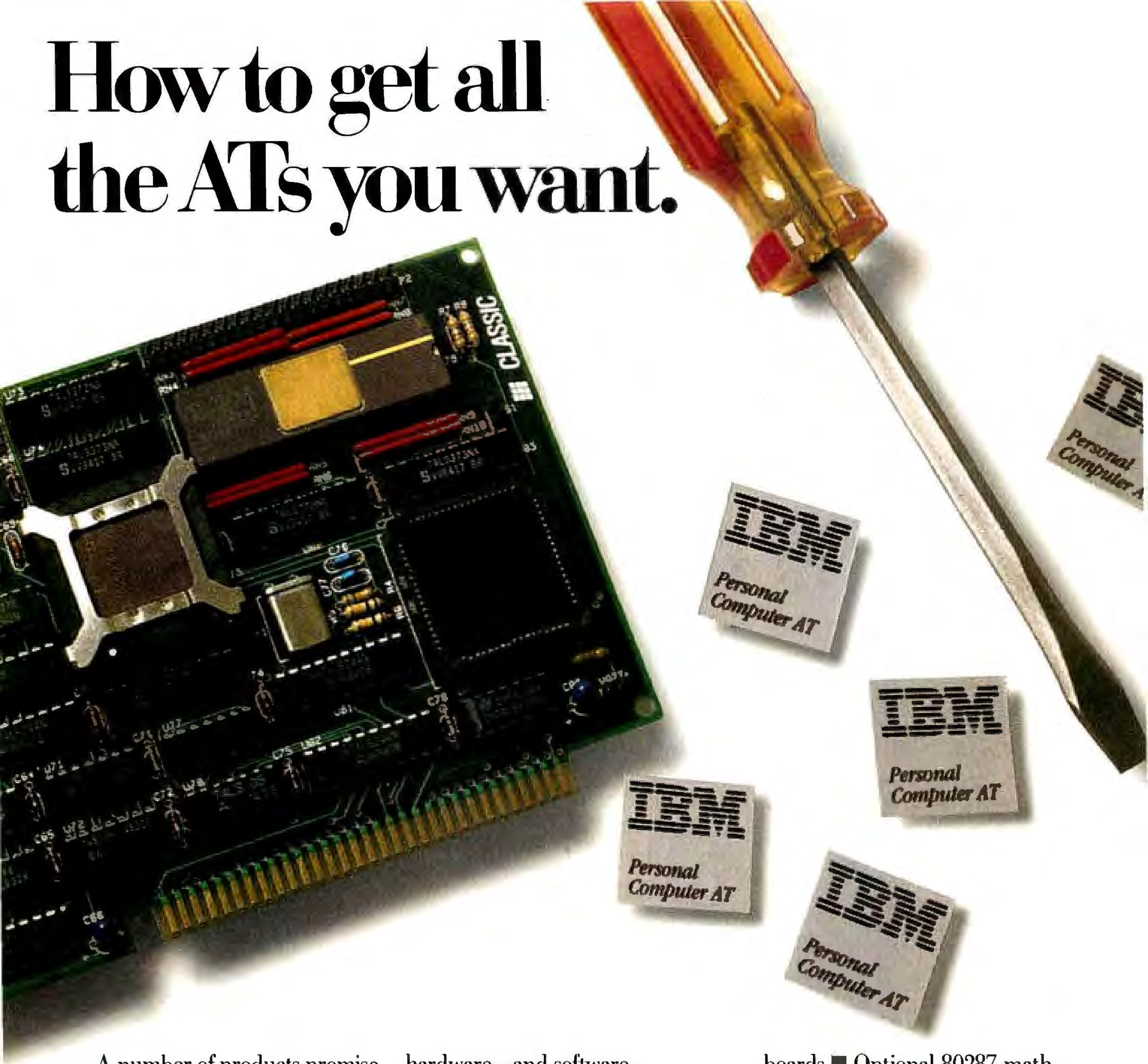

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BADFILE: CP/M SYSTEM PROGRAMMING IN C

BY LOUIS BAKER

This utility identifies the names and locations of files containing bad sectors or tracks

THE PLETHORA OF CP/M utilities that were designed to help users who have encountered bad sector problems, such as Disk Doctor and Findbad, often fail to supply some useful information. It's important to know what file, if any, contains the bad sector and where it is located. This may not be of interest to you if you are using a disk straight out of the box, but it is valuable information if your disk contains files you want to salvage. The utility I will describe, Badfile, gives you the name and location of the file if you know the bad track and sector or its allocation group. (The CP/M utilities Disk Doctor and Findbad are two that will supply this track and sector information.)

I wrote this routine in Manx Software Systems' Aztec C, version 1.05, as an experiment to determine the advantages and disadvantages of coding in C versus assembly language for CP/M. The August 1983 issue of BYTE, with its C-language theme, inspired me to become more familiar with C, and writing this utility seemed a fine way to start.

In addition, the Badfile utility was just the excuse I needed to delve into CP/M.

ADVANTAGES AND DISADVANTAGES OF C

The major virtues of the C language are its flexibility and portability. For example, you have the ability to address individual operand bytes through pointers and unions, to store important variables in registers, to use logical shifts, bit-wise operations, and pre- and post-incrementing and -decrementing of variables. Yet you do not sacrifice the ability to specify loops easily or calculate arithmetic expressions, including floating-point operations. The typical constructs of structured programming, i.e., if . . . then . . . else, while, for, and switch statements, are available, as well as labels and goto statements, when the occasion demands.

C will not generate code that is as fast or memory-efficient as assembly language. This is a potential problem in writing a BIOS (basic input/output system) but generally is not a problem in utilities. The code I discuss here is I/O (input/output)-bound rather than compute-bound and requires negligible time to scan the directory of a 5¼-inch disk.

While writing this article, I came across Andy Johnson-Laird's book *The Programmer's CP/M Handbook* (Osborne/McGraw-Hill, 1983). In the first half of the book he discusses writing custom BIOS routines in assembly language, but then he uses C to discuss utilities. To me this seems a reasonable approach.

The C language has been criticized for not being as self-documenting as Pascal or COBOL. However, it is clearly more readable than machine-language code. Loop structures are obvious, especially when you employ the indented format found in structured languages in general.

AZTEC C

The Aztec C compiler has virtues that make it the CP/M C compiler of

(continued)

Louis Baker (2904 La Veta Dr. NE, Albuquerque, NM 87110) has a Ph.D. in astronomy from Columbia University and works at Mission Research Corporation in Albuquerque.

Listing 1: *The Badfile utility reports the location of a bug within a file of a given track and sector or allocation group. This program is for CP/M systems.*

```
#include "libc.h"

#define ESC 27
#define CR 13
#define LF 10
#define FF 255 /* code returned by find bdos call if no file */
#define DFCB 92 /* 92 = 5CH address of default file control block */
#define DMA 128 /* address of DMA */

struct dph {
    char spt[2];/* low order byte first */
    char bsh;
    int blmexm,dsm,drm,al,cks; /*not used */
    char off[2];
  } /* disk parameter block structure */ ;

struct fcb{
    char drive;
    char fname[8];
    char type[3];
    char fex;
    char sys[2];
    char frec;
    char falg[16];
    char cr;
    char r0,r1,r2;
} /* file control block */;

main (argc,argv) /* identify file corresponding to bad sector */
int argc;
{
    register int i;
    static int mode,alg,track,sector,secpt,offset,bls,length,j;
    static int bad,blksf,driven,bc,de;
    int *hl;
    struct fcb *fcbp,*fcb2;
    struct dpb *dpbp;
    char name[13],byte;
            /* CP/M version number */
    bc=12; de=0 /* used */; j = bdos(bc,de) ;/* this works */
    printf(" CP/M version number %x \ n",j);
            /* desired drive? */
    printf("enter drive (default=0, A=1,B=2,etc) ");
    scanf(" %d",&driven) /* scanf need pointers */;
            /*input desired mode of search */
    printf("enter 0 is track/sector given, 1 if group");
    scanf(" %d",&mode);
    /* BIOS call to select disk if not default */
    bc=driven-1;/* bc registers for disk selection */
    /*SELDSK 9th bios entry hl points to disk parameter
            header */
     if(bc! = -1) hl = bioshl(9,bc,de);
    printf(" alloc. group of disk parameter header %x \ n",hl);
    if(mode= =1) { /* read in allocation group */
    printf(" enter hex alloc. gp.");
    scanf("%x",&alg);
    /* use hl= adr of disk parameter header to get dp block */
        hl = hl +5; /* 5 words = 10 bytes */
    /* hl now points to dpb address */
    printf(" address containing dpb address %x / n",hl);
    dpbp= *hl; /* dpbp= contents of what hl points to */
```

(continued)

choice. As discussed by Christopher O. Kern in "Five C Compilers for CP/M-80" (August 1983 BYTE, page 110), it was the only compiler reviewed that fully implemented the Kernighan and Ritchie standard C language and possessed their standard library. Full source code (C or assembly language) is provided. The code is compatible with the Microsoft M80 assembler, making it possible to use the Microsoft FORTRAN libraries from C or write C routines callable from FORTRAN or compiled BASIC. Only the linkage conventions and floating-point formats differ.

However, Aztec C is not a perfect compiler. Page VI.22 of the Aztec C manual states that the function bdos returns the contents of the HL register. In fact, it returns the contents of the A register. You have to call the undocumented function bdoshl to achieve the stated effect. Fortunately, the source code that is provided with the compiler lets the programmer discover this function (with a bit of digging). The BIOS calls bios and bioshl have a parallel structure to the BDOS (basic disk operating system) calls that lead one to suspect such a function might exist.

I noted a circumlocution in the manual's description of the function pfilen, which is necessary to get around a compiler bug. If you attempt to use only one structure pointer, fcb2, which is passed as an argument and used in operations within the pfilen function, the result is a compiler error code 88—"not a structure." The manual's syntax is identical to that of an example on pages 148–149 of Jack Purdum's *C Programming Guide* (Que Corporation, 1983). The compiler accepted fcb2 as pointing to a "local" structure within the function, with the pointer passed to the function being used in an assignment statement.

BADFILE

I have tried to make the source code for Badfile (shown in listing 1) fairly self-documenting through the use of indentation and comments. [*Editor's note: This source code for Badfile is also avail-*

(continued)

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```
        printf(" loc of dpb %x \ n",dpbp);
        /*dpbp points to address in dpb field of dpb */
        }
        else {
                printf(" enter track(decimal)");
                scanf(" %d",&track);
                printf(" enter sector (decimal)");
                scanf(" %d",&sector);
                /* determine allocation group */
                /* another way to locate dp block-BDOS CALL */
                bc = 31;
                dpbp = bdoshl(bc,de) ;/* get dpb address.
                                       de unused */
                /* now find allocation group */
                secpt = (dpbp- >spt[0]) +256 * (dpbp- >spt[1]) ;
                printf(" sectors per track %d \ n", secpt);
                offset= (dpbp- >off[0]) +256*(dpbp- >off[1]);
                printf(" offset %d \ n",offset);
                blksf = dpbp- >bsh;
                /* printf(" loc offset %x \ n",&(dpbp- >off)); */
                printf(" block shift factor %d \ n",blksf);
                alg =
                 ( (track - offset)*secpt +sector - 1 ) > >(blksf);
                } /* END of else clause */
        /* echo check */
        printf(" alloc.gp. = %x \ n", alg); /* code working up to here */
                /* now search for that alloc. gp. */;
        fcbp = DFCB        /* specify file control block */
        fcbp- >drive= driven /* drive name */;
                /* set file name,type,extent to wild card= ? */
        for (i=0;i<8;i+ +)
                fcbp- >fname[i]= '?';
        fcbp- >type[0]= '?';fcbp- >type[1]='?';fcbp- >type[2]='?';
        fcbp- >fex= '?' /* we don't use strings, which require /0
                term. */ ;
        /* loop over files max 64 directory entries in CP/M*/
        length = dpbp- >drm;
        print(" directory length %d entries \ n",length);
for (bc=17,j=0; j<length;j+ +,bc=18) {
                mode = bdos(bc,fcbp);
                 /* DE=fcbp points to fcb. A=directory code
                  in variable mode =FF if done else 0 to 3 */
                if (mode= =FF)
                        goto fini;
                fcb2 = mode*32 + MDA ;/* point to found fcb */
                /* loop over groups in this extent */
                for(i=0;i<16;i+ +){
                        if(fcb2- >falg[i]= =alg)
                                goto found;
                        /* could put here goto next file if falg=0 */
                if (fcb2- >falg[i]= ='\ 0') break;
                } /* end of the for loop over extent*/
        } /* end of for loop over directory entries */
fini: printf(" no user file at that group \ n");
        goto term;
found:/* print file name. get size and approx. position */
        j=fcb2- >fex;
        printf(" bad record %d of extent %d \ n",i+1,j);
                /* BDOS call for record count */
        bc=35;
        fcb2- >drive = fcbp- >drive:/* move drive i.d. to
        make fcb out of file information in DMA area */
          hi = bdoshl(bc,fcb2); /* CP/M to get record count*/
```

(continued)

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BADFILE

```
/* call to bdos or CP/M equivalent, as answer in fcb */
      if ( (fcb2- >r2) = = 1 ) length = 65536;
        else length = ((int)(fcb2- >r0)) + 256*((int)(fcb2- <r1));
      printf(" bad file: %d records \ n",length);
/* position of bad sector NB- 1 record can be >1 sector in file */
      length=(100*(16*j+1))/length;
      printf(" bad record approx %d percent into file: \ n",length);
      pfilen(fcb2);
term: exit(0);/*return to system, job done */
}
pfilen(fcb){
struct fcb *fcb2,*fcb;
static char pname[9],ptype[4];
register int i;
      fcb2=fcb;
      pname[8]='\ 0';ptype[3]='\ 0';
      /* move i no longer needed for position of bad gp. */
      for (i=0;i<8;i+ +) pname[i]= fcb2- >fname[i];
      for (i=0;i<3;i+ +) ptype[i]= fcb2- >type[i];
      /* terminate string name—eliminate trailing blanks in name */
      for (i=7;1> -1;i- -){
                if(pname[i]= =' ')pname[i]='\ 0';
                else break; /* do NOT eliminate embedded blanks */
      }
/* output file ID */
      printf ("%s.%s \ n",pname,ptype);
}
```

able for downloading via BYTE*net Listings at* (617) 861-9764 *and can be obtained on disk* (*see page* 350 *for details*).] The file-control block and disk-parameter block are declared as structures. You might be able to gain some speed by mapping byte and integer arrays onto these structures with a union declaration; however, to attain this speed gain, you might have to sacrifice clarity and portability of the program.

In the listing, I describe two routes to the disk-parameter block. The first, used when the allocation group is specified, uses BIOS calls to find the disk-parameter header, which contains the address of the disk-parameter block. The second route, used when the track and sector are specified, uses BDOS calls. The size of the file is found with a BDOS call, while the drive is selected with a BIOS call.

The Badfile program does not make any attempt to determine if the bad sector is in an erased file. If the file has been erased, chances are you probably don't care if it is subsequently "lost" through a bad sector. The directory is searched until BDOS call 17 or 18 returns a hexadecimal FF in the HL register. If the offending allocation group is not part of a file, it is reported. Otherwise, BDOS call 35 is used to find the size of the file, and the approximate position of the bad group in the file is reported along with the filename.

CONCLUSION

I have described a program that will help you locate bad files. It will give you the name and location, if you know the bad track or sector. It is written in C, which has some drawbacks, but I believe its use, as explained in this article, illustrates the potential of C for writing utilities. Overall, I think that Badfile can be of use to many CP/M users. ■

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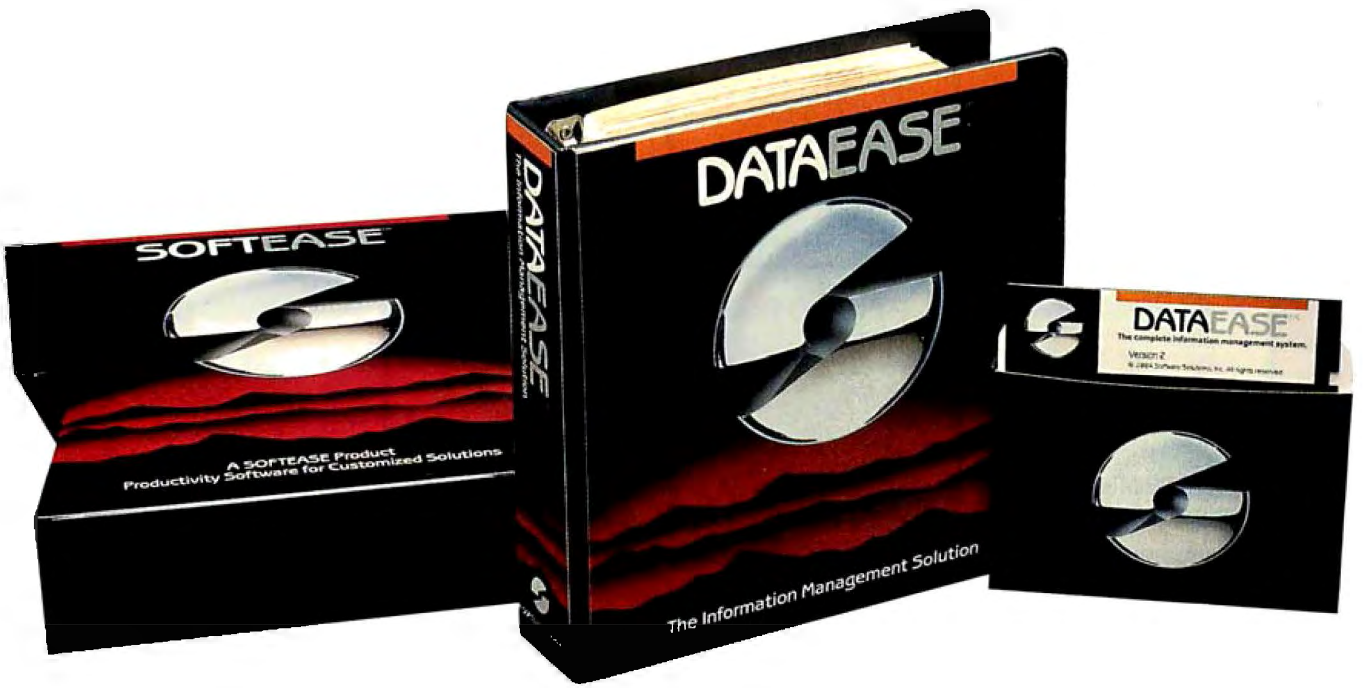


ABCDEFG

Text Processing

"PROCESSING TEXT" PERHAPS better summarizes the contents of this theme, since all of the articles discuss the manipulation, analysis, and organization of text. And, be forewarned, the interests of our authors extend well beyond mere word processing.

When Donald Knuth first got involved with text formatting eight years ago, he could not have predicted that the problem would consume so much of his time. His interview with G. Michael Vose and Gregg Williams reveals his excitement.

Like Knuth, Pierre MacKay also has devoted his time to the area of computer typesetting. His article explores scripts that provide a challenging series of problems in text formatting.

Jim Tankard offers a delightful series of programs that determine with some precision the authorship of text by examining text structure and word use. In particular, he applies the programs to the historic *Federalist* papers, to determine the relative contributions of James Madison and Alexander Hamilton.

For those interested in immediate rewards, James Gimpel explores SNOBOL4, whose pattern-matching facility makes it a particularly rich language for analyzing strings. His examples bring out the richness and flexibility of a language that is highly useful for a variety of text-processing tasks.

For the more immediate future, Michael Newman, an enterprising poet, discusses the enlightened possibilities for poetry processing; Paul Holzer, a programmer working with Michael, presents an interesting algorithm for syllabification, a necessary step in comparing prose to meter.

In the challenging realm of artificial intelligence, Jordan Pollack and David Waltz offer a model for a psychologically realistic natural-language processor that takes syntax, semantics, and contextual knowledge into consideration. The article and the code they provide reveal many of the problems of and potentialities for natural-language interpretation.

Finally, Donald Olson and Laurie Jasinski test the conventional assertion that the Dvorak layout vastly lessens finger travel compared to the standard QWERTY layout. Without doubt, Dvorak typists will continue to extol their method, but the article should at least dispel some common claims.

The primary use for most microcomputers is, and undoubtedly will remain, the processing of text; as the articles in this section well illustrate, however, there is much more to text processing than word processing. So it should be.

—*Jon R. Edwards, Technical Editor*

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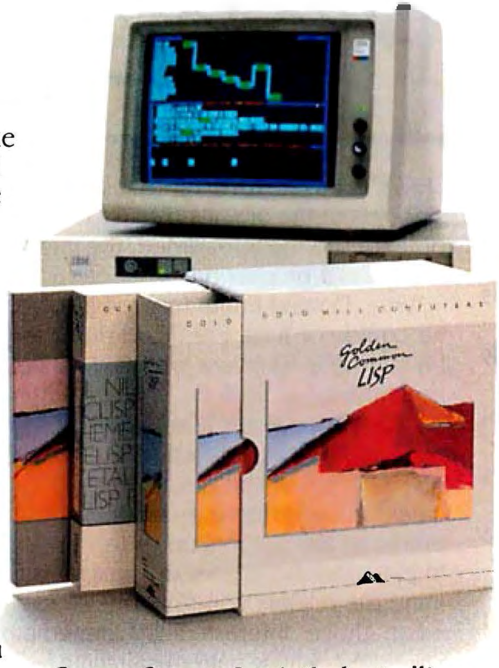

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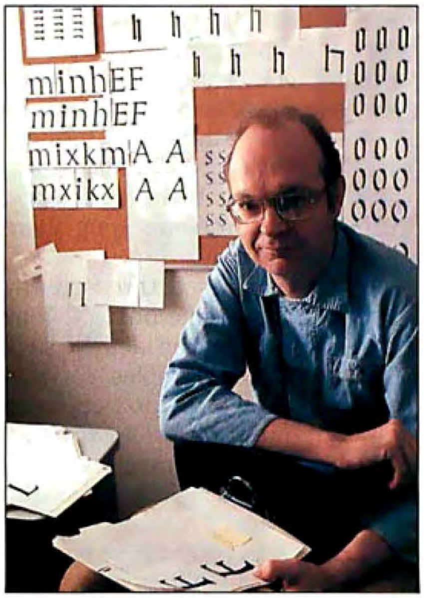
COMPUTER SCIENCE CONSIDERATIONS

CONDUCTED BY G. MICHAEL VOSE AND GREGG WILLIAMS

Donald Knuth speaks on his involvement with digital typography

Text processing as a computer science problem has consumed a major portion of the time and energy of Stanford professor Donald Knuth over the past eight years. Knuth authored and placed into the public domain a highly regarded typography system that he calls TEX *(pronounced "tech"), along with a font creation language called* METAFONT. *In conjunction with the completion of* TEX, *Knuth and Addison-Wesley are publishing a five-volume work entitled* Computers and Typesetting. *Volume 1 is* The TEXbook, *volume 2 is the source code for* TEX, *volume 3 is* The METAFONT Book, *volume 4 is the* METAFONT *source code, and volume 5 is* Computer Modern Typefaces.

To discover what so intrigued Knuth about this subject, BYTE *senior editors Gregg Williams and Mike Vose conducted the following interview with Professor Knuth at Addison-Wesley's offices in Reading, Massachusetts, on November 11, 1985.*



Donald Knuth

BYTE: *Dr. Knuth, how did you become involved with digital typography and the public-domain system known as* TEX?

Knuth: : got interested because I had written books and seen galley proofs, and suddenly computers were getting into the field of typesetting and the quality was going down.

Then I was working on a committee at Stanford planning an exam, and we got a hold of some drafts of Patrick Winston's book on artificial intelligence. We were looking at it to see if we should put it on the reading list for a comprehensive exam. It had just been brought in from Los Angeles where it had been done on a digital phototypesetter. This was the first time that I had ever seen digital type at high resolution. We had a cheap digital machine at Stanford that we thought of as a new toy. But never would I have associated it with printing a book that I'd be proud to own.

Then : saw this type, and it looked as good as any I had ever seen done with metal. I knew that it was done just with zeroes and ones. I knew that it was bits. : could never, in my mind, ever, conceive of doing anything with lenses or with lead, metallurgy, and things like that. But zeroes and ones was different. I felt that I understood zeroes and ones as well as anybody! All it involved was getting the right zeroes and ones in place and : would have a machine that would do the books and solve all the quality problems. And, also, I could do it once and for all. I still had a few more volumes to write |*of his seminal work,* The Art of Computer Programming, *a seven-volume series of which three volumes are finished*| and

(continued)

'I was excited that I started out trying to apply computer science to typography and wound up applying typography to computer science: in fact, right in the center of computer science.'

by the time I was ready with volume 7, the technology would change another three times and the quality would go down each time. So if I could only figure out a way to generate the right zeroes and ones, then I could have that in a computer program that I know how to write, and everything would be solved.

So within a week of seeing this example from Winston's book, I told my wife I had to start changing my present plans to work on typography. I was going to spend one year doing all this typography, and I was going to write a system that would be useful to do my books. At the end of the year I would go back to write those books the way I had been doing.

BYTE: *And what year was this?*
Knuth: That was 1977, '78. If I had estimated that it would take eight years, of course, I never would have started. I certainly didn't have any idea that this would be as difficult a problem as it turned out to be. It looked pretty easy to me at first.

BYTE: *So you embarked on this project mostly out of necessity—you needed a superior system for producing your books. Then, once you got into it, what captivated you about typography as a computer science problem that's held onto you for eight years?*
Knuth: I found that it was very rich. I found that there were a lot of things below the surface that were really interesting from both the theoretical and the practical points of view. For example, I needed to develop a lot of mathematics for rounding curves so that they looked right as raster images. At first, I didn't think that was going to be very hard. I didn't realize the importance of symmetry, how hard it is to make a left parenthesis look like a mirror image of a right parenthesis if you don't put the line exactly the same. If you have something that wants to be 2½₀ pixels wide and you put it down in one place it becomes 3 and in another place it becomes 2. All of the obvious approaches to visualization failed. I kept going on it because I felt that I was in the right place at the right time and was destined to do the job.

I knew that these were problems that took a pretty good mathematician to solve, and there weren't any other good mathematicians looking at it. So I felt that it was my duty, and it was also interesting. And partly because I felt that here I was with 40 years of training pertinent to this interesting and important problem. New things kept turning up because it was a case where the territory hadn't been gone over by mathematicians before, so there were good mathematical problems lying there just for the asking.

And there was another reason why I spent so much time on TEX. Tony Hoare came up with an idea. He said, "Don, we need examples of large computer programs for people to look at," and he said, "How about publishing your programs for TEX." That was mind-boggling. I thought, "I'm a professor of computer science and I hacked together this program in a big hurry trying to finish it in a year and now I'm supposed to publish it! Ouch—I have a reputation as a computer scientist. Nobody ever shows what you really do in computer programs, so this is out of the question. We tell students what they are supposed to do, but do we really have time to dot the i's and cross the t's when it comes down to it?" On the other hand, it seemed to me that this was kind of a ridiculous situation, for a professor of computer science to be ashamed of a program he had written. Could I really do something that would make a large program understandable? Could I write a program that was useful, accommodating the compromises of the real world, and still have something that I could say that I was proud of?

Then it occurred to me, I had one thing going for me that would make it easier: I had a typographic system, so I could use typography to help the documentation of my programs. So then I realized that there were lots of other ideas floating around that people had used that could all be brought together with typography in making a way of documenting programs so that a large program could be well understood.

This led to what is now called the WEB system, a new way to write programs. |*Editor's note: Knuth defines* WEB *as follows: "*WEB *is itself chiefly a combination of two other languages: (1) a document formatting language and (2) a programming language. My prototype* WEB *system uses* TEX *as the document formatting language and* Pascal *as the programming language, but the same principles would apply equally well if other languages were substituted." Quoted from "Literate Programming" by Donald E. Knuth,* The Computer Journal, *vol. 27, no. 2, 1984.*|

BYTE: *So* WEB *as a programming paradigm grew out of a fusion of typography and structured programming?*
Knuth: It turned out that I got so excited about WEB that I wanted to go back and rewrite every program I had written since the 1950s. I felt that at last it was real programming. Of course, I'm too much of a fan of this |WEB| to be considered unbiased. I love the fact that once I got to be writing programs in this way it was a turn-on just because I felt that the program was being exposed the way a program should be, and I am an expositor at heart.

I was excited that I started out trying to apply computer science to typography and wound up applying

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typography to computer science: in fact, right in the center of computer science.

BYTE: *Right now one of the hottest topics in computers is desktop publishing, and there is a plethora of new programs out that do what TEX does, only not as well. Are programs like TEX going to fundamentally alter the way people work with words?*

Knuth: I think it will affect a lot of people. I'll just tell you what I know about this. Whenever something becomes a lot easier, when a person has the power to do something he couldn't do before, this affects his life. When something becomes 10 times cheaper than it was before, all of a sudden it becomes an option for somebody that they never would have thought of. In my case, when type became zeroes and ones instead of metal, it became an option to me.

I would say that about 60 percent of our students get infected with the idea that they can do beautiful typesetting. Therefore, they are writing better term papers. They are thinking more about the problem of communication, and, since they are in control of it and don't have to explain a notation to some intermediary, then they are coming up with better notations. They will now consider a part of their own job description to be communicating in type, which they never would have thought if they had only a typewriter. My own experience is mainly with computer science students, but other parts of the community are affected, too. You find a lot of chemists and a lot of physicists, and musicians to a great extent.

Even when we had only low-quality, low-resolution printers, the precursors to TEX excited people. Stanford, Carnegie-Mellon, MIT, and USC were given four obsolete XGP printers, which Xerox decided not to market, about 1972, '73. These printers had a resolution of 200 dots to the inch, but that resolution was actually 240 dpi in the middle of the page and 150 at the edges of the page. (Words looked different on different parts of the page because the machine was intended to scan in at the same distortion and scan out. It was not intended to be a computer generating the image; it was intended that the image was to be gotten by analog means and produced in analog.) The machine was of poor quality, but people had a lot of fun making fonts for it. After three years of this, so many people had come up to the Stanford AI Lab just to use that machine that the parking lot would be only half full on a day that the XGP was busted. An important part of their lifestyle was to be able to use this printer. And you see that there's this lurking tendency in a lot of people to experiment. When IBM puts out another type ball for the Selectric typewriter, Olde English or something, all of a sudden thousands of documents are created with Olde English in all caps. People just love to see something new that they can control and make words come out in a different way. This is lurking everywhere, and it is blossoming now because it's becoming available to people through less expensive machines all the time. So I know a revolution is coming. Some of the output people generate will be atrocious, but it will also have the good effect that people will take pride in their work; they will put some more time into it and do a good job.

BYTE: Is TEX *finished at this point?*

Knuth: Yes. Absolutely.

BYTE: *Are you going to move on?*

Knuth: I'm going to write volume 4. When I get back from sabbatical I'm going to spend three months gearing up to work on the book and start writing in January '87. ■

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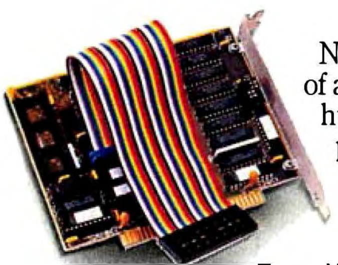

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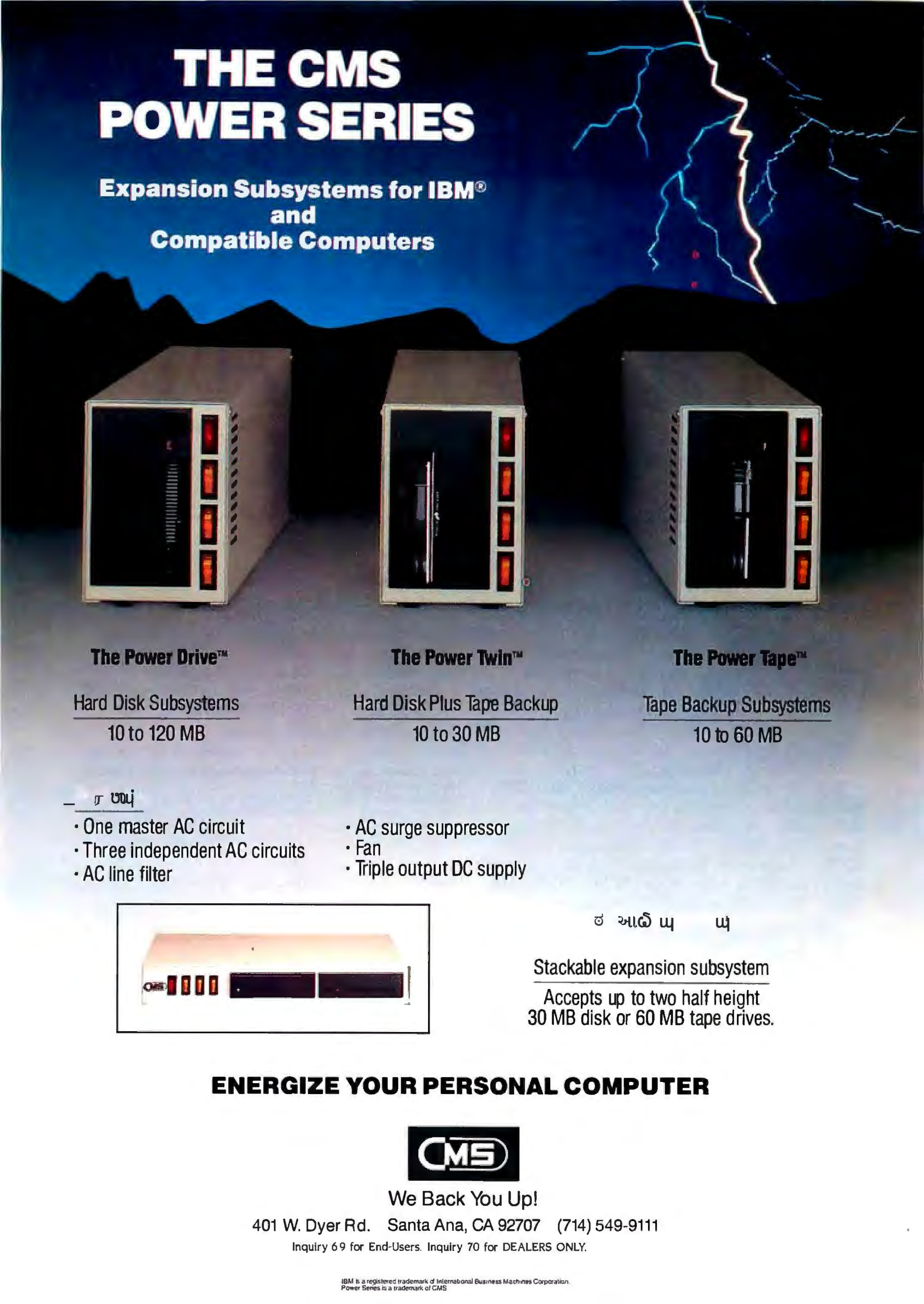
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PROCESSING STRINGS IN SNOBOL4

BY JAMES π GIMPEL

Some elegant examples of this language's pattern-matching capabilities

TO THE MODERN PROGRAMMER familiar with microcomputer operating systems, SNOBOL4 is perhaps more like Prolog, APL, and LISP than Pascal, C, Ada, and Modula-2. Its strong points are its ease of use, portability, free-floating (garbage-collectable) storage, and its great facility for manipulating strings of characters. SNOBOL4 grew out of a mainframe environment (there *was* nothing else back then) but inherits very little from its batch-processing origins except one characteristic: size. Early versions of SNOBOL (SNOBOL and SNOBOL3) could fit comfortably within the equivalent of a 128K-byte main memory environment, but SNOBOL4 could not. Hence the adaptation of SNOBOL4 to the micro environment had to wait until 256K-byte memory machines became widely available.

SNOBOL4 is a rich language. It contains fully dynamic arrays and structures, the ability to convert strings at run time to executable code, the ability to return variables from functions (i.e., a function call may appear on the left-hand side of an assignment operation), the ability to define new operators or redefine or extend old ones, a form of associative array called the table, and a comprehensive set of tracing facilities. On top of this, it has a pattern-matching facility so rich as to amount to a language within a language.

Such flexibility is largely the result of an inner structure that is harmonious, even elegant, in which all objects swim about in a pool of common renewable (garbage-collectable) storage and can be uniformly designated by a small one- or two-word descriptor. Whereas BASIC employs a garbage-collection scheme in the support of inert data (strings), APL in the support of arrays (of inert data), and LISP in support of two-valued fixed-size recursive structures (containing the famous car and cdr fields), SNOBOL4 supports all of this plus garbage-collectable units of varying size (arrays and structures) containing pointers to other such units (in support of recursive data structures). Whereas APL has a healthy variety of array operators, SNOBOL4 has a similarly healthy pattern-matching facility employed in analyzing strings. One can readily implement all of LISP (at least classic LISP) in SNOBOL4, but the converse does not hold. The popularity of LISP for artificial intelligence applications may have something to do with its greater availability on small machines and the existence of superb LISP programming environments. Future systems, with larger memory available, will almost certainly be able to support an interactive SNOBOL4 environment, and it will be interesting to see whether SNOBOL4 regains the luster that it once possessed.

EASE OF USE

For years, SNOBOL has been a synonym for programming ease, especially in its specialized area: string processing.

(continued)

James F. Gimpel received his Ph.D. from Princeton University and spent 15 years working at Bell Laboratories. He is currently an associate professor at Lehigh University and can be contacted at the Department of Computer Science and Electrical Engineering, Lehigh University, Bethlehem, PA 18015.

For example,

```
A = B C
```

will concatenate strings B and C and assign the result to A. As another example,

```
A 'Cat' = 'Tiger'
```

will scan the string A looking for the substring 'Cat' and (if found) replace it with 'Tiger'. Also,

```
LOOP   S ' ' =      :S(LOOP)
```

will search S for a blank, replacing it with nothing and, if successful, branch to label LOOP, thereby repeating the process until all blanks are removed from S.

To carry out these operations in most other languages requires a detailed prescription for the sequential indexing through one, two, or three arrays of characters and, in the case of substitution of one string for another, a sophisticated storage-management facility. Yet here they are specified with the simplicity and ease of addition or subtraction. It is for reasons such as these that SNOBOL4 has been characterized as a nonprocedural (you don't have to specify the exact procedure) or DWIM (do what I mean) language. It has also been described as a right-hemisphere language, referring to the fact that the appeal is to the artistic or intuitive portion of the programmer's brain rather than the logical and exact but plodding left hemisphere.

The original SNOBOL did not have much more than these basic fundamental operations and was quite successful. Replacement associated with the conditional branch is all that you need to program anything that is programmable (shown by Markov in 1956 and called the Markov algorithm). SNOBOL3 added arithmetic operations and functions and a more abundant pattern facility.

SNOBOL4 is the most recent and easily the most sumptuous of this series of languages. Its pattern-matching facility is so powerful that a pattern could be written that could match SNOBOL4 itself, i.e., an arbitrary SNOBOL4 program. By the introduction of alternation to the set of pattern operators and by elevating patterns to the status of data objects and using deferred evaluation (a kind of indirection), you can directly translate any BNF (Backus-Naur Form) expression into a SNOBOL4 pattern. It's worthwhile presenting a simple example of this. Suppose we want to match simple arithmetic expressions involving ' + ', 'A', and parentheses. We may assign

```
F = 'A' | '(' *E ')'
```

By this we are assigning to F (for factor) a pattern that matches either 'A' or a '(' followed by an E (for expression) followed by ')'. The *E means "defer evaluation of E until pattern-matching time—not at the time of assignment." Then we write

```
E = *F ( '+' *E | NULL )
```

This specifies that E is a pattern that matches any factor (F) followed optionally by a ' + ' followed by an instance of E. If the ' + ' is not there, NULL will match the null string. To apply the pattern E to match the contents of a string S we may employ it in a pattern-matching statement as in

```
S  E
```

or more likely we might embed the E in another, larger pattern.

Not only can the patterns of SNOBOL4 encompass all of BNF, but, through the deferred evaluation mechanism (applied to functions), they can make any test at pattern-matching time. Theoretically, a pattern can be written to match anything recognizable. This goes considerably beyond the capabilities of BNF.

But if SNOBOL4 can recognize an arbitrarily complex pattern, so what? Would that facility be merely a programming curiosity? Or could it be used successfully in a practical translation process? Perhaps surprisingly, it took a number of years to realize how this could be accomplished easily and naturally within the existing language facilities. I will present an outline of this technique toward the end of this article.

An Interactive Environment

Although SNOBOL4 lacks a formal interactive environment as part of the implementation, you can easily write a simple interactive testing facility. One such is shown below, and the novice SNOBOL4 programmer is urged to write something like this in order to test expressions or small sections of programs:

```
LOOP    S_  = INPUT                          :F(END)
        S_  ';'                              :S(STMT)
        OUTPUT = EVAL(S_)                    :(LOOP)
STMT    C_  = CODE(S_ '; :(LOOP);' ):S<C_>
        OUTPUT = '*** Syntax'                :(LOOP)
END
```

What the program does is this: If the input line contains a semicolon, the line is taken to be a SNOBOL4 statement (or statements separated by semicolons) and is executed. If it does not contain a semicolon, it is assumed to be a SNOBOL4 expression, and it is evaluated and its value printed. In either case, flow of control goes back to LOOP. The keys to converting strings of text into executable SNOBOL4 code are the functions EVAL() and CODE(). The EVAL() function evaluates expressions (like a function of the same name in LISP) and the CODE() function converts strings of text into an executable form. The strings of text are assumed to be SNOBOL4 statements separated by semicolons.

The first line of the program reads a line from the console (on an end-of-file condition a failure occurs, directing control to the END label where the program terminates). We deliberately used a strange variable name, S_, to avoid collision with any user variables. We test to

(continued)

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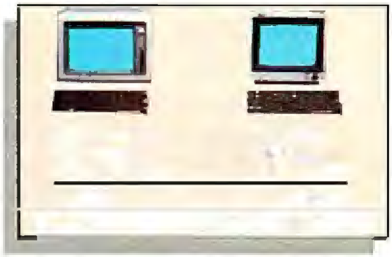

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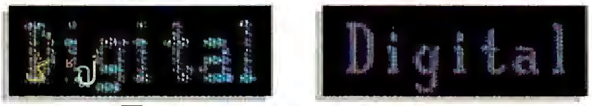

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see if the line contains a semicolon, and if so we branch to STMT. Otherwise we call upon EVAL() to evaluate the expression and print out the results. Control then returns to LOOP.

At the statement labeled STMT we call upon the CODE function. Notice that we first textually append to the string a jump to the label LOOP so that we are assured of getting there after execution. We precede the GOTO with a semicolon so that there is no interference from any other GOTO construct in the line. The value returned by CODE() is a data object; the data object represents code that is potentially executable. No execution occurs until we branch to the code by means of the <C__> construct in the GOTO field (note the angle brackets, which are different from the parenthesized forms in other statements).

If CODE fails, we had a syntax error, and we receive a report to this effect.

This interactive environment is very primitive but is quite effective in trying to figure out what the language does with various constructs. Below is a sample session:

```
Human:        S = 'A QUICK BROWN FOX';
Human:        S  'FOX' = 'WOLF';
Human:     S
Machine:   A QUICK BROWN WOLF
```

You must take care to indent the statements or else SNOBOL4 will interpret the first identifier (S in the above) as a label.

"Bread and Butter" Facilities

Before proceeding with intricate SNOBOL4 algorithms, it is wise to consider a garden-variety string-processing problem and see how SNOBOL4 is uniquely capable of demolishing its complexity.

Consider the following problem (one which I had to write recently in another language, unfortunately). The input file contains text all in lowercase. Some of the information in the file, every instance of some selected set of names, must be converted to uppercase. The names to be converted are to be read from some other file (which I will simply refer to as file number 2). The SNOBOL4 program in listing 1 will perform the conversion.

The third line of the program associates the variable NAMES with file number 2. We subsequently employ TRIM(NAMES), which delivers a line from file 2 stripped of trailing blanks. At LOOP1 the names to be capitalized are read in. They are grouped together in a big pattern. In the line following LOOP1, this pattern is associated with the variable NM. This causes NM to be assigned the characters matched by PATTERN.

At LOOP2 the lines of the input file are read. At LOOP3 they are repeatedly matched and replaced by their uppercase equivalent. Finally, the LINE is output and the program returns to LOOP2 for another line from the input file.

Few, if any, programming languages can match this level of simplicity and, if it were not for the labels strewn about, you might even say elegance. (I should mention that no conclusive experimental evidence exists to indicate that GOTOs are hard to follow by human readers. Indeed the evidence for small programs seems to be the opposite.)

A purist would point out that you may not want to blindly search for names in a file, since they might be embedded in longer names. This deficiency is easily corrected by placing the following line after LOOP1:

```
  PATTERN =    (POS(0) ONOTANY(LOWS))    PATTERN
+              (RPOS(0) I NOTANY(LOWS))
```

This indicates that the string to be matched must be at the left edge of the string (POSition 0) or be preceded by a nonlowercase and it must be followed by either the extreme right of the string (Right POSition 0) or a nonlowercase character. [*Editor's note: The + in the leftmost column indicates a continued line in* SNOBOL4.]

At this stage it is instructive to consider how much work would be involved in writing this program in your own favorite programming language and then, once this version is written, how arduous (and error-prone) it might be to make the enhancement I just mentioned.

Structured SNOBOL4 Programs

SNOBOL4 has a function (or subroutine) capability with an unusual twist: the function's definition is executable. This results in great flexibility but, if used unwisely, can serve to destructure SNOBOL4 programs.

Consider the example shown in listing 2, which defines a function ROMAN(n) that converts an integer to Roman-numeral form. Thus ROMAN(23) returns 'XXIII'.

The function starts with DEFINE, which when executed establishes the existence of the ROMAN function as starting at label ROMAN and continuing until the thread of execution takes it to a RETURN (or FRETURN or NRETURN) statement. After defining the function, we jump around the body of the function to avoid flowing prematurely into it.

The first line of the function rips off the last character from the string N. "What string?" you say, "you passed ROMAN a number." No matter: the conversion from number to string is made automatically by the pattern matcher. This first pattern match looks strange until you realize that the binary dot operator has higher precedence that concatenation. RPOS(1) matches a position just before the rightmost character in the string and LEN(1) matches a string of length 1. Consequently, this one line extracts the last character from the number (thus dividing it by 10) and simultaneously assigns the remainder to T.

The second pattern match is contained on two lines. It converts a number between 0 and 9 to its Roman-numeral equivalent. The pattern BREAK(S), where S is a string, will match all characters up to but not including one of the characters in S. The string beginning with '0,1I,2II,3 . . .' is a good example of simultaneously defining a data structure and accessing it. In virtually all other languages an array would be allocated, a name assigned to it, and the

Listing 1: *This program reads a series of names from one file and converts a select number of those names to uppercase. The names to be converted are read from a second file.*

```
        LOWS = 'abcdefghijklmnopqrstuvwxyz'
        UPS  = 'ABCDEFGHIJKLMNOPQRSTUVWXYZ'
        INPUT  'NAMES', 2
        PATTERN = TRIM NAMES
LOOP1   PATTERN = PATTERN ² TRIM NAMES          :S LOOP1
        PATTERN = PATTERN . NM
LOOP2   LINE = INPUT                            :F(END)
LOOP3   LINE PATTERN = REPLACE NM, LOWS, UPS    :S(LOOP3)
        OUTPUT = LINE                           : LOOP2
END
```

Listing 2: SNOBOL *code for the function* ROMAN() *that converts an integer to Roman numerals.*

```
        DEFINE  'ROMAN N T'                     : ROMAN_END
ROMAN   N  RPOS 1   LEN 1   . T                 :F RETURN
        '0,1I,2II,3III,4IV,5V,6VI,7VII,8VIII,9IX,'
+            T  BREAK ','   . T
        ROMAN = REPLACE  ROMAN N ,'IVXLCDM','XLCDM**'  T
+                                      :S RETURN F FRETURN
ROMAN_END
```

array initialized and then accessed. Anyone reading the program would then be burdened with finding the array and then perhaps determining where values were assigned to it.

The third statement serves to multiply the Roman equivalent of N by 10 using the REPLACE statement; it also tacks on the Romanized version of the remainder.

This algorithm could be rewritten for most programming languages, but few come close to the SNOBOL4 rendition in simplicity and compactness.

EVERYTHING IS A STRING

When using SNOBOL4, it is possible to exploit the paradigm that all the world is a string. That is, all data structures can be represented, however convoluted, in string form. For example, although you can write sort routines for SNOBOL4 that involve arrays or linked lists, probably the simplest sort to write is one where the basic aggregate data object is a comma-separated list, as in the following:

```
',JOE,PAT,TOM,'
```

If S is such a string, a new name, NM, can be inserted into S by a pattern-matching statement:

```
 S ',' (BREAK(',') $ T   *LGT(T,NM) | RPOS(0)) . T
+        = ',' NM ',' T
```

Note that LGT will be successful if the first argument is lexically greater than the second, that the * preceding LGT defers evaluation until pattern-matching time, and that $ T assigns a substring to T dynamically. Thus for each comma in the subject string an assignment to T is made and that value is compared against NM to see if it is greater. Once such a T is found, NM is inserted just before it.

Data objects that are normally handled with linked lists, such as trees, can also be encoded as strings. For example, the tree consisting of a root node labeled A and containing two leaves B and C can be encoded in string form as

```
'A[B,C]'
```

In general, a binary tree is defined as a simple name or a string having the form:

```
name [ tree , tree ]
```

If this is the case, we may define a pattern to match a tree as

```
TREE = NAME ( '[' *TREE ',' *TREE ']' | NULL )
```

Consider then the following problem. Find in some tree called LARGE_TREE an interior node identified as 'Div', replace this node with one called 'Rdiv', and reverse its two subtrees. The following statement will do this:

```
 LARGE_TREE 'Div' '[' *TREE . T1 ',' *TREE . T2 ']' =
+            'Rdiv' '[' T2 ',' T1 ']'
```

I need hardly point out that few (if any) other languages allow you to search an entire aggregate of information and replace and rearrange selected contents all in a single statement.

The advantages of employing strings as data structures

(continued)

Listing 3: A *portion of a* SNOBOL *program to generate random sentences.*

```
        DEFINE ( 'SELECT(S)N' )                       :(SELECT_END)
SELECT
        S  RPOS(1) LEN(1) . N
        N = RANDOM(N)
        S  (N-1) ARB . SELECT N                       :(RETURN)
SELECT_END
        DEFS = TABLE()
        DEFS[ 'SENT' ] = '0The <NOUN> <VERB>s the <NOUN>1'
        DEFS[ 'NOUN' ] = '0boy1man2dog3<NOUN> who <VERB>s the <NOUN>4'
        DEFS[ 'VERB' ] = '0bite1walk2pet3lick4smack5'
        STACK = '<SENT>
        SENTENCE =
L1      STACK  POS(0) '<' BREAK('>') . NM '>' =       :F(L2)
        STACK  = SELECT( DEFS[NM] ) STACK             :(L1)
L2      STACK BREAK('<') .S =                         :F(L3)
        SENTENCE = SENTENCE S                         :(L1)
L3      SENTENCE = SENTENCE STACK
        .
        .
        .
```

are not only that you can employ the powerful pattern-matching operations on entire aggregates but that printing, saving, and restoring aggregates and expressing aggregate constants are all immediately available in the language. Structures become humanly visible for debugging and analysis; also, they may be dumped to disk in a machine-independent and portable manner.

NOT EVERYTHING IS A STRING

Although it is tempting to treat everything as a string, there are many instances where built-in aggregates within the language serve as a better expression of some algorithm, to mention nothing about the increased efficiency.

Consider the following program that will generate random sentences from the schema:

SENT = the NOUN VERBs the NOUN
NOUN = boy | man | dog | NOUN who VERBs the NOUN
VERB = bite | walk | pet | lick | smack

Two sample sentences from an infinite number of possibilities are

the dog bites the dog
the dog who walks the boy smacks the man

A program to generate such random sentences is given in listing 3. SENTENCE emerges from the sequence equal to some random sentence. The program also assumes the existence of a random-number generator RANDOM(N), which returns a random integer uniformly distributed in the range from 1 to N.

The program is something of a halfway house between encoding the data as a string and using a built-in aggregate. Here, we use the powerful and convenient TABLE data structure, a kind of associative array, to record the possible alternatives for syntactic variables (nonterminals). Thus one can assign to and obtain the value of DEFS['SENT'] as readily as one can access A[2] (where A is an array) in some other language. As an added bonus the value of DEFS['SENT'] can be any object (string, number, array, or even another table).

The list of alternatives is kept as a string. A stack is needed to retain the unexpanded sentential forms, but the stack is implemented as a string rather than as some composite structure.

The SELECT() function selects a random component of the list of alternates by doing a pattern match. The latter employs ARB, a pattern that matches an arbitrary string.

Another variation on the design of a stack in SNOBOL4 is the use of structures (or, as they are descriptively denoted, programmer-defined data types). We define three entry points in a package of routines that deal with the stack: PUSH, POP, and TOP. PUSH(X) will push the value X (it may be any type), POP() will remove the most recent item pushed, and TOP() will simply return the most recent item pushed (without popping). As an interesting twist, and something that can't be done in just about any other language, is that PUSH() and TOP() will return variables. In the case of TOP() this means that you may not merely observe the top value on the stack, but you may also modify it as in

TOP() = 'ABC'

PUSH() will place a new item on the stack before returning the top value as a variable. We will exploit this variable-returning property of PUSH in a pattern-matching context as in

Pattern $ *PUSH()

The intent here is that any item matched by Pattern is pushed onto a stack. The binary $ operator normally

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Listing 4: A SNOBOL-*simulated stack.* PUSH(X) *pushes* X *onto the stack,* POP() *removes the item most recently pushed, and* TOP() *returns the top stack entry without popping.*

```
         DEFINE( 'PUSH(X)' )
         DEFINE( 'POP()' )
         DEFINE( 'TOP()')
         DATA( 'LINK(NEXT,VALUE)' )                        :(STACK_END)

PUSH     PUSH_POP  = LINK( PUSH_POP, X )
         PUSH  = .VALUE( PUSH_POP )                        :(NRETURN)

POP      IDENT( PUSH_POP)                                  :S(FRETURN)
         POP  = VALUE(PUSH_POP)
         PUSH_POP  = NEXT( PUSH_POP )                      :(RETURN)

TOP      IDENT( PUSH_POP)                                  :S(FRETURN)
         TOP  = .VALUE( PUSH_POP )                         :(NRETURN)

STACK_END
```

associates a simple variable on the right with a pattern on the left in such a way that, whenever the pattern matches, the value is immediately assigned to the variable. Here we are using a function call, but the basic idea is the same provided the function returns a variable. By placing an asterisk in front of PUSH() we are deferring the call to PUSH() to pattern-matching time rather than pattern-building time. In this way it occurs repeatedly during a pattern match, not just once when the pattern is formed.

As an added bonus, POP() and TOP() fail if there are no more items on the stack. Thus,

```
LOOP   POP()      :S(LOOP)
```

flushes the stack. The routines for the three functions are in listing 4.

PARSING

By parsing we mean recognizing the syntactic structure of a statement in some language. We can illustrate parsing using a simple arithmetic expression. For example, if the statement were

```
A = B * C + D
```

and if the language were any of a number of common programming languages (including SNOBOL4), then a parse would recognize that the = operator is being applied at the highest level to two arguments, the first being A and the second being an argument whose highest level operator was a *, etc. The parsing facility that we saw early in this article (E for expression and F for factor)' could recognize simple expressions. Turning the recognizer into an effective parser (i.e., something useful) means having it either build the associated tree or carry out actions in accordance with the meanings of the various tree components in the prescribed order. Critical to this is the SNOBOL4 dot operator. Consider the pattern

```
P1 . *A()  P2 . *B()  |  P3 . *C()
```

(continued)

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Equivalent Program Segments

```
;-------PROMAL---------
REPEAT
   PROMPT_AT 5,24, "Add Chg/Quit?"
   IF Reply = 'A'
      ADD Item
      New_Items = New_Items + 1
   ELSE IF Reply = 'C'
      CHANGE Item
UNTIL Reply = 'Q'
```

```
11910 REM-----BASIC---------
11920 CL = 5:LN = 24:PR$ = "Add/Chg/Quit?"
11925 GOSUB 9490:REM GET REPLY
11930 IF RP$<>"A" THEN 11950
11940 I9= IT:GOSUB 10100:REM ADD
11945 NI = NI + 1:GOTO 11920
11950 IF RP$<>"C" THEN 11970
11960 I9 =IT:GOSUB 6050:REM CHG
11970 IF RP$<>"Q" THEN 11920
```

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EXECUTIVE (APPLE II & C64 Only)

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EDITOR

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- Function key controlled
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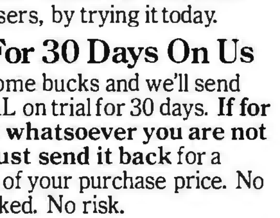

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More About SNOBOL

The original SNOBOL developers at Bell Laboratories were Dave Farber, Ralph Griswold, and Ivan Polonsky. Jim Poage joined this team for the development of SNOBOL4.

Ralph Griswold publishes a SNOBOL4 Information Bulletin, and this is available from the Department of Computer Science, University of Arizona, Tucson, AZ 85721.

There are a number of good implementations of the SNOBOL4 language for the MS-DOS environment. One is by Mark Emmer of Catspaw and is published by Prentice-Hall (Englewood Cliffs, NJ). This low-cost package contains excellent documentation and a large number of example programs. The examples given in this article were tested under that implementation.

For production purposes you may want to investigate a version of SNOBOL4 by Robert Dewar (New York, NY). His implementation runs at speeds approaching those achieved by compiler implementations of the language. He has versions of SNOBOL4 (uniformly referred to as SPITBOL—Speedy Implementation of SNOBOL4) for a number of machines including those that run UNIX and MS-DOS.

The original SNOBOL4 manual is still one of the best documents describing SNOBOL4: it was authored by its implementors—Griswold, Poage, and Polonsky—and is available from Prentice-Hall. A SNOBOL4 primer by Ralph and Madge Griswold is available from the same publisher. The internals of the original implementation of SNOBOL4 have been described by Ralph Griswold (available from Freeman and Company, San Francisco).

A history of the SNOBOL4 language has been written by Ralph Griswold and appears in *History of Programming Languages*, edited by R. L. Wexelblat (Academic Press, New York, NY).

A collection of SNOBOL4 algorithms, some tricky and some plain, was published by John Wiley and Sons, New York, NY, authored by J. F. Gimpel. Some of the examples in this article were based on that collection.

Recall that binary dot binds more closely than concatenation. The binary-dot generator causes the value matched by a pattern to be assigned to the right-hand argument if the overall pattern is successful and if the dot operator's left-hand argument has contributed to its success. Thus if P1 and P2 match, then A() and B() are called (in that order); but if P1 matches, P2 fails, and P3 matches, then only C() is called. This is precisely what we need to extract all and only those items that have been successfully matched.

Let P be a pattern and consider

```
P . *PUSH()
```

If this pattern is embedded in a larger pattern, and if P successfully matches within the larger pattern, then the string matched by P is assigned to the right-hand component. As we have seen previously, PUSH() returns a variable, so it makes sense to have a function call on the right-hand side. But what is the * doing there? As we have seen earlier, in the case of the binary $ operator, this serves to inhibit evaluation of PUSH() until the assignment.

If we are interested in only calling a function for its side-effects, we may associate it with a pattern that always succeeds. One such is NULL, which is predefined to be the null string (as is every variable). Thus,

```
NULL . *F()
```

will succeed in invoking F(), but F() must return a variable in order to satisfy the value assigner. For this we will simply return a dummy variable named, suitably, DUMMY.

The statements in listing 5 define in pattern E a simple arithmetic expression parser based on these principles. It not only parses arithmetic expressions but also invokes semantic routines associated with each of the four fundamental algebraic operations and unary minus. The semantic routines serve to evaluate the expression, converting numeric strings into integers and evaluating identifiers for their (presumably numeric) value. The overall effect of a pattern match is to interpret or evaluate arithmetic expressions (a restricted version of the EVAL function described earlier), leaving the final value on the stack.

The semantic routines required to interpret the arith-

(continued)

Listing 5: *In this code fragment, pattern* E *becomes a simple arithmetic expression parser.*

```
        LET = 'ABCDEFGHIJKLMNOPQRSTUVWXYZ'
        DIGITS = '0123456789'
        IDEN = (ANY(LET) (SPAN(LET DIGITS) | '')) . *PUSH()
+              NULL . *EV()
        INTEGER = SPAN(DIGITS) . *PUSH()
        PRIMARY = IDEN | INTEGER | '(' *E ')'
        FACTOR = PRIMARY | '-' PRIMARY . *NEG()
        TERM = FACTOR
+           ARBNO( '*' FACTOR . *MUL() | '/' FACTOR . *DIV() )
        E = TERM ARBNO( '+' TERM . *ADD() | '-' TERM . *SUB() )
```

metic expression and produce a value (on the stack) go something like this:

```
         DEFINE( 'EV()T' )
         DEFINE( 'ADD()' )
         DEFINE( 'SUB()T' )
         .
         .
         .
                                    :(SEMAN_END)
EV       EV = 'DUMMY'
         PUSH($POP())               :(NRETURN)
ADD      ADD = 'DUMMY'
         PUSH( POP() + POP() )      :(NRETURN)
SUB      SUB = 'DUMMY'
         T = POP()
         PUSH( POP() - T )          :(NRETURN)
         .
         .
         .
SEMAN_END
```

The ellipses above are meant to be filled with similar definitions for multiply (MUL), division (DIV), and negation (NEG). You can fill these in for yourself, if you like.

To take an example, the statements

```
'3 + 4' POS(0) E RPOS(0)
OUTPUT = POP()
```

will output the value 7. Also,

```
ALPHA = 3
BETA = 4
'ALPHA - (BETA - 3)'   POS(0) E RPOS(0)
OUTPUT = POP()
```

will output the value 2.

The essential method of operation is that it is the responsibility of each component (E, TERM, FACTOR, PRIMARY, INTEGER, and IDEN) to leave a value on the stack. When a routine like ADD() is called, it POPs the two values and PUSHes their sum. It then returns a dummy name (to keep binary dot happy).

Of course, these semantic routines can be replaced by routines that write out assembly or machine code, thereby producing a compiler. Alternatively, you can invoke tree-building calls so that the result of the scan is a parse tree.

SUMMARY

To summarize at this point is like asking an astronaut to summarize his flight experience while he's on the way up. There are many aspects of the language that I have not mentioned, and I have just begun to scratch the surface of the application areas. SNOBOL4, having been pronounced dead on a number of occasions, is alive and available on more machines than ever in its history.

The language will probably always have a cult following among the religiously recursive and those interested in ease of programming. ■

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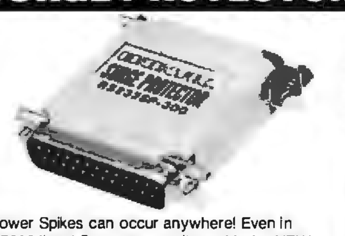

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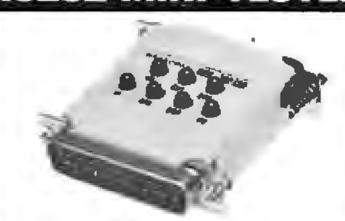

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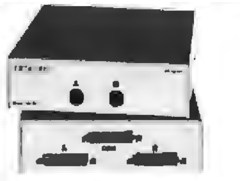

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INTERPRETATION OF NATURAL LANGUAGE

BY JORDAN POLLACK AND DAVID L. WALTZ

A potential application of parallelism

This article was adapted from "Parallel Interpretation of Natural *Language," presented to the International Conference on Fifth Generation Computer Systems, November* 1984.

THE INTERPRETATION of natural language requires the cooperative application of both language-specific knowledge about word use, word order, and phrase structure and real-world knowledge about typical situations, events, roles, contexts, and so on. While these areas of knowledge seem distinct, it isn't easy to write a program for natural-language processing that decomposes language into its parts; i.e., you cannot construct a psychologically realistic natural-language processor by merely conjoining various knowledge-specific processing modules serially or hierarchically.

We offer instead a model based on the integration of independent syntactic, semantic, and contextual knowledge sources via spreading activation and lateral inhibition links. Figure 1 shows part of the network that is activated with the sentence

John shot some bucks. (1)

Links with arrows are activating, while those with circles are inhibiting. Mutual inhibition links between two nodes allow only one of the nodes to remain active for any duration. (However, both nodes may be simultaneously inactive.) Mutual inhibition links are generally placed between nodes that represent mutually incompatible interpretations, while mutual activation links join compatible ones. If the context in which this sentence occurs has included a reference to "gambling," only the shaded nodes of figure 1a remain active after relaxation of the network. But if "hunting" has been primed, only the shaded nodes shown in figure 1b will remain active.

Notice that the "decision" made by the system integrates syntactic, semantic, and contextual knowledge: The fact that "some bucks" is a legal noun phrase is a factor in killing the readings of "bucks" as a verb; the fact that "hunting" is associated with both the "fire" meaning of "shot" and the "deer" meaning of "bucks" leads to the activation of the coalition of nodes shown in figure 1b; and so on. At the same time, the knowledge base in our model is easy to add to or modify. In this model of processing, decisions are spread out over time, allowing various knowledge sources to be brought to bear on the elements of the interpretation process. This is a radical departure from cognitive models based on the convenient decision procedures provided by conventional programming languages.

Our program operates by dynamically constructing a graph with weighted nodes and links from a sentence while running an iterative operation that recomputes each node's activation level (or weight) based on a function of its current value and the inner product of its links

(continued)

Jordan Pollack is currently writing his doctoral thesis in computer science at the University of Illinois. He can be reached through the Coordinated Science Laboratory, 1101 West Springfield, Urbana, IL 61801. David L. Waltz is a professor with the computer science department of Brandeis University and a senior scientist at Thinking Machines Corp., 245 First St., Cambridge, MA 02142.

and the activation levels of its neighbors. For these examples, we are primarily interested in the behavior of the network and not in the program that dynamically constructs the network. The syntactic portions of the networks in this paper were constructed by a parser modeled after Kay (see reference 1), while the semantic and contextual portions are permanently resident in memory. Initially all nodes are given zero weight, except for the nodes used to model context (e.g., "hunting" and "gambling"). Each activation link has a weight of .2 and each inhibition link has a weight of −.45. The iterative operation uses a proportional function to compute new weighting for nodes, similar to the one used by McClelland and Rumelhart in their interactive activation model (reference 2).

The net effect of the program is that, over several iterations, a coalition of well-connected nodes will dominate, while the less fortunate nodes (those that are negatively connected to winners) will be suppressed. We exploit this behavior several ways in our system. By putting inhibitory links between nodes that represent well-formed phrases with shared constituents (which are thus mutually exclusive), we ensure that only one will survive. Similarly, there are inhibitory links between nodes representing different lexical categories (i.e., noun or verb) for the same word; between concept nodes representing different senses of the same word (i.e., submarine as a boat or as a sandwich); and between nodes representing conflicting case role interpretations. There are activation links between phrases and their constituents, words and their different meanings, roles and their fillers, and corresponding syntactic and semantic interpretations.

Semantic Garden Paths

Because our system operates in time, we are able to model effects that depend on context and effects that depend on the arrival times of words. Consider the network shown in figure 2, which shows three snapshots taken during the processing of the sentence (due to Charniak, reference 3):

The astronomer married a star. (2)

Figure 2 includes three possible meanings for "star," namely (1) the featured player in dramatic acting, (2) a celestial body, or (3) a pentagram. We presume that "astronomer" primes STAR by the path of strong links: astronomer → ASTRONOMER → ASTRONOMY → CELESTIAL-BODY, but that MOVIE-STAR would be

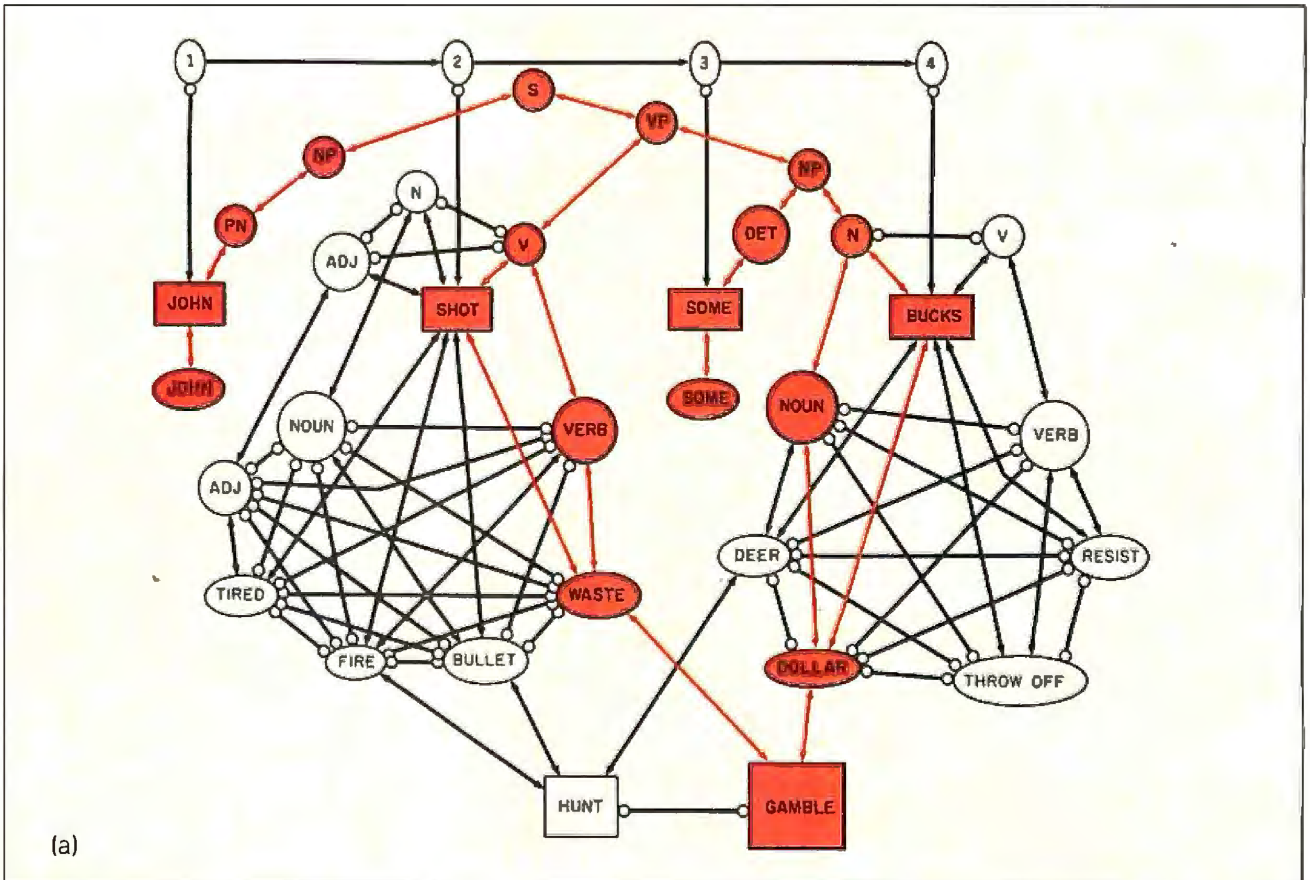


Figure 1: *Two interpretations of "John shot some bucks": (a) shows the result in the context of gambling (i.e., John wasted some money), while (b) shows the result in the context of hunting (i.e., John fired a gun at some deer). Both examples required about 25*

primed very little, if at all, because any activation of HUMAN via "astronomer" and "married" is spread fairly evenly among a vast number of other concepts (PHYSICIAN, PROFESSOR, etc.). When the word "star" is encountered, the meaning CELESTIAL-BODY is initially highly preferred, but eventually, since CELESTIAL-BODY is inanimate, whereas the object of MARRY should be human and animate, the MOVIE-STAR meaning of "star" wins out.

In figure 2d we show the activation levels for CELESTIAL-BODY and MOVIE-STAR as functions of time. One can see that the activation of CELESTIAL-BODY is initially very high and that only later does MOVIE-STAR catch up to and eventually dominate it. We argue that, if activation level is taken as a prime determinant of the contents of consciousness, then this model captures a common experience of people when hearing this sentence. This phenomenon is often reported as being humorous and could be considered a kind of "semantic garden path." It should be emphasized that this behavior falls out of this model and is not the result of juggling the weights until it works. In fact, the examples shown in this paper work in an essentially similar way over a broad range of link weightings.

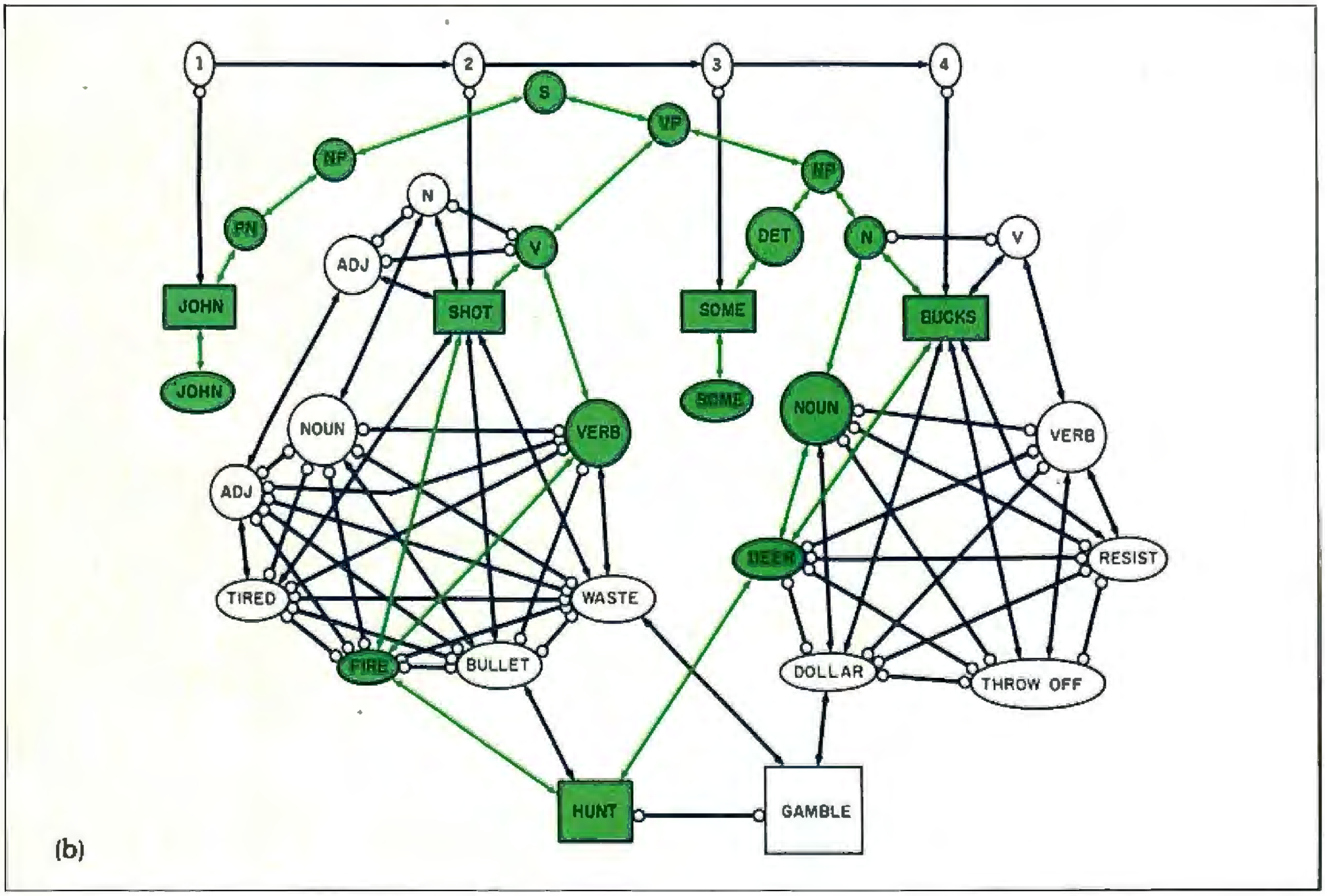
TEXT AND CONTEXT

Earlier, in figure 1, we used "context-setting" nodes such as "hunting" and "gambling" to prime particular word and phrase senses in order to force appropriate interpretations of a noun phrase. There are, however, major problems that preclude the use of such context-setting nodes as a solution to the problem of context-directed interpretation of language. A particular context-setting word—e.g., "hunting"—may never have been explicitly mentioned earlier in the text or discourse but may nonetheless be easily inferred by a reader or hearer. For example, preceding sentence 1 with

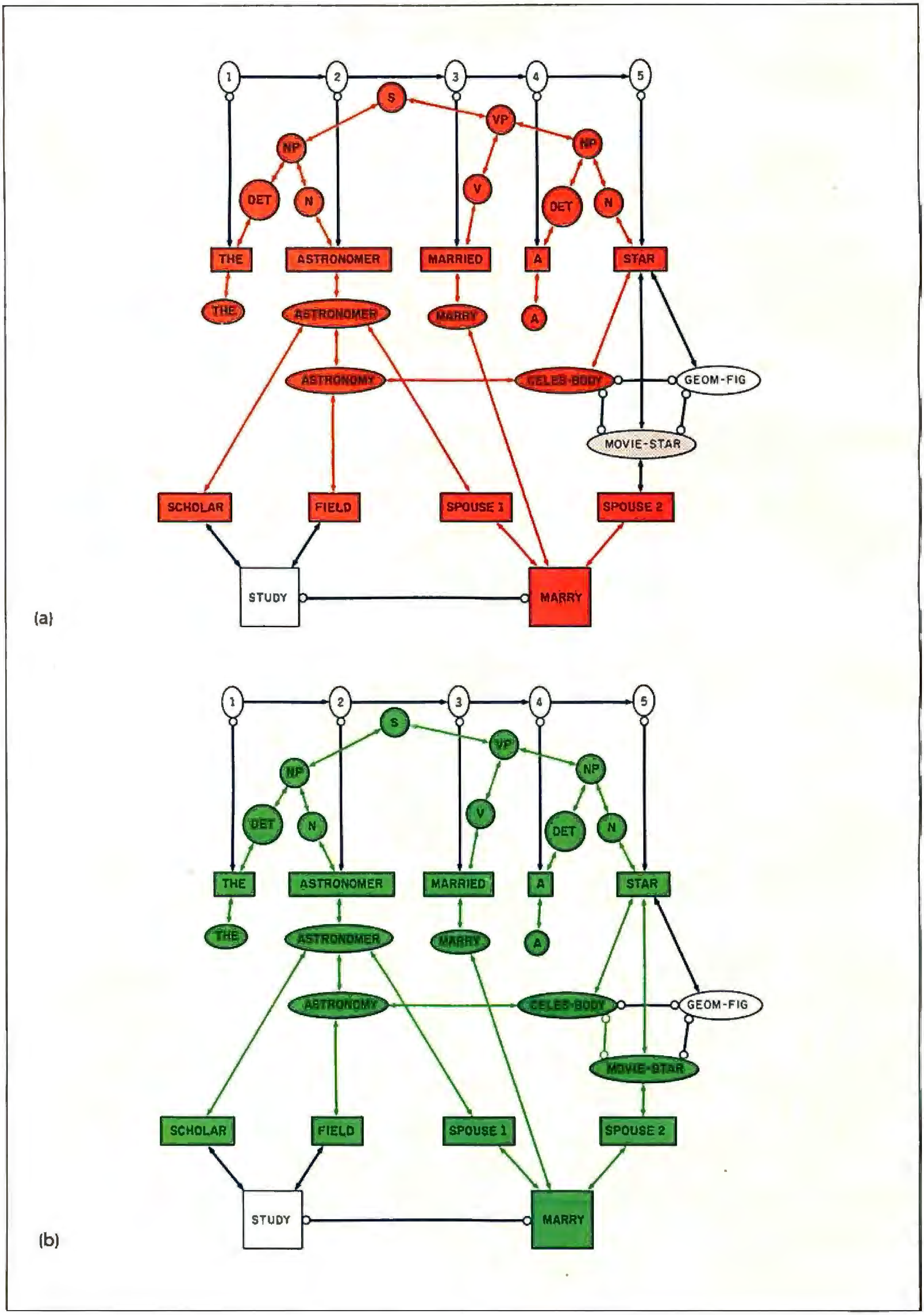
John spent his weekend in the woods. (3)

should suffice to induce the "hunting" context. Mention of such words or items as "outdoors," "hike," "campfire," "duck blind," "marksman," etc., ought to also prime a hearer appropriately, even though some of these words (e.g., "outdoors" and "hike") are more closely related to many other concepts than to "hunting." We are thus apparently faced with either (a) the

(continued)



cycles to settle. In each case, only a slight initial advantage was given to HUNT *or* GAMBLE. *The numbered nodes control arrival times of the words. The circles at the ends of connecting lines between nodes indicate inhibition and the arrows indicate activation.*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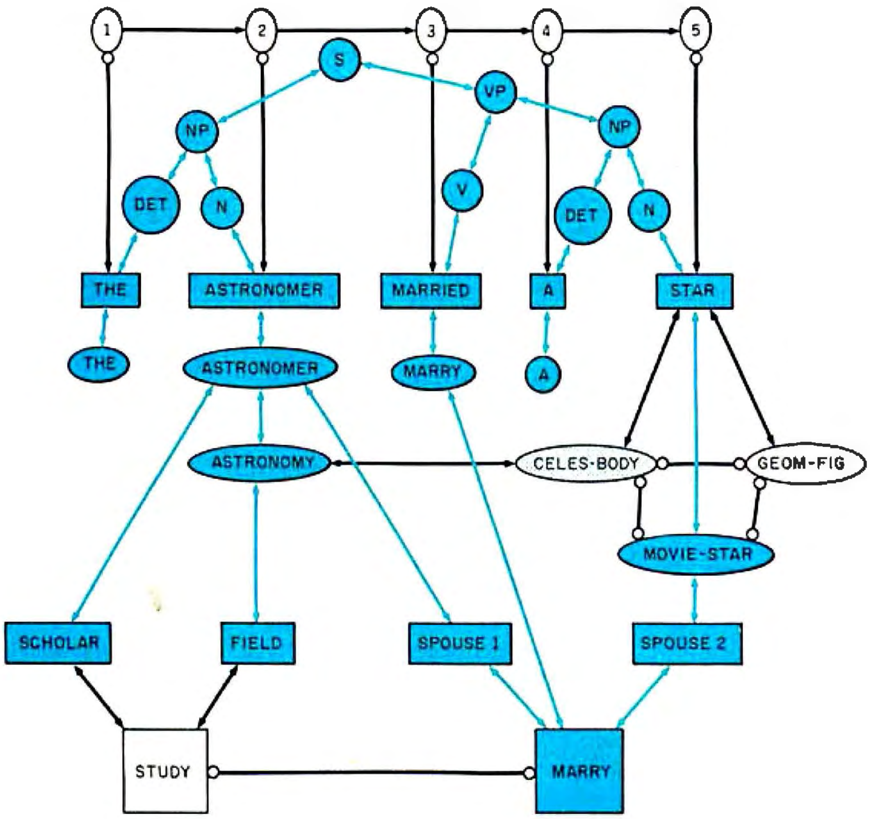
(c)



(d)

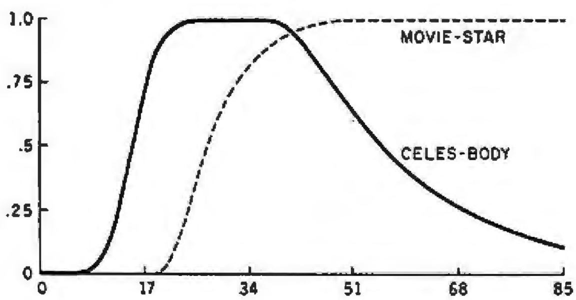


Figure 2: *The cognitive "doubletake" when processing "The astronomer married a star": (a) shows* CELESTIAL-BODY *dominant at cycle 27; (b) shows a balance of power at cycle 42; (c) shows* MOVIE-STAR *finally winning the battle by cycle 85; and (d) shows a plot of their activation values over time.*

need to infer the special context-setting concept "hunting," given any of the words or items above, or (b) the need to provide connections between each of the words or items and all the various word senses they prime. There is, however, a better alternative.

We propose that each concept should not merely be represented as a unitary node but should in addition be associated with a set of "microfeatures," or generalized associations. We suggest that microfeatures should be chosen on the basis of first principles to correspond to the major distinctions humans make about situations in the world, that is, distinctions we must make to survive and thrive. For example, some important microfeatures correspond to distinctions such as threatening/safe, animate/inanimate, edible/inedible, indoors/outdoors, good outcome/neutral outcome/bad outcome, moving/still, intentional/unintentional, or characteristic lengths of events (e.g., whether events require milliseconds, hours, or years). Microfeatures serve both to define the concepts, at least partially, and to associate the concept with others that share its microfeatures. We propose a large set of microfeatures (on the order of thousands), each of which is potentially connected to every concept node in the system (potentially on the order of hundreds of thousands). Each concept is in fact connected to only some subset of the total set, via either bidirectional activation or bidirectional inhibition links. Closely related concepts have many microfeatures in common. As in Hinton's model (see reference 4), hierarchies arise naturally, based on subsets of shared microfeatures, rather than being the fundamental basis for organizing concepts in a semantic network, as in most artificial intelligence models.

Microfeatures as a Priming Context

Let's see how microfeatures could help solve the problems presented by the example in figure 1. Figure 3 shows a partial set of microfeatures, corresponding to temporal-event length or location (setting). A small set of concepts relevant to our example is listed across the top. Solid circles denote strong connection of concepts to microfeatures, open circles, a weak connection, and crosses, a negative connection. A simple scoring scheme allows "weekend" and "outdoors" to appropriately prime concepts related to "fire at" and "deer" relative to "waste money" and "dollar," as well as the ability of "casino" or "video game" to induce an opposite priming effect, as shown in figure 3b. It is interesting to compare these effects with the effects of priming with "hunting" or "gambling" directly. No relaxation was used, though it obviously could be. (A concept could activate microfeatures, priming other concepts, and then the primed concepts could change the activation of the microfeatures, in turn activating new concepts and eventually settling down. We have tried hard to be fair in constructing figure 3a, for example, priming with "outdoor" rather than "woods," and including links between "casino" and "desert" to acknowledge Las Vegas. Time periods characterize event lengths. Locations are to be taken as settings or surroundings, not objects. All links are clearly culturally dependent though, we think, roughly in accord with current middle-class American language usage.) We have been experimenting with a number of possible weighting and propagation schemes and have built up a much larger matrix than the one shown in figure 3.

Related Work

There are many research projects that are very much in the same spirit as ours. Beginning in the early 1970s, Schank argued that semantics, not syntax, should have the central role in both theories and programs for natural-language processing; Riesbeck's parser for MARGIE (reference 5) has a clear relationship to the model proposed here. Steven Small was another worker in AI to question the traditional serial integration of language processing (reference 6). He suggested that rather than having separate modules for syntax and semantics, each word was an expert in interpreting its own meaning and role in context. Following on that work, Gary Cottrell is recasting word-sense selection into a connectionist framework (reference 7), and his work is very closely related to our own. Mark Jones is also working on parsing with spreading activation, but of the digital kind (reference 8).

Other work has set integrated parsing into the production-system framework. BORIS uses a lexically-based demon-driven production system to read stories and answer questions about them (reference 9). The READER system (reference 10) is a multilevel parallel production system that models chronometric data, that is, data on how long humans visually fixate on each word while reading.

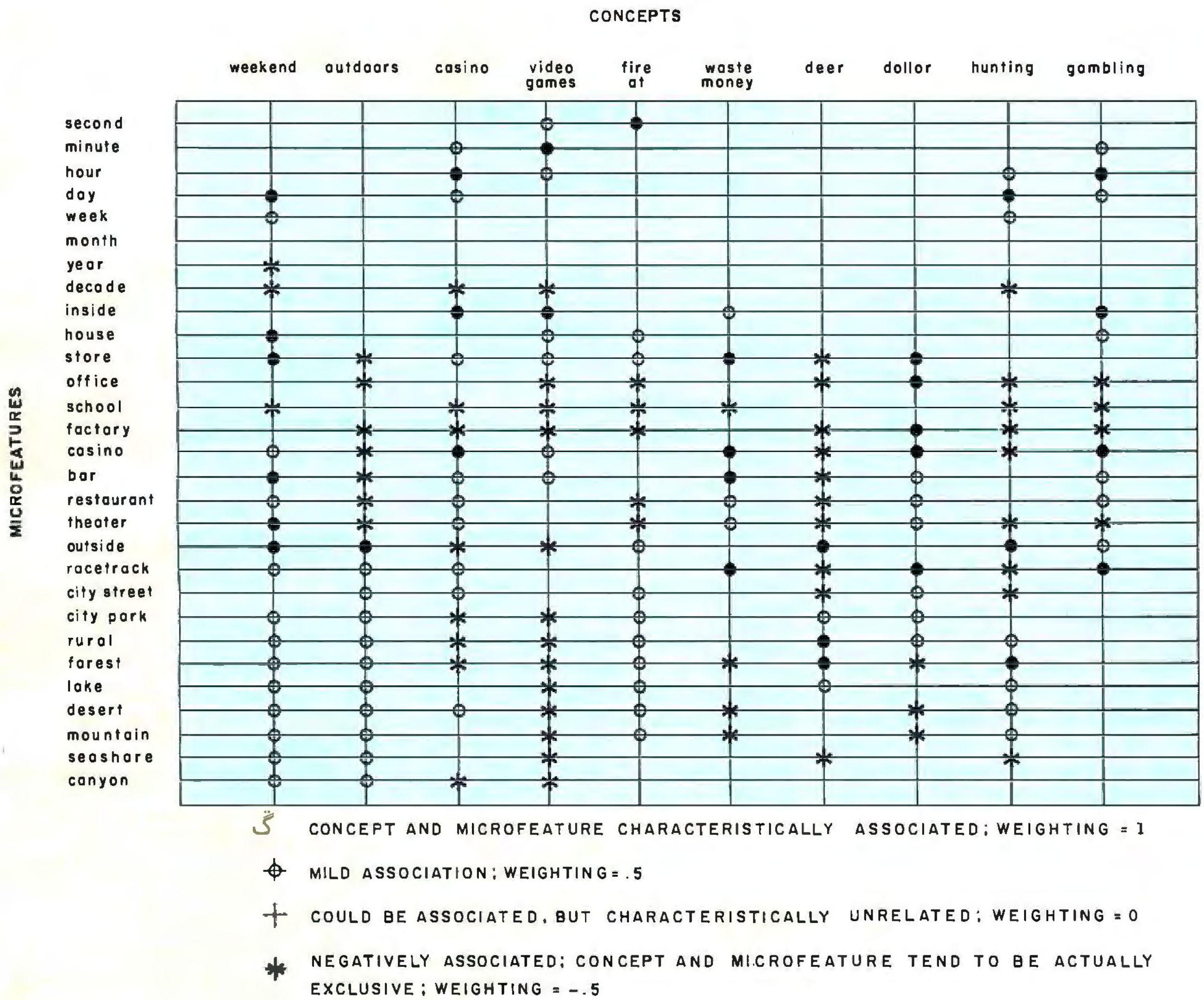
Another interesting approach to language integration is taken by Hendler and Phillips (reference 11), who are using a message-passing ACTOR system (reference 12) to model the interactions between syntax, semantics, and pragmatics. Other work that has influenced our research includes the spreading activation work by Ortony and Radin (reference 13), based on a network of free associations to English words.

Architectural Considerations

Our work, and, in general, other work in connectionist modeling (references 14 and 2) is particularly well suited for implementation on parallel computers. Unlike cognitive models based on parallel production systems such as HEARSAY II (reference 15) or READER (reference 10), in which concurrent access to the "blackboard" is a bottleneck permitting only small speedups, connectionist models permit a speedup proportional to the number of processors.

There are both advantages and disadvantages of the connectionist models with respect to the communications costs in a parallel system. One disadvantage is that since a cycle

(continued)



(a)

PRIMING CONCEPTS	PRIMED CONCEPTS (fraction of maximum possible score) Fire at	Waste	Deer	Dollar
Weekend	.41	.55	0	.46
Outdoors	.41	0	.44	.08
Casino	.05	.59	0	.42
Video Games	.18	.36	0	.19
Weekend & Outdoors	.41	.07	.25	.12

(b)

Figure 3: *Illustration of the use of Time and Place microfeatures to provide contextual priming: (a) shows a microfeatures/concepts matrix; (b) shows the instantaneous priming effects on concepts after undergoing a single priming cycle. All concept values began at 0.*

AN ACTIVATION NETWORK ERECTOR SET

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At the laboratories where this kind of research is taking place, people have built sophisticated tools for network construction, simulation, and analysis. Most of them are machine-specific, dependent on the powerful graphics environment provided by personal LISP workstations. I've constructed a LISP accompaniment to the article, a small, nongraphic version of such a tool in the public-domain language XLISP 1.4, which will run on IBM PCs and compatibles. [*Editor's note: The author has also provided a version of this program that can run under* XLISP 1.2. *It is available for downloading from* BYTE*net Listings*, (617) 861-9764. *See also page* 350 *for information on how to obtain listings on disk*.] Just as you can't build a space shuttle with a hardware erector set, you can't build a mind with this "network erector set," but you can have some fun.

It is actually a full-featured network tool, based on a program I wrote several years ago, before I had access to a LISP machine. With this tool, you can construct, inspect, and modify activation networks as well as simulate, animate, and plot their behavior.

USING THE PROGRAM

The top-level program, called EDITNET, uses a simple nested menu system. Each item in a menu has a unique first character, which is all you need to type to invoke the item. Since on most systems the input is buffered, once you become familiar with the sequences of selections needed to evoke commands, you can type ahead.

The menu is tree-structured and a whole command is a path through the tree (see table A). For example, when you call EDITNET, the top-level menu is displayed: (QUIT FILE MODIFY EXECUTE SHOW)?>. To modify the (initially empty) network, you type M, which brings up the modify menu: (ADD LINK SET DELETE UNLINK)?>. To add a node, you type A, and you then are prompted for the name of a node: node?>, to which you might type FOO. Similarly, to add BAR you would type M A BAR. To create an activation link between FOO and BAR, type M L A FOO BAR and to give FOO some initial energy, type M S FOO 50. Finally, to watch FOO activate BAR, type E C 10.

Some interesting features of the program are its abilities to save the networks you construct in command files (F S filename) and read them back in later, to display the connections between one node and the rest of the network (S node), and to plot activation-level versus time graphs in a format that can be printed on any printer.

Table A: *The tree structure of the* EDITNET *program.*

```
((QUIT)
(FILE
  (CLEAR)          ; erases all nodes and links
  (LOAD filename)       ; direct input from "filename.net"
  (SAVE filename)       ; makes a command file "filename.net"
  (PLOT numberofnodes node1 . . . noden numberofcycles filename))
      ; makes a file "filename.plt"
(MODIFY
  (ADD node)        ; create new node
  (LINK
    (ACT fromnode tonode)     ; create activation link
    (INH fromnode tonode))     ; create inhibition link
  (SET node initialvalue)    ; sets a nodes initial value
  (DELETE node)       ; delete a node
  (UNLINK fromnode tonode))      ; remove a link
(EXECUTE
  (RESET)          ; sets each node to initial value
  (CYCLE numberofcycles))      ; animate the network
(SHOW node)
```

IMPLEMENTATION NOTES

To demonstrate the object-oriented facility of XLISP, I used two kinds of objects in the program and defined three macros for dealing with them to improve XLISP's readability. (DEFCLASS newclass superclass (ivars. . .)) defines a new class of objects, (DEFMETHOD class selector (args) exprs. . .) defines a new method for a class, and (=> obj selector args. . .) sends a message to an object.

As always, several compromises had to be made for portability. First, since XLISP has no pointing device such as a light pen or mouse, nodes have to be uniquely named in order to be selected. Second, lack of graphics subroutine calls means that animation is accomplished by terminal cursor control. There are three functions, GOTO, CLS, and ERASETOEOL, that are written for the ANSI standard, available as an option for PCs; they may have to be rewritten for different systems. Third, since XLISP has no real numbers, scaled fractions are used for computing activation levels, and these cause some round-off error as nodes approach 0. To keep it simple, I used a scaling of 100, so a node or link value of 0.5 is represented as 50.

consists of a whole barrage of messages crossing the network, message-passing architectures with indeterminate delays are problematic. One advantage is that since each message is a quantitative value that is ultimately to be summed, we can distribute the addition through the network. We have designed two such communication networks for modeling activation networks in parallel using the concept of message-merging processors. In the first design (reference 16), each activation node corresponds to an NMOS (negative-channel metal-oxide semiconductor) cell, which contains memory for its activation level, an ALU (arithmetic logic unit), and special-purpose sorting shift-registers for its links. The cells are laid out in the simplest geometry—a linear array—and processing takes place in three stages: First, the activation and inhibition links, which are composed of a relative destination and magnitude, are multiplied by the current activation level and loaded into shift registers. Second, the full barrage of messages is forwarded through the network in a constant number of very small shifting cycles. The shift registers both keep the messages sorted to send out the longest one first and combine messages with the same destination. The result is that the length of the longest message decreases by 1 every shift cycle, leading to a constant time (shift time * length(longest message)). And third, the activation levels are recomputed. The second design (reference 17) generalized this process to a two-dimensional topology.

CONCLUSION

We have not actually built the hardware but continue to refine the natural-language model, keeping the constraints of VLSI (very-large-scale integration) implementation in mind. We have been developing our programs in LISP but plan to implement them on the Connection Machine (reference 18) when it is available.

Using spreading activation and lateral inhibition enables a good framework for embedding comprehension phenomena that cannot even be approached with binary serial models. We have explored ties to psychological and linguistic results and theories; these are reported in reference 19. There, we show that structural preferences such as "minimal attachment" (reference 20) can be understood as side effects of, rather than as strategies for, a syntactic processor; current hypotheses about lexical disambiguation in context (references 21 and 22) can nicely fit into a model with lateral inhibition; it could not be accounted for by activation alone. Garden paths at different levels of processing can be explained by the breakdown of a common approximate consistent labeling algorithm—lateral inhibition. ■

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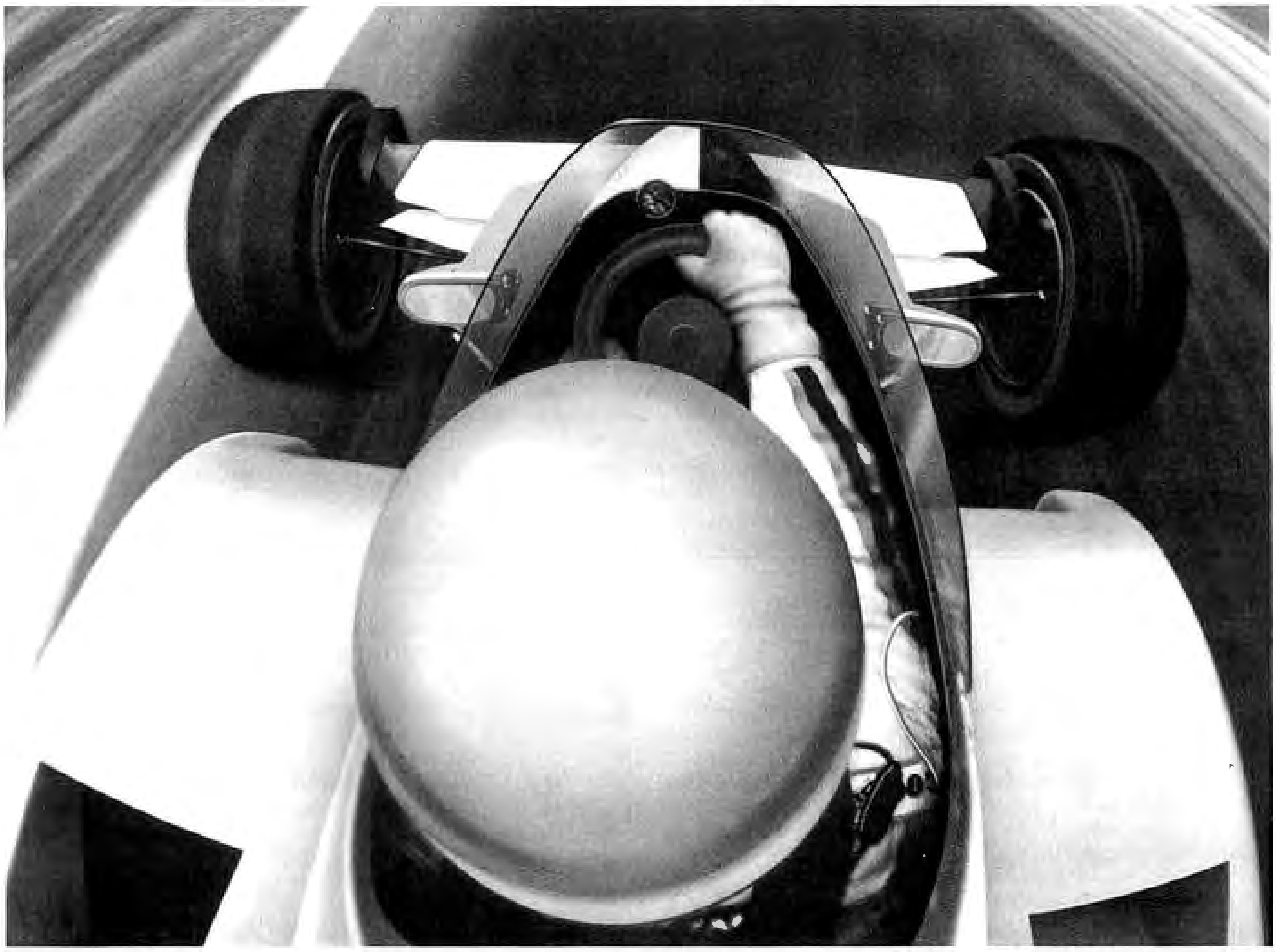

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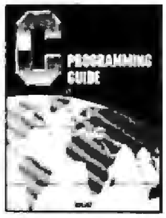

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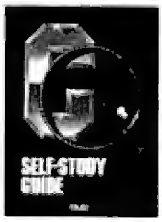

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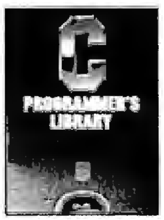

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TYPESETTING PROBLEM SCRIPTS

BY PIERRE ع MACKAY

Computer typesetting provides a solution for Arabic and similar scripts

THE COMPLICATIONS of typesetting non-Latin scripts offer a challenge to the typesetter who has been spoiled by the English language. Even the clustering of several accents around a single character presents difficulties, and the problems created by genuinely context-sensitive scripts are particularly problematic in systems based on the traditions of movable type.

Computer-assisted digital photocomposition offers an opportunity to overcome the compromises imposed on certain non-Latin character sets during centuries of hot-metal typesetting.

CHARACTERISTICS OF NON-LATIN SCRIPTS

The next time you are moved to exasperation at the arbitrary historical rules of English spelling, think about some of the benefits that come with them. It is partly the arbitrariness and inexact match between phoneme and orthographic representation that has made it possible for English to represent its rich and complex system of sounds without resorting to the use of diacritical marks, which are modifying marks near or through a character that indicate a phonetic value different from that of the unmarked character.

Every word in English can be correctly coded using the simple, unadorned characters in the old Hollerith code set. The results, however ugly, can be read directly from a printed copy, even when only uppercase letters are available. Among the remaining European Latin-letter languages, diacritical marks are the rule rather than the exception. (Ironically, Russian is one of the very few widespread languages besides English that has freed itself from diacritical adornments to its alphabet.)

The addition of diacritical marks to an alphabet, such as the accents of French, German, Turkish, or, to take a really extreme case, Czech, cannot help but complicate text editing, formatting, and general processing. Many languages are even more complicated. In some of these scripts the actual graphic shapes of the characters of the basic alphabet are altered drastically.

The reason for this lies in the history of literacy in the language. The development of a particular style of graphic representation for an alphabetic character set (we will avoid any consideration of an ideographic script like Chinese) is strongly influenced by the medium on (or in) which the graphic shapes are produced.

A fairly well-known example of a script influenced by the medium on which it is represented is the syllabary of Sumerian, Akkadian, Babylonian, and old Persian. The graphic shapes used for these languages were created by pressing a narrow triangular stylus into clay, producing the wedge-shaped marks, cuneiform, from which the script gets its name.

The rounded shapes of several South Indian scripts are believed to be derived from the "Vatteluttu" script forms, created by pressing a stylus on palm leaves. The free-flowing curves of this script were less likely to cut through the fiber of the leaf than straight lines.

The more recent Semitic scripts, of which Arabic is presently the most widespread in general use, were pen-

(continued)

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and-ink scripts. It is the development of Arabic exclusively along the lines of efficient handwriting that has made it relatively difficult to work with in an automated environment.

STONECUTTING

Handwriting played a part in the development of literacy in both the Roman and the Greek worlds, but there was always an alternative model for letterforms in those cultures. Most of the Greek states, and Athens in particular, covered every available flat stone surface with text. Law decrees, membership lists, letters, prayers, and even histories and philosophical treatises were chipped into stone all over the Greek world.

The Romans tended, in this as in other things, to imitate the Greeks. The stonecutters of the Roman Empire worked out several elegant styles of detached letterforms for their official inscriptions. With the invention of movable lead type, Italian, French, and Dutch typeface designers also learned to look at the stonecutter's work rather than at manuscripts for their models. (The Latin-letter serif is basically a stonecutter's trick to give a more formal termination to the end of an inscribed line.)

We can see the importance of stonecutting in type design when we consider the long and rather unsatisfactory history of the development of Greek typefaces. There was plenty of Greek inscriptional material waiting to be discovered, but it was not available to typeface designers. For centuries after they had moved firmly in the direction of inscriptional models for the Latin-letter alphabet, they continued to produce hybrid typefaces full of illegible ligatures for Greek.

From the late 18th century on, when Western Europe began to be flooded with Greek inscriptions carried over from the eastern Mediterranean, the Scottish and English type designers made a thorough break from handwritten forms.

ARABIC SCRIPT'S UNIQUE PROBLEMS

When the first attempts were made in the late Renaissance to design a type font for Arabic, there was no model for the script except handwriting. In its early centuries, the Arabic language was not often inscribed on stone, and, as the culture developed and monumental stone inscriptions became fashionable, stonecutters were given no incentive to develop their own letterforms.

The finest Arabic script inscriptions are imitations of handwriting, and it is significant that they are usually cut

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DT1406-8M	Current Output	–	–	–	8	12	28.5	–	–
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in relief. A calligrapher painted an inscription on the surface, and the stonecutter chiseled away the unpainted surface to leave the letters standing out against a background. In the overall history of Arabic script, the result is a wonderfully fluid repertory of graphic shapes, all very beautiful, but extremely difficult to adapt to the technology of movable type or matrix-bound character design.

If we disregard the problems of graphic representation and look at the basic linguistic elements of Arabic, the character set is rather well suited for computer applications. It is economical, and it matches the normalized phonetics of the language very closely. As in all the Semitic languages, the consonantal character set carries the essential elements of meaning, and what we would call vowels in English provide the clues to syntactical relationships and other shades of interpretation.

There are only 28 consonants in the Arabic language. Persian has 33, and it requires only a few more for Urdu, Pashto, Sindhi, Malay, and other languages that are, or can be, written in Arabic script. If we include the very limited set of vowels formally recognized in Arabic morphology (disregarding any of the complications of actual pronunciation), we can certainly get just about any Arabic script language into the 52 graphic character cells of an ASCII coding table normally occupied by the uppercase and lowercase Roman-letter alphabets. (The distinction between uppercase and lowercase does not exist in Arabic script.)

On a purely abstract level, as long as no display or hard copy is required, Arabic script is really rather efficient, and it will demonstrate its advantages quite soon in applications such as electronic speech synthesis. But the moment the graphic character set is needed, the problems begin.

In Arabic script, as a general rule, the graphic shape of every consonantal symbol is potentially affected by the shapes of all other consonants in the word. If storage memory were infinite and free and if processing cycles were instantaneous, the best way to treat the display of Arabic would be to generate each word in the lexicon as a distinct word shape and emulate the practice of the calligrapher exactly.

As soon as any of these resources become limited or in any way expensive, we must compromise. The problem is to determine where the line of compromise is drawn. During the past century, there have been several radical suggestions to force an entirely new character set on the entire Arabic-literate public. In the case of another language, Turkish, this was actually done in all regions of Turkish speech except northwest Iran and the Sinkiang region of China.

Almost every variety of Turkish was once written in Arabic script, but in 1928 the Turks of Turkey were required by their own government to switch to a Latin-letter orthography, while the Turks in the various Russian provinces, who pioneered in the use of Latin-letter orthography, have since been forced to use Cyrillic. But Turkish belongs to a language family quite different from Arabic, and this example creates no likelihood at all that the Arabic-speaking world will consent to drop Arabic script.

ARABIC FONTS

The scripts of India and some other regions involve graphic variability, but Arabic is certainly the most intractable case. A really superior type font for Arabic in the old days of lead type could run to nearly a thousand distinct sorts. With the use of digital phototypesetters, laser printers, and similar devices, it is now possible to exceed that range without much difficulty. The great advantage that modern systems have over lead type

(continued)

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is that they are not constrained by the physical boundaries of the type body. The problem that remains, simply stated, is to take a character set with only 28 members and map it into a repertory of graphic shapes of more or less unlimited size by evaluating the preceding and following context.

BIDIRECTIONAL TYPESETTING

Several rigid mathematical algorithms for typesetting Arabic scripts were developed on the assumption that only the immediately preceding and following context needs to be considered. Unfortunately, that is not the case. A more flexible algorithm is needed. In addition to the complexity of the graphic character repertory, there is the problem of bidirectional setting.

Arabic, like most Semitic languages, is written from right to left, but it has adopted a numeric character set that reads from left to right. Outside the computing environment, you might simply choose to enter all numeric values least significant digit first, but the universal convention for numeric values in computing environments is most significant digit first, and when a mixture of alphabetic and numeric data is to be displayed in an Arabic script environment, the problem of bidirectional setting must be faced.

As soon as any word or phrase from a non-Semitic language is incorporated into an Arabic script text, the same problem arises. (It also appears in Hebrew.) The remainder of this article describes an approach to the display of scripts based on the paradigm of high-quality typesetting. I believe that a satisfactory solution to the problems of typesetting is broadly applicable to all forms of display and that techniques adapted from Donald Knuth's TEX system can be used for everything from interactive data entry to low-resolution hard copy to fine book production.

THE TEX TYPESETTING SYSTEM

Donald Knuth's precise and thoroughly documented TEX typesetting system (pronounced "tech," from the sound of the Greek character chi), along with the associated METAFONT design system, was originally developed for Latin-letter and mathematical texts. These systems include a number of general features that allow their capabilities to be extended into a wide range of languages that use context-sensitive character sets, such as Arabic, Hindi, Persian, Sanskrit, and many others.

Until quite recently, computer-assisted typesetting was a tightly closed industry in which special-purpose software was normally run on dedicated turnkey hardware. Among the few systems that were generally available were the Ibycus system for scholarly publishing developed by David Packard Jr. and the TROFF system, long a part of the UNIX environment. Both of these systems were targeted to the same film-font typesetter, the Graphic Systems Inc. C/A/T, and it is probably for that reason that the TROFF user has access to an unexpectedly good Greek text font (developed for classicists using Ibycus). Unfortunately, both systems were limited in their availability. Ibycus ran only on a special model of the Hewlett-Packard minicomputer, and TROFF ran only on UNIX systems.

The TEX system for technical typesetting has an advantage in that it runs on any computer with a sufficient range of addressable memory and a reasonably robust Pascal compiler. There are versions of TEX now running on everything from DECsystem-10 machines all the way down to IBM PC XTs and Macintoshes.

When properly implemented and validated, all versions will accept exactly the same input files and produce exactly the same interchangeable output from them. It is reassuring to know that the software at the heart of the work is stable and widely implemented on a variety of machines, particularly when you face a long process of development.

Moreover, the software itself is free. Some of the more difficult implementations are marketed at reasonable prices, but the buyer in this case is paying for the special effort of implementation rather than for TEX itself.

TEX was released openly, with exhaustive source-code documentation, and can be studied by all users for guidance toward further enhancements. Finally, although there is only one family of type fonts (Computer Modern) through which the entire range of TEX's capacity can now be enjoyed, there is no reason for this limitation to continue. For work on texts in non-Latin scripts, where there is a limited number of existing fonts and few of those are accessible outside professional typesetting shops, METAFONT is the essential accompaniment to TEX.

FONTS FOR NON-LATIN SCRIPTS

The first requisite for a non-Latin display or hard-copy system is a satisfactory graphic character set. A decade ago, when most applications were still governed by hardware costs, various Arabic script repertories were proposed based on a fairly radical distortion of the normal written form.

Perhaps the most extreme was the character repertory used by the National Computer Center in Baghdad, which made no provision for context-influenced variants at all. A similarly limited range of shapes appeared on a drum printer developed for the Egyptian government in 1972, and perhaps the most successful of all such approaches was the one that drew on the repertory developed for the mechanical typewriter, which was subsequently adopted for various electromechanical devices such as the IBM Selectric typewriter.

The typewriter font at its best was quite readable when implemented on a large office-standard machine with differential character widths and escapements. It was a good deal less satisfactory when implemented on a fixed-width Selectric type element or on the petals of a daisy wheel. Moreover, even the very best typewriter designs were essentially distortions of genuine Arabic script. In the newspaper industry, a slightly larger character repertory was used, based on a very peculiar system of keyboarding, but one Arab critic of a

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well-known newspaper font remarked in despair that it was fortunate that this typeface was never seen at any size larger than 12 point, since its true hideousness would be all too obvious at any larger size.

There are still applications for which it is appropriate to use a limited and distorted character repertory, but the increasing availability of more powerful technologies argues in favor of returning to the better styles of Arabic script. Good typefaces are no luxury; they materially enhance legibility and ease of understanding for the reader. In the past 20 years, the computer has completely transformed the typesetting industry, and in the past four or five years, programs such as Micro-T_EX have brought the capabilities of genuine typesetting within reach of even the personal computer user.

There are now signs that the computing industry has begun to learn from the typesetter. The general accessibility of bit-mapped displays, medium-resolution dot-matrix printers, and laser printers is creating a better f ıg.

All su(ıracter sets are based on same prin iple The low-resolution dot-matrix character is the most easily described. Omitting the small number of applications that use color or gray-scale values for special enhancements of the character set, every character in a modern computer-based system is generated by turning a selected area either black or white.

At very low resolutions, where a single character space may contain 200 or fewer cells, it is often acceptable to work directly with a grid, using some sort of interactive program to blacken individual pixels one by one. Many of the currently available personal computers offer this facility to the user who wants to create a new character set. You can't go too far wrong with a matrix of this small size, although optical effects can sometimes be surprising when a large pattern is reduced to a normal typeface size.

At the developing industry standard of 300 dots per inch, a large character in a 10-point font occupies a field of over 2000 pixels. It would be tedious to create even one font at this density by blackening pixels one by one, and when you consider that every distinct point size requires going through the entire character set again, it is obvious that some sort of automation is essential.

There are two approaches to this automation.[1] One, commonly used in the typesetting industry, involves scanning complete images to produce digitized outline representations of each character. A computer can then superimpose these images on a matrix of any required density. This

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is by far the most efficient way to produce imitations of older classic type fonts, but it requires expensive hardware and is not readily available to the general user.

METAFONT

The other approach is the METAFONT system, a program closely associated with $\mathrm{T_EX}$ that will run on any machine powerful enough to run $\mathrm{T_EX}$. A METAFONT description defines the shape of a character by specifying the movement of a pen over a Cartesian coordinate system. The coordinate system is entirely independent of both point size and pixel-per-inch resolution, so that a single METAFONT description can be used for a very wide range of display technologies, from CRT displays of 72 pixels per inch to typesetters of 5333 lines per inch.

The metaphor of penmanship used in METAFONT requires some modification and adjustment when applied to a Latin-letter font, but it is ideal for scripts based on handwriting. In the new version of METAFONT we can shape a pen, apply it to the paper with the appropriate orientation, and proceed to create penstrokes in just the manner that is required for Arabic script. METAFONT does not offer a quick-and-dirty way to create typefonts; the real effort of design is the same no matter what the tools may be, but a METAFONT character set produced with the proper attention to detail should be able to rival any other font created for digital typesetting.

SETTING NON-LATIN TEXT

Even when we take account of the fine details of line breaking and hyphenation, an English-language paragraph is a fairly simple artifact. Most typesetting software will accept an undifferentiated sequence of ASCII or EBCDIC character codes and space codes and will break this up into lines of acceptable length. In nearly all instances, moreover, the match between input code and output graphic symbol (typeface) is fairly close to one to one.

(continued)

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In a heavily accented or context-sensitive script, this match can no longer be counted on. (We may still be able to stay fairly close to the one-to-one match in accented languages that require only simple diacritical marks, such as accented French, for example). If there is only a single diacritical mark, it can be floated over the letter graphic with reasonable precision and without an excessive overhead in positioning software.

However, in a language such as scholarly Greek, where a cluster of three diacritical marks is not unusual and four or five is not unknown, the overhead for repositioning individual accents is no longer acceptable. It is nearly impossible to get satisfactory accent placement without resorting to special preformed characters that combine the full accent cluster with its supporting letter.

For the Devanagari character repertory used in Hindi and Sanskrit, the problem is even greater, since consonants regularly cluster into special graphic elements representing three or more consonantal sounds. With Arabic's rich and fluid character repertory, the problem becomes extreme.

There are, however, mechanisms in the TeX system that can provide a solution. In all three instances noted above—Greek, Devanagari, and Arabic script—the graphic character repertory can be viewed as a collection of ligatures. We can use the ligature mechanism of TeX to generate the references to the needed graphic shapes. This mechanism is used in the normal English-language applications of TeX to take care of typical Latin-letter typesetting conventions such as the generation of the "ffi" ligature from the three letters f, f, and i. This ligature is appropriate in a serifed Roman font but not, for example, in a fixed-width typewriter font, and the ligature specifications are therefore tied not to the general program but to the style of the particular font itself.

TFM Files

Each type font used by TeX has an associated "TeX Font Metric" (TFM) file. This file contains all the information about each character in the font except what the character actually looks like. Among the other details, such as height, depth, and width for each character (or, more correctly, for the "box" in which each character fits), is a tag indicating whether there is a ligature "program" associated with that character. Each statement in such a program is contained in a 32-bit word read as four 8-bit bytes. The programming language used is described in the source code of the TeX program and associated TeX-ware programs.

This mechanism is certainly powerful enough to deal with the more densely accented forms of Greek, and it is probably sufficient even for the conjunct graphic characters of Devanagari. The only question that might arise in the case of Devanagari is whether a 256-character font is large enough to hold all the required conjuncts.

In all probability, a judicious use of half-characters side by side with fully formed ligatures will provide the full range of graphic shapes needed. The operations applied to the input codes will be essentially the same as those used to generate the ffi ligature. There will simply be more of them.

For Arabic script, however, the existing ligature "program" is not adequate. If we treat each alphabetic input code independently and supply a ligature graphic for each significant pairing, we end up with an immense character repertory whose identifier codes run well beyond the limits of the 8-bit fields that TeX currently reads. (There are many unused bits in the ligature program word, but, unfortunately, at this time TeX does not read them.)

Moreover, if we look forward only, as the standard ligature program does, we quickly run into a formidable number of permutations, most of which generate significant ligatures. There is an interesting cautionary note in the TeX source that gives some indication of the overhead involved:

(continued)

"Even though comparatively few characters have a lig/kern program, the bf-repeat construction here counts as part of TEX's inner loop, since it involves a potentially long sequential search. For example, tests with one commonly used font showed that about 40 percent of all characters had a lig/kern program, and the bf-repeat loop was performed about four times for every such character."

CONTEXT EVALUATION

Without attempting an estimate, we may guess that the extensive evaluations needed for Arabic would soak up most of TEX's computing time. We need to find some way to shorten the search, and the best approach appears to be the one used 10 years ago in the KATIB typesetter program, which was successfully used to produce only a single book before it died of an acute case of machine-dependent code.

In this program, the characteristics of the preceding input code were remembered, and the program chose one of several different paths of evaluation by referring to that "preceder" code. To further reduce the number of different paths, the graphic shapes of Arabic were classified by penstroke rather than by alphabetic value. For example, the letters B, P, T, TH, N, and Y all behave in the same way at the beginning of a word and are differentiated only by the application of clusters of dots that float either above or below the basic penstroke. Therefore, the letter B can be used as a general paradigm.

The evaluation program first selects the correct form for the continuous penstroke and then applies the appropriate cluster of dots. The new context-evaluation program is based on TEX, but it will not be built into TEX. For a time it seemed that it might be necessary to create an Arabic-speaking dialect of TEX, but that was clearly undesirable, and in a UNIX environment, the alternative "little program" approach through a preprocessor is clearly preferable. The preprocessor will borrow as much usable code as possible from TEX and will avoid tampering with the control sequences and the general non-Arabic script elements of a TEX input file.

The Arabic text will be written in some sort of efficient coding such as the ASMO 449 code, which is likely to become an international standard in the near future. Just as Latin-letter fonts carry their own ligature styles, so the Arabic fonts will carry their own context-evaluation styles. Each Arabic script font will have an associated context-evaluation (CTX) file as well as a canonical TFM file. The effort of producing a good Naskhi style of context evaluation will probably be all I wish to undertake, but

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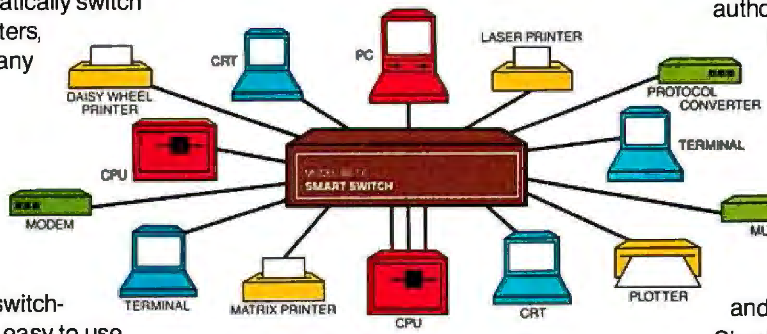

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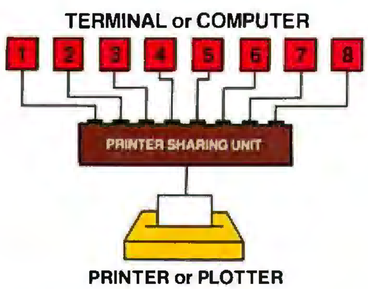

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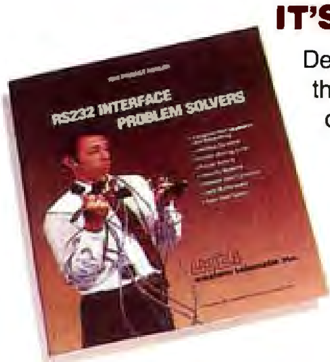

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One of TEX's best features is its line-breaking algorithm.

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There is every reason to hope that METAFONT will be used to increase the availability of non-Latin fonts of every description. Assuming that all this development goes smoothly, TEX should be able to produce a device-independent (DVI) file with all the rich variety of Arabic script characters ready to paint onto typesetting film.

There would be one flaw. The Arabic script text would be in the wrong order for reading. TEX sees the world through Latin-letter spectacles and has a deeply ingrained bias in favor of left-to-right text. Moreover, that bias lies at the very heart of one of TEX's best features, the line-breaking algorithm. To alter that in any way would be to lose one of the most attractive features of TEX.

Fortunately, no alteration is necessary. Although the other features of Arabic script seem designed to make automation as difficult as possible, solving the problem of bidirectional typesetting, which Arabic shares with the scripts of other Semitic languages, turns out to be relatively simple.

No matter what the dominant text direction is, it will always be satisfactory to set all text in either right-to-left or left-to-right order and to reverse the inverted text after it has been set. If we assume that the general environment is left-to-right Latin-letter text, then any insert in right-to-left order should be treated as an "atom" within that environment.

If a right-to-left atom is so long that it extends past a line break, then it should be treated exactly as a hyphenated word is treated. The first fragment of a hyphenated word in Latin-letter text appears at the right end of the line, and the second part appears at the left end of the succeeding line.

Similarly, the first part of a split right-to-left atom appears at the right end of a Latin-letter line and the second part appears at the left end of the succeeding line. If the right-to-left atom is so long that it extends over more than a line, then some part of it will fall in a line that is composed entirely of right-to-left text, and in this case the entire line must be reversed, which is not difficult at all. This is a particularly satisfactory solution in that it can take care of nested changes of reading direction to any level of nesting.

The example given above is of a right-to-left atom in a left-to-right environment, but it can easily and correctly be extended to take care of an inner left-to-right atom within the first atom, etc., to whatever depth of reversal it is possible to imagine. Owing to the peculiarities of the numeric character set in Arabic and Hebrew, a nesting level of 2 will be quite common, and levels of 3 and 4 can easily be imagined.

DVI FILES

In integrating a system of text reversals with TEX output, we run into a piece of sheer luck. We can easily set some sort of marker at the beginning and end of any reversing insert, but that provides only half the guidance needed. Each line must be reversed separately after the paragraph algorithm has done its job, and the input file cannot have any knowledge of where the line breaks will fall. We need the assurance that we can discover the beginning and end of each line in a paragraph by inspection of the device-independent file. (DVI files contain text to be output, in TEX's internal device-independent form of ASCII code. DVI files can be transferred from one type of computer to another without modification.)

Among the codes provided in the tight and economical format for DVI files is a pair of stack-oriented PUSH and POP commands. For the start of each line of a paragraph there is a PUSH to an inner level and a POP back to the next outer level at the end

(continued)

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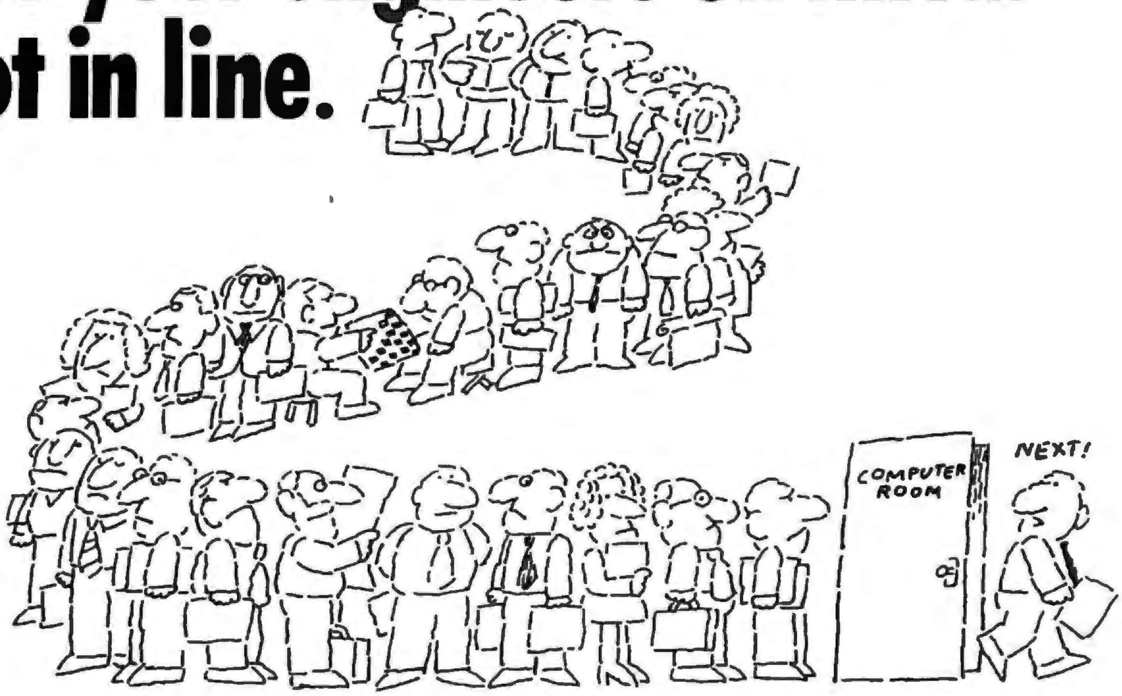
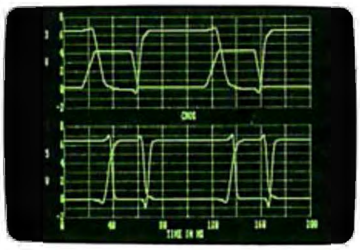
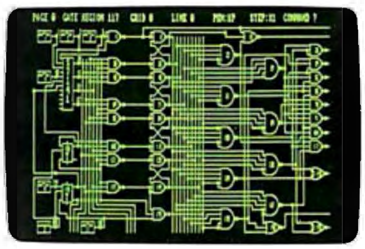




"Typical MICROCAP Transient Analysis"



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MICROCAP and MICROLOGIC are available for the Apple II (64k) IBM PC (128k), and HP-150 computers and priced at $475 and $450 respectively. Demo versions are available for $75.

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Inquiry 310

The nature of Arabic script precludes the use of hyphenation as a justification aid.

of the line. Any reversal of direction will take place within a line and therefore at an inner stack level. The specific guarantee of this essential feature can be found in the WEB source listing of TeX in the module that declares the procedure hlist_out.

IVDDVI POSTPROCESSOR

Assuming that we have entered a state in which horizontal material is being accumulated for eventual reversal, whenever a DVI postprocessor detects a drop to a lower stack level, any code sequence that has already been accumulated is reversed and sent to output. As long as the stack level remains low, the codes discovered in the DVI file are not subject to this process of reversal (we are here disregarding the effect of inner levels of reversal), but as soon as the stack level climbs again, code sequences begin to be accumulated for reversal once again. The postprocessor assigned to this function is, for obvious reasons, called IVDDVI.

For a script such as square-letter Hebrew, this part of IVDDVI is sufficient, and the operation described above is very similar to a scheme developed for output from a bidirectional TROFF system created by Cary Buchman and Daniel Berry at the University of California at Los Angeles, and another created for a bilingual enhancement of the IBM DCF SCRIPT system by Peter Schilling and R. Wonneberger of DESY, Hamburg, West Germany.

The IVDDVI program does something more, however, for Arabic script. The nature of the script precludes the use of hyphenation as an aid to line justification, and TeX will have to treat lines of Arabic script as if the prehyphenation penalty did not exist. This will inevitably result in some very loose interword spacing. Conventional automated and semiautomated typesetting systems have tended to use short extensions of the join line between appropriate pairs of Arabic script characters to fill out the text and close up the interword space. This practice is based on one of the traditional methods of adjusting the length of a word, but in an automated environment it tends to introduce a hard horizontal rule into a script that is otherwise gently curvilinear.

A far more satisfactory system is to introduce alternative long-letter forms into appropriate positions, particularly at word end. Unlike the hyphen, which is usually felt to be an unfortunate necessity in typesetting, alternative long forms actually add to the aesthetic appeal of an Arabic script text, as long as they are not used too often. ■

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Inquiry 306

POETRY PROCESSING

BY MICHAEL NEWMAN

The concept of artistic freedom takes on new meaning when text processing handles the mundane tasks of prosody

For over a year, Michael Newman, Hillel Chiel *(a researcher at* Columbia Medical School*), and* Paul Holzer *(a programmer and analyst for* PaineWebber*) have been developing* The Poetry Processor: Orpheus A-B-C. *The software is not yet commercially available, but we are pleased to share* Michael Newman's *thoughts on poetry processing and a module of* Paul Holzer's *code that shows off some of the new application's capabilities.*

THE PROPERTIES OF a medium can have a decisive impact on the nature of what the medium conveys. Poetry began in an oral, bardic tradition. It was newsy, folksy, evocative of the doings of great heroes. It had to be accessible to folk encountered at a roadside as well as pleasurable to more educated people met at court. There was no great emphasis on intricate forms, on how the poem looked on a page, because the page was not where the poem resided. The poem was voice-resident, ear-active.

When Gutenberg invented movable type he did more than spring the Bible. His invention ultimately provided a watershed, an opportunity for the consolidation of language itself—and Shakespeare jumped on the opportunity. He reconfigured poetry, bringing together history, tragedy, and comedy under its roof. And, by casting poetry as theatre, he popularized it immensely.

Poetry in print became more permanent, less permutable; more visual, less aural. In this century, with the development of free verse, the poem has become almost a visual object, broken up and spread all over the page. There is even concrete poetry, which makes a fetish of typography.

Another world that makes a fetish of typography is software, specifically the largest part of software: word processing. Software is about as permanent as print because you can always get a printout, but it is much more permutable. And, above all, it is interactive.

So what will be the impact of this revolutionary new medium on the oldest, most interactive, programmatic, musical, and image-provoking form of human speech? And what will be the impact of poetry on software?

Classical poetic forms—such as the sonnet, the villanelle, the sestina—are natural-language programs, algorithms. The sonnet is a set of instructions specifying 14 lines of iambic pentameter; a line of iambic pentameter contains five iambic units (feet). An iamb is a two-syllable unit with the accent on the second syllable.

Poetic algorithms have more in common with programming than their algorithmicness and use of powerful syntax. Poems involve iteration: Not only do iambs repeat and five-beat lines repeat, but ending-sounds repeat (rhyme in a sonnet), whole lines repeat (refrains and rhymes in a villanelle), words repeat (ending words in a sestina). Individual letters repeat in alliteration. This repetition is something poets count, and something poetry readers see and hear. If poets can count these things, so can a computer. If readers see and hear these things, so can the computer user—in an enhanced way.

Poems also involve two other cornerstones of computer science: recursion and conditionality. Every sonnet written refers to others of its kind. It

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Poet-biologist Michael Newman *was a protégé of* W. H. Auden, James Watson, *and* Albert Lehninger. *He is a contributing editor of* The Paris Review *and the author of the best-selling* 1977 *Fotonovel,* Grease. *He can be contacted at* POB 372, Hancock, NH 03449.

is virtually impossible to write a sonnet without reference to the work of Shakespeare and Keats and Millay. And every line in a given sonnet is written with a hyperenhanced consciousness of all the other lines (and words and parts of words) in that sonnet. In a form such as the villanelle, which repeats a pair of rhyming lines over and over again in different syntactic and semantic contexts, the recursion is patently manifest.

Conditionality? Anyone who's ever rhymed knows the meaning of conditionality: You may not write this line unless is rhymes with that line. If it does you can say anything you want—providing it also maintains the rhythm, stays in line with the themes, and ends when it's supposed to.

Conditions? Poetry has all you'd ever want to deal with: Whatever you were planning on talking about, make sure you know rhyming words that deal with it, and be prepared to integrate your chosen themes with the themes brought into the poem by the denotations and connotations of rhyme words you hadn't planned on using. Be prepared to jettison some meanings you were planning on including to leave room for the images developed by the way these words hook up. Maybe plan on using the jettisoned meaning in another poem. You're writing a sonnet? Fine, lead up to a dynamite punch-couplet, then use it as the repeating lines of a villanelle. Work the jettisoned meanings into the villanelle. You may still have some left over, which you could now work into a terzanelle and perhaps a nice pantoum. Perhaps you'd like to cap it all off with a sestina. No need to set up all those alphabetical looms—the computer will take care of the looms. You just keep weaving.

With computer programs there's a point to all those conditions. What, a twentieth-century person might be expected to ask, is the point of all these poetic—or more properly, prosodic—constraints? To answer that question, we should define prosody and do so in an up-to-date, if possible scientific, way.

Prosody, according to Erik R. Kandel's classic textbook, *Principles of Neural Science*, is "the musical intonation of speech." Prosodic modification of semantic structures occurs, says Kandel, in the prosodic part of the brain's text-editing anatomy, located in the right brain. When there is a lesion in the left brain, it produces what is called an aphasia. When there is a lesion in the right brain, neural science calls it *aprosodia*.

It would follow, then, that a person commencing to measure out and sound meaningful statements (to do prosody) would of necessity be routing sugar-laden brain blood into prosodic right-side cell circuits. And thus a program that induces a user to use more and more measure and rhyme on meaningful statements would be a program that induces a user to feed more and more blood and sugar to neural circuits in the right brain—*and* more and more calcium ions to neural terminals to facilitate more and more release of more and more neurotransmitters from more and more neural cells (see also my letter "Plasticity Explained" on page 14, *Popular Computing*, June 1984). If the program were interacting with very young people, it might be promoting blood flow and enhancing neurotransmitter synthesis among otherwise dormant neurons in both propositional and prosodic left- and right-brain linguistic areas, causing new neural circuits to be constructed, perhaps bridging the hemispheres, perhaps facilitating integration of the neocortex, perhaps facilitating evolution.

Neural scientists will not find these to be farfetched notions, considering the things we've learned about calcium in the past few years only. At the very least, we poets know, prosodic practice will continue delivering endorphins of a peculiarly spectacular vintage to mental pleasure centers—put there, without doubt, to ensure that the special practices that stimulate the restrictive pleasures of verse will be conserved. Poetic forms have been conserved over much time by all the great poets for good and universal reasons largely forgotten in this century, if in no other.

It seems very likely that the function of poetry has always been to route blood and calcium ions this way—that poetry is a tool for evolution of more than the brain's linguistic product, but of the brain's linguistic nature as well. It is possible that poetry in print has always been limited in how effectively it can catalyze this evolution; and it is possible that poetry in an interactive electronic medium may finally be coming into its own.

"Poetry," said W. H. Auden in "In Memory of W. B. Yeats," "makes nothing happen. It exists in the valley of its saying, where executives would never want to tamper." But if the valley of its saying is the corpus callosum, that Great Divide between the cerebral hemispheres, and if the saying of syntactic circuits constitutes construction of a physiological and subsequently anatomical bridge over the divide, well then Auden's lines of print are true only of print.

Poetry makes cerebral integration occur in the physical world through the properties of information organization. In that sense of being generative, poetry is just like genes. In another sense, poetry must activate genes—in the brain cells it awakens and reorganizes. And this capacity for integrating and reorganizing the brain's structure must be at the root of poetry's much-touted, perennial propensity for healing the mind and soothing the soul.

It's my belief that we inherit neuroses, which are like embedded programs, from family and society. These programs must have a certain amount of power over us, possibly measurable in the number of cells involved. I think in terms of blowing away 10-cell neuroses by building 100-cell poetic structures. In real life, as an example, it took 400 sonnets to get me over a divorce. I know if I'd written them in prose, that prose would have quickly begun dwelling on bad things and getting me mad. But the rhyming became a game, and soon I was above cavil. The rhyme made for its own logic, whose purpose transcended the merely human

POETRY PROCESSING

motivation that prompted the effort. When you get higher principles than love and hate off the ground with a formal procedure, they call those principles art.

The poems interacted with the people who received them in a very focused way, like software. Relative to the computer world, I mention this because I know there is a lot of divorce. Wouldn't it be nice if there were a way of dealing with intense feelings without getting mad? A way that took advantage of an engineer's command of systems? There is a way. Poetry has always been natural-language programming, has always had this enhanced province. It just took the advent of the computer to shed the kind of light—coherent light, like the laser light necessary to reveal holograms—needed for the perception of poetry's ultimate holistic nature.

What specifically, then, can software do for poetry? In what way may the practice be made more interactive and, to really make something happen, more widespread? To answer these questions it is necessary to speak about a specific program that Hillel Chiel, Paul Holzer, and I have been developing for the past year. It is called The Poetry Processor, but I will speak of poetry processing as a general concept (see the text box "Machine Reading of Metric Verse" on page 224 for a discussion of one of the application's modules).

One of the nice things about producing software at this early stage of its development is that one has the opportunity to develop a general concept before anyone else has got a hold of it, and perhaps setting a trivial standard (like a limerick generator). Marketing general-concept software can be less pleasurable than designing it because innovation causes confusion in the racks—but hardware evolves so rapidly that existing avenues of distribution can't sell enough of it unless new general applications come along and bring new kinds of users into a saturated marketplace.

This situation is radically different from the situation in book publishing. Books never change and have no need for innovation. A manuscript could have an unprecedented syntax and never get it across to anyone with the power to make a book of it. A manuscript is a book like the seashells whose indecipherable patterns Thomas Mann comments on in *The Magic Mountain*—the intricate patterns must mean something, but only to their creator.

Mann was wrong, too. Modern biology has deciphered all sorts of seemingly indecipherable natural code. And modern software has made it possible for an innovator to be sure that someone is interacting with proffered syntactic structures. You don't need to know how a sonnet works to read it, but you *do* need to know how to use software. Software users are plain kept more honest than book readers. We are much more interactive linguistically. But our cultural subtext is thus far quite shallow and mechanistic. We have much to learn from the poets.

Like many valid applications, poetry processing came about first as a solution for its designer. Although I've published many poems and have had poems in major anthologies, I'd never been able to put out a book because I could never decide on a table of contents. That was because I wrote poetry on many topics, in many forms. There were poems addressed to neurophysiologists, which weren't for geneticists or kids. There were poems about basketball, which weren't for basketball haters. There were poems for computer users only. There were equally worthy poems whose purpose was but to make a damsel blush. Which to play up front in the table of contents? How to title the book?

If the book were for biologists, I'd want to play up the big words, because these are buzzwords of biology. But I wouldn't want to turn away kids, because they mattered to me as much as biologists. Certainly I wouldn't want to turn away the damsels.

The solution, I decided, would be a relational database, a random-access

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table of forms and topics that would fish out poem titles according to what a given user wanted to read. The user could scroll down a list of topics and pick, say, basketball. Then the user could go to a list of forms and find which forms were available on the subject of basketball. Then the user could choose from these and find out the titles. The poem could be in the program, or there could be a reference to a page in a book.

Similarly, a poetry-oriented individual could scroll down the forms, pick "sonnet," and see what topics were available in a sonnet package. The book to be sold with the Orpheus B software contains Orpheus C, about 600 poems, in a dozen forms, on a great many topics. There are several kinds of something for just about everyone that reads.

As my database of titles came into being on Holzer's Sanyo IBM PC clone, I began to think of how else to popularize the poetry game by facilitating its conversion into a new medium. What else belonged in the database?

A rhyming dictionary was the first thing I thought of, when I got around

MACHINE READING OF METRIC VERSE

ě β£6ľH R'H I·

A computer can definitively scan a line of poetry for its stress pattern principally in one of two ways: (1) an algorithm can deduce the syllabic structure and the stressed syllables from analysis of the letters that make up the word, or (2) the computer can look up every word in a dictionary database that holds the syllabification and accentuation of every word. The lookup method requires a large database, and the algorithmic approach is complex and requires a deep analysis of English phonetics and spelling.

One of the features of a poetry processor is that the poet-user can specify the meter of every line of a poem (see photo A). For example, the string .-/.-/.-/.-/.-/ represents iambic pentameter. Dots (.) indicate an unstressed syllable and dashes (-) represent a stressed one. The slash (/) indicates the end of a foot, the basic metric unit. The first line of Shakespeare's Sonnet 18

shall I comPARE thee TO a SUMmer's DAY?

is an example of a line of iambic pentameter. The stressed syllables are in uppercase.

After writing a poem, users might request a metric scan of the poem. I will describe here a method for doing this that is not based on one of the two general solutions I mentioned in the first paragraph. Instead, the processor will break each word into its syllables and then redisplay each line, with each syllable in uppercase or lowercase according to the position of the dots and dashes in a user-specified metric form. So, were Shakespeare trying to compose trochaic pentameter, with the metric pattern -./-./-./-./-./, the processor would reply with

SHALL i COMpare THEE to A sumMER'S day?

He would read this to himself, trying to put the stress on the uppercase syllables. Noting the rhythmic clumsiness, he might rewrite his line as follows:

To a summer's day I shall compare thee

and the processor would respond:

TO a SUMmer's DAY i SHALL comPARE thee.

Sounds better!

The main task for the computer is to break each word into its syllables. The algorithm is based on a systematic application of what appear to be the general rules by which English words break into syllables. Of course, there are no fixed rules, as evidenced by the fact that different dictionaries give different syllabifications for the same word.

The following is a simple version of the algorithm:

1. Break the word up into a sequence of alternating vowel and consonant groupings. Thus *microcomputer* becomes *m i cr o c o mp u t e r*. Wherever there is a vowel or group of contiguous vowels, there will be a syllable. We need only assign the neighboring consonants to the syllable on the right or to the syllable on the left.
2. If the first vowel group has a consonant group to its left, then assimilate this consonant group to the vowel group. This leads, in our example, to *mi cr o c o mp u t e r*.
3. If the final vowel group has a consonant group to its right, then assimilate this consonant group to the vowel group. We now get *mi cr o c o mp u t er*.
4. For the remaining unassigned consonants, do the following:
   a. If the consonant stands alone, attach it to the following vowel. Thus we get *mi cr o co mp u ter*.
   b. If there are two consonants, split them. We get *mic ro com pu ter*.
   c. If there are three consonants, then
      i. If there is a doubled consonant, split the pair; thus *apply* becomes *a ppl y* and finally *ap ply*.
      ii. If there is no doubled consonant, but the first of the three consonants is *n*, *r*, or *l*, then split between the second and third consonants.
      iii. In all other cases, split between the first and second consonants.

Before applying this algorithm, however, we must preprocess the initial string of letters in order to take into account certain peculiarities of English orthography:

1. Final *e* is silent (with certain exceptions); treat it as a special consonant. Thus *compute* becomes *c o mp u te*, then *co mp ute*, and finally *com pute*.
2. Translate many two-letter sequences into special single consonants, e.g., *sh*, *th*, *gu*, *qu*, and *ck*.
3. Identify common suffixes. For example, the algorithm applied to *blameless* would yield *bl a m e l e ss* and then *bla me less*. However, when *less* is removed as a suffix, then the *e* in *blame*

to thinking of the program as something for *me* to use—the relational table of contents was so the *user* could access my work. The program was originally to have been just a floppy solution to my table-of-contents dilemma. But you don't get that involved in a software application without elaborating and generalizing. In that way software is very much like poetic forms. You use it for the sake of using it. It generates its own kind of trance. Poetry and programming, once you look at them in context, were just made for each other.

Marriages like this one, made in heaven, often are so because they are marriages of convenience. One of the impediments to formal verse writing is the inconvenience of having to make repeated book accesses for rhymes, just when the form has prompted some involvement. You stop and look and lose something. That's one reason people have tried to do without forms. But that's throwing out the baby with the bathwater. You don't stop measuring and sounding things out, and you don't abandon

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would be recognized as silent, yielding *blame less*.

4. Identify some prefixes. For example, if *en* is recognized as a prefix, then *enact* becomes *en act*, rather than *e nact*.

It seems to be impossible to come up with a reasonably small set of rules and preprocessing steps to guarantee correct syllabification of all words. Two examples will illustrate some of the inherent difficulties:

1. Compound words: The algorithm will not detect the silent *e* in *snake* within the compound word *snakebite* unless the fragment *bite* is recognized as a word or treated as a suffix. Avoiding the problem would require either extensive word or prefix table lookups.
2. Successive vowels in different syllables: In *reach*, the *ea* is a single vowel sound, and the algorithm would treat it correctly. In *react*, we pronounce the *e* and *a* separately, and the correct syllabification is *re act*. Were the algorithm modified to isolate *re* as a prefix, it would treat *react* correctly, but turn *reach* into *re ach*.

Where ambiguities can arise, the best approach is to formulate a rule that leads to the smallest number of cases requiring table lookups for resolution. The present algorithm is not perfect, but it produces a readable, if not dictionary-perfect, syllabified word 95 percent of the time.

I have provided a Pascal program that implements the syllabification algorithm and illustrates how The Poetry Processor "reads" a user's poem according to a user-specified metric scheme. [*Editor's note: The Microsoft Pascal source code and executable version are available from* BYTEnet Listings, *telephone* (617) 861-9764, *as* SCANPOEM.PAS *and* SCANPOEM.EXE. *The executable version requires any* MS-DOS *or* PC-DOS *machine.*]

To run the program, prepare two files. TEST.POE must contain the lines of poetry. You can write TEST.POE as a text file with each line of the poem on a separate line. A second text file, TEST.FRM, should have a line containing a string of dots (.) and dashes (-) indicating the accentual scheme that each line of poetry is supposed to follow. Slashes indicating the end of a foot are optional.

As an example, a Shakespearean sonnet (iambic pentameter) will have a TEST.FRM file consisting of 14 lines of .-/.-/.-/.-/.-/. Each line in TEST.FRM must end with an asterisk. After editing the TEST.FRM and TEST.POE files, you can run the program by entering its name, SCANPOEM. The computer will "read" the poem, printing in uppercase the appropriately stressed syllables.

Note that the program is a prototype version of the algorithm. It will not handle text with capital letters, apostrophes, or punctuation, so be careful not to include these features in TEST.POE. When using this demonstration program, you will undoubtedly find that some words are not properly syllabified.

Paul Holzer (140 West 16th St., Apt. 3W, New York, NY 10011) is a financial analyst and programmer for PaineWebber *Inc. He has a* B.A. *in philosophy from Princeton University and an* M.A. *in applied mathematics from City University of New York.*

Photo A: *Setting the prototype of The Poetry Processor for iambic pentameter.*

"PLAYING" WITH THE POETRY PROCESSOR

Nine-year-old Dougal McQueen of Dunedin, New Zealand, was the first child to try the Orpheus program. First, he chose these rhymes and stuck them vertically on the right of the screen: freed, rhyme, speed, and rime.

I suggested he not rhyme "rhyme" with "rime" (Auden would not have approved), but he insisted. Then, having followed the rules of the game as far as they went, he played it his own freestyle way. He wrote

it wert koala you sope freed
yuiop pot deede awert rhyme
for dead people yuiop baskiop speed
yuiop astee yuiop wert wexs wertyuiop
  rime

Examining the poem, I saw that the "wert" and "yuiop" were sequences straight off the QWERTY(UIOP) keyboard! He was playing cadenzas. It sounded like Old English. The only real words, besides the rhyme words, were "koala" and "dead people."

His next go, he chose the rhymes "amazing, auto, nothing, ego."

I pointed out that they were feminine endings and didn't rhyme properly, but again he insisted. He wrote:

ling is nothing amazing
kine might do nothing auto
Yuiop is named because wert nothing
By mercury the fist planet Ego.

By his second try, the poem was full of words that meant something, and the third line explained his use of yuiop. The fourth line he started to say "first planet" and thought better of making too much sense. The last line *is* something amazing.

His sister, 12-year-old Amelia, was even more amazing. She wrote

aamoves lose bacollide
back ok accolade
can't be oxide
live in a barricade

Note how "bacollide" (a neologism worthy of Joyce), "accolade" and "barricade" seem to flow into one another, how "bacollide" seems to *back* into "accolade." Okay!

The rhyming dictionary presents each user with virtually *all* rhyming possibilities; the machine makes it possible for everybody to have the same size effective vocabulary! The *program* prompts them to reach into that vocabulary.

How they pick *what* is where the individuality will arise. Even as the beginnings of this new writing process excite me now, the extent to which coming generations will exploit the opportunity promises to ease my old and perhaps even middle age.

Amelia didn't need to know exactly what those words meant in order to exploit their musical interactive potential. Having used them, she will be sure to find out what they mean. Links we plan on making with syllabified electronic dictionaries will make "Definitions in Stride" possible as well.

When I first used even a limited rhyming dictionary (see photo B), I felt for the first time the freedom from having to use brain sugar in an inefficient, alphabetical, usually monosyllabic search for rhyme. Instead of that sempiternal turn-off, I felt the masterful turn-on of leisurely running the highlight bar through all possibilities and making carefully premeditated selections. Selection is a higher-order process than mere recall; poetry is a more pleasurable pursuit than trivia.

The freeing of the imagination to select from all possibilities has to be equal in importance to the achievement of calculators setting us free of low-order counting and allowing us to evolve to more creative estimation and projection. Moreover, the *human* dimension of this liberation is what will finally set the machine loose in the home, where people live their personal lives—and where mere productivity and diversion have not penetrated.

Math is at the heart of hardware design, but the soul of software is language. Poetry as a hit in software is not unlikely at all. Scrabble, slow and uninventive, crossword puzzles, with no freedom at all, still reign, because they are word games. Software makes it possible for poetry to be the next word game, the first and now the last.

User-friendliness, moreover, is a red herring. Dougal didn't know how to type, but to get at that rhyming dictionary, he quickly mastered WordStar-type commands. Poetry is the carrot at the end of the joystick.

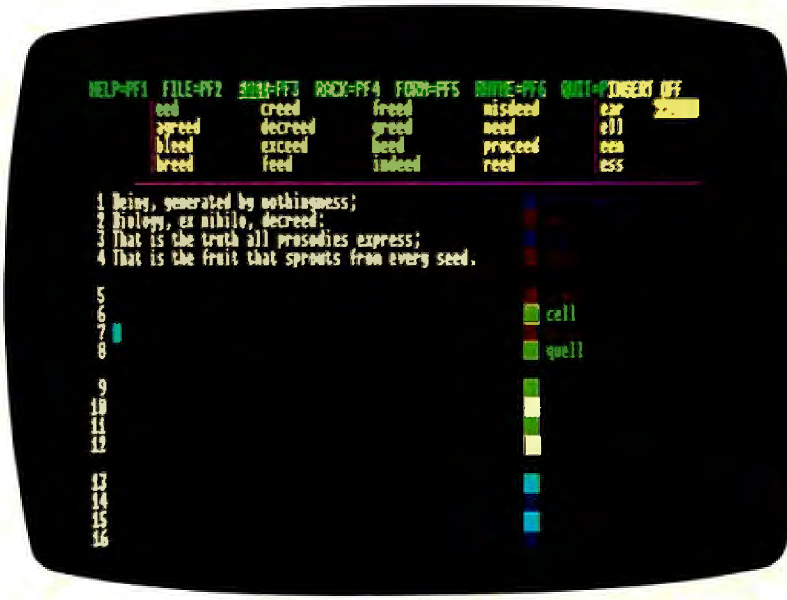

Photo B: *Using The Poetry Processor rhyming dictionary.*

the traditional formal procedures—you just speed them up to where you don't lose momentum keeping up with the demands of artifice. Those demands are prompts put there to *increase* momentum.

The sestina demands you use six words seven ways. That gets more out of you on them than ever before. It's the *setting up* of the sestina that slows you down. That friction can be removed by having the computer set up any six words in a sestina format. That eliminates loom craft from the poet menu of chores and allows for the art of word weaving. The idea is not to do free verse, but to free up formal verse. Sestinas, if optimally set up, can be written freely. True freedom comes only under pressure, anyway. It's not the same thing as mere liberty, or license.

Whenever I have rhymed in the past, I would stop writing to go fish out rhymes from memory, usually going down the alphabet, coming up with mostly one- and two-syllable words. If the form were rhyme-intensive, like a villanelle, I'd go to the book to make sure I had a cushion of extra rhymes. If I used the book I'd be drawing from three-syllable words as well, and I would find the ending in more spellings than I could pan off the top of my brain.

These rhymes went on lists that always got thrown out. Why not use the computer to keep and file the lists? It was an obvious application. The only reason publishers hadn't jumped on it was that there didn't, at first glance, seem to be much of a market. And why not have a master list of rhymes in the computer? Then a *drawback* of poetry in print could become a *feature* of poetry in a electronic setting. Throw those switches a few more times, make enough features of drawbacks, and you will have a valid application.

Stanford students Evan Kirschenbaum and Tim Torgenrud, majors in computer science and literature respectively, delivered Holzer a 20,000-word rhyming dictionary, which has been compressed to about 60K bytes and will be usable separately as a RAM-resident database. Searches for lists of all metric units (such as iamb and trochee) will be featured as "Foot Finder."

If poetic forms were considered as psychoactive outlines, then the text-editing aspect of the program could be considered a sort of ultimate outline generator. I mention that genre of product because it, like RAM-resident databases, is one of the few spin-offs of text editing to establish a market, and both have done very well, in ways that nobody envisioned. The appropriateness of the application for the powers of the medium have begun to define a market.

Before designing the text editor proper, I chose the dozen or so most algorithmic poetic forms I knew, put them on a scale of ascending difficulty (more conditions, more iterations, more recursions), and began writing poems in these forms on a broad range of topics. I developed enhanced ("turbo") versions of some forms, with added rhyme. I would take a 4-line poem, use its lines as the last lines of four 10-liners, and come out with a 44-liner, then add more rhyme and rewrite certain lines so you could see clearly how many more images occurred when harmonic pressure on meaning is increased by added rhyme.

To exemplify this, I wrote a series of poems for small children called Orpheus.jr. It started with some stanzas of half-rhymed common measure and went on until a fully rhymed hymnal stanza got up enough steam to develop. I then took that hymnal stanza and used it to write a 44-line glose (a Portugese song form). Here is the hymnal "Texte" and part of the first 10-line stanza of the glose glossed from it:

Poems are diaries that sing
And keep the love alive;
Poems are lives where everything
That lives gets to survive.

Any old thing can creep into
A thing that isn't rhymed;
A thing that isn't measured out
Cannot be too well-timed.

The appropriateness of the application for the powers of the medium have begun to define a market.

Then, to show how added rhyme can quickly enhance the imagery, I made the first line rhyme with the third:

Any old thing can creep into
A thing that isn't rhymed;
Without music it's all a zoo,
A *circus pantomimed.*

Adding rhyme brought a zoo into the picture, which lead readily to a circus. This caused the poem to become something of a bestiary—a theme always popular with children. (For examples of children interacting directly with The Poetry Processor, see the text box "'Playing' with The Poetry Processor" at left.)

Holzer first created dynamic walk-throughs of the designated forms in order to learn them himself and to prepare for creating a master algorithm, with which a user could specify the parameters of any form—by entering how many lines, metric units, repeating words, endings, phrases, or lines were desired—and custom-tailor a form-template to be written on.

We ended up with the Prosodic Spreadsheet, a split screen on whose left side one could enter prosodic variables and on whose right side the template being created could be viewed. We made it so the form could also be sounded out—so the user could hear as well as see a rhythmic matrix before even considering what words to pour into it. In a sense, these templates *format* the user's sensibility; that is, they provide a preapprehension of how the utterance will be configured.

An upshot of this development is

(continued)

that recently a 2½-year-old interacted with the program, just hitting a button and listening to the skeleton of a limerick. I had known that women disserved by software thus far were a market for electronic poetry, that old people with their wealth of experience were a sizable potential constituency, that hackers with their powerful syntactic abilities and estranged spouses needed a way of communicating effectively in natural language—but I hadn't known the gamelikeness of prosody could appeal to someone that young.

Neither did I know, when I started out, that I was going to be designing a piece of integrated software. But before we knew it, we had databases, a text editor, and a spreadsheet. By now poetry itself was finding expression entirely in the terms of integrated software. All that was missing was a telecommunications feature, and the utility here was not hard to envision.

One of the worst things about the world is the way the practice of poetry isolates people in it. Here we have the most interactive form of linguistic activity—insofar as one person interacting with natural language—but the interaction with other people is negligible. As an example, I had a poem in *The Poetry Anthology: 1912-1977* (Houghton Mifflin, 1978) after 10 years on the job. Ten years later I've had no feedback. Print moves much too slowly for poetry's interactive nature. The isolation I used to feel was an artifact of print, not poetry. The uncommerciality of my work was also an artifact of an inadequate medium.

How I envied the hackers, with their product-specific and language-specific networks. All that close-knit interactivity, I thought, but it's all about machines. If only it could be about human events.

Of course it can be about human affairs, and will be. Our Instant Anthology will link sonnet hackers with each other. It will encourage sonnet hackers to make villanelles out of their sonnets' best heroic-couplet punch lines (and to make sestinas out of the most-frequently occurring words in a linked set of prosodic modules). Feedback can be instantaneous and specific. Competence of execution—not social connections—will be the criterion of inclusion. Many more people than ever before will be able to write poetry competently, and many, many more like-formatted, compatible minds will know about it. To this cohesion can accrue much.

Software today has barely scratched the surface of its ultimate applications. Games that do not simulate nature, productivity without creativity—these are passing phases in the infancy of an industry. This is not so obvious to marketing people, especially those from the world of print; theirs is a world of diminishing categories, of lower and lower common denominators. It is a world where it seems safer to compete with a host of similar products through familiar licensing and promotional tactics than to try to shoehorn something unprecedented into the racks in an unfamiliar way.

I've learned to regard this sluggishness of institutional response as an opportunity for individual entrepreneurial feats. It is obvious to those of us outside marketing dogma's false conditionalities that language and its media have always evolved to accommodate human purposes and to facilitate human evolution. And it is clear to those of us committed to this project that poetry is the sempiternal and now supercharged crucible of linguistic evolution, that poetry can be many things to many people—natural-language programming, turbo word processing, personal debugging, the ultimate word game. It has always been with us, and will in the future be with us in force. ■

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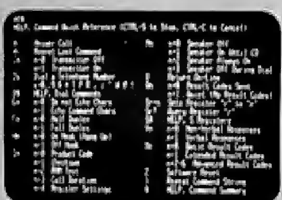

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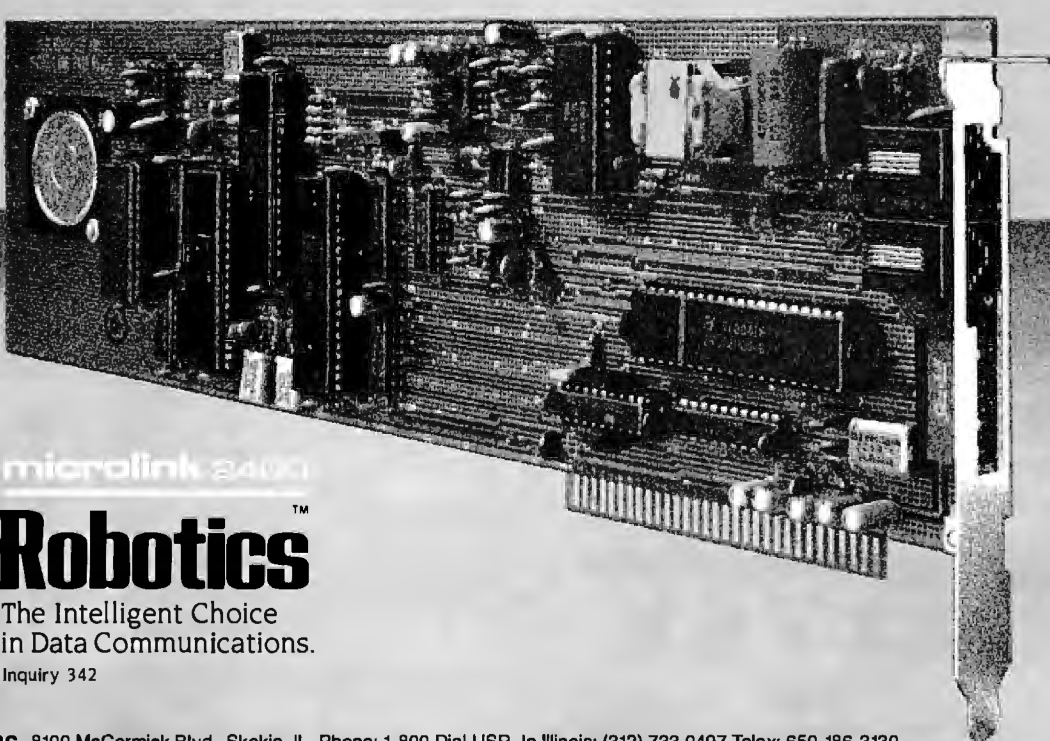

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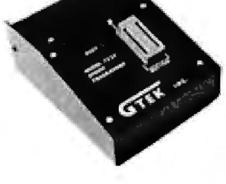

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THE LITERARY DETECTIVE

BY JIM TANKARD

Use your computer to identify an unknown author

THE POWER TO play literary detective has been granted to all of us by the invention of the microcomputer. The literary detective tries to identify an author purely by examining samples of writing. Some of the problems facing the literary detective might be trying to determine whether a famous author really wrote the works attributed to him or her, which of two likely candidates actually wrote a disputed document, or who wrote some famous but anonymous papers.

Researchers have taken various approaches to the problem of identifying the unknown author. T. C. Mendenhall used a word-length frequency approach to explore the controversy over whether Shakespeare actually wrote the plays attributed to him. Mendenhall counted the lengths of 400,000 words from Shakespeare and 200,000 words from Francis Bacon. He then drew a frequency curve for word lengths of each author. The curves from Shakespeare and Bacon did not match up very well, although a curve for Christopher Marlowe agreed with Shakespeare's about as well as Shakespeare did with himself.

G. Udny Yule used a different approach—the counting of the frequency of certain nouns—to try to determine whether Thomas à Kempis or Jean Charlier de Gerson wrote *The Imitation of Christ*. This work is sometimes said to be second only to the Bible in its importance in Christian literature, but there has been some controversy about who wrote it. Yule looked at the frequency of use of particular nouns in *The Imitation* and in other works by the two possible authors. He found that a number of classes of nouns were used at a much higher frequency by Gerson than they were in either *The Imitation* or à Kempis's other works, and this led him to conclude that à Kempis was the true author.

Alvar Ellegard used a similar approach—one based on counting the frequencies of certain major types of words—to determine the authorship of the Junius letters. "Junius" was the anonymous author of a series of letters that appeared several times a month in the London *Public Advertiser* from January 21, 1769, to January 21, 1772. The authorship of the letters, which were often critical of public officials, was a subject of frequent speculation at social gatherings around London. The most likely author on historical grounds was Sir Philip Francis, but it was also suggested that the letters might have been written by such candidates as Edmund Burke or Edward Gibbon. Ellegard concluded on the basis of his statistical analysis that the author was indeed Francis.

Frederick Mosteller and David L. Wallace counted the frequency of "minor function words" to determine whether Alexander Hamilton or James Madison was the author of 12 disputed *Federalist* papers. The *Federalist* papers were published anonymously in New York papers in 1787–88 under the name of "Publius." Not until the French edition of a book containing the letters was published in 1792 was it publicly announced that they were the work of Alexander Hamilton, James Madison, and John Jay. Later, both Hamilton and Madison claimed authorship of 12 specific papers. Hamilton left a note in a friend's

(continued)

Jim Tankard (3003 Cherry Lane, Austin, TX 78703) wrote his first computer program in 1963 while taking a FORTRAN course at Virginia Polytechnic Institute. He teaches journalism at the University of Texas at Austin.

bookcase before his duel with Aaron Burr, and the note listed the authors of the various "Publius" papers. Twelve papers that Hamilton assigned to himself in this list were listed in Madison's personal copy of the papers under Madison's name. These papers—numbers 49 to 58, 62, and 63—are the disputed papers. In contrast to the major word types used by Yule and Ellegard, Mosteller and Wallace found that minor words such as "a," "an," "by," "to," and "that" made good discriminators. Mosteller and Wallace, on the basis of their analysis of the use of minor function words, assigned all 12 of the disputed *Federalist* papers to Madison.

In a radically different approach, William Ralph Bennett Jr. has shown that the frequency of use of letters alone can serve to distinguish between samples of text. The frequency of use of single letters is often sufficient to differentiate between different languages, such as English and Spanish. The frequency of letter pairs, or digrams, is often sufficient to differentiate between authors. There are 26 times 26, or 676, possible letter pairs. Bennett reports a study using letter-pair frequencies that was able to distinguish the works of Hemingway, Poe, Baldwin, Joyce, Shakespeare, cummings, Washington, and Lincoln.

STYLISTIC FINGERPRINTS

To stick with the detective analogy a minute more, a writer leaves distinctive traces on his or her writing that can be thought of as stylistic fingerprints. Some of these traces could appear at the level of letter frequencies or letter-pair frequencies. One advantage of looking for stylistic idiosyncrasies at this level is that they are probably not even conscious parts of a writer's style. But they create a lot of points at which two authors could differ; for example, with a letter-pair analysis, there are 676 points of comparison.

William Paisley of Stanford University has referred to the small but telltale characteristics of a communicator's style as "minor encoding habits," and he has shown that they exist in painting and music as well as in writing.

I wrote some programs for the Apple IIe that would allow me to try the single-letter frequency and letter-pair frequency approaches to author identification. Then I attempted to test each approach by seeing if it could correctly identify the author of each of the 12 disputed *Federalist* papers. The identifications would be considered correct if they agreed with Mosteller and Wallace's.

Breaking the problem down, I needed programs that would read text from a file, perform the single-letter and letter-pair counts, normalize the counts to a standard sample such as 1000 letters or 10,000 letters, and compute a difference index that would summarize the differences in frequencies for any two samples of text.

I expected the programs for the single-letter analysis to be fairly easy to write. One program would read in the letters from a file, a letter at a time, and count them by incrementing an element of an array corresponding to the character's ASCII number. Since there are only 26 letters, this would only require a one-dimensional array with 26 elements. The second program for the single-letter analysis would take the frequency counts from two different samples of text and compute a difference score.

In contrast, I expected the letter-pair analysis programs to be much more difficult to write. Not only would they require a two-dimensional array with 26 elements in each dimension, but also I anticipated that it was going to take some tortuous programming to count the letter-pair frequencies. Finally an obvious solution occurred to me. I only had to modify the program for single-letter frequencies so that it remembered the previous letter while it was counting the present one, and it would be able to count letter pairs. This was one of those instances where you really see the power of the computer: Through a simple algorithm the computer would be able to do with great speed and absolute accuracy a task that would be maddening for a human coder. The second program for the letter-pair analysis would take the frequency counts for two different text samples and compute a difference score, and it would be similar to the second program for the single-letter frequency analysis.

THE PROGRAMS

I wrote four BASIC programs for the Apple IIe. TEXT GOBBLER 1 reads text from a file, counts the frequencies of single letters, normalizes them to a sample of 1000 letters (not counting spaces or punctuation), allows you to print out a table listing the results, and lets you store the frequencies in a file for later analysis. A sample table printed by TEXT GOBBLER 1 appears in figure 1. FREQUENCY ANALYZER 1 takes any two frequency data files created by TEXT GOBBLER 1 and computes a difference index based on the differences in frequencies of use of every letter.

TEXT GOBBLER 2 reads text from a file, counts the frequencies of letter pairs, normalizes them to a sample of 10,000 letters, allows you to print out a table listing the results, and lets you store the frequencies in a file for later analysis. A sample table printed by TEXT GOBBLER 2 appears in figure 2. FREQUENCY ANALYZER 2 takes any two frequency data files created by TEXT GOBBLER 2 and computes a difference index based on the differences in frequencies of use of every letter pair.

The FREQUENCY ANALYZER programs compute the difference index for two samples by taking the difference between the frequencies of a given letter (or letter pair) in the samples, getting the absolute value of that difference, and summing those values for all 26 letters (or, for letter pairs, for all 676 letter pairs). The smaller this index is, the more the two samples are alike. The larger this index is, the more the two samples are different. Bennett suggests a slightly different index, but I did not use his because it involves comparing each sample with a sample representing

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"standard English," and it is not clear what you should use as the sample of "standard English."

TRYING IT OUT

I compared the disputed *Federalist* papers with a sample of Hamilton's text and a sample of Madison's text to see which they resembled most. The first *Federalist* paper known to be written by each man was the "known" sample. These papers were number 1, by Hamilton, and number 10, by Madison. The Madison paper, at 18,087 characters, was about twice as long as the Hamilton paper, at 9399 characters. This should not affect the results, however, since frequencies are normalized to a sample of 1000 for single letters and to a sample of 10,000 for letter pairs.

The results for the single-letter analysis are presented in table 1, and the results for the letter-pair analysis are presented in table 2. In each table, the analysis assigns 9 of the 12 disputed papers to Madison. This can be compared with the results of the Mosteller and Wallace study, which assigned all 12 to Madison.

The explanation for the difference in results probably lies in the size of the text samples that were used as the known samples in the two studies. Mosteller and Wallace went outside the *Federalist* papers to get more text from Madison because he had fewer known papers in the set than Hamilton. They ended up examining about 70,000 words of known text, divided about equally between the two authors.

My study used one *Federalist* paper from each author as the known sample. This involved about 6000 words of known text, with one-third from Hamilton and two-thirds from Madison. A larger sample of known text in the present study might have produced a more dependable measure of the style of each author.

Another reason the letter frequency analyses may not have been 100 percent correct in their identifications is that the Hamilton-Madison discrimination is a particularly difficult one. The writing style in *The Federalist* is formal, and the writers may have even been attempting to write alike. Certainly it is a more difficult author-recognition test than distinguishing James Joyce, who made up his own words, from more standard writers of English or from writers in other countries and in other times.

Perhaps even more puzzling was that the single-letter frequency analysis was as effective in discriminating between Madison and Hamilton as the letter-pair frequency analysis. This finding means there was a pronounced difference between Hamilton and Madison in the frequency with which they used certain in-

(continued)

FILENAME DISPUTED49

NUMBER OF CHARACTERS 9981

NUMBER OF SPACES 1763

LETTER	ACTUAL	NORMALIZED
A	557	69
B	137	17
C	248	31
D	272	34
E	1095	136
F	184	23
G	131	16
H	437	54
I	583	73
J	16	2
K	16	2
L	296	37
M	181	23
N	604	75
O	658	82
P	241	30
Q	22	3
R	465	58
S	469	58
T	835	104
U	234	29
V	103	13
W	125	16
X	19	2
Y	103	13
Z	1	0

Figure 1: *Sample output from* TEXT GOBBLER 1, *an Applesoft* BASIC *program for discovering the author of an unknown text. Dividing the actual count for a letter by the actual count of all the letters and multiplying by* 1000 *gives the normalized count (number per* 1000 *letters) for that letter.*

FILENAME DISPUTED49

NUMBER OF CHARACTERS 9981

NUMBER OF SPACES 1763

FIRST LETTER SECOND LETTER

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
A	0	20	25	27	0	0	20	0	31	0	4	83	14	126	1	21	0	93	50	101	11	11	2	0	9	0
B	4	0	0	0	80	0	0	0	4	10	0	30	0	0	4	0	0	7	1	0	12	0	0	0	19	0
C	34	0	6	0	42	0	0	55	29	0	1	4	0	0	67	0	2	2	0	39	15	0	0	0	2	0
D	6	0	0	1	72	0	2	0	36	0	0	2	2	0	9	0	0	2	6	0	5	7	2	0	0	0
E	49	0	60	78	12	12	16	2	21	1	0	24	25	153	21	32	12	172	93	14	0	26	6	24	6	0
F	6	0	0	0	12	7	0	0	11	0	0	11	0	0	31	0	0	14	0	1	2	0	0	0	1	0
G	17	0	0	0	24	0	1	24	16	0	0	2	1	2	19	0	0	11	4	1	7	0	0	0	0	0
H	60	0	0	0	305	0	0	0	57	0	0	0	5	0	32	0	0	1	1	24	1	0	0	0	1	0
I	19	4	59	19	26	10	20	0	0	0	2	14	16	161	103	7	0	32	83	117	2	27	0	0	0	1
J	0	0	0	0	10	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	7	0	0	0	0	0
K	0	0	0	0	11	0	0	0	2	0	0	1	0	2	0	0	0	0	1	0	0	0	0	0	0	0
L	40	0	1	32	70	4	0	0	37	0	0	37	0	0	15	0	0	0	10	7	10	4	1	0	39	0
M	25	12	0	0	86	0	0	0	21	0	0	0	11	1	21	6	0	0	10	0	11	0	0	0	0	0
N	34	0	39	82	46	14	54	1	21	1	1	11	19	6	31	1	4	0	67	105	9	7	1	0	6	0
O	4	12	6	7	2	123	1	0	5	0	1	11	24	203	7	47	0	78	30	34	68	30	20	0	1	0
P	45	0	0	0	72	0	0	7	11	0	0	37	0	0	35	21	0	50	2	1	16	0	0	0	0	0
Q	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	0	0	0	0	0
R	41	1	4	16	147	2	4	2	46	0	4	1	11	21	45	5	0	5	30	45	6	2	0	0	21	0
S	11	0	1	0	63	1	0	16	52	0	0	10	1	0	30	7	0	1	35	87	27	0	2	0	1	0
T	26	0	0	0	62	0	0	356	127	0	0	7	19	0	81	0	0	25	42	10	35	0	6	0	21	0
U	19	15	14	11	25	2	10	0	10	0	0	44	11	20	4	6	0	31	26	44	0	0	0	0	0	0
V	10	0	0	0	96	0	0	0	16	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
W	4	0	0	0	31	0	0	45	24	0	0	0	0	4	34	0	0	2	2	0	0	0	0	0	0	0
X	2	0	1	0	5	0	0	0	2	0	0	0	0	0	0	9	0	0	0	4	0	0	0	0	0	0
Y	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
Z	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 2: *Sample output from* TEXT GOBBLER 2, *showing the frequencies of letter pairs in a disputed* Federalist *paper.*

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dividual letters. I had not anticipated this, and it is a difficult finding to explain.

USING THE PROGRAMS

These programs are designed to work on an Apple IIe and an Apple Dot Matrix Printer. The programs are TEXT GOBBLER 1, FREQUENCY ANALYZER 1, TEXT GOBBLER 2, and FREQUENCY ANALYZER 2.

The text samples you want to analyze should each be placed in a separate text file. The program is written so this can be done with a word-processing program such as Apple Writer. This makes it easy to look at the files and to make corrections in them. The files can also be created with the MAKE TEXT program in the Apple IIe *DOS Programmer's Manual* or on the DOS 3.3 "Sample Programs" disk. The only stipulation is that you must place an asterisk (*) as the last character of the text file. (If you do not, the program will not know that it is at the end of the file and will produce an error message.)

One of the big problems in using the programs is keeping all the files straight. For each text sample you are dealing with, you will have three files: one containing the text sample itself, a second containing the single-letter frequencies, and a third containing the letter-pair frequencies. Since I was dealing with 14 different text samples, I found it useful to draw up a table of the names of all the various files.

If you want to perform a single-letter frequency analysis on two or more samples, you will first run TEXT GOBBLER 1. This program deals with one text sample at a time. It will ask you for the name of the file the text sample is in. Then it will proceed to read in the text and perform the letter frequency counts. It can take it 10 to 15 minutes to do this on a text of 2000 to 3000 words. The program will ring the bell on the Apple IIe to indicate that it is through reading text. The program will then give you several options: printing out a table of the frequencies, storing the frequency data in a file so it can be analyzed later with FREQUENCY ANALYZER 1, running FREQUENCY ANALYZER 1, and so forth. You need to store the frequency data in a file and have at least one other set of frequency data stored in another file before you can run FREQUENCY ANALYZER 1.

If you want to perform a letter-pair frequency analysis on two or more samples, you go through the same steps as above except that you use TEXT GOBBLER 2 and FREQUENCY ANALYZER 2 instead of TEXT GOBBLER 1 and FREQUENCY ANALYZER 1. TEXT GOBBLER 2 can take quite a bit longer than TEXT GOBBLER 1 because it is searching for 676 elements instead of just 26. A run of TEXT GOBBLER 2 on a 3000-word sample might take as long as half an hour. This program will also signal when it is through by ringing the bell. The program then presents you with the option of storing the frequency data in files so it can be analyzed later. In this case, however, the frequency data will be for letter-pair frequencies and it will be analyzed by FREQUENCY ANALYZER 2.

The programs were written to work with the Apple IIe, but it should be possible to modify them to run on any microcomputer that uses BASIC. The principle modifications would be in

(continued)

Table 1: *Difference index for single-letter frequencies in the disputed* Federalist *papers, as generated by* FREQUENCY ANALYZER 1.

Disputed Paper Number	Paper No. 1 (Hamilton)	Paper No. 10 (Madison)	Assigned To
49	58	79	Hamilton
50	98	71	Madison
51	73	52	Madison
52	94	91	Madison
53	77	68	Madison
54	110	105	Madison
55	90	77	Madison
56	92	95	Hamilton
57	88	87	Madison
58	73	72	Madison
62	55	52	Madison
63	71	72	Hamilton

Table 2: *Difference index for letter-pair frequencies in the disputed* Federalist *papers, as generated by* FREQUENCY ANALYZER 2.

Disputed Paper Number	Paper No. 1 (Hamilton)	Paper No. 10 (Madison)	Assigned To
49	2066	2222	Hamilton
50	2494	2490	Madison
51	2357	1953	Madison
52	2291	2239	Madison
53	2069	2154	Hamilton
54	2465	2373	Madison
55	2256	2212	Madison
56	2603	2447	Madison
57	2207	2013	Madison
58	2039	2027	Madison
62	1796	1694	Madison
63	1891	2001	Hamilton

the routines in TEXT GOBBLER 1 and TEXT GOBBLER 2 that read text from files. Also, if you do not have an Apple Dot Matrix Printer, it may be necessary to modify the portions of those programs that set up the printer.

The next logical step in this kind of research would be to extend the level of analysis to trigrams, or sets of three letters. The problem with doing this on a micro is that the storage capacity needed begins to exceed that available on many machines. A single-letter frequency analysis requires matrices with 26 elements. A letter-pair frequency analysis requires matrices with 26 by 26, or 676, elements. A trigram analysis requires matrices with 26 by 26 by 26, or 17,576, elements. In any of these analyses, two matrices have to be used at one time to compute the difference index, and each element requires at least two bytes of memory. So a trigram analysis will require at least 70,304 bytes, and that is not even allowing for the disk operating system or the rest of the BASIC program needed to do the analysis. This exceeds the capacity of a 64K-byte machine and probably puts a strain on a 128K-byte machine unless some memory allocations are changed and programming is extremely efficient.

A trigram analysis should increase the sensitivity of the author-recognition technique considerably. It would theoretically look at 17,576 variables on which the two authors could differ. And it would begin to pick up three-letter words. These would probably include still more of the minor function words that Mosteller and Wallace found to be such good discriminators. ■

[Editor's note: *The programs described in this article are available (in source code) for downloading from* BYTEnet Listings. *Call* (617) 861-9764. *The files are* GOBBLER.ONE, GOBBLER.TWO, ANALYZER.ONE *and* ANALYZER.TWO. *You will need an Apple IIe, printer, and Applesoft* BASIC.

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KEYBOARD EFFICIENCY

BY DONALD W. OLSON AND LAURIE JASINSKI

Is the Dvorak layout worth learning?

THE STANDARD KEYBOARD, called QWERTY after the first six letters in the top row, was developed by C. L. Sholes in 1872. Because keys were prone to jamming on early versions of the typewriter, the QWERTY keyboard was designed with commonly used letter pairs purposely separated—paradoxically, to slow a typist down.

August Dvorak, a professor of statistics at the University of Washington, designed the Dvorak keyboard in the early 1930s. Dvorak was primarily concerned with efficiency of speed and movement and with reducing typing errors and fatigue.

In the home row, Dvorak put vowels on the left hand and the most commonly used consonants on the right hand. The top row contained the next most commonly used letters, and the bottom row contained those least used. (See figure 1 for a comparison of the QWERTY and Dvorak keyboard layouts.)

Dvorak claimed that 70 percent of the typing would be done on the home row and that 35 percent of the most commonly used words could be typed using only the home row, with almost no finger motion. This emphasis on the home row was hailed as the revolutionary improvement of the Dvorak system.

Proponents of the Dvorak system claim improvements in speed and accuracy ranging from 35 percent to 50 percent for skilled typists. Indeed, August Dvorak's students regularly won typing competitions in the 1930s and 1940s. The reigning World's Fastest Typist, Barbara Blackburn (170 words per minute, according to the *Guinness Book of World Records*), is a Dvorak typist. Considering today's increased use of electronic keyboards, is the Dvorak layout worth learning?

FINGER TRAVEL

Another claim of Dvorak superiority relates to the reduction of "finger travel" and, presumably, fatigue. In recent interviews, Barbara Blackburn stated that the fingers of a typist using the QWERTY layout for eight hours will travel between 15 and 16 miles, while a Dvorak typist's fingers will travel only about 1 mile. Indeed, in most of the Dvorak-related articles that we read we found similar numbers, suggesting that a typist using a QWERTY keyboard has to move his or her fingers about 16 times the distance of a Dvorak typist.

The original distance stated in August Dvorak's 1943 article "There Is a Better Typewriter Keyboard," which appeared in the *National Business Education Quarterly*, is from 12 to 20 miles for a skilled QWERTY typist over a working day, compared to the Dvorak figure, which is "a little over a mile."

This lack of precision makes it difficult to deduce an exact ratio. However, Dvorak states further that finger motions "have been reduced by more than 90 percent," implying a distance ratio of 10 to 1 or more.

Adoption of the Dvorak keyboard was hindered by four factors: its introduction during the Great Depression,

(continued)

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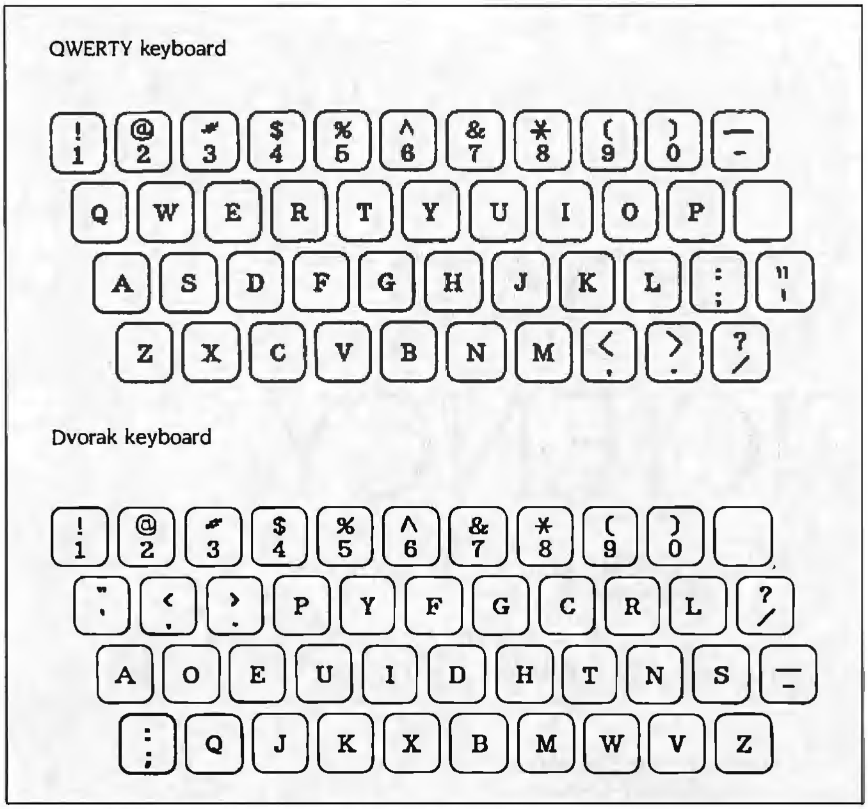

Figure 1: QWERTY *and* Dvorak *keyboard layouts.*

government standardization to QWERTY during World War II, a government report in 1956 that favored QWERTY over Dvorak for training new typists, and, most important, the well-established position of the QWERTY keyboard in the business world and users' resistance to relearning.

THE DVORAK REVIVAL

In the decade since Dvorak died in 1975, there has been a revival of interest in his system. The Apple IIc has a built-in keyboard switch that converts the keyboard from QWERTY to Dvorak and back again almost instantaneously. Separate keyboards with the Dvorak layout are available for the IBM Personal Computer, and Dvorak elements can also be purchased for IBM Selectric typewriters.

Software conversions that remap the keyboard layout are available for the Apple IIe, the IBM PC family, some Tandy models, and the Commodore 64. In addition, several popular programs that use computers to teach typing allow students to enter lessons

(continued)

Table 1: A *comparison of finger-travel distance ratio (relative efficiency) for* QWERTY *versus Dvorak keyboards, based on typing the sample texts shown in the right-hand column.*

Ratio = QWERTY/Dvorak (Inches)	Words	Text Used for Test
1.45 = 1818 / 1256	472	The Bill of Rights (Amendments I–X)
1.32 = 1222 / 926	305	Lyrics to "Help!" "All My Lovin," and "In My Life" by the Beatles
1.44 = 1142 / 791	294	Lyrics to "Mr. Tambourine Man" by Bob Dylan
1.34 = 945 / 705	280	Genesis I, v. 1–13 (Creation story)
1.50 = 876 / 585	263	"The Gettysburg Address" by Abraham Lincoln
1.39 = 955 / 686	261	Hamlet's "To Be Or Not To Be" soliloquy by William Shakespeare
1.33 = 828 / 621	252	"Stopping By Woods. . ." and "The Road Not Taken" by Robert Frost
1.36 = 1010 / 743	232	"The Raven" (first four stanzas) by Edgar Allan Poe
1.40 = 623 / 445	200	*A Tale of Two Cities* (opening paragraphs) by Charles Dickens
1.33 = 547 / 410	151	"I Wandered Lonely As a Cloud" by William Wordsworth
1.39 = 9966 / 7168	2710	

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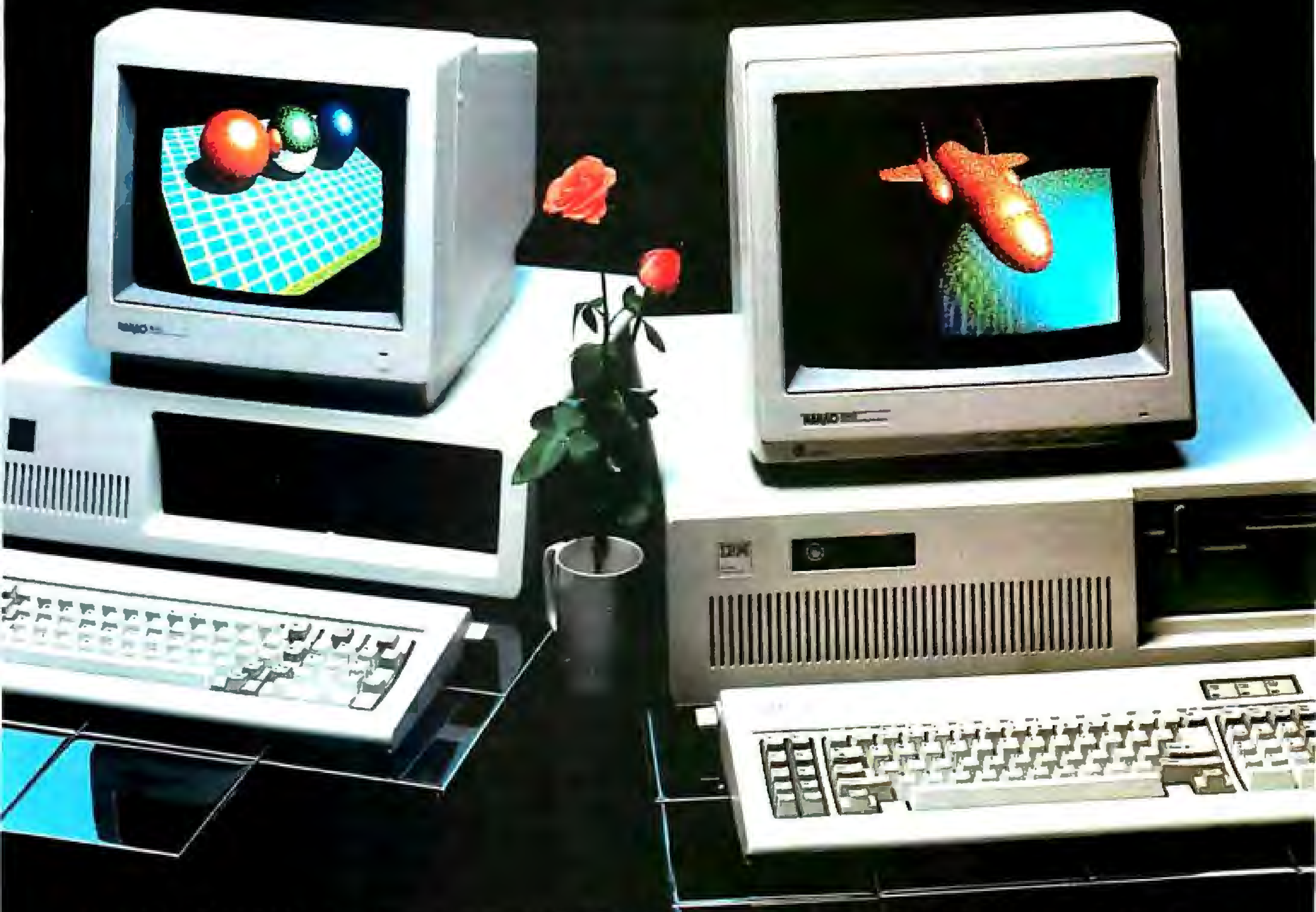

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in either QWERTY or Dvorak format.

[*Editor's note: Apple IIc users will notice two switches just above the keyboard. The use of the 80/40-column switch is obvious, but the function of the keyboard switch probably requires reference to the* Owner's Manual. *According to page 15 of the* Owner's Manual, "*Locking down this switch changes the layout of the keyboard from the standard arrangement to the Dvorak Simplified Keyboard, which is designed to increase typing speed and efficiency by locating frequently used keys in the home-base row. To complete a permanent conversion the keycaps must then be rearranged following the diagram on page 16 of the manual.*"]

VERIFYING THE CLAIMS

Partly as an exercise in programming and partly to check the 10:1 and/or 16:1 distance claims, we wrote a short Applesoft BASIC program to study finger motion as a typist enters a passage of text. It is a relatively straightforward task to monitor each letter as it is received from the keyboard, to infer which finger the typist used and the location of that finger relative to its home position, and to keep running totals of the distance traveled by each of the eight fingers.

The program accepts uppercase and lowercase letters, as well as punctuation, math symbols, and most of the special symbols. After each line is entered, it is analyzed twice, once to compute the motions of the fingers under the QWERTY system and again to compute the finger motions if the typist had used the Dvorak layout. Updated distances traveled for finger, hand, and grand totals are displayed at the top of the screen for each type of keyboard.

Our program, DVORAK.BAS, makes no statement regarding typing speed. We compute only the distances of finger travel. We typed 10 passages with rather surprising results. Although there was some variation from one selection to another, we found that the ratio of QWERTY finger-travel distance to Dvorak distance fell consistently in the range between 1.3:1 and 1.5:1 (see table 1). This is far less than the ratios of 10:1 or 16:1 that are often quoted. It is unlikely that this discrepancy was caused by our choice of text material, since we had a wide variety of sources (songs, poems, speeches, plays, etc.) from different authors (see table 1).

Defining a "typical" working day is somewhat arbitrary, but a typist assumed to be producing 70 words per minute for 50 minutes of each hour for 8 hours would type 28,000 words. Using the numbers for finger travel (inches per word) from table 1, we can estimate a total distance of 1.63 miles per day for a QWERTY typist and 1.17 miles per day for a Dvorak typist.

Because these numbers and their ratio are so different from those quoted by Dvorak in 1943 and by Dvorak proponents ever since, we wondered if our program was too simple or if it had some major flaw that we had overlooked. We later discovered that a major research effort that studied typing, typists, and keyboards arrived at results similar to our own.

We wrote a program to study finger motion as a typist enters text.

Donald Norman, Donald Gentner, David Rumelhart, and their coworkers at the University of California at San Diego (UCSD) have used stop-action videos (60 frames per second) and high-speed motion pictures (100 frames per second) to analyze the finger motions of typists. Both experts and novices typed on keyboards connected to microcomputers that in turn recorded the time of each keystroke. These tests enabled the UCSD group to construct a computer model that simulated a skilled human typist and estimated typing speed based on the frequencies of different finger movements required.

Based on this model, the researchers concluded that, in terms of typing speed, the Dvorak keyboard is actually better than the QWERTY, but only slightly (perhaps 5 percent to 10 percent faster). Just as we found with finger travel, the relative improvement is significantly less than what Dvorak proponents claim it to be.

Which keyboard should you use? The QWERTY system is entrenched in our society. Anyone who must type at more than one location is almost forced to use the QWERTY keyboard. A person who does almost all of his or her typing on only one machine, however, would benefit from learning and using the Dvorak layout.

It will be interesting to see if Dvorak products become more available in the next few years. Although we believe that certain numerical claims may have been exaggerated in the past, the Dvorak keyboard is definitely more efficient than the QWERTY keyboard. ■

[*Editor's note: The program described in this article,* DVORAK.BAS, *along with a description and instructions for its use,* DVORAK.TXT, *is available for downloading on* BYTE*net Listings at* (617) 861-9764.]

FOR FURTHER INFORMATION

The classic book detailing Dvorak's original studies is *Typewriting Behavior* by A. Dvorak, N. L. Merrick, W. L. Dealey, and G. C. Ford (American Book Company, 1936).

The UCSD research on typing is summarized in "The Typist's Touch" by D. R. Gentner and D. A. Norman in *Psychology Today*, March 1984, pages 66–72.

Current information and sources for Dvorak-related products can be found in a newsletter available from Dvorak Dvelopments, POB 717, Arcata, CA 95521. The newsletter costs $6 for two sample issues and includes additional material.

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Step 2: To reach BIX via Tymnet.*

- Call your local Tymnet number and log on.
- Tymnet will ask you for a "terminal identifier." Type the letter "a."
- Tymnet will ask you to log on. Type "byteneti" and a carriage return.
- Tymnet will ask you for a password. Type "mgh" and a carriage return.
- You will then be at the BIX computer. At the next prompt, type "bix" and a carriage return. You're now on line with BIX.

**BIX is accessible from anywhere in the country through local Tymnet numbers. Call Tymnet's 24-hour customer service number, (800) 336-0149, for local Tymnet numbers and for assistance in setting your computer's communications program properly. This is also the number to use to report problems with the Tymnet system. (There is a premium charge for Tymnet, but you still reach BIX for much less than regular long distance.)*

Step 3: Once on BIX, you will be asked to enter your name. Since this will be your first time on the system, enter "new" and a carriage return. This will take you to a special section where you enter the information we need to register you as a BIX user. Follow the on-line prompts and supply the information requested. BIX lets you reenter data if you make a mistake.

When you've completed your registration, BIX will automatically take you to a special "Learn" conference where you'll get a quick tutorial on how to use the system. (Typing "help" or "?" at any prompt while you are on BIX will give you an immediate review of available commands.)

Problems: If you follow these instructions but still are unable to log on to BIX, call the BIX Customer Service Line for assistance at (800) 227-2983 from 8:30 a.m. to 4:30 p.m. eastern time weekdays.

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Reviews

THE MOTOROLA VME/10, based on a 68000-series microprocessor, is an expansion-oriented system with a configuration that ultimately reflects the user's requirements. In other words, you buy the basic set of boxes and boards, but what you add to it after that is pretty much up to you. As such, reviewer Robert E. Robinson III points out, the VME/10's versatility gives it utility in applications from business to science. The possibilities can get a little bewildering after a while, but Dr. Robinson goes into all the permutations with ease and clarity. If you've decided that what you need is a powerful computer that can continue to increase in power, you'd be doing yourself a favor by reading this article.

In our next review, Larry Crockett takes us through MacCharlie from Dayna Communications. Designed to permit you access to IBM software through a Macintosh, the unit consists of an 8088 processor running at 4.77 MHz, 640K bytes of RAM, and two 360K-byte 5¼-inch floppy-disk drives (Dayna now sells a wider variety of configurations, including a hard-disk model, but this is the one we received for review). MacCharlie also comes with the software necessary to combine the two modes of operation, transfer files, etc., as well as its own MS-DOS operating system and GW-BASIC. Dr. Crockett points out that any product with one foot in each of two different worlds runs the risk of performing below expectations in both operating areas. In this case, he feels that MacCharlie performs its self-appointed task as a bridge well enough that you could consider it seriously if you feel you need the kinds of capabilities it offers. If you've already got a Macintosh and want or need access to IBM software, this review could open up a new path for you.

Lattice continues to update and improve its 8086/8088 C compiler, and this month's review of version 2.15 highlights a product that is a major departure from earlier versions. (Just as we were going to press, the company announced an even newer version, 3.0, but what Lattice sent to BYTE was still a preproduction copy and could not be used in our evaluation. Rather than hold on to the review indefinitely until a final copy of the update is available, we decided to proceed with the review of the current production version.) Comparing release 2.15 with earlier versions, reviewer Dayle S. Woolston points out that it includes "major improvements in the speed and accuracy of the math libraries, a new command-line option, refinements, and bug fixes."

Our final review this month covers version 3.0 of Borland International's Turbo Pascal. Reviewer Mark Bridger notes that the reason for Turbo Pascal's increased speed over other Pascals is the fact that it has no link step. Additionally, Turbo Pascal is 5 to 10 times smaller than other implementations. Now, how does version 3.0 stack up against the company's own earlier versions? According to Mr. Bridger, 3.0's major changes involve offering more of the same qualities most evident in previous incarnations. Version 3.0, for example, compiles about twice as fast as version 2.0. Aside from speed, our reviewer also comments on the package's new graphics procedures.

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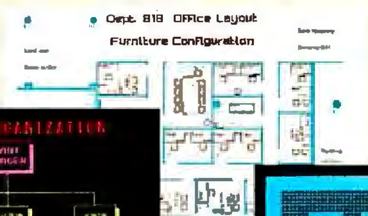

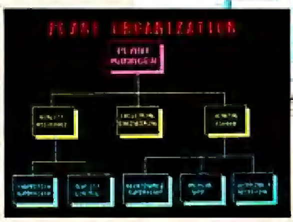

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R·E·V·I·E·W·E·R'S N·O·T·E·B·O·O·K

Zenith's new laptop portable, the ZP-150, looks to be a well-featured unit in some respects. For example, it comes with its own modem, Microsoft Word instead of a simple text editor, a database program, a spreadsheet, telecommunications software, removable ROM-pack for the applications packages, BASIC programming language, two sockets for memory expansion, and several other attributes that seem well-considered and thoughtfully implemented. It has two methods of adjusting the readability of the screen—with a contrast-control thumbwheel or by adjusting the angle of the screen with the aid of multiposition hinges. In spite of this, however, the 80 by 16 LCD screen was hard for me to read under any but the most favorable light. I found it to be one of the least attractive features of the ZP-150.

Power is supplied by ten AA cells when you're away from an electrical outlet. The keyboard is standard in its alphanumeric layout and has a cross-shaped cursor pad in the upper right corner. There are ten function keys arrayed latitudinally across the face of the key platform above the row of numeric keys.

One feature I like is that, unlike such laptops as the HP Portable Plus or the Tandy family of LCD-screen portables, the ZP-150 uses standard telephone, serial, and parallel interfaces. You can go into a hotel room, for example, and telecommunicate without having to fool around with separate cables, plugs, or associated devices. On the other hand, you're going to be stuck poking along at 300 bits per second while the timer at the bottom of the screen shows you just exactly how expensive it is to check your electronic mailbox.

You also should be aware that the telecommunications program is not able to take a Word document and transform it automatically into an ASCII document for uploading. The way it works is that you have to set the margins to zero, print the Word file to another file (hoping all the while that you have the memory for it), and then upload that file.

Having enough memory is no joke with the ZP-150. I had a major problem when one file disappeared when I tried to rename it. The status message at the bottom of the screen said there wasn't enough memory to perform the operation I'd requested; and when I went to look at the document under its old name, the screen stubbornly and irrevocably remained blank. If I'm sometimes skittish around laptops, the reason is that I have a hard time reconciling myself to big mistakes that I was unaware could happen until the results are in. Avoiding catastrophic failures becomes second nature after a while, but the learning curve is a bother.

One of our reviews this month is of MacCharlie from Dayna Communications, an interesting approach to the mingling of IBM and Apple philosophies (or, at least, programs). Newer yet is the recently announced hard-disk MacCharlie that can significantly speed up the swapping of information between IBM PC and Apple Macintosh formats. Slow disk drives being one of the reasons why the Macintosh is criticized, the availability of faster disk access (even if it is through a serial interface) can be considered a step in the right direction. Another Dayna introduction designed to make things simpler for mixed machine environments is Dayna's new external chassis that will take up to six IBM PC expansion boards.

Granted that the communication between a Macintosh and an IBM PC represented by the various Dayna products is a more sophisticated thing, I think that the file-transfer capabilities to be found in an ordinary Imagewriter printer cable could use a brief mention. The Imagewriter printer cable can be used as a null modem connection between a Macintosh and an IBM PC or compatible. Either leave the cable plugged into the Macintosh's printer port or move it over to the modem port. Plug the other end with the 25-pin connector into either the serial printer port or the modem port on the IBM PC/compatible. You may need to buy a gender changer for the IBM end, depending on how your brand of compatible is set up. You need a communications program up and running on each machine, but the transfer process is straightforward. Data-transfer rate is 9600 bits per second.

General Computer looks as if it is continuing to innovate with its new HyperDrive 2000. By itself, the HyperDrive 2000, with its 12-MHz clock, 1.5-megabyte RAM, and floating-point math coprocessor, looked impressively fast running sample graphics programs alongside HyperDrive 20s and 10s and a 512K-byte Macintosh. It was still having trouble synchronizing its fast clock with the others' 6-MHz rates, however, in a demonstration of networking software. The object of that software, by the way, is to allow each HyperDrive on the link to be accessed by every other HyperDrive or Macintosh. The net result is intended to be a proliferation of file servers that will continue to act as personal computers in the foreground while they simultaneously function as network nodes in the background.

—*Glenn Hartwig*
Technical Editor, Reviews

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The Motorola VME/10

A flexible multiuser system

BY ROBERT E. ROBINSON III

Robert E. Robinson III is a physician in the private practice of internal medicine. An electrical engineer prior to attending medical school, he did research at Wake Forest and the University of California at Los Angeles on the application of computer systems to the processing of medical information. He can be reached at 2323 Northeast 26th Ave., Suite 103, Pompano Beach, FL 33062.

Although initially designed as a development system for original equipment manufacturers that use the Motorola 68*xxx* series of microprocessors, the VME/10 is a flexible computer of considerable interest for business and scientific applications.

The control-unit chassis, which measures 23 by 19 by 7 inches, houses a 400-watt switching power supply, a fan, a processor/MMU (memory-management unit) board, a graphics/interface board, a disk controller, a 15- or 40-megabyte hard disk, a 5¼-inch floppy-disk drive with a 655K-byte capacity, and an expansion-card cage that provides a five-slot VMEbus backplane and a four-slot I/O (input/output) channel backplane (see photo 1).

The graphics/interface board has 384K bytes of RAM (random-access read/write memory), 32K bytes of ROM/PROM/EPROM (read-only memory/programmable ROM/erasable PROM), an interrupt handler, a time-of-day clock, a keyboard interface, an I/O channel interface, and a graphics subsystem. The RAM is multiported to facilitate shared access between the microprocessor, VMEbus, and graphics controller. The graphics subsystem displays characters in an 80-column by 25-line format, graphics in an 800- by 600-pixel matrix, or a combination of character and pixel graphics. The medium-resolution mode dedicates 192K bytes of RAM to graphics. You can modify an 8K-byte character-display RAM to redefine characters. The subsystem provides color or seven shades of gray.

The processor/MMU board, a small daughterboard located on top of the graphics/interface board, contains the MC68010 microprocessor and up to three MC68451 memory-management units. Each can handle 32 separate program/data segments.

The graphics/interface, processor/MMU, and disk-controller boards that form the VME/10 system-control module are not plug-compatible with the VMEbus. Reliance on the large graphics/interface board has two major disadvantages. Updating the microprocessor electronics requires replacement of an expensive, multifunction board. And the board, which is virtually fixed in place, is much more difficult to remove and service than a module that you can unplug.

Serial terminal communications are provided through use of one or more of the MVME331 or MVME400 modules. The MVME331 is a 68010-based intelligent controller capable of handling six RS-232C or RS-422 ports. Four can be either synchronous or asynchronous. The MVME400 has two RS-232C multiprotocol ports with data-transmission rates extending from 50 to 307,200 bits per second. The MVME410 16-bit parallel port serves as a dual Centronics-type printer interface. In addition to the modules, Motorola supplies a variety of backplanes, floppy- and hard-disk assemblies, power supplies, and I/O adapters that are used for industrial control systems.

With the VME "Open System" starter system, you can replace the functions of the system-control module with a monoboard computer (MVME121), system-controller module (MVME050), and an intelligent disk controller (MVME320). The starter system also includes a 15-slot chassis and power supply (MVME943) and a floppy-/hard-disk module (MVME820). You can add 1024- by 1024-pixel resolution graphics to this configuration by installing the MVME390 graphics-display module.

The mass-storage subsystem includes a disk controller, a double-sided quad-density 96-tpi (tracks per inch) floppy-disk drive with a formatted capacity of 655K bytes, and a 15- or 40-megabyte Winchester disk drive. Average seek time is 70 milliseconds for the 15-megabyte and 33 ms for the 40-megabyte Winchester drive. Despite a number of power failures in our building, the drives have so far survived without developing any mechanical problems. Media difficulties

(continued)

have been responsible for rare, irrecoverable read/write errors on the floppy-disk drive.

The 105-key detachable keyboard has the full ASCII character set, 16 function keys, a cursor/tab-control pad, interchangeable keycaps, and a numeric pad. The main key grouping conforms to the QWERTY layout. However, the Ctrl and Alt keys are where the shift keys normally are and Del is in the backspace location. In addition, I would prefer to have the Clear, Break, and Reset keys, which are on the cursor-control pad, in an even more remote location.

The display unit, which mounts on a tilt-and-swivel stand, comes in one of two models: a 15-inch green-phosphor monochrome video display or a 14-inch color monitor. The review unit's monochrome display had quite good picture quality and was trouble-free. However, the cable connecting the display to the control-unit chassis is very short; the display must rest on top of or immediately beside the control unit.

THE VMEBUS

The VMEbus is a versatile bus that provides for the rapid, reliable transfer of 32-bit data. The VMEbus uses an asynchronous protocol and can support data-transfer rates up to 57 megabytes per second when operating in the 32-bit mode. The cards that connect to the bus conform to the Eurocard format, which is a convenient card size except that a minimum of panel space is available for mounting connectors.

Two high-quality 96-pin connectors provide for data transfer between the cards and the bus. The primary connector implements a parallel non-multiplexed data-transfer bus with 8- and 16-bit data transfers, 24-bit addressing, and all control signals. The second connector provides expansion to full 32-bit address space and data transfer. See table 1 for a partial listing of the modules now available for use with the VMEbus and the I/O channel.

There have been two recent extensions of the VMEbus. The VMXbus is a subsystem bus that facilitates expansion of a local processor's memory in a multiple-processor configuration. It has a maximum data-transfer rate of 80 megabytes per second. The VMSbus is a self-arbitrating serial bus used to handle control-message traffic between multiple processors. It can transfer data at rates up to 3.2 megabits per second.

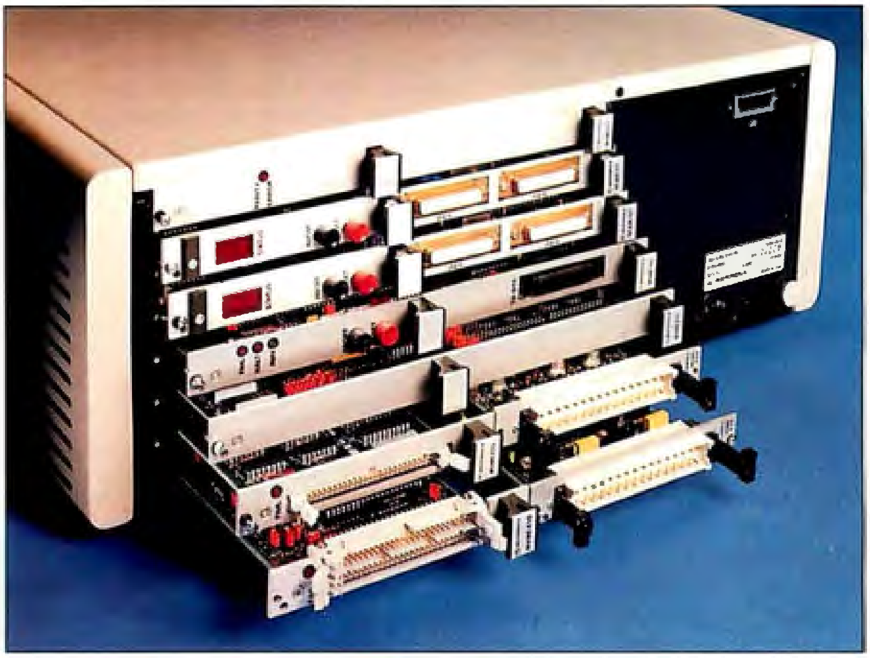


Photo 1: *The rear view of the control-unit chassis showing the VME modules.*

HARDWARE PROBLEMS

The VME/10 has been extremely reliable; I have had only three problems during 17 months of heavy use. A mask error in the early production run of the MC68010 microprocessor caused a failure in the reset function. Until I installed the replacement for the MC68010, I had to reset the system manually on power-up, a trivial inconvenience.

The MVME201 256K-byte memory module functioned normally under the VERSAdos operating system and passed repeated system diagnostics, but it intermittently failed when running UNIX. A later version of the module corrected the problem. Finally, I had to replace the cooling fan when it developed a noisy bearing.

OPERATING SYSTEMS

Motorola supplies three operating systems for the VME/10. I used VERSAdos on the system for nine months; subsequently, I have used UNIX. I have not been able to test CP/M-68K.

VERSADOS

VERSAdos provides multitasking, multiprogramming capabilities. Programs execute in dynamically assigned, variable-length segments with read/write privileges. Instructions and data are located in separate memory segments. The RMS68K real-time executive supports memory management, provides task services, handles interrupts, and facilitates intertask communications. The I/O system supports device independence, logic I/O, overlapped computation, and physical I/O. File-system features include contiguous, sequential-length, and indexed-sequential file structures; shared access; dynamic file allocation; and fixed or active protection.

Pascal, FORTRAN, and an assembler are available under VERSAdos. BASIC and C are in the planning. The assembly language is powerful, easy to use, and includes structured con-

(continued)

DŽ DŽġ gDŽ § ₹

Name
Motorola VME/10

Company
Motorola Semiconductor Products Inc.
Microsystem Operations
2900 South Diablo Way
Tempe, AZ 85282
(800) 521-7274

Components
Processor: 32-/16-bit 10-MHz Motorola MC68010
Memory: 384K bytes (basic) expandable to 16 megabytes
Display: 15-inch monochrome green-phosphor video display or 14-inch color monitor
Keyboard: 105 keys with 16 function keys, QWERTY
Mass storage: 655K-byte floppy-disk drive, 15- or 40-megabyte Winchester drive
Expansion: Five VMEbus slots, four I/O-channel slots, approximately 37 Motorola modules provide major system expansion

Software

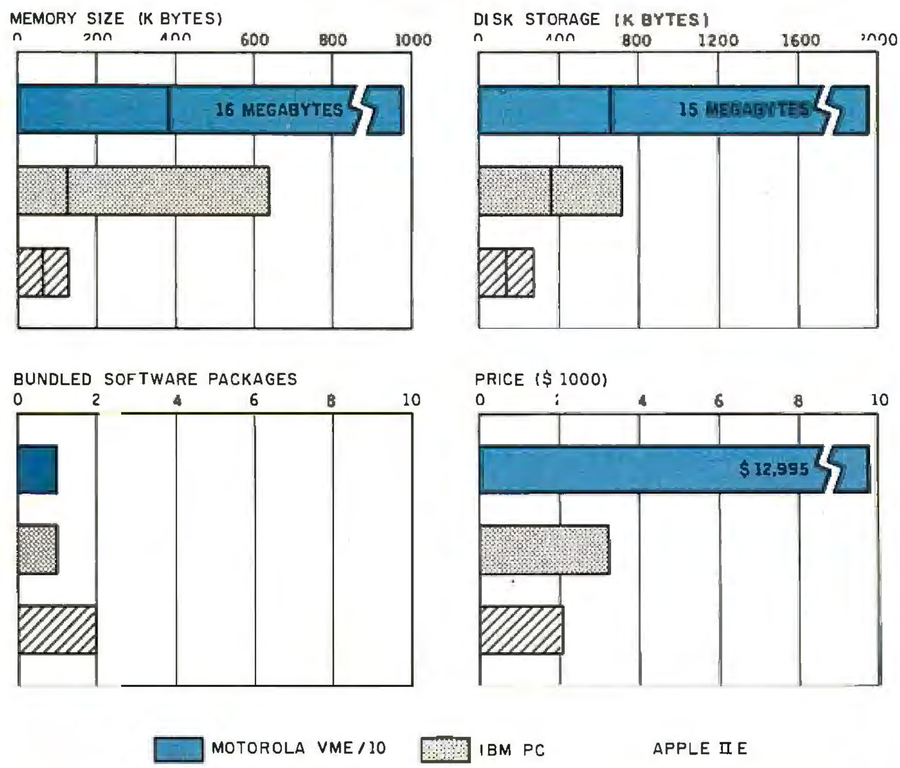
CP/M-68K	$350
UNIX System V/68	$1695
VERSAdos	$2000

(included with VME/10 and "Open System")
Assembler, BASIC, C, CBASIC, FORTRAN, Pascal, PL/I

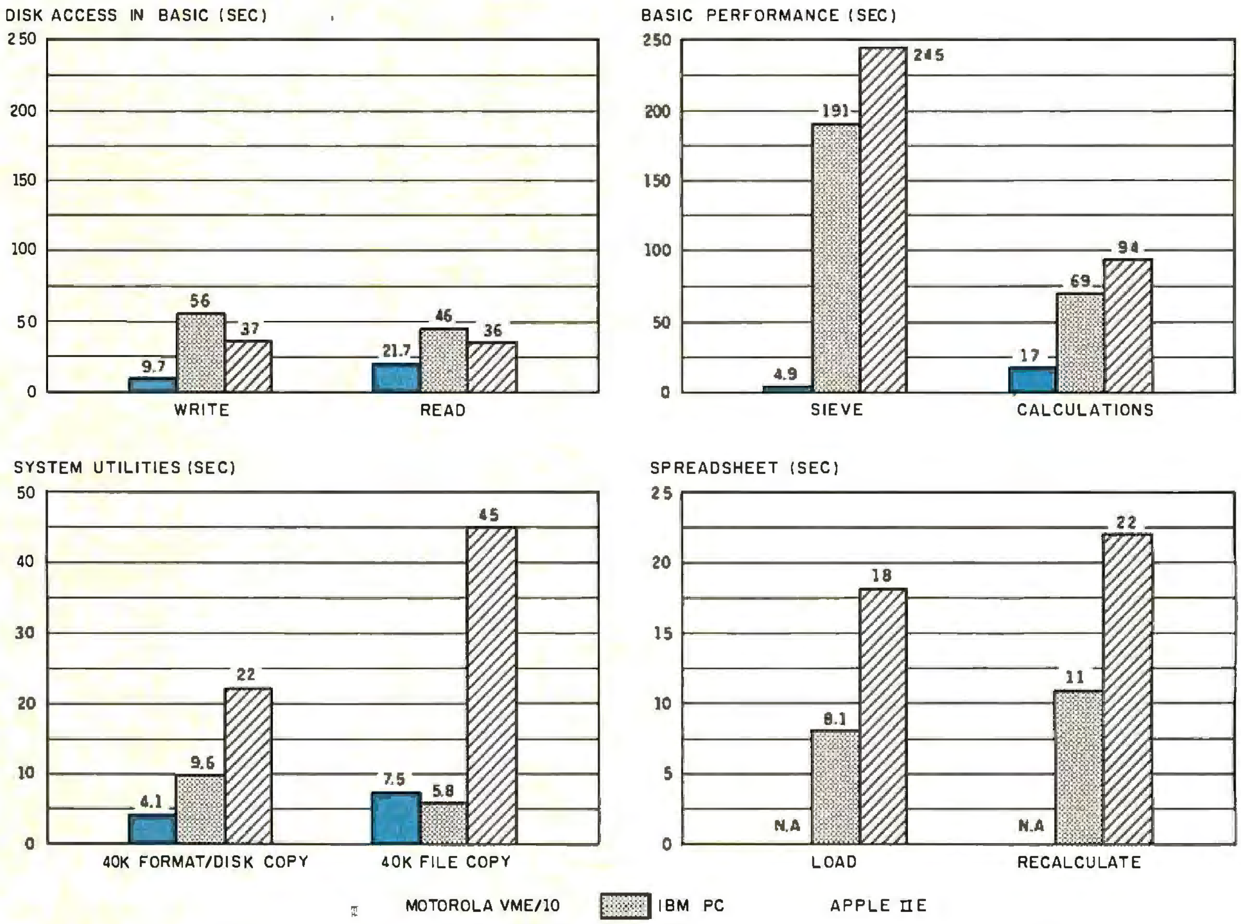
Documentation
Technical and software manuals—approximately 3000 pages

Price

Monochrome display and 15-megabyte Winchester drive	$12,995
Monochrome display and 40-megabyte Winchester drive	$14,995
Color display and 40-megabyte Winchester drive	$16,530
VME "Open System" and 15-megabyte Winchester drive	$9995



The Memory Size graph shows the standard and optional memory for the computers under comparison. The Disk Storage graph shows the highest capacity for a single floppy-disk drive and the maximum standard capacity for each system. The Bundled Software Packages graph shows the number of software packages included with each system. The Price graph shows the list price of a system configured with two disk drives, a monochrome monitor, graphics and color-display capability, a printer port and a serial port, 256K bytes of memory (64K bytes for 8-bit systems), the standard operating systems for the computers under comparison, and the standard BASIC interpreter. The price for the Motorola VME/10 includes a monochrome display and the 15-megabyte Winchester disk drive.



The graph for Disk Access in BASIC shows how long it takes to write and to read a 64K-byte sequential text file to a blank formatted floppy disk. (For the program listings, see June 1984 BYTE, page 327, and October 1984, page 33.) The Sieve column in the BASIC Performance graph shows how long it takes to run one iteration of the Sieve of Eratosthenes prime-number benchmark. The Calculations column shows how long it takes to do 10,000 multiplication and 10,000 division operations using single-precision numbers. The System Utilities graph shows how long it takes to format and to copy a standard text file to disk (adjusted for 40K bytes of disk data) and to copy a 40K-byte file using the system utilities. The Spreadsheet graph shows how long it takes to load and recalculate a 25- by 25-cell spreadsheet where each cell equals 1.001 times the cell to its left. These benchmarks have been run on a VME/10 with 640K bytes of RAM and a 15-megabyte Winchester disk drive. This configuration is less than the minimum 896K bytes of RAM and 40-megabyte Winchester recommended by Motorola. The 40-megabyte drive is significantly faster than the 15-megabyte drive. The operating system used was UNIX System V/68, release 1, version 2.8. The Winchester disk drive operates in a polled mode and the system is slower than the interrupt mode used in the now-available release 2. For the VME/10, the Disk Access and Sieve tests are from David F. Hinnant's article "Benchmarking UNIX Systems" (August 1984 BYTE, page 132). The Calculations benchmark is a C version of BYTE's test. The Disk Write benchmark creates and writes a 512- by 256-byte file. The Read benchmark randomly reads this file. The disk-format time is the time required per 40K bytes of floppy-disk space. The file-copy time is that required for the UNIX utility cp to copy a 40K-byte file from one area to another on the hard disk. These tests have been done using an almost-full 15-megabyte disk that contains more than 800 files. The time required is due partly to the searching of the directories and locating free disk space.

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trol statements and other advanced features. The assembler provides for absolute/relocatable code generation, complex expressions, macros, and conditional assembly. I have not encountered any assembly errors. Motorola Pascal follows the standard with the addition of many UCSD extensions for string processing. Unfortunately, it has no capability for randomly accessing disk-based files. Utilities include an editor, system-accounting routines, graphics, a spooler, a file copier, and other file-maintenance programs. In addition, VERSAdos has a 16K-byte resident firmware monitor and debugging package.

UNIX System V/68

In order to use UNIX, you must expand the basic VME/10 system to include one memory module, a dual-channel parallel port, and a dual- or six-channel serial I/O controller.

UNIX System V/68 is quite comprehensive, and its content is similar to that of a typical large-scale system. The size of the object-code version of UNIX is approximately 15 megabytes. The UNIX System V/68 consists of a sophisticated multitasking multiuser operating system called the kernel, a C compiler, a variety of other language processors, a command language called the shell, text editors and document-preparation aids, graphics, an accounting system, communications, and a variety of programming utilities. It is remarkably free of many of the restrictions and cumbersome operations characteristic of many operating systems.

UNIX does have some disadvantages. The system carries out frequent housekeeping operations that place heavy demand on the hardware, and a significant degradation of performance occurs while housekeeping is in process. The file system is easily corrupted, and major problems can result from main power failures and from running out of free disk space.

FORTRAN, SNOBOL, C, assembly language, BS (a remote descendant of BASIC and SNOBOL with some C

(continued)

Table 1: *Motorola VMEbus-compatible and I/O-channel-compatible modules. Approximately 120 companies are reportedly manufacturing more than 500 VMEbus-compatible products.*

VMEbus-compatible modules:

MVME050	System control with time-of-day clock, printer port, two serial ports, 64K bytes of RAM or 512K bytes of EPROM	$1595
MVME200	64K-byte dynamic RAM with byte parity	$895
MVME201	256K-byte dynamic RAM with byte parity	$1050
MVME202	512K- to 2048K-byte dynamic RAM with byte parity	$1395
MVME204	1024K-byte dynamic RAM with byte parity and dual porting for VMEbus and MVMX32bus	$4200
MVME210	Static RAM/ROM module	$795
MVME211	Static ROM/RAM module	$750
MVME214	Static RAM/ROM module with MVMX32bus	$1400
MVME222	1- to 2-megabyte dynamic RAM with parity	$1750–$2750
MVME300	IEEE-488 GPIB controller with DMA	$1395
MVME310	Universal intelligent controller	$1180
MVME315	Intelligent floppy/controller SASI interface	$1295
MVME316	I/O-channel interface	$630
MVME319	Intelligent floppy/tape controller and SASI/SCSI; supports up to eight Winchester drives and combination of cipher floppy/tape and/or floppy-disk drive	$1395
MVME320	Winchester/floppy intelligent disk controller; controls two Winchester and two floppy-disk drives or four floppy-disk drives with serial data rates to 5 megabits per second	$1650
MVME330	Ethernet LAN controller	$2600
MVME331	Six-port MC68010-based intelligent serial synchronous/asynchronous I/O controller with 128K/512K bytes of RAM	$1999
MVME333	Six-port MC68010-based intelligent serial synchronous/asynchronous I/O controller with 128K/512K bytes of RAM, four-channel DMA	$2310
MVME340	Parallel I/O interface with 60 pins of programmable I/O	$1125
MVME390	Graphics-display module with 1024- by 1024-pixel resolution	$3149

I/O-channel-compatible modules:

MVME400	Dual RS-232C multiprotocol serial port	$395
MVME410	Dual 16-bit parallel port (printer interface)	$350
MVME420	SASI adapter	$395
MVME435A	Buffered nine-track magnetic tape adapter	$875
MVME600	12-bit analog input module	$750
MVME605	12-bit analog output module	$675

added), and the shell command language are bundled with UNIX. Pascal, BASIC, and CBASIC are options. I have primarily used C, which seems identical to AT&T C. I have not encountered any errors in the compiler.

Programming support tools include make, a program for maintaining and updating computer programs; sccs, the source-code control system; lex, a lexical-analyzer generator; and yacc, a general tool for imposing structure on the input to a computer program.

A library of some 400 utilities includes most of those found in the larger UNIX systems. The notable exceptions are windowing software and a relational database manager.

The text editors are ed, edit, ex, sed, and vi. The vi editor is display-oriented and based on an underlying line editor, ex. Absent is emacs, another display-oriented editor available on many UNIX systems. Other document-preparation tools are the text formatters nroff and troff and the spelling checker spell.

Although vi is more than adequate for editing program text, it is not a good word processor. It has restrictions related to the line-oriented mode of operation, and there can be delays in the display of typed characters. For example, vi and sync, a UNIX utility that flushes all previously unwritten buffers out to the disk, periodically write text data to the disk. During these disk operations, there can be a disconcerting delay of several seconds.

The communications programs include cu, uucp, and their associated utilities. The routines facilitate computer-to-computer communication under both user and program control. The current UNIX System V/68 version of these programs has several major deficiencies: You cannot use the same serial port for outgoing and automatically answered incoming calls, speed sensing is not reliable, and the system does not work with modems that have auto-dialing capability. The communications package AT&T uses on its 3B2 series of computers does not have these deficiencies. This is the only instance to date of a major difference between UNIX System V and UNIX System V/68.

Bringing Up UNIX

UNIX is difficult to install because the system is complex and the documentation is poor. I also had an early release with major system software bugs and a hardware failure that occurred only when running UNIX.

Dozens of shell scripts and data tables control the operation of the UNIX environment. The bundled software package defines most of these, but you will still have considerable work to tailor the system to your needs, such as defining system and user profiles and setting up accounting routines.

Installing terminal facilities is a major undertaking. For example, in order to use a line printer connected to the dual-channel parallel port, you must write a shell-script printer-interface program and a C program to set up the spooler commands and to control printer indentation, column size, and lines per page. The installation of serial terminal facilities requires complex entries in multiple shell scripts and tables. The documentation describing these steps is grossly inadequate.

Documentation

Motorola's hardware documentation is excellent. Each module comes with a detailed, well-written manual containing the theory of operation, circuit schematics, interconnections, parts lists, and other pertinent information.

Most of the software manuals are loose-leaf notebooks, there are thousands of pages, and the books now occupy about three feet of shelf space. The description of VERSAdos is well organized, is clearly written, and provides detailed information and many programming examples. The Pascal manual is confusing, is difficult to use, and contains few helpful programming examples.

The UNIX manuals consist almost entirely of material from AT&T texts. They are geared toward knowledge-

(continued)

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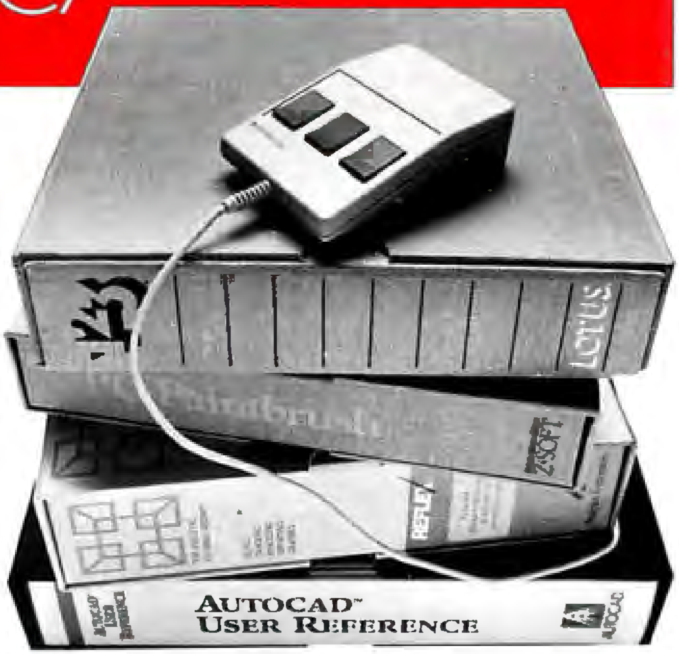

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able UNIX programmers, not beginners. Many commands are quite complex and should be described in more than a few lines of text. For example, users would appreciate a well-commented and nontrivial example of the use of each command. Moreover, many procedures, like the implementation of terminal operations, involve multiple files, and the required explanations are scattered throughout different manuals.

Application Programs

Motorola publishes a listing of sources of application software for operation under the VERSAdos and UNIX operating systems, but much of it is not yet ready. The sources for VERSAdos software included company telephone numbers that were no longer in service, programs that were advertised but never developed, and others that are to be available soon. I obtained a C compiler, but it had so many problems that I could not use it.

Some users groups and universities provide public-domain C source-code programs, and a number of books list small but useful C functions. For example, you can obtain the entire text and program library of Brian W. Kernighan and P. J. Plauger's *Software Tools* (Addison-Wesley, 1976) for a nominal charge. Finally, AT&T's recently implemented UNIX System Toolchest is a library of C source-code programs that currently includes the emacs editor, Korn shell language, LISP, windowing, and a relational database manager. Access to the library requires a special $100 AT&T license. The charges for the software are quite reasonable, and the programs are distributed electronically via UNIX's uucp communication facility.

Maintenance

The Tempe, Arizona, office of Motorola's Four-Phase Systems Division provides VME/10 hardware and software support. You can reach them during regular working hours with an 800 number. The staff with whom I have had contact have been quick, knowledgeable, and helpful.

You can purchase a full-service contract or on-site repair with payment for time and parts, or you can choose to ship defective modules to Motorola for exchange. The full-service contract provides automatic updating of the hardware with the latest engineering changes. On-site maintenance usually only involves swapping a module. The Tempe office arranges aid within a day. Motorola will soon offer a new service, remote problems analysis, that will use modem-to-modem communications to provide remote access to users' systems for evaluating software and hardware problems and for transmitting software patches and updates.

Motorola's VME/10 is expensive, but it is a well-designed and well-constructed system.

Motorola frequently updates UNIX and VERSAdos to provide new capabilities or improved functions. You can obtain these updates either by having a software-maintenance contract or by purchasing the software as it becomes available. Updates are expensive, however, and can become a significant part of the total system cost. Moreover, significant delays might exist between the time that AT&T releases a version and when it is adapted to the VME/10.

Conclusion

The VME/10 is expensive, but it is a well-designed and well-constructed microcomputer system useful for a variety of business, industrial, and scientific applications. The hardware is highly reliable, it has an extensive set of system software, and Motorola provides good technical support. VMEbus modules allows major system expansion, and the modular "Open System" equivalent of the VME/10 is easy to upgrade. Be warned, however, that it is not easy to install UNIX, and applications software can be difficult to get. ■

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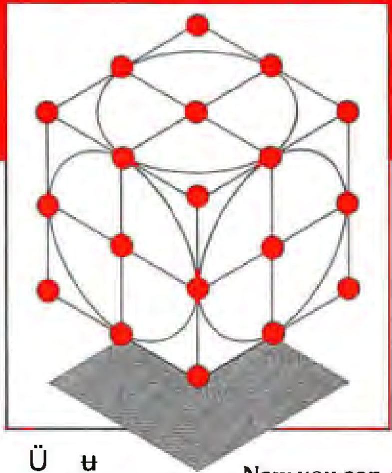

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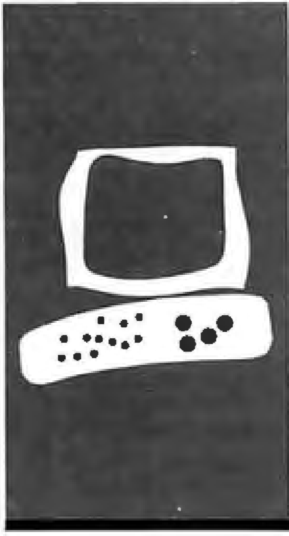

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MacCharlie

A marriage of radically different systems

BY LARRY CROCKETT

Products that bridge gaps with claims of "the best of both worlds" often deliver the worst of each. Having learned my lesson about bridge products, ranging from TV-advertised items that "slice, dice, clean, and sharpen" to integrated software that often is nine miles wide and two inches deep, I prepared myself for disappointment again as I opened the box labeled "MacCharlie."

I am happy to report that MacCharlie, from Dayna Communications, is on its way to being a winner. There are some problems, but MacCharlie is worth a close look.

MacCharlie consists of three parts (see photo 1). First, the system unit itself, which contains the 8088 processor, 640K bytes of RAM (random-access read/write memory), and two 360K-byte 5¼-inch disk drives, is only one-half the size of a Macintosh and sits on the right side of the standard Mac. The footprint of the combined Mac/MacCharlie unit totals a very compact 15 by 11 inches. Second, a keyboard extension that wraps around the standard Mac keyboard, providing 10 general function keys on the left side and an 18-key numeric/specific function keypad on the right side (see photo 2). Third, three disks and documentation. A 3½-inch disk supplies the Macintosh MacCharlie software and two 5¼-inch disks deliver an MS-DOS 3.1 operating system and a GW-BASIC interpreter. Documentation includes a Macintosh-style general introduction and an MS-DOS manual.

As a self-proclaimed bridge product, MacCharlie can be looked at in two distinct ways. First, it can be viewed as one of the most expensive, and probably the most intriguing, of the 75 or so Macintosh hardware accessories. Physically, it mimics the distinctive Macintosh styling. Only the 5¼-inch drives on the front of the unit provide the tip-off that something decidedly un-Macintosh is going on inside; MacCharlie is even more spartan than the Mac in terms of logos and nameplates. MacCharlie provides access to the IBM world through the familiar Macintosh window. Outside the window is the Mac environment with its pull-down menus, desk accessories, and mouse. Inside the window is the IBM environment with its power spreadsheets and powerful operating systems.

Second, MacCharlie can be viewed as an IBM Personal Computer clone that requires a Mac monitor and a keyboard. Its 8088 processor runs at the conventional 4.77-MHz clock frequency. It supports MS-DOS and other IBM PC-compatible operating systems that don't depend on *IBM ROM* (read-only memory). It supports the 8087 math coprocessor, and it should run the majority of IBM PC software. Its performance is comparable to a standard PC: MacCharlie ran the Sieve of Eratosthenes in 184 seconds, compared to 191 seconds for the IBM PC. A promised optional expansion chassis will purportedly offer the MacCharlie owner the ability to expand the system with various PC-compatible add-on cards and other hardware.

SETTING UP

Setting up the system is quite simple. You connect the base that supports the Macintosh to the MacCharlie unit. Then you slide the Mac keyboard into the MacCharlie wraparound keyboard; the Mac keyboard cable connects to the MacCharlie keyboard, which, in turn, connects to the Macintosh with a similar cable.

Around back, things are somewhat busier but are still manageable (see the photo in the "At a Glance" section). The Mac power cable is replaced by a short cable, and the reassigned Apple cable provides the entire MacCharlie with power. The Mac's printer port is connected to a port on MacCharlie; the rinter port on MacCharlie serves the system. Both the modem port and the external drive port on the Mac remain open for use with MacCharlie connected.

The MacCharlie disk uses Finder 4.1 and the MiniFinder so that, after the opening screen appears, you are presented with the

Larry Crockett (731 21st Ave. S. Minneapolis, MN 55454) is an assistant professor of mathematics and computer science at Augsburg College in Minneapolis. His interests are in philosophy and artificial intelligence.

MiniFinder screen with two programs available for opening. If you choose "MacCharlie," the printer port is used to communicate with the MS-DOS side and MacCharlie expects the Imagewriter to be the printer. If you choose "MacCharlie A," however, the modem port is used and MacCharlie is set up to use AppleTalk and the LaserWriter.

I have been informed by Dayna that the drives on all but the earliest units are Panasonic drives, even though the literature says that the drives are manufactured by both Control Data and Panasonic. The drives on the units I tested were quiet and smooth. I even managed to get them to format and use old 5¼-inch disks that were rated single-sided single-density. No disks died and I lost no data during the test period.

As figures 1 and 2 illustrate, MacCharlie adheres closely to the standard Macintosh interface. Dayna claims that Mac desktop utilities will work in MS-DOS mode and that they can be installed in the usual fashion. However, with one desk accessory, MacTracks, I did experience some difficulty. Given MacCharlie's technically complicated interface, you should try to check out a desk accessory before buying it.

TWO WORLDS

Each of the two systems, Macintosh/Finder and IBM PC/MS-DOS, has its advantages. For example, if I want to do word processing or graphics, the Mac wins hands down. On the other hand—at least until the appearance of the more powerful spreadsheets such as Jazz and Excel—doing large spreadsheet work meant choosing MS-DOS. But even with the deluge of powerful Mac software, I still find that manipulating files is done best in the MS-DOS environment, with its filtering, piping, and batch processing.

Dayna stresses the "synergistic" potential of this system and, while the easy invocation of trendy terms such as "synergistic" generally irritates me, in this case it is apt. Suppose, for example, that I have a list of names in a Mac Word document that I want to sort alphabetically. I could, using Switcher, copy the list via the Clipboard over to Multiplan or File and perform the sort. But that is like using a semi to get a half-gallon of milk at the store. With MacCharlie, using several keystrokes, I port the list over to MS-DOS, which has a nice sort utility, sort it, and port it back to the Mac. Moreover, with the powerful manipulation tools available in MS-DOS through piping, filtering, and batch processing, you can develop routines that dramatically increase the versatility and power of the ever-friendly Finder when that power is needed. Even UNIX tools, according to Dayna, can be brought to bear on tasks done in a Mac en-

(continued)

Photo 1: *A Macintosh with MacCharlie attached.*

vironment using MacCharlie.

[*Editor's note: MacCharlie automatically formats text data as it is transferred to the receiving machine. That is, MS-DOS text files are stripped of carriage returns and linefeeds during transmission to the Mac (making it suitable for MacWrite) or these characters are added to a Mac text file transmitted to MacCharlie. This formatting of data can lengthen the amount of time it takes to transfer a file. Transferring a 40K-byte file took 41 seconds from Macintosh to MacCharlie and 220 seconds from MacCharlie to Macintosh. MacCharlie was allowed to format the data for the destination system, which means that the resulting file could be larger or smaller.*]

Running the other direction, having most of the Mac interface available for use in the MS-DOS window is particularly welcome. MS-DOS users who like SideKick on the IBM PC, for example, can use Macintosh SideKick (which improves on the original) on the MS-DOS side. Having the Mac Clipboard available in PC programs is also a boon.

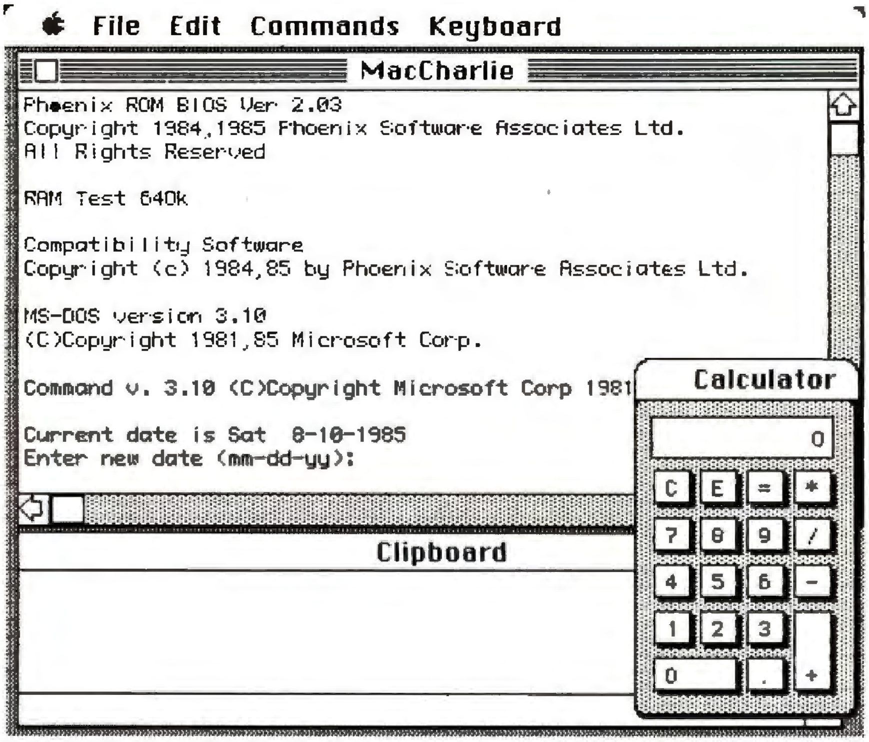


Figure 1: *MS-DOS comes up as a Mac window on the Mac desktop. This window can be sized and moved like any Mac window. Mac desk accessories remain available, as do many—but not all—Mac editing procedures.*

Photo 2: *The MacCharlie function keys and numeric keypad attach to the Macintosh keyboard.*

MacCharlie does support Lotus 1-2-3, with the exception of the graphics module, as illustrated in figure 3. Hence, MacCharlie passes one conventional test of IBM PC compatibility. However, owing to slow screen refreshing on the Macintosh, MacCharlie does not support 1-2-3's graphics. Early MacCharlie observers suggested that the bottleneck lies in the relatively slow serial ports on the Mac, but I suspect the problem lies more in the overworked 68000 in the Macintosh. Graphics programs and modules with modest refresh needs may work; the rest will not. The list of compatible software I saw from Dayna is respectable, but the company should also maintain a list of incompatible software in order to save users the headache of having to play Sherlock Holmes of the MS-DOS world.

Impressive is the fact that MacCharlie RAM can be used as a printer buffer for the Mac provided that there is not an application running on the MacCharlie side. This works well in draft mode, but it is little help in medium- or high-quality mode—again, because the 68000 is so busy. However, Mac RAM cannot be used as a buffer for the MacCharlie side. Dayna promises that future releases of MacCharlie software will enable the Mac to use the MacCharlie drives for storage space but, again, not vice versa.

WHAT MAKES MACCHARLIE TICK?

Inside MacCharlie are two central processing units, an 8088 and an 8032AH running at 12 MHz. The 8032, which has its own ROM, RAM, and I/O ports, provides the link between the 8088 and the 68000. In its world, according to Dayna, the 8088 knows nothing of the Macintosh; the 8032 keeps track of both the 68000 and the 8088. When a key is pressed,

(continued)

Name
MacCharlie

Type
Macintosh accessory that provides MS-DOS capabilities

Company
Dayna Communications Inc.
50 South Main St.
Salt Lake City, UT 84144
(801) 531-0600

Size
14 by 15 by 11 inches,
15 pounds

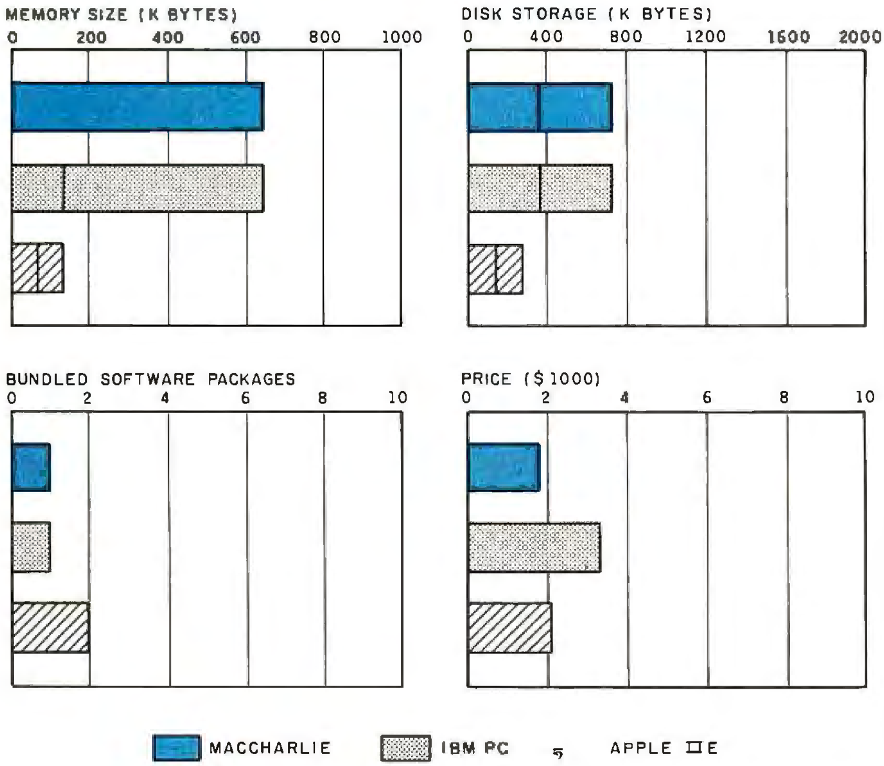
Components
Display: Uses Macintosh 9-inch screen
Keyboard: 10-key function pad with 18-key numeric pad; supplements the Macintosh 58-key software-mapped keyboard
Processors: Intel 8088, 8032AH
Memory: 640K bytes
Mass storage: Two 360K-byte double-sided double-density 5¼-inch disk drives

Hardware Needed
Either a 128K-byte or 512K-byte Macintosh

Software
MS-DOS 3.1, GW-BASIC, MacCharlie applications programs

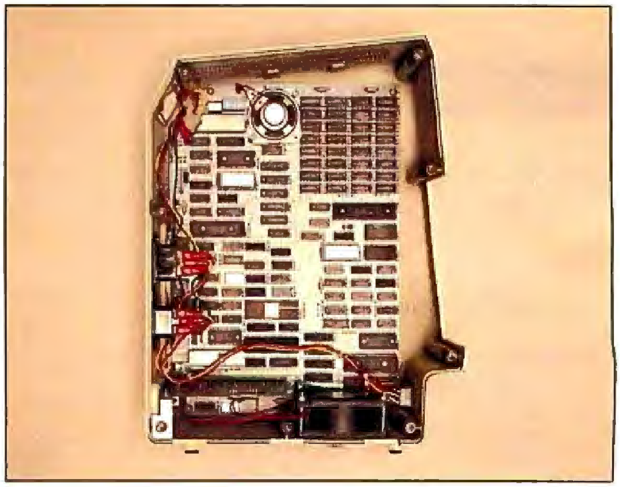
Options
8087 can be installed by dealer ($199)

Price
$1795 (price without Macintosh)

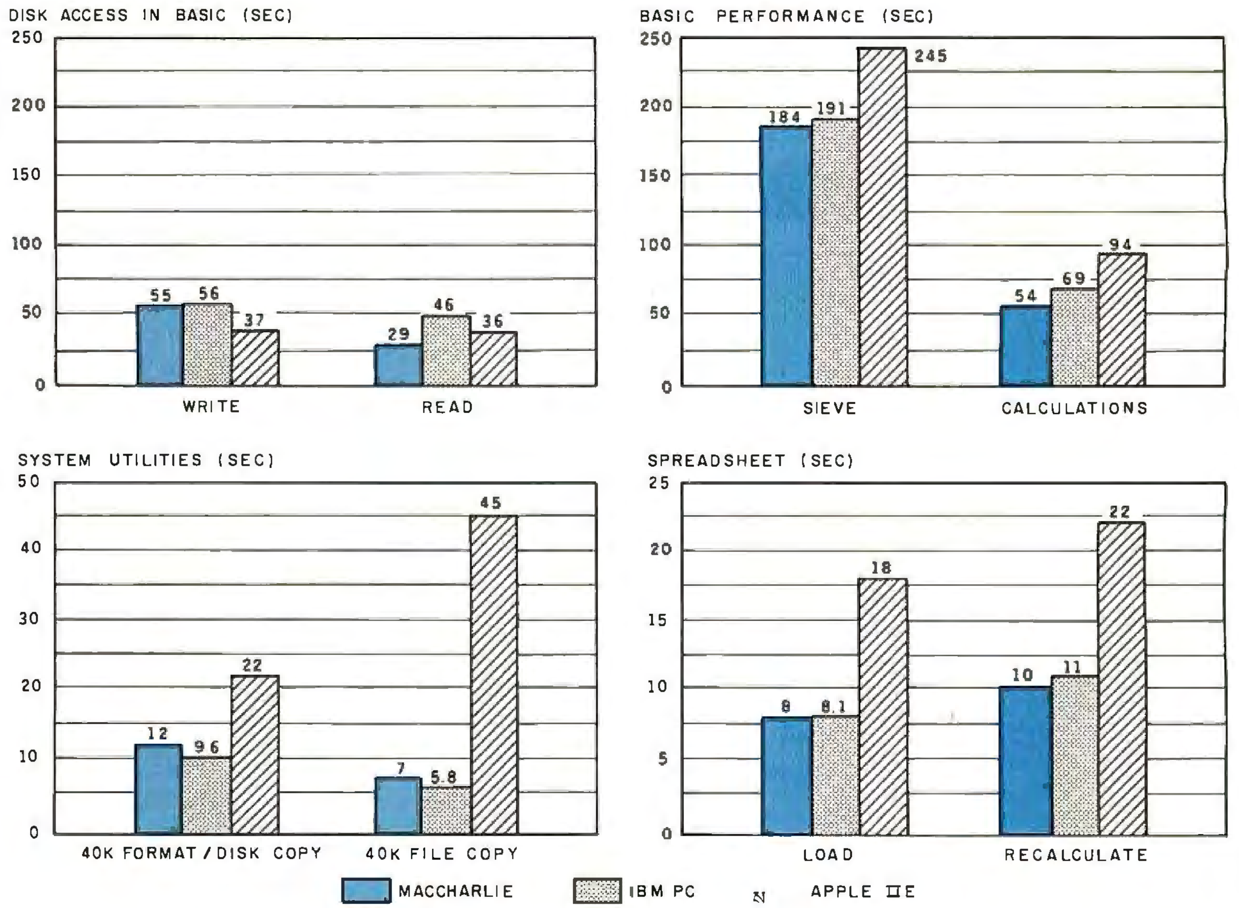


The Memory Size graph shows the standard and optional memory available for the computers under comparison. The Disk Storage graph shows the highest capacity for a single floppy-disk drive and the maximum standard capacity for each system. The Bundled Software Packages graph shows the number of software packages included with each system. The Price Graph shows the list price of a MacCharlie system with two high-capacity disk drives, keyboard extension, and 640K bytes of memory. The other systems include two disk drives, monochrome monitor, graphics and color-display capability, a printer port and a serial port, 256K bytes (64K for 8-bit systems), the standard operating system for each system, and the standard BASIC interpreter for each system.

The rear of the Macintosh/MacCharlie systems. Note that the Mac gets its power from the MacCharlie unit. The Mac printer port is dedicated to communicating with MacCharlie.



Inside the MacCharlie unit. An Intel 8032AH connects the two systems.



The graphs for Disk Access in BASIC show how long it takes to write a 64K-byte sequential text file to a blank floppy disk and how long it takes to read this file. (For the program listings, see June 1984 BYTE, page 334, and October 1984, page 33.) In the BASIC Performance graph, the Sieve results show how long it takes to run one iteration of the Sieve of Eratosthenes prime-number benchmark. The Calculations column shows how long it takes to do 10,000 multiplication and 10,000 division operations using single-precision numbers. The System Utilities graph shows how long it takes to format and copy a disk (adjusted for 40K bytes of disk data) and to transfer a 40K-byte file using the system utilities. The Spreadsheet graph shows how long the computers take to load and recalculate a 25- by 25-cell spreadsheet where each cell equals 1.001 times the cell to its left. The spreadsheet program used was Microsoft's Multiplan. Tests for the Apple IIe were done with the ProDOS operating system, except for the spreadsheet test, which was done with DOS 3.3. The IBM PC was tested running under PC-DOS 2.0, and MacCharlie was tested running MS-DOS 3.1.

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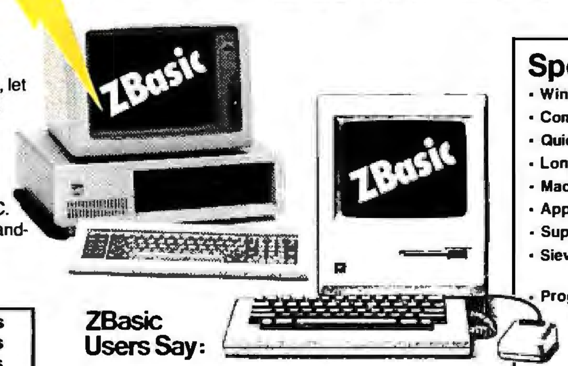

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BASIC Interpreter	2190 seconds

Sieve from BYTE, Jan., 1983 on an IBM PC, 10 iterations.

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PC WEEK, Nov. 12, 1985

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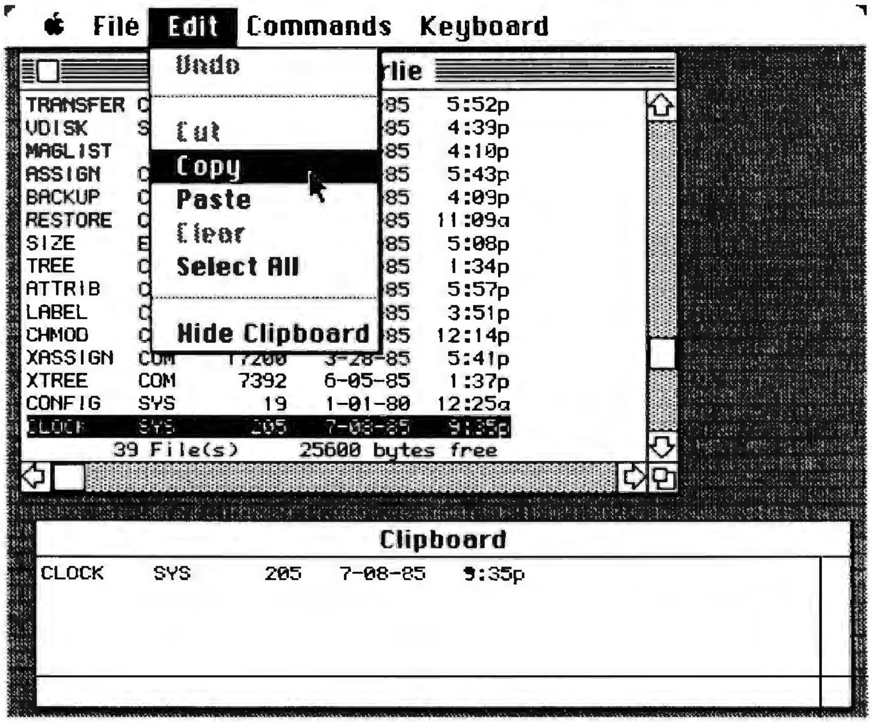

Figure 2: *Using the Macintosh interface on the* MS-DOS *window. Here the mouse is used to select a line of text in the* MS-DOS *window and copy it to the Clipboard. Clipboard contents can be pasted on either the* MS-DOS *or Finder side. Note that the unavailable options, Cut and Clear, are dimmed in accordance with Macintosh convention.*

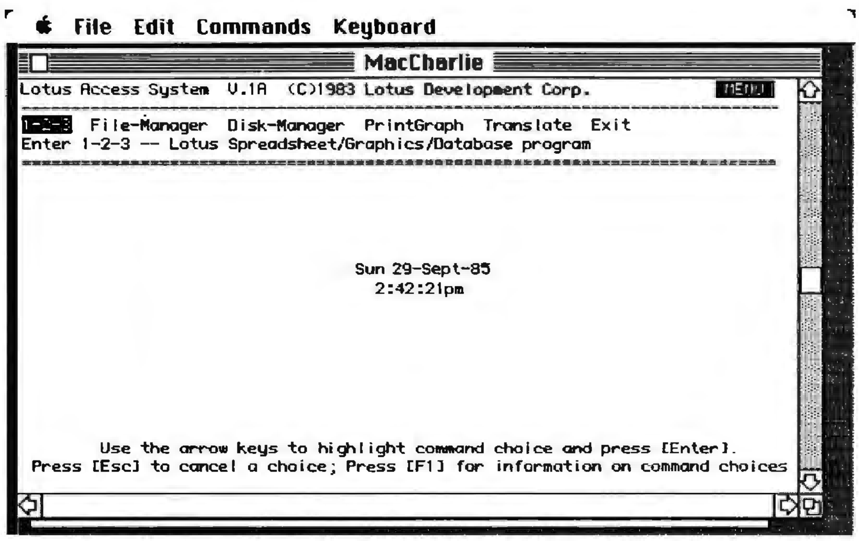

Figure 3: *Lotus 1-2-3 running on MacCharlie. Lotus 1-2-3, except for the graphics module, will run on the Macintosh now. 1-2-3 files should be convertible to Jazz files using MacCharlie and Lotus's conversion utility. Most* MS-DOS *software—except games and some graphics programs or modules—should run on MacCharlie. Dayna Communications maintains a list of compatible software.*

the 8032 presents an interrupt to the 8088; hence MacCharlie works with an interrupt-driven interface. Since its service overhead is relatively high, the interrupt interface is another bottleneck in the Mac-to-PC connection. Dayna has informed me that it is attempting to implement a DMA (direct memory access) interface, which should speed things up enough to work well with hard disks in the promised expansion chassis.

MacCharlie's ROM is a custom ROM, but an off-the-shelf IBM PC ROM could have been used. The customization is apparently designed more to satisfy patent lawyers than enhance performance. The BIOS (basic input/output system) was written by Phoenix Software Associates.

EVIDENCE OF A PREMATURE RELEASE

Nevertheless, I found evidence that MacCharlie was brought to market somewhat prematurely. For example, some menu options are permanently dimmed because they are not yet available. Several addenda to the user's manual refer to features "that have not been implemented yet." Some Dayna manuals claim that MacCharlie is compatible with the Apple LaserWriter on the AppleTalk network, and some say it is not. Leaving everything to chance, I attempted to make the link but failed. Dayna concedes that MacCharlie cannot be used as a printer buffer when used in conjunction with the LaserWriter. Since those people who invest in both a Mac and a MacCharlie will also often have a LaserWriter and will want the printer-buffer feature, this is a definite shortcoming.

Being a fan of Switcher, I was disappointed to read that MacCharlie does not yet work with it. I tried anyway. The predictable result (with Switcher 2.0) was a serious system error and a complete crash. I did find that Switcher 4.4 works relatively well with MacCharlie 1.8. The exception was operations involving the serial port (for example, attempting to print a file). Dayna claims that MacCharlie

(continued)

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2.0, released in October, is fully compatible with Switcher. [*Editor's note: A quick check of MacCharlie 2.0 with Switcher 4.4 showed no problems.*]

These difficulties are almost inevitable, given the newness of the product and the complexity of the task. Interfacing two systems as different as the Macintosh Finder and MS-DOS is technically quite complicated.

There are obvious bugs in the system. For instance, after using a Finder application first, I often found it impossible to access MS-DOS—MacCharlie informed me that it had failed to establish communications with MS-DOS. Once in such an interface standoff, it became impossible to reestablish the link. It should be noted that MacCharlie handled such difficulties gracefully by allowing me to attempt to establish communications again or to exit; it never crashed under such circumstances. I eventually learned that I could overcome such a dead end by turning the entire system off, doing a cold boot, and opening MS-DOS first. Or, you can often avoid the problem by invoking MacCharlie immediately upon powering up instead of using the Mac side first. But this is not acceptable performance.

DOCUMENTATION

The documentation is good. MacCharlie's 100-page user's guide comes in the now-familiar Macintosh style. It is attractive, generally well written, and covers most topics in enough detail to get you comfortable with the system. However, the technically minded will be disappointed because it is not written for the hobbyist or programmer. Also, I found the addendum to the user's guide to be less clear and organized than the main manual. As I've noted, it also has some inconsistencies.

CONCLUSION

If Dayna can eliminate some of the early bugs and deliver on both the promises it has made and the promise of this system, MacCharlie will be a successful and useful bridge between two popular microcomputer systems. The potential of this system is significant for people who need monochrome PC/Macintosh limited compatibility and integration. A remarkable and intriguing effort, MacCharlie largely—but not entirely—succeeds in what it attempts to do.

On balance, I like the system and would say it is worth a look if you can justify the $1795 expense and believe that you need what it has to offer. I am unwilling to relinquish mine now that I have become accustomed to having it. After spending a month with MacCharlie, I do not want to go back to a conventional Macintosh, in spite of MacCharlie's several shortcomings. There's too much freedom on the bridge between the worlds. ■

 Inquiry 340 Inquiry 33 →


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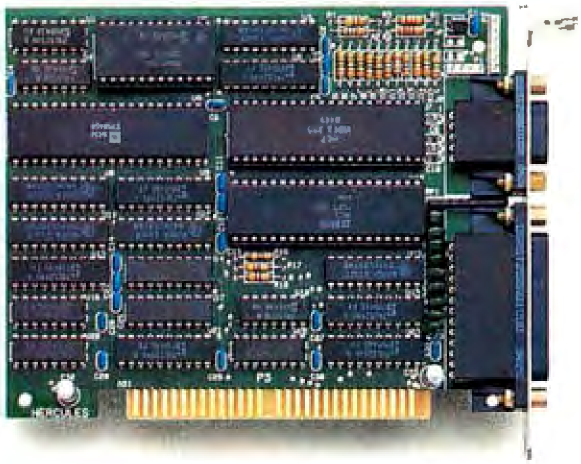

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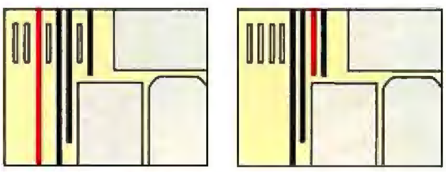

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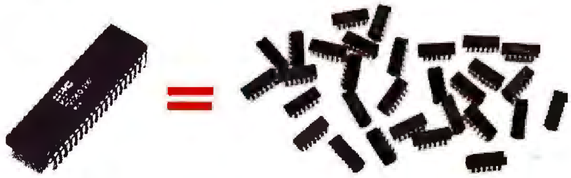

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Inquiry 155

Lattice's 8086/8088 C Compiler

Release 2.15 has improved math libraries

BY DAYLE S. WOOLSTON

Lattice has continued to improve its 8086/8088 C compiler. Release 2.15 includes major improvements in the speed and accuracy of the math libraries, a new command-line option, refinements, and bug fixes.

Kernigan and Ritchie's text, *The C Programming Language* (Prentice-Hall, 1978), is not always explicit and complete; therefore, it is crucial that Lattice state its interpretation of various aspects of the language. The manual points out that the Lattice compiler departs from the Kernigan and Ritchie standard in two categories. The first defines differences that are lexical or syntactical, and the second describes differences that are imposed on the developers of any compiler by practical limitations. Some of these differences and limitations are:

- In the standard C definition, comments may not be nested. A compile-time option allows you to override this rule. You can then easily comment out large blocks of code during development.
- Identically written string constants refer to the same static storage location, whereas in the standard they are considered unique.
- The compiler must be able to identify the expression preceding the · or -> operators as a structure, or a pointer to a structure of a specific type. This rule is used to identify both the offset and specific attributes of individual structure members.
- Structure members having the same name but belonging to different structures are considered unique by this compiler. I have used C compilers in which the name of a structure member may not be used in another structure, which can be inconvenient.
- The maximum constant expression defining an array subscript is one less than the largest signed integer (32766 for 16 bits).
- The maximum length of any input source line may not exceed 256 bytes.
- Macros may not have more than eight arguments.

These assumptions, exceptions, and limitations are cross-referenced with Appendix A of the Kernighan and Ritchie text.

The 8086/8088 version of the Lattice C compiler is a two-pass compiler. (Lattice calls these passes *phases*.) Each pass is executed by a separate program. The basic function of the first pass is to syntactically and lexically analyze a source file and perform all necessary preprocessor functions. This pass generates symbol tables and produces intermediate files that are to be processed by the second pass. The second pass of the compiler takes these intermediate files and produces an object file in the MS-DOS format.

The Lattice compiler allows you great flexibility in determining the characteristics of the resulting object module. These characteristics are specified by parameters supplied to each compiler pass. Here are some compile-time options:

- The size of the compiler's execution stack has a default value of 2048 bytes. One compile-time parameter permits you to adjust it as required.
- The Lattice compiler attempts to hold values in registers as long as possible. An actual assignment to a memory location is not made until a change in control flow occurs, such as a call to another function. This feature, used to improve performance, can be suppressed.
- The compiler normally aligns all program code pointers, structures, and unions on a word boundary. An option cancels this alignment.
- One symbol may be defined at compile time. This symbol definition is treated as if the symbol were declared in the source by a #define command.
- A path prefix may be specified that defines a default path (or drive) for locating #include files.
- The developer can force word alignment for all data elements except char. This can

(continued)

Dayle S. Woolston (175 West 1300 North, Pleasant Grove, UT 84062) is a systems programmer with Wicat Systems Inc., working on educational software and authoring systems. His interests (besides computer science) include foreign languages, current events, and carpentry.

((ǵ g(ĵ § Ŭ

Name
Lattice 8086/8088 C Compiler version 2.15

Type
Two-pass compiler

Company
Lattice Inc.
POB 3072
Glen Ellyn, IL 60138
(312) 858-7950

Format
Three 5¼-inch master disks, not copy-protected

Computer
IBM PC with 128K bytes of memory and two floppy-disk drives or one floppy-disk drive and one hard-disk drive

Documentation
One manual

Price
$500

be advantageous to reduce the extra clock cycles consumed by the 8086 central processing unit in fetching a word from an odd byte address.

A new compile-time option included in release 2.15 causes the first pass of the compiler to execute preprocessing only and write the resulting source file to disk. No intermediate file is produced.

The Lattice C compiler supports four memory models: S, P, D, and L. One of these memory models must be selected at compile time and used for all object files that are linked to form the executable file. In choosing one of these memory models, you can tune a particular program to a suitable level of efficiency, as well as to a useful range of addressability.

The S model is the smallest. It has a program address space of 64K bytes and a data address space of 64K bytes. The P model has a program address space of up to 1 megabyte and a data address space of 64K bytes. The D model has a program address space of 64K bytes and a data address space of up to 1 megabyte. The L model has program and data address spaces of up to 1 megabyte. The manual provides a good discussion of each model and how it uses the segmented architecture of the 8086.

Object modules compiled under a specific model must be linked to libraries under that same model. There are two library modules furnished with each model. The first (LC.LIB) is for programs without float or double operations, and the second (LCM.LIB) supports these data types. You can reduce the size of an executable file by not linking in floating-point libraries where they are not needed.

The Lattice compiler supports the standard data types: char (8 bits), int (16 bits), short (16 bits), unsigned (16 bits), long (32 bits), float (32 bits), and double (64 bits). Types int and short are equivalent. In its discussion of data types, the Kernighan and Ritchie text states that unsigned is a modifier that may be applied only to variables of type int. In the Lattice implementation, unsigned is a data type, not a modifier. Therefore, there is no unsigned long or unsigned char. I have used compilers that support unsigned long and unsigned char data types. These proved useful in several instances, but the Lattice compiler seems to hold closer to the accepted standard in this respect. Lattice indicates that this version of its compiler does not support register variables because of the small number of registers available on the 8086.

The Lattice implementation has the usual categories of functions that you might expect with a C compiler. There are functions to handle memory allocation, file I/O (input/output), transcendentals, and string processing. The presentation of each portable library function in the documentation is very well organized. Each function is explained clearly. In preparing for this article, I wrote several programs from scratch. Of course, I referred to the manual in many instances for descriptions of functions, parameters, and return values. I found this section complete and easy to use.

I have worked extensively with another 8086 C compiler on a substantial software project. The other compiler had a larger selection of portable library functions; however, I needed only the functions that are supplied with the Lattice compiler. It's safe to say that while the Lattice package does not have the number of functions provided by the other compiler, the selection of functions offered is complete for a reasonable implementation of a C compiler.

There are three levels of memory allocation provided with the Lattice compiler. The first level of functions offers a UNIX-compatible memory-allocation facility. There is overhead associated with the use of this class of memory functions, but UNIX portability is achieved. The second level of memory-allocation functions is not UNIX-compatible but is a more efficient implementation under DOS. The third level consists of primitives that can be used to construct more sophis-

(continued)

ticated forms of memory allocation.

Several levels of I/O functions are provided in the standard library. As in memory allocation, the Lattice compiler offers the flexibility required to write portable software or deal with a specific local environment. The highest levels of I/O are supported through single-character functions such as get and put. The lowest levels are serviced with direct byte-stream functions. Another class of functions deals explicitly with console I/O.

A special group of functions provides an interface between the Lattice C compiler and the MS-DOS environment. For instance, there is a function call to the MS-DOS command processor, a function call to get an environment string, and a function call to generate DOS functions through interrupts. The interrupt function has been updated to return the processor status bits after the interrupt call.

Along with the compiler itself, Lattice provides several utility programs to help the software developer. The Function Extract Utility (FXU) aids you in grouping specific functions from several source files together in a single source file. This is useful because the compiler generates a single object module for each source file compiled. Where only a subset of functions is required by a program, you may extract these functions and bind them together in a single source file for compilation into a smaller object module. Another utility is the Object Module Disassembler (OMD). It is sometimes advantageous to debug a program at the machine-code level. OMD provides you with a machine-code listing of a articular object module. Several options associated with OMD increase its functionality. Most notable is that a machine-language listing can be produced with interspersed lines of source code.

Also supplied with the compiler is a copy of PLIB86, the object-module

Table : *Minimum size comparison in bytes.*

	Release 2.14 .OBJ	Release 2.14 .EXE	Release 2.15 .OBJ	Release 2.15 .EXE
MAIN	110	10,278	110	10,260
PRINT	170	11,702	170	11,684
I/O	342	10,610	342	10,592
PUTS	192	10,310	197	10,292

Listing : A C *program* (TRIG) *using the trigonometric functions available in the math library of Lattice's* C *compiler.*

```
extern double sin();
extern double cos();

#define COUNT 200

main()
{
        double a,c;
        int i;

        a = 3.14;

        for(i=0;i<COUNT;++1)
        {
           c = cos(a);
           c = sin(a);
           c = cos(a);
           c = sin(a);
           c = cos(a);
           c = sin(a);
           c = cos(a);
           c = sin(a);
           c = cos(a);
           c = sin(a);
           c = cos(a);
           c = sin(a);
           c = cos(a);
           c = sin(a);
```

Table 2: *Benchmark results between the two versions of Lattice's* C *compiler. Version* 2.14 *times are with the* 8087 NDP. I *inserted two small functions to keep track of the time, which affect the size of the benchmark, but not the comparison.*

Release 2.14 small-model statistics

	COMPILE (seconds)	RUN (seconds)	.OBJ (bytes)	.EXE (bytes)
FLOAT	33	21	1045	15,214
SIEVE	35	14	1114	22,108
FIB	35	60	776	13,952
SORT	50	250	2029	18,486
FILEIO	53	300	2106	14,908
TRIG	41	101	1215	25,644

Release 2.15 small-model statistics

	COMPILE (seconds)	RUN (seconds) with NDP	RUN (seconds) without NDP	.OBJ (bytes)	.EXE (bytes)
FLOAT	30	20	290	1045	15,850
SIEVE	31	13	—	1223	23,884
FIB	30	60	—	776	13,934
SORT	45	224	—	2029	18,388
FILEIO	48	387	—	2106	14,810
TRIG	48	6	148	844	16,138

librarian by Phoenix Software Associates. With this utility, you can create libraries from the object modules generated through compilation. This is a powerful tool that allows you to merge libraries or extract individual modules. PLIB86 can create libraries containing only those modules that are actually used by a program, as well as provide cross-referencing. In order to determine the minimum size requirement of the newest implementation of the Lattice C compiler, I wrote four short programs. The first was nothing more than a function called main followed by a matching pair of braces. Its object and executable size were 110 bytes and 10,260 bytes, respectively. The next function contained a single printf statement with the phrase HELLO WORLD. The object module was 170 bytes and the executable file was 11,684 bytes. This program was linked without the math libraries. I then produced a function with four I/O calls: fopen, fgets, fputs, and fclose. The object module was 342 bytes in size; the executable file was 10,592 bytes. Then I wrote a function with a single puts call. The object file was 197 bytes and the executable size was 10,292 bytes. Table 1 lists this data and that for the Lattice 2.14 release. The numbers for the 2.15 version are just a bit smaller than those for 2.14.

BENCHMARKS

A look at some benchmarks is useful in assessing improvements of the 2.15 release. In the August 1983 issue of BYTE, pages 88 through 94, there are listings of five benchmark programs intended for C compilers: the Sieve of Eratosthenes benchmark, a floating-point benchmark, a sorting benchmark, a Fibonacci series benchmark, and a disk-file I/O benchmark. These tests give us a reasonable measure of the compilation and execution speeds of versions 2.14 and 2.15 of the Lattice compiler. Lattice claims that its 2.15 release represents substantial improvements in its math libraries. So I added one more benchmark (see listing 1). The TRIG benchmark is similar to the FLOAT benchmark except that it exercises the trigonometric library functions. I compiled and executed these five benchmarks under the 2.14 release and the 2.15 release for several memory models. Table 2 lists the data from the small memory model. The results are worth noting. Across all memory models for the Sieve, floating-point, sorting, and Fibonacci benchmarks, the total time involved in compiling and executing is about 10 percent less for the 2.15 release than for the 2.14 release. This is a respectable increase in speed. The cost of this optimization is usually (but not always) a small increase in

(continued)

Generally, release 2.15 represents an improved Lattice C compiler.

the size of the executable file (about 1 percent). There are two noteworthy exceptions to this: the FILEIO benchmark and the TRIG benchmark. The FILEIO test sequentially writes a 65,000-byte file out to disk. Next, it randomly generates long integers that are used as a disk address. It reads, and then it writes a random-length string of bytes to that random address. Again, the compile time was about 10 percent less for the 2.15 version. The surprise came in the actual running of the benchmark. The 2.14 release averaged approximately 300 seconds, while 2.15 averaged close to 400 seconds. On the other hand, the TRIG benchmark showed a phenomenal increase in speed between 2.14 and 2.15. Although 2.15 took longer to compile, you can see in table 2 that it reduced the execution time of 101 seconds down to 6 seconds. Also, the 2.15 version of the executable file is significantly smaller than the 2.14 version. This comparison confirms that Lattice has indeed improved its math libraries.

I investigated the use of the 8087 math chip. Both the 2.14 and the 2.15 documentation indicate that the compiler will sense the presence of the 8087 and adjust the code accordingly. The 2.15 release has enhanced the way the compiler uses the chip. The presence of the 8087 is only detected once at start-up time. A public byte can be turned off in the main program to suppress this detection if you don't want to use the chip. The standard math module contains code for software emulation of floating-point operations, as well as code that makes use of the 8087. There is a provision with the 2.15 release to include only one or the other through the use of one of two object modules. NONDP.OBJ should be linked with those programs that are intended to execute only on systems without the 8087 chip. NDP.OBJ should be linked with programs that are intended to execute only on systems with the 8087 chip. The floating-point benchmark compiled with the 2.14 release executed in 21 seconds. The execution time of the 2.15 version of the floating-point benchmark was 20 seconds. I linked up two more versions of the 2.15 floating-point benchmark, one with NONDP.OBJ and one with NDP.OBJ. The NDP.OBJ version ran in 20 seconds with an executable size of 14,554 bytes. Since the original floating-point executable was 15,850 bytes in size, you can clearly see that judicious use of NDP.OBJ will reduce the size of a program. The NONDP.OBJ version of the floating point benchmark executed in 290 seconds. [*Editor's note: Using the* NONDP.OBJ *file generated an executable file that was 22,874 bytes in size.*]

The Lattice manual is an outstanding piece of work in content, organization, and appearance. It begins with a brief section on getting started, describes the minimum machine configuration needed to run the compiler (128K bytes and two floppy-disk drives), and explains how to set up a hard-disk or floppy-disk system. (A batch file that comes with the package sets up the hard-disk system automatically.)

Three of the manual's five sections take a generic approach; that is, they describe aspects of the compiler that are not hardware-dependent or implementation-specific. The first section introduces the product. The second discusses the differences between the Lattice compiler and C as described by Kernighan and Ritchie. The third section covers the portable library functions furnished with the Lattice package. The fourth and fifth sections discuss the run-time implementation and the operating-system interface, respectively. Appendixes cover error messages, files, and functions. Following a function index is an index of the entire manual.

Generally, the 2.15 release represents an improved Lattice C compiler. Most 2.15 benchmarks I ran compiled and executed faster than their 2.14 counterparts. The math libraries have been improved. Any increase in the size of the 2.15 executable files is almost negligible. The addition of a separate function index to the manual is a fantastic idea. Lattice's customer support seems reasonable. I am impressed with the product. ■

UPDATE

As this issue went to press, Lattice announced its version 3 C compiler for MS-DOS computers. While we saw a prerelease copy of version 3.0, we cannot verify that all of the claimed enhancements have been implemented or are without flaws. Some of the reported changes are:

- The compiler can generate code for either the 80186 or 80286. A compile-time option determines the instruction set generated. (The default is 8086/8088 code.)

- A compile-time option allows you to generate in-line floating-point instructions for either the 8087 or 80287 numeric data processor, resulting in smaller executable programs.

- Support for MS-DOS version 1 has been removed. Lattice will continue to support the version 2 C compiler for developers using MS-DOS version 1. Removing this support reduces the size of the libraries.

- The library files have been updated. This change affects the user in two ways. First, programs using file I/O functions may have to be modified to call the library routines properly. Second, the libraries are now shipped in a space-efficient format. This new format can be handled by IBM and Microsoft linkers later than version 2.1. However, a conversion package called OML can be used to repack the libraries into the old format if required. OML is included with the version 3 C compiler.

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The 1844 Morse telegraph. With it, Samuel Morse revolutionized telecommunications.

1844 Morse tapped out a series of dots and dashes on his new telegraph, and the message "What hath God wrought?" traveled instantly between Washington D.C. and Baltimore. Telecommunications was born. Today, we've teamed our new 1200 bps modem with Microsoft's® Access software, and telecommunications has come of age.

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Then we teamed it with today's most advanced communications software. Access by Microsoft.

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Turbo Pascal 3.0

An update on Borland's compiler

BY MARK BRIDGER

It seems that hardly a month goes by without a new piece of software from Borland International. Turbo Pascal has appeared in its third version, so perhaps it is time to take another look. [*Editor's note: Tom Wadlow reviewed version 1.0 in our July 1984 issue, page 267.*]

Briefly, here are some of the unique features of Turbo. It is small (version 3 is just under 40K bytes). It contains not just a compiler but a full-featured full-screen editor that is integrated with the compiler so that compilation errors land you directly in editor mode with the cursor at (or near) the offending line. Other Pascal compilers, even those not containing editors, are from 5 to 10 times larger; in fact, Turbo is about the size of a small text editor. This is significant because Turbo can be tucked away in a corner of a disk or RAM drive.

It is fast (see the benchmark graphs in the "At a Glance" section). Turbo compiles easily five times faster than other Pascals. One of the reasons for this is that it has no link step (more on this later). It produces small, fast code. Turbo-compiled executable programs are as fast or faster than those compiled on any other Pascal compiler (again, see the benchmarks). Furthermore, these programs themselves are smaller than those produced by other compilers by a factor of one-half to one-third.

Version 3.0 offers several major improvements and several minor ones. The three most noticeable changes have to do with speed. Unlikely as it may seem, Turbo 3 compiles programs approximately twice as fast as version 2. This may appear insignificant for small programs, where the difference between 5 seconds and 9 seconds hardly matters. But when you are debugging a 3000-line program, the difference between 1 minute and 2 minutes can really add up.

The second speed difference is in the floating-point routines—those routines that deal with real-number operations. Here Borland has obviously spent a fair amount of effort to write good libraries. Version 3.0 executes real-number manipulations approximately twice as fast as version 2.0. There is still room for improvement, however. (See the CALC and TRANS benchmarks.)

The third speed improvement is in Turbo's editor. Previously the editor wrote to the screen by using calls to PC-DOS service routines. These routines are notoriously slow and are usually used only when absolute compatibility with future hardware changes is essential. The 3.0 editor writes by poking character codes directly into screen memory. This tremendously improves the speed of the editor. Borland has also managed to eliminate the static (caused by accessing memory while the screen is being written) that usually accompanies this sort of screen writing.

Another new feature unrelated to speed is the addition of nice graphics procedures. Even in version 2.0 Borland had broken with Pascal's puritanical avoidance of graphics support; color choice and routines for point and line drawing were included (for IBM PC-compatibles only). Borland has added the following procedures in Turbo 3.0 (for IBM PC-compatibles only, of course).

The Circle and Arc routines draw circles or pieces of circles with a given radius, center, and color. The Fill routine comes in several types, enabling you to fill the entire screen, an irregular region bounded by a closed unbroken curve, or a rectangle. This last fill can be done with a specified "texture," or pattern of dots, though only in one color (as opposed to the more versatile TILE command in IBM BASIC).

The GetPic and PutPic commands are the same as GET and PUT in IBM BASIC; they enable you to move or copy the contents of a rectangular patch on the graphics screen.

A series of turtle graphics procedures have been added that emulate the commands in the Logo programming language.

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Name
Turbo Pascal 3.0

Type
Pascal compiler and development environment for MS-DOS and CP/M-80

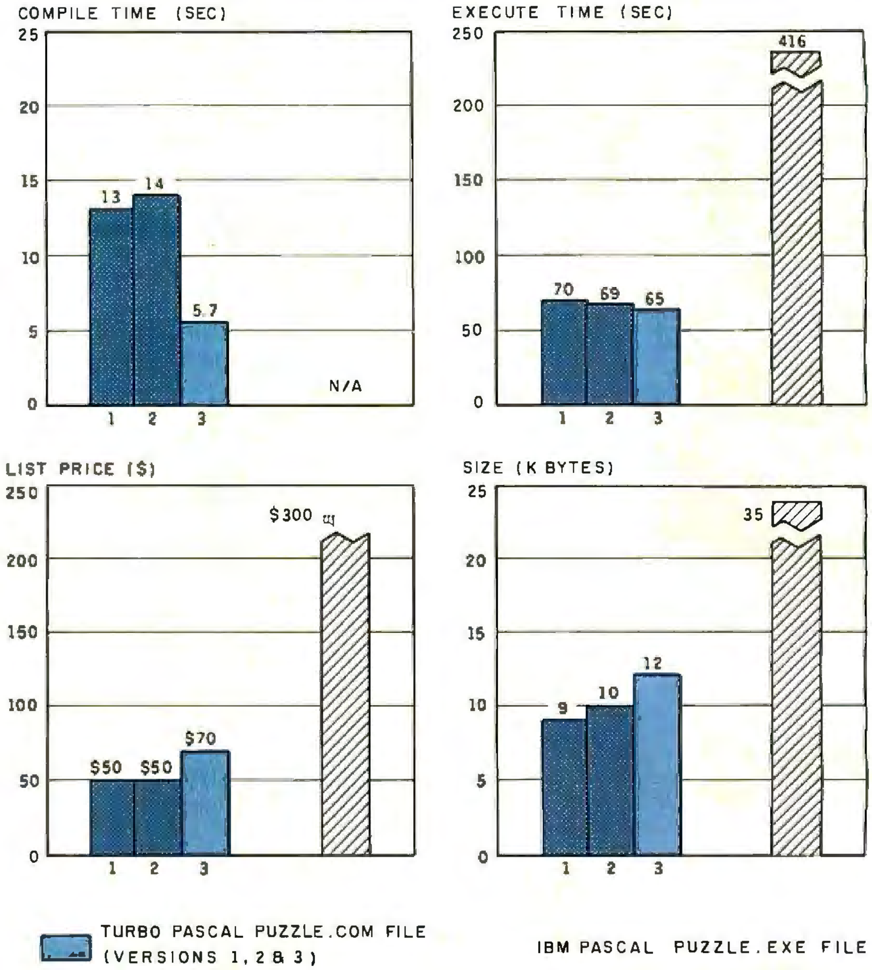
Company
Borland International
4807 Scotts Valley Dr.
Scotts Valley, CA 95066
(408) 438-8400

Size
Compiler and editor take approximately 39.6K bytes in MS-DOS

Features
Built-in screen editor and fast compilation to memory or disk; many language additions and special routines for performing systems programming

Documentation
Soft-bound 376-page manual

Price
$ 69.95
$109.90 with 8087 support
$109.90 with BCD support
$124.95 with both 8087 and BCD support



A comparison of Turbo Pascal and IBM Pascal version 1 running under PC-DOS on the IBM Personal Computer. To visualize the improvements made in the three versions of Turbo Pascal, we ran the Puzzle program in Tom Wadlow's review of Turbo version 1 (July 1984 BYTE, page 267). The size of the compiled code increased slightly with each version. There is little difference between versions 1 and 2 in terms of size, compile time, and running time. With version 3, however, there is a substantial improvement in compile time and a slight improvement in running time. These improvements become more pronounced as the size of the file increases. All three versions of Turbo Pascal outperformed IBM Pascal in this test as far as code size and running time. As mentioned in the earlier Turbo review, a compile time for IBM Pascal version 1 is not shown because its compilation method involves several steps; it would be meaningless to compare it with the one-step compilation of Turbo Pascal. [*Editor's note: In the aforementioned review, the Puzzle program on page 274 has one error. The line* pieceMax[1] := 1 + d* + d*d*3 *should read* pieceMax[1] := 1 + d*0 + d*d*3.]

You can move the turtle (tiny pointer) around with simple commands such as Forwd (some distance), TurnLeft (angle) or TurnRight (angle), and Pendown (leave a trail), among others. These, of course, must be used in a program, not typed directly from the keyboard as in Logo. To some extent they are a reasonable alternative to the "string drawing" commands in IBM BASIC.

In addition to speed and graphics enhancements, Turbo now provides I/O (input/output) redirection and the path and tree-structured directories of DOS 2.0. It also contains a procedure enabling Turbo programs to access parameters from the DOS command line.

Miscellaneous useful additions include the ability to put several external (machine-language) procedures in a single file and the ability to run programs calling overlay procedures while in "memory mode." (In Turbo, a program can be compiled to a standalone executable file or be compiled and run in memory. In the latter case, when program execution stops, you are returned to your program in the Turbo editor.)

Finally, Turbo's annoying habit of clearing the screen when a program is run has been eliminated; the procedure ClrScr can be called to do this chore at the programmer's discretion.

BENCHMARKS

To test some of Borland's speed claims I ran some straightforward benchmark programs (see table 1). CALC (listing 1) and SIEVE (the source code is on page 274 of the July 1984 BYTE) are standard BYTE speedtesters. The former tests real-number multiplication and division, while the latter tests data manipulation in memory. I also added the program FLOAT (listing 2), which tests Turbo's library of transcendental functions, in particular sine, log, and exponential.

As you can see from FLOAT and CALC, the new version of Turbo is between two and three times faster than the old one when it comes to real-number manipulations. There is little difference between the two when it comes to the simple arithmetic of the SIEVE test. Note also that while using the 8087 chip speeds up real-number crunching immensely, there is little discernible difference between the old and new Turbos when this chip is used. This shows that Borland has rewritten the Turbo libraries that do floating-point calculations but has done little or nothing to improve Turbo's 8087 interface. (See the "Acid Test" text box on page 285 for a comparison with Microsoft Pascal.)

The program TRANS (listing 3) tests character-by-character copying of ASCII files, while BTRANS (listing 4) tests the speed of arbitrary file copying by block transfers. An ASCII file is a disk file composed of bytes, each representing a character; word pro-

(continued)

Table 1: *The* CALC *program shows how long it takes to do* 10,000 *multiplication and* 10,000 *division operations using single-precision numbers. The* FLOAT *program tests Turbo's library of transcendental functions. The* SIEVE *program shows how long it takes to run one iteration of the Sieve of* Eratosthenes *prime-number benchmark. The* TRANS *program shows how long it takes to copy a* 10,000*-character file one character at a time, while* BTRANS *shows how long it takes to copy this file* 128 *bytes at a time. The* LINETEST *routine was run first with Turbo's standard Draw routine and then with Gary Derman's in-line drawing routine to illustrate how much Turbo's line-drawing routine can be improved. An asterisk indicates that the test was irrelevant. Times are in seconds.*

	Turbo 2.0	Turbo 2.0 (with 8087)	Turbo 3.0	Turbo 3.0 (with 8087)
CALC	82.5	6.5	32.0	6.5
FLOAT	175.0	3.0	65.0	3.0
SIEVE	14.0	*	13.0	*
TRANS (RAM to RAM)	67.0	*	81.0	*
TRANS (disk to disk)	94.0	*	117.0	*
BTRANS (RAM to RAM)	1.2	*	1.2	*
BTRANS (disk to disk)	17.0	*	17.0	*
LINETEST (Turbo's Draw)	17.0	*	17.0	*
LINETEST (Derman's LINE)	1.2	*	1.2	*

Listing 1: *The* CALC *program coded in Turbo Pascal. This benchmark is run to test real-number multiplication and division.*

```
program CALC;
var A,B,C: real;
N, I: integer;
  begin
    N: = 5000;
    A:= 2.71828;
    B:= 3.14159;
    C:= 1;
    For I:= 1 to N do
      begin
        C:= C * A;
        C:= C * B;
        C:= C/A;
        C:= C/B
      end;
    write(chr(7));
    writeln('Error = ', C-1)
  end.
```

Listing 2: The FLOAT *benchmark tests Turbo's library of transcendental functions.*

```
program FLOAT;
var I: integer;
  x,y: real;
begin
  x:= 1;
  for I:= 1 to 1000 do
    begin
      y:= sin(x);
      y:= ln(x);
      y:= exp(x);
      y:= sqrt(x);
      y:= arctan(x);
      x:= x + 0.01
    end
end.
```

cessors, for example, create ASCII files. A file of integers is composed of pairs of bytes, each pair representing an integer. On the disk, however, all files are, physically, just strings of bits. For convenience and for its internal record keeping, DOS divides these data bits into 8-bit bytes and, generally, collects groups of 128 bytes into a block called a record. It is up to the program reading the disk file to determine how to clump the bytes it reads. If a file is declared to be a file of integer, then Pascal reads it from the disk in groups of 2 bytes; files of reals are read in groups of 6 (or 8) bytes, etc. However, if you just want to copy a file from one place to another (disk to disk or disk to memory, for example), then it is faster to take larger gulps. Turbo enables you to do this using its block read/write procedures. The default-size gulp is a block or record of 128 bytes.

TRANS and BTRANS were tested on a file of 10,000 characters (bytes). As you can see from the benchmark, copying by blocks is much faster, but for each type of copying there is little difference between the old and new Turbos.

To test Turbo's graphics I zeroed in on the line-drawing procedures, which are the heart of any graphics system. The speed at which a line is drawn is determined, for technical reasons, not just by its length but, to varying degrees, by the positions of its endpoints and its slope. The program LINETEST (listing 5) draws lines of varying position and slope and gives Turbo's Draw procedure a good workout. There was no difference in time between Turbos 2.0 and 3.0. In general, Turbo's line-drawing routines are fairly slow. One reason for this is that they must check to see if some "window" has been established outside of which the line must be "clipped" off. To show what can be done, I substituted an in-line machine-code line-drawing algorithm by Gary Derman for the Turbo Draw procedure. (Mr. Derman can be contacted at 15 McAdams Rd., Framingham, MA 01701.) Note the dramatic improvement. I suspect the Turbo Fill procedures would also benefit from faster line-drawing algorithms. Finally, I put Turbo to the test of compiling a long commercial product. Results are in the text box.

TURBO'S LIMITATIONS

One reason Turbo compiles so quickly is that it produces .COM executable files. Without going into technicalities, suffice it to say this entails some limitations: No program can have compiled code longer than 64K bytes, and it is not possible to compile parts of a program separately and link them later.

The first restriction is significant only for long programs. The SURF program described in the "Acid Test" is about 3000 lines and compiles to approximately 50K bytes. Since about 12K bytes of this is the unavoidable overhead of Turbo's run-time libraries, it is clear that programs of at least 4000 lines are feasible.

Longer programs can be created using "overlays." An overlay is a separately compiled procedure that resides on the disk. When the main program needs it, the overlay is read from memory and placed in a space left open by the main program. The main program can actually pass values to it. When the overlay is no longer needed, the main program reasserts itself, but the space in memory is left open for calling another overlay. Most word processors, integrated spreadsheets, and database managers use overlays—that's why you have to keep the program disk in the drive when you are using them.

The second limitation is often cited, yet it is not clear to me how valid it is. If a 3000-line program can be compiled in about 80 seconds, the assertion that modular compiling can save time seems to lose some of its force.

Listing 3: *The* TRANS *program tests the speed of copying a file one character at a time.*

```
program TRANS;
 var
   F,G: file of byte;
   ch: byte;
 begin
   assign(F, 'infile.txt');
   assign(G, 'outfile.txt');
   reset(F); rewrite(G);
   while not(EOF(F)) do
      begin
         read(F, ch);
         write(G, ch)
      end;
   close(F); close(G);
   write(chr(7)); {Beep}
end.
```

Listing 4: *The* BTRANS *program tests the speed of copying a file in 128-byte chunks.*

```
program BTRANS;
var
   F,G: file; {untyped files for
     blockmoves}
   buffer: array[1..128] of byte;
   I: integer;
begin
   assign(F, 'infile.dat');
   assign(G, 'outfile.dat');
   reset(F); rewrite(G);
   while not(EOF(F)) do
      begin
         blockread(F, buffer, 1,I);
         blockwrite(G, buffer, 1,I)
      end;
   close(F); close(G);
   write(chr(7)); {Beep}
end.
```

Listing 5: *The* LINETEST *program tests the speed of Turbo's line-drawing routine.*

```
program LINETEST;
  var
    i, j : integer;
  begin
    graphmode;
    Palette(1);
    for i := 0 to 15 do
     for j := 0 to 9 do
      draw(20*i, 20*j, 319-20*i,
        199-20*j, i+j)
  write(chr(7)) {Beep}
end.
```

You can argue that in a team programming effort it is not feasible to put all parts of a long program together just to test an individual component; yet, that doesn't quite hold water. It is certainly a trivial matter to test whether a bunch of procedures are syntactically correct using Turbo. You create a dummy main program body to call the procedures and run the whole thing through the compiler. In fact, if you were truly programming in a top-down fashion, everyone on the project would have a copy of the main body of the program, since it would be virtually a simple list of the procedures. Furthermore, if more than a syntactical test of procedures is necessary, separate compilation is decidedly inferior to creating a simple main program, including assignment of variable values, which would "drive" the procedures in question.

Certainly it's possible to imagine a situation in which the size limitation of Turbo would cause a problem. A 10,000-line program in which overlaying is impossible is just not going to work. Also, an application that demands the fastest possible 8087 real-number crunching will likely require Microsoft Pascal.

Finally, there's the question of the so-called Pascal standard. I submit that with a quarter of a million copies sold, Turbo is as close to becoming a de facto standard as any other "standard." If Borland could get Turbo working on 68000-based machines—especially the Macintosh—who could dispute Turbo's claim of being the microcomputer Pascal standard?

AN ACID TEST

I have developed several scientific programs, one of which, SURF, draws three-dimensional surfaces defined by mathematical equations (see the March 1985 BYTE, page 240). This program is approximately 3000 lines long and consists of three modules: the main program, a function; the parser, which reads and interprets functions entered from the keyboard; and a video interface that contains, among other things, some fast line-drawing algorithms combined with hidden-line checking.

Since the SURF program was originally written for Microsoft Pascal, I was able to make comparisons between Microsoft and Turbo compilation and execution times. In the Microsoft Pascal version, the main program, the parser, and the video interface were all compiled separately as units, then linked. All compilation was done in RAM on an IBM Personal Computer, so as not to confuse the issue with disk-drive start-up times, etc. Except for the 8087 times (run on a PC), the executable times are all for the PCjr—twice as slow as the PC. I used the PCjr for two reasons. First, it shows dramatically how significant differences in execution time can be. Second, I had trouble finding a machine that didn't have an 8087 chip installed (I'm surrounded by scientists) and I didn't want to open my machine to turn my chip off.

The Scale and Graph columns refer to the times required to scale and graph the function $z = sin(x*y)$. In the first case, 225 points are computed, each involving the calculation of $sin(x*y)$ and, among other things, the product of a 3 by 3 matrix with a 3-vector. In the second, 1800 points are calculated in a similar fashion, but the points are connected on the screen, with hidden-line checking.

Compiling SURF.PAS (2922 lines)
(times in minutes)

Turbo Pascal 2.0	1.4
Turbo Pascal 3.00	0.8
Microsoft Pascal	7.0

Running SURF on the PCjr
(times in minutes)

	Scale	Graph
Turbo Pascal 2.0	1.0	7.5
Turbo Pascal 3.0	0.4	3.0
Microsoft Pascal	0.8	5.2

(Microsoft Pascal compiled with $Float-Calls+, the fastest-running non-8087 option.)

Running SURF with the 8087 (IBM PC)
(times in seconds)

	Scale	Graph
Turbo Pascal 2.0	3.4	25.0
Turbo Pascal 3.0	3.4	24.0
Microsoft Pascal	2.3	12.8

Note that with version 3.0, Turbo is now faster than Microsoft Pascal for non-8087 number crunching. On the other hand, the Microsoft 8087 support still produces code running twice as fast as Turbo's. The executable code for the Microsoft version is in excess of 77K bytes, while the Turbo code is less than 55K bytes. This could be a significant factor in running the program in some environments.

SOME NEGATIVES

My copy of Turbo 3.0 had a serious bug in the BlockRead procedure. If the source file had more than n but fewer than $n+1$ 128-byte blocks, only n of them would get read unless the so-called "optional" fourth parameter were added (even if only as a dummy). Furthermore, the FileSize function would incorrectly determine the number of blocks in a file of this type. This bug is not in version 2.0 of Turbo. Borland assured me that it was aware of this problem and that it would be fixed within a few weeks. I'm sure it will be by the time you read this. I just wonder, however, if there shouldn't be some automatic notification of software owners about defects in a product. If I didn't happen to be using the BlockRead procedure when I did, and didn't happen to notice its particular quirk, I might have later included it, unknowingly, in a program. This is especially important in tools such as compilers where a defect can taint hundreds of products. It would be nice if Borland took the lead in the industry in offering such an automatic user-protection policy—sort of the software equivalent of an automotive safety recall.

Another "hidden" problem is decreased compatibility. At least one hardware configuration that used to

(continued)

Borland acknowledged Turbo 3.0 is "somewhat more IBM-specific."

run programs compiled by Turbo 2.0 will no longer run the same programs compiled using 3.0. Borland acknowledged that version 3.0 is, indeed, "somewhat more IBM-specific." I suspect the problem lies in Turbo's new screen writing. Nevertheless, this is something you should watch out for if you have an IBM PC-compatible.

Here are some other items that deserve attention. The line-drawing algorithm should be speeded up, and there should be some provision for using XOR as an aid in animation. The 8087 support should be rewritten so as to bring it up to Microsoft Pascal speed. This might be important for scientific applications. The editor should have better facilities for changing the drive being written to or the name of a given file. Currently, if you want to save the file you are working on under another name or on another drive, you have to mark the file with ^KB and ^KK editor commands and then use the BlockWrite function, ^KW, to write the file out to the drive and filename you then specify. It would also be lovely to be able to split the screen while in the editor and work between two files simultaneously. Finally, how about 4-byte integers so we will not be limited to arrays of 32K bytes?

CONCLUSIONS

It is hard to avoid recommending Turbo to anyone who wants to program in Pascal. If you have version 2.0 and want to compile or crunch reals twice as fast, or do fancier graphics, then the price of version 3.0 is well worth it, especially since Borland offers a trade-in discount. ■

Editor's note: The listings in this article, along with those mentioned in the July 1984 review of Turbo version 1, can be downloaded from BYTEnet Listings at (617) 861-9764.

 Inquiry 153

R·E·V·I·E·W F·E·E·D·B·A·C·K

"DEAD ON ARRIVAL"

Reading the letter by Farrell Chown (November 1985, page 367) on the printer difficulties he ran into and the reviews he read made me resolve to tell what happened to me. I'll bet many purchasers who depend on what they read in BYTE, *PC Week*, and other magazines could match this sad tale.

I bought a C.Itoh 1550 SCEP because I read the reviews of printers, and the literature, and the tables of comparison data. In short, I researched it. In buying it from a local merchant, paying a reasonable premium over mail-order discount, I thought—if anything goes wrong...

The machine arrived DOA: it never peeped. I called "technical support." They implied I must have used a wrong cable; i.e., it was my fault. Anyway, the local merchant agreed I was due a replacement. OK. After several weeks, it arrived.

The second one emulated the IBM graphics as advertised, and since I was behind in my work, I began using it without trying all the options. Later, I tried to use the color option and it did not seem to work. I called technical support and learned only the black-and-white mode emulates, not the color! Huh? The advertising material clearly stated that this printer was a color printer and that it connected directly to the IBM PC. I paid about $250 extra for this option. "You should call our customer-handling group," I was told.

I called the Customer Satisfaction Office. A spokesperson said he'd look into it and get back to me. Unfortunately, he did not get back to me, and on subsequent calls, I learned that he was out of the office. He never called.

I did a self-test in color to see if that would work; no emulation or computer input is needed. Negative. I dialed the tech support group. "Well, no doubt there is a physical problem. Take it to the merchant." The merchant's technician said: "There's a little motor that moves the tricolor ribbon up and down and it's out—the microswitch is OK. We will order a motor and fix it under the warranty." Later he called me. "You have to take it to an approved repair station." This entailed a two-hour round trip (twice) at my expense.

What is the bottom line? I put my money down in July. It is now late November and I still do not have an operational printer. I am thoroughly disenchanted with C.Itoh and with the distribution and warranty repair system. Meantime all I can do is spread the word—write to BYTE, talk it up at my local PC club, and I'm sure the word will spread.

MILTON H. FELDMAN
Corvallis, OR

FIVE C COMPILERS FOR THE MAC

I have been waiting for a review of C compilers for the Macintosh and found Tim Field's "Five C Compilers for the Macintosh" (November 1985, page 275) very informative. As a professional programmer (but new to the Macintosh), I have some disagreements with him.

The Aztec now comes in one fat binder instead of two. The 600-page documentation is good, but lack of an index is unforgivable. Aztec gives a tutorial section, but it is missing some key things. If you follow the tutorial, the printer won't work. Aztec forgot to tell you that the Imagewriter file from a system disk must be loaded onto the disk first and bin/prsetup on disk two has to be run to set up the printer. Furthermore, disk one is too full just to add these files, so you have to decide what you want to copy to a new disk before you have even used the compiler. All in all I must agree that Aztec has made an extremely nice compiler and work atmosphere with room for improvement.

I am constantly annoyed at the prejudice that my fellow professionals show when talking about the mouse interface. Field said, "Certain computer applications do not lend themselves well to the Mac user interface. . . . Software development is just such an application." Well, Aztec has now integrated almost all the UNIX-like commands into mouse-controlled pull-down menus as well as leaving the line commands as before. The cat command that Field referred to is even under mouse control. I agree that line command systems add needed ease and speed, but the idea that a mouse menu-driven interface has no place and cannot complement the system is utterly wrong. I wish that all Macintosh software was written with line and mouse commands, giving us the best of both methods.

DOUGLAS J. GARDNER
Riverdale, MD

NCR MODEL 4

Though Elaine Holden's review of the NCR Personal Computer Model 4 (July 1985, page 258) was a fair and accurate assessment, it did fail to note the fact that the P4 has a communications port arrangement that differs from that of the IBM PC. This is easily solved by getting a cable that switches pins so that modems like Hayes will work as shipped.

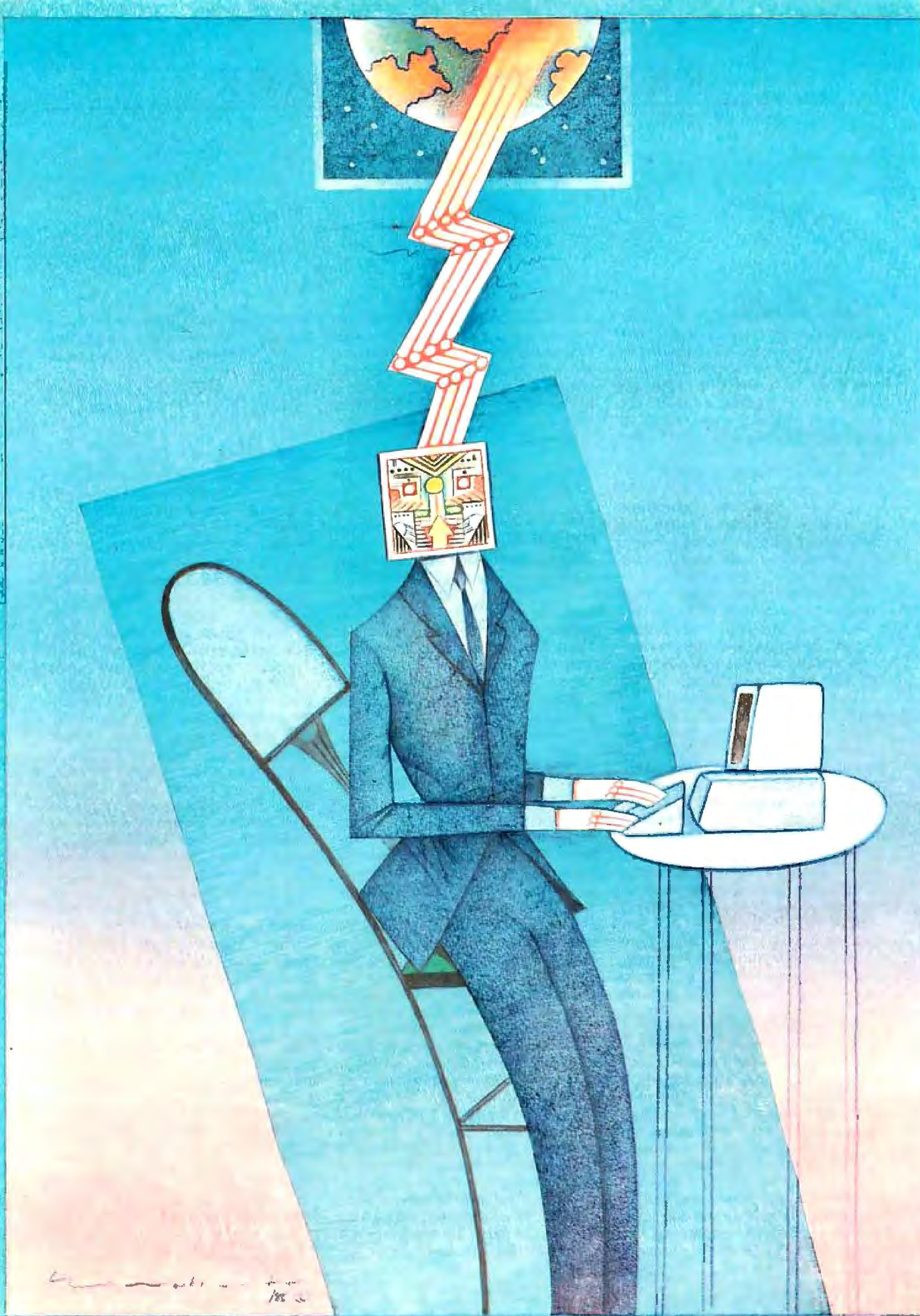
A more serious problem exists in the NCR-DOS (versions 2.11 and lower), which does not control one of the Com1: pins used to start sending data again to devices like an HP LaserJet printer after the buffer is full. This causes the printer to produce several pages of a long document and then hang up while your P4 waits in vain for the send-again signal. The problem has been fixed in version 2.11.5 of NCR-DOS. Customers may exchange their original disks for the update version at no charge. Unfortunately, some of the sale offices that have received the updates are not aware of what it fixes.

My experience with a wide variety of programs has shown compatibility problems only with an early version of EM100 (a terminal emulator program that will dial, log on, and download files but will not exit) and the Volkswriter Scientific word-processing program, which requires IBM DOS. Supplied with IBM DOS, the P4 can run it.

The superior keyboard, drive gates, good technical support, and operation of the NCR P4s in the student lab have made it my home as well as office computer.

JOHN J. TREACY
Dayton, OH

REVIEW FEEDBACK *is a column of readers' letters. We welcome responses that support or challenge* BYTE *reviews. Send letters to Review Feedback,* BYTE *Publications,* POB 372, *Hancock,* NH 03449. *Name and address must be on all letters.*



Kernel

Jerry Pournelle thought that things were about to settle down, that his chaotic life at Chaos Manor would become somewhat less chaotic. This did not happen, and he is starting to accept that the hectic pace he lives at is normal. This is clearly shown in this month's column. Jerry covers a large number of products (just look at the huge "Items Discussed" box). One of the new products he looks at is Turbo Lightning from Borland International. Jerry predicts that this thesaurus and spelling checker will be another winner for Borland.

Bill Raike reports on the 1985 Software and Data shows held in Japan in October. T-Maker III and iBASE plus are two popular software packages he found of interest at the Software Show, and the Kan-tamu telecommunications program also caught his attention. At the Data Show, 1200-bps modems were evidence that it recently became feasible to attach direct-connect modems to phone lines in Japan. The Data Show also featured some new printers, and a new IBM PC-compatible from Sanyo was introduced.

This month Dick explains how Amiga got itself an operating system from the British company Metacomco, and he discusses many of the operating systems' innovative features. The Tripos operating system, as it was originally called, was based on a multitasking kernel developed as a doctoral thesis project at Cambridge in 1976. When Metacomco was given the go-ahead to port the operating system to the Amiga, the name was changed from Tripos to AmigaDOS.

Bruce Webster finally got his hands on one of the highly publicized new computers, the Atari 520ST. This month's column contains his first impressions of that machine. He also discusses TDI Modula-2/ST, a new native-code compiler. Bruce's product of the month is TurboPower Programmer's Utilities, a package of nine programs for Turbo Pascal owners. He closes out the column by looking at new and previously mentioned Macintosh products.

We printed these typefaces "as-is" on an Epson MX-80.

C·O·M·P·U·T·I·N·G A·T C·H·A·O·S M·A·N·O·R

Communicating

Ampro Little Boards
MPI Printer
Laser BDS 630/8
Kaypro 286i
OmniTel 1200
Crosstalk
Turbo Lightning
TurboLink
UNlock
Ready!
Modula-2 Compiler
Stride 440
Quick BASIC

BY JERRY POURNELLE

I keep thinking that things will settle down to normal. I suppose one of these days I'll have to admit it: the hectic pace I live at *is* normal, and I'd better get used to it. Friends go further. They tell me I'd hate it if things slowed down to a walk, and I ought to count my blessings since there are plenty of writers who'd be glad to swap places with someone who has too many contracts. All of this is probably true, but it doesn't help much when my desk is piled three feet deep in paper, and the Federal Express man arrives cursing the seven packages he has to carry up the walk.

Actually, this month wasn't so bad, except that I managed—through total mismanagement—to have engagements in three separate cities—Los Angeles, Seattle, and San Jose—on the same Friday. Rick Foss, my crack travel agent, is a wizard, but not even he could manage that one. I had to beg off from my Los Angeles speech. The San Jose trip was for CONTACT, an annual conference of science-fiction writers and anthropologists that is perhaps my favorite convention of the year. I arranged to have my CONTACT speech moved to Saturday, fly to Seattle Thursday morning for my meeting with Microsoft, make my Seattle speech Friday morning, and catch a dinner flight for San Jose.

It almost worked, except that Hurricane Diane not only stranded Microsoft's chairman, Bill Gates, on the East Coast but also delayed my Seattle-to-San Jose flight by three hours. It turned out well, though: I may have missed Bill Gates, but I saw a lot at Microsoft; and while waiting in the airline lounge, I met a former senior official from Apple who was also going to San Jose. Given the delay, we both had more scotch than usual, which gave me a chance to learn things I'd never have known.

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.

PROMISES

For the past year, Mrs. Roberta Pournelle has been using the Zenith Z-150 and WordStar. She's been happy enough with the Zenith, but sometimes she goes on a trip and takes the Otrona Attache, or we work together with Zeke, the CompuPro Z80. Both of those machines run WRITE, the text editor that Tony Pietsch designed to suit Larry Niven and me; and after a session with WRITE, she *hates* to go back to WordStar. I really can't blame her either.

When we first set up her Zenith Z-150, she was experimenting with Steve Ciarcia's speech-synthesis boards and the KoalaPad. Both of those demand a PCompatible machine. I had explained that WRITE wouldn't run on the Zenith. "But you ought to learn WordStar," I told her. "Everyone ought to know WordStar. It's the closest thing to a universal editor we have in this business."

She agreed and, indeed, wrote her reading book with WordStar, but like most creative writers, she was never entirely happy with it. WordStar is universal and versatile, but it never becomes fully transparent; and for creative writing, transparency is second only to not losing text. "When will we have WRITE for my machine?" she kept asking.

"Real Soon Now." Alas, that was the only answer I could give; Tony keeps promising to do a version of WRITE for PCompatibles, and now that CompuPro is selling the S-100 PC Video board that Tony designed, it seems even more reasonable that he'll get it done; but so far it just hasn't happened.

There were other irritations, including problems converting her WordStar files into something I could work on before we sent it to our agent. The upshot was that I mentioned that it was about time I set her up with a machine that would run WRITE. I said that on Saturday morning about an hour before we were supposed to leave for Tom and Terri Pinckard's annual weekend party in Santa Maria.

"Sure. I don't believe you."

"Eh?"

"You've said this monthly for nearly a year, but all I get is promises. We'll go up to the party and come back Sunday night.

(continued)

When are you ooing up to see Bill Godbout?"

"Uh, I leave Monday night—"

"And then Seattle and San Jose. You won't be back for a week. Forget it."

I could see the beginnings of a domestic crisis, and, worse, it really *was* all my fault. "Okay," I said. "I'll do it right now." With a little help from the boys, I lugged her Zenith Z-150 upstairs to the workroom. Then I brought down the Ampro Little Board machine assembled by Don Castella of Disks Plus (15945 West Pope Blvd., Prairie View, IL 60069).

It's quite a machine. It also runs ZCPR instead of CP/M 2.2. While ZCPR (a public-domain operating system) is much better than CP/M 2.2, it's also *different*, and the differences aren't all that easy to learn.

There's plenty of documentation—too much, in fact. The table of contents is inadequate, and there's no index. One of my readers, Carl Hennig of the University of Waterloo, recently sent me a reprint of some famous quotes about indexing. Thomas Carlyle thought so little of books without indexes that he condemned publishers of same "to be damned ten miles beyond Hell, where the Devil could not get for stinging nettles." That may be a bit harsh, but I do wish the ZCPR documents were better arranged.

Anyway, my intention was to set up the machine so that on power-up it would log onto Roberta's own directory on the hard disk and then bring up WRITE. That way, she wouldn't have to understand CP/M, ZCPR, or anything else. Of course, I'd have to impress on her the importance of saving onto floppies as well as the hard disk, but that could be done with an instruction file put right into the WRITE help file. (One of WRITE's nicer features is that the help file can be edited and expanded by the user.)

It took about half an hour to move the machine, set it up, and be sure it was working. Now for the start-up file. Look in the Ampro documents...

Half an hour later I called Don Castella. By then it was 2:00 p.m. on a Saturday afternoon in Chicago, but he was there. It took us another half hour working by phone, after which everything was running fine. Don got something out of it, too: he's adding some summary and index materials to the documents that come with the Ampro machines he sets up.

We went off to our party. Come Monday, it was time to hook up a printer. That shouldn't be hard at all. After all, this is a CP/M system, WRITE knows how to handle all kinds of printers, and I have several. Hah.

The Great Printer Flap

The simplest way to hook up a printer is through a parallel port. Parallel has limits, among them that the cable can't be too long, but it should be simple to connect up. After all, the Centronics cable connector is standard...

Well, no, it isn't standard. As it happens, the parallel printer I have handy is an MPI (Micro Peripherals Inc.), which is portable, fast, smart, and plenty good enough for drafts. In a double-blind experiment done by Paul Chisholm, my own editors rated MPI's letter-quality fancy output fairly low on aesthetic appeal; but it's acceptable. Chisholm wasn't using WRITE, which knows a lot about how to massage the MPI. There's also a pretty good graphics capability. Mostly, though, the MPI is rugged and fast and easy to set up, and WRITE knows how to talk to it, so it was my first choice.

Alas, the MPI was designed to work with Zenith PCompatibles. The Zenith uses the same cable connectors as the IBM PC. The IBM PC doesn't use Centronics connectors; it uses a DB-25 connector, which looks just like the plug on the end of an RS-232C serial cable.

Naturally, the Ampro machine had Centronics connectors. When Don Castella set up the machine, he thought I'd have cable problems and made a couple of different printer cables but none with a DB-25 plug. I wondered if Priority One would have such a cable, but I decided that it didn't matter. Even if they did, there'd be no time to go get it, set it up, install WRITE properly, and test every-

(continued)

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thing; and as sure as anything, if I left without testing the system, something would go wrong.

I called Don Castella. Together we pored through the Ampro documents. They really are complete, if a bit confused in organization. I also read to him from the MPI manual, which is quite well organized and comes with an excellent analytical table of contents. It told *exactly* how to make up a Centronics–to–DB-25 cable; but, of course, I didn't have either the time or the equipment to do that.

Eventually it was obvious: we'd have to use a serial printer. Installing serial printers not premated to the computer (as the MPI is to Zenith and other PClones) can be a black and frustrating art. Fortunately, though, I suddenly realized that I had a printer that would work fine. "I've got a laser printer," I said. "It's Diablo 630-compatible. The Ampro has a serial printer driver that will work with the Diablo."

"Right," said Don. "What *is* this printer?"

"Something new. It's called a Laser BDS 630/8, and it came while I was in Europe. We don't even have it uncrated yet. But it swears it's Diablo 630-compatible."

"Better uncrate it," Don warned.

We did. Everything looked standard. The Laser BDS 630/8 came with a thick book that gave complete information about the pin layout in the cable. I read it off to Don. There was some tricky stuff about pin 20. Castella thought for a moment then said, "It sounds like a straight-through RS-232C cable will work fine."

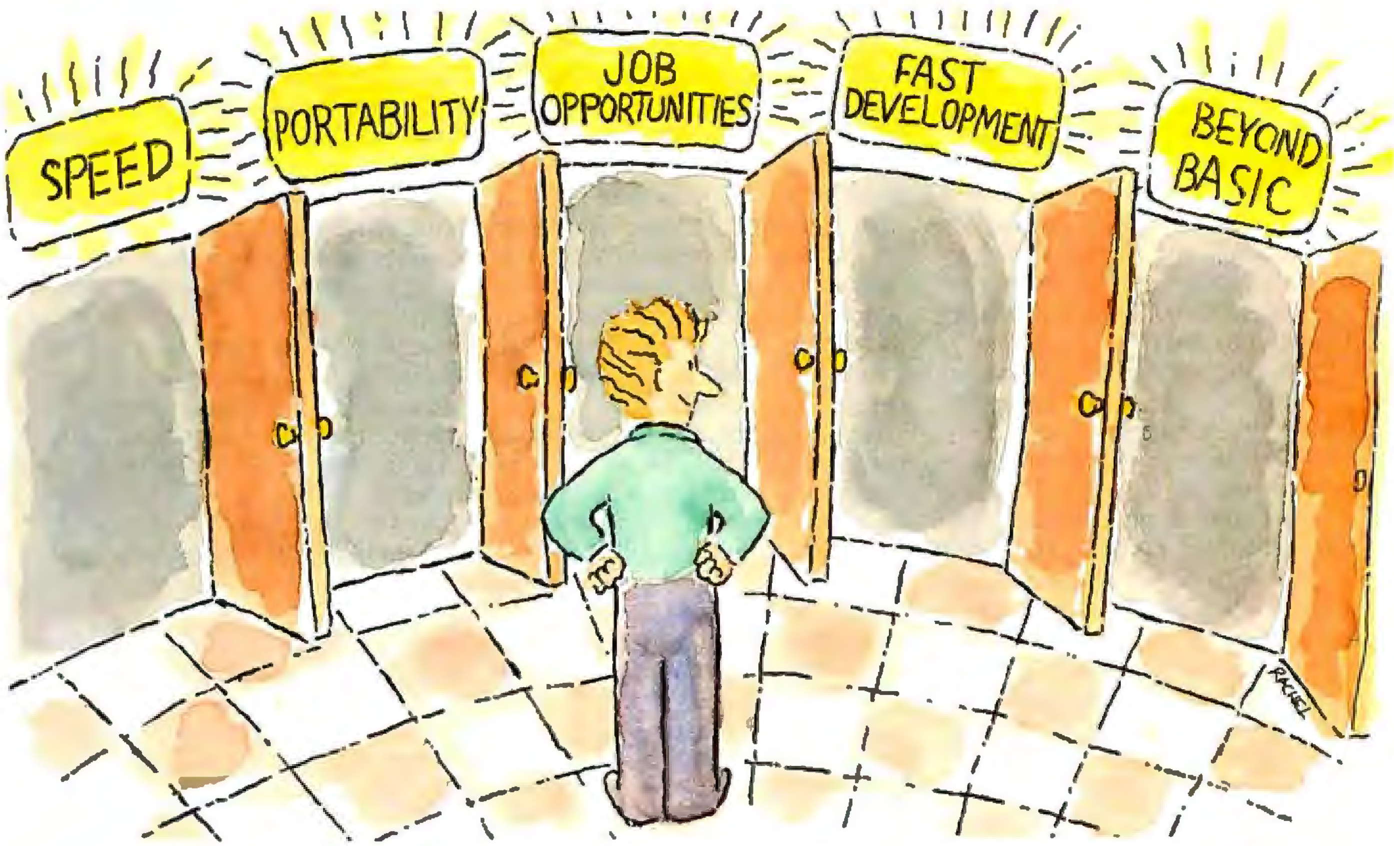
"Good. Those I have."

It took a bit more fiddling, of course. I had to edit the start-up file for the Ampro; the computer normally thinks it's going to talk to a parallel printer, and I wasn't going to try to teach Roberta the mysteries of logical versus physical devices and device assignment with STAT.

The ZCPR start-up file has enormous power; you can practically rewrite the BIOS (basic input/output system) with it. On the other hand, the instructions

(continued)

Doors Open When You Know C



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for doing that are not precisely a model of clarity. With Castella's help, the job got done.

"Now for the acid test." I was still on the phone to Chicago. I connected up the printer and turned it on.

The Laser BDS 630/8 looks a lot like the Hewlett-Packard LaserJet, which is reasonable since both are built around the Canon laser engine. My assistant dug out the BDS laser cartridge; it looked identical to the one used in our Canon copier. Certainly it went in as easily.

Everything warmed up. I loaded in the print test file that comes with WRITE. It's designed to test every possible feature of a printer: horizontal and vertical spacing, boldface printing, underlining, alternate character sets; if the printer is supposed to be able to do it, WRITE and that test file will make it happen. "Here goes," I said. I swear I could hear Castella holding his breath.

A couple of seconds later we knew. "Works fine. Works just like the HP LaserJet."

In fact, I was wrong. The Laser BDS 630/8 works *better* than the LaserJet, at least for the printing we were doing.

BDS

Some years ago, an MIT student named Leor Zolman wrote one of the first Z80 CP/M C compilers. (It's still one of the cheapest and best ways to experiment with the C language, and a lot of good programs have been written with it.) For reasons of his own, Leor called it BDS C and named his company Brain Damaged Software.

The Laser BDS 630/8 has no connection with Zolman's BDS. I have searched through the manual, and if BDS stands for anything, I can't find it. Probably the initials of the founders or something. Anyway, BDS has a heck of a printer.

The print resolution is what you'd expect from a laser printer. BDS claims 300 by 300 dots to the inch, and it looks it. This is the same resolution as the LaserJet, of course; it has to be, since they're both using the Canon engine.

The Laser BDS 630/8 has 24K bytes of data buffer, meaning that it will hold five or six pages of single-spaced text. Like the LaserJet, it's quiet and fast, turning out about eight pages a minute with great regularity. (The first page takes about 20 seconds.) The sheet feeder works fine.

The BDS has better controls than the LaserJet and gives more information, including the page number of the last page it has received. You can "hard-set" margins the same way that you would on a Diablo; indeed, as far as I can see, the Laser BDS 630/8 will do just about anything a Diablo will except feed fanfold paper.

Spelunking the BDS manual yields an interesting fact: there's an error message, CI 7, that "requests that you insert an envelope, then press Resume." I have looked all through the manual and can't find another reference to envelopes, so perhaps this is an unimplemented capability. I'd sure like to be able to do envelopes in a laser printer.

There's another anomaly. The other day, Don Hawthorne, our hardworking editorial assistant, decided it was time to order new cartridges for the Canon copy machines. I asked him to order some for the laser printer while he was at it.

"Which one?"

I had forgotten that we had two. "Both. Get spares for both the HP and the BDS. I expect they're the same anyway."

"The BDS cartridge looked just like the one for the copier," Don said.

"It looked like it, but it can't be the same. The resolutions aren't the same. Look it up, here's the BDS manual."

An hour later Don gave up. The BDS manual has one, and only one, reference to ordering the laser cartridge, and that gives only a BDS company part number. We could, I suppose, have opened up the machine and found the Canon number of the cartridge that's in there, but Mrs. Pournelle was using the printer at the time. The manual I have is obviously a test version; I expect BDS will give the Canon part number in the final edition.

I'm not an expert on printers. All I do is use them. I can say that we've used the LaserJet and the Laser BDS 630/8 pretty intensively in the past month, and both have worked flawlessly. The BDS is a bit easier to control, and the documents show how to hook it up as either serial or parallel, change driver protocols, etc. None of that is child's play, but if you know what you're doing at all, the BDS documents are complete enough. There's even a section on configuring WordStar.

We've become quite fond of the Laser BDS 630/8. The only problem I foresee with it is that Mrs. Pournelle doesn't need that much printer. Once I get a cable made up, she'll have to make do with the MPI, so we can liberate the Laser BDS 630/8 for the office staff. Now all I have to do is explain that to her. . .

COLLEGIATE COMPUTING

Frank, my second-oldest boy, has just started college at the University of Southern California. While I was pretty well disgusted by that television commercial that implied that any kid who hadn't grown up with a home computer would inevitably flunk out of college, I also know that I'd have benefited enormously from having a computer when I was an undergraduate. Alas, there's a lot of truth to the old story of the cobbler's children going barefoot; as I write this, I haven't set him up with a computer system. Partly, it's a problem of *embarras de richesses*: there are far too many to choose from. But I've got to make up my mind.

Indeed, it's a good topic for this column to address in the months ahead. Given an agreement that computers are desirable (and certainly I think they are), what is the best one for today's first-year student? My oldest boy was a computer science major, and besides, there weren't so many choices when he went off to school. Alex got an S-100 system (and still has it).

Unlike Alex, Frank is monumentally uninterested in computer science; he's fascinated by the world of commerce and takes courses in business and in-

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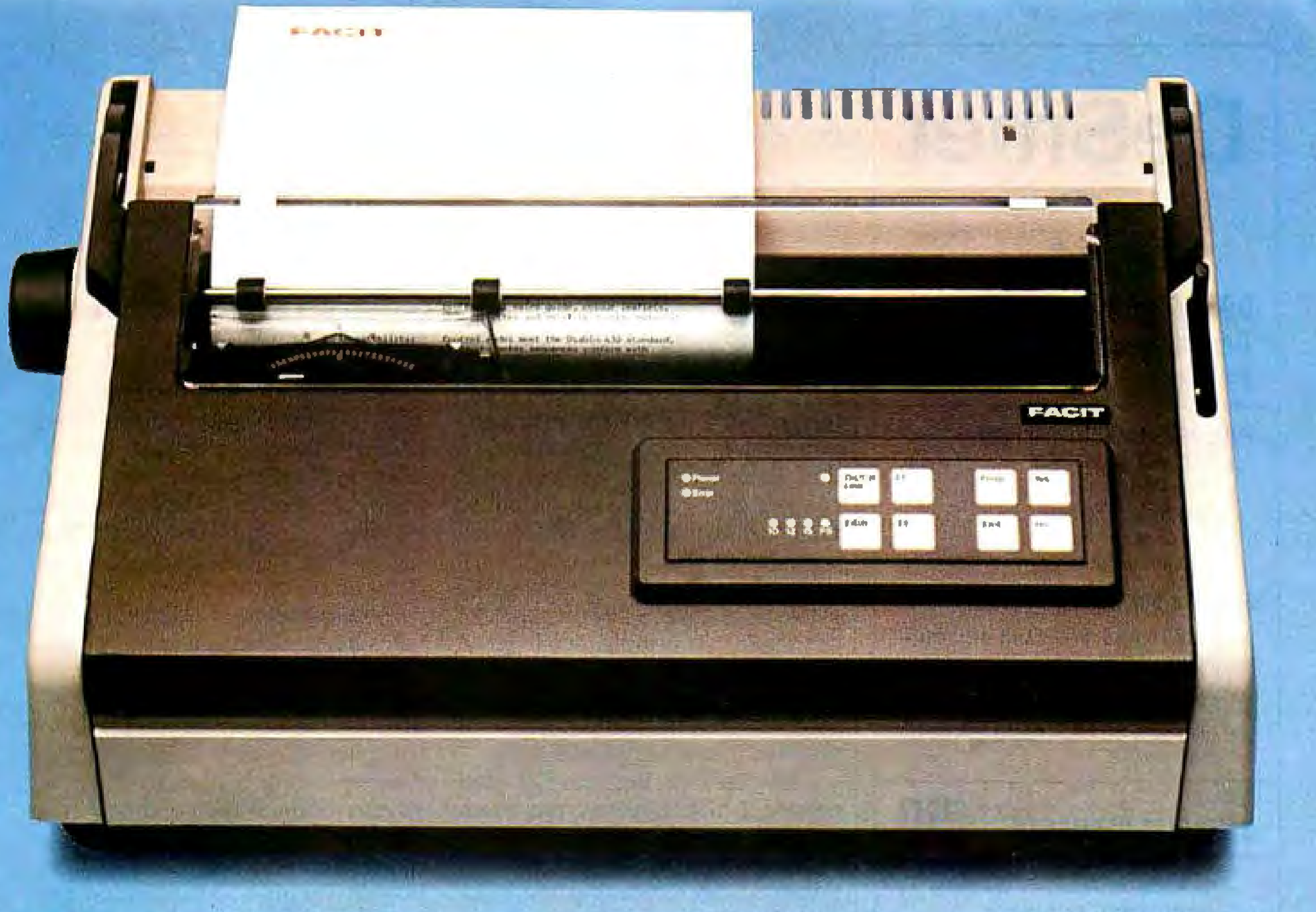

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ternational relations. He's also working on the school paper. At the moment, his only interest in a computer is as a word processor.

Of course, that will change. He's already taking physics; a small computer with BASIC could help a lot with that. Later there will be economics courses, and I'm already on public record as saying that the better computer games, such as Strategic Simulations' Cartels and Cutthroats and the whole Blue Chip Software series of economic simulations, can teach more about economics than any of the courses I took as an undergraduate. It would be useful if he had a machine that could handle those.

A few years ago, business plans and economic models were pretty much graduate subjects. No longer. Spreadsheets and small computers have taken complex forecasting from graduate schools down to the undergraduate level. Frank will need a machine that can handle SuperCalc or Lotus 1-2-3 or the equivalent. He'll also need to learn about the world of databases.

Finally, given that he's interested in a computer only as a tool and doesn't want to spend a lot of time learning how to use one, it would be well if I could provide him with something that will last the whole four years he's in school. That's not an absolute requirement, of course; things *flow* in the computer world. Today's marvel is tomorrow's toy, and four years is a long time in this volatile industry. Still, I don't want to make him spend more time than need be learning how to use the system.

CHOOSING

Now that we understand the requirements, we can look at real choices. The obvious one is the Macintosh. It's easy to learn. MacWrite has lots of problems, but it does work. Microsoft's Excel for the Macintosh is the best spreadsheet I know of, bar none. Many economic games, including all those from Blue Chip Software, run on the Macintosh. I own two of them: why not hand him one?

Almost as obvious is a PCompatible. No purchasing agent ever got fired for specifying IBM, and certainly Frank isn't going to be worse off for understanding how to use an IBM or compatible. Excel is, in my judgment, a better spreadsheet than Lotus 1-2-3, but 1-2-3 is very nearly the standard of the industry. As for text editors, give him WordStar; everyone ought to know it. We have half a dozen PClones, including Eagle, Zenith, and Big Tex, the TI Professional. Let him borrow one of those.

There's another choice: set him up with an 8-bit CP/M system. It's unlikely he'll be using that system when he graduates, but it will get him started and has the advantage that he'll be using WRITE, which is still the best creative-writing text editor I know. Kaypro makes some good 8-bit machines, or we could have Don Castella put one together from Ampro Little Boards. There's also the Companion computer, which has been rather thoroughly redesigned since my review last May. Any of those would do.

There are other choices. As I write this, I haven't decided, but I'm leaning toward the PCompatible. The Macintosh is easy to learn but slow. Worse, it's a closed system with what amounts to a proprietary operating system. The new management at Apple apparently regrets this and is trying to make amends, but I find it unlikely that four years from now the Macintosh will have achieved great penetration into the business community. Finally, while CP/M systems may well be optimal for those with severe cost constraints, I'm fortunate—I don't have that problem.

Which compatible? Both Zenith and Texas Instruments make portable (well, luggable) models of their PClones. Luggability could be convenient for college students. The Zenith is more PCompatible than the TI. But the TI has those wonderful natural-language interface programs that make it both easy to learn and easy to use. There's lots of business software. Either would use one of the portable MPI printers.

Last-minute addition: At the Heath User Group show I saw the new

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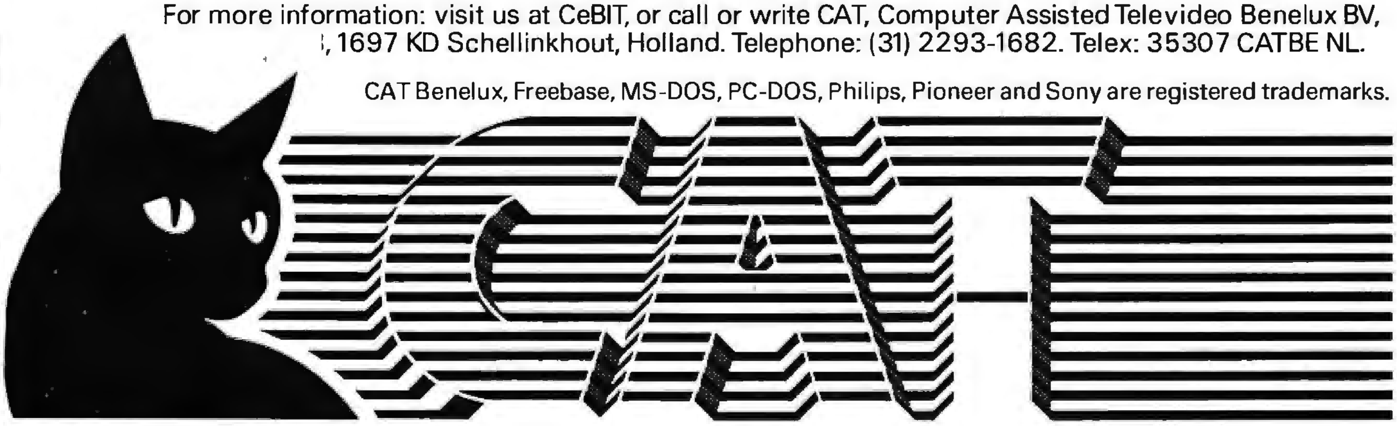

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8-MHz Z-100. It already runs CP/M—and thus WRITE. Now there are not one, but two different ways to make it 97 percent PCompatible as well. The Z-100 with one of the new compatibility boards may just be the best possible low-cost machine for students and small businesses alike.

Now all I have to do is stop thinking about it and decide. I have at least another week . . .

KAT COMPATIBILITY LESSONS

As described last month, Big Kat, the Kaypro 286i PC AT clone, had a catastrophic failure of his Seagate hard disk. Nobody's quite sure what happened. When the technicians got to work on him, they found that the disk drive was so totally "munged," the heads wouldn't move; no files were recoverable. They had to replace the hard-disk drive.

That was all they did. When they returned Big Kat, he had the same central processor, disk controller, memory, etc. What he didn't have, due to my own carelessness, was backups of the programs he'd had. Trying to get everything running again was instructive.

The first thing was the operating system: the technicians had installed PC-DOS 3.1 on the hard disk; but they hadn't put on all the utilities, like CHKDSK.COM and the like. We had the original IBM PC-DOS 3.0 that came with the Kaypro 286i and transferred over the utilities using PC-Sweep.

About half of them wouldn't work: they'd return messages of "incorrect DOS version." Eventually, we said forget it and scrubbed DOS 3.1, reformatted the hard disk, and installed DOS 3.0.

Next was GW-BASIC. I took the Heath/Zenith GW-BASIC 2.0 and copied it onto Big Kat's hard disk. Invoked it.

"You cannot SHELL to BASIC," the computer informed me. Since I was certain that I'd used GW-BASIC before, this threw me. A hasty search through the BASIC manuals didn't help. Neither did a longer one, nor did a search through the DOS manuals.

I looked through the disks supplied by Kaypro with the 286i and found another copy of GW-BASIC 2.0. This one seemed to work fine. I happily began to install the computer games I'm fond of, particularly Epyx's Crush, Crumble and Chomp! (There's nothing like flattening Washington after a hard day's work!) It runs under BASIC. I set it up, started it, made several moves, and suddenly the game crashed. Did it again. And again. Same thing. Each time the forces of good shot at me, the game crashed.

Could it be the keyboard? Or the video monitor? I'm using the Enigma Research Model 9000 business key-

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board (which is *much* nicer than the keyboard that comes with the Kaypro) and a 19-inch Zenith high-resolution Video Component System color monitor. I changed back to original Kaypro components. The game still crashed.

"It always worked before," I raged. Eventually it came to me: when I first got Big Kat, I didn't have GW-BASIC 2.0. I dug out the old copy of 1.0 and installed that. The game works fine now.

I suppose there's a moral to this story.

Back On Line

I use Big Kat primarily for communications. In particular, I've been using the OmniTel 1200 internal modem with Crosstalk. This combination works well with Borland's SuperKey and SideKick, and I was quite happy with them once I got used to Crosstalk's command structure. Before I got the OmniTel 1200 I'd used MITE, and we had a new copy of that, so I thought I'd give it a try.

It turned out not to be as simple as I thought. One of the nice features about the OmniTel modem is that you can set it to use port 3 or port 4. We'd originally set it up as port 4. Crosstalk has no problem with that. MITE does. The MITE communications program is almost totally menu-driven. If you want to tell it which communications port to use, you don't type in a 3 or a 4; you press return to toggle through 1, 2, 3 — and back to 1. There is no way to tell MITE you're using port 4. We'd have to reset the OmniTel; no big deal, but work.

Naturally, the documents for the OmniTel got misplaced during the move upstairs. Eventually, though, Alex was able to set the OmniTel, and we installed MITE. I used it to call BIX, the BYTE Information Exchange conferencing network that absorbs a lot more of my time than it ought to. MITE's menu system is a bit awkward: unlike Crosstalk, MITE has no single screen display that summarizes everything. To see what the various settings are, you have to go from one menu to another. That takes time.

There are other annoyances. Crosstalk has a status line. I'm not fond of status lines that you can't turn off (I'd like to be able to toggle it on and off at will), but I do rather like the way Crosstalk tells me how long I've been logged on. MITE doesn't have that feature, and I miss it. Worse, while I had no trouble at all telling Crosstalk that I wanted to change the "attention" key from Escape to Alt-1—you just go into setup and press the key that you want to be the attention getter—that's very hard to do with MITE.

The final blow came when I tried to use the SideKick editor with BIX. SideKick has a great feature: while logged on to BIX, you can write a short essay and edit in SideKick, then squirt the text out through the modem. The procedure is simple and well documented and works fine with Crosstalk. When I tried it with MITE, nothing but garbage went out. I looked through the MITE manuals but saw no obvious explanation. Back to Crosstalk, which I'm still using.

I'm told there's a later version of Crosstalk that has even more advanced features. Meanwhile, I've sent to OmniTel for the new documents. I've been using the OmniTel—it's as Hayes-compatible as it's possible for a non-Hayes modem to be—and Crosstalk for six months now, and I like them. I expect to like the improved versions even more.

Rambo?

A few days after I'd switched Big Kat back to Crosstalk, I got a call from Philippe Kahn of Borland International. When Philippe has developed something he likes, he's not shy of telling about it. "I have this fantastic new program," he said. "You'll love it. Online thesaurus and spelling checker, and it's very fast and sophisticated, and you're going to say it's fantastic, and . . ."

Eventually he slowed down. I admitted that it sounded great. "So when do I get a copy?" I asked.

"I'll send it over your modem. It's too secret, I don't trust the mails."

"Sounds a bit odd. Besides, I've never received any programs by

(continued)

modem. Alex and Barry do that, but I don't know how."

"It's time you learned. Nothing to it. Do you have Crosstalk?"

Once I admitted that I had Crosstalk, the rest was automatic. We set up a new directory on Big Kat's hard disk, set up a path to Crosstalk, and set Crosstalk on Answer mode. A minute later the phone rang. It took a couple of times—I had to tell all my assistants, and my kids, not to answer that line—after which Big Kat answered the phone and proceeded, untouched by human hands, to gather in files for more than an hour. Some of those files were *big*. Crosstalk tells you in advance how large the file will be and issues progress reports on how much has been received. It's totally painless.

Once that was done, I set up the AUTOEXEC.COM program to bring in the new programs. As I write this, Borland has given the project a code name of Rambo, but, of course, that isn't how it will be marketed. The real thing will be called Turbo Lightning and will include Lightning Libraries. Lightning is a set of resident utilities; it installs after SuperKey and before SideKick. With all three of those utilities aboard, Big Kat has 400,784 free bytes of the 655,360 he started with. So far I haven't missed the memory—and, wow, what I get for it!

This crazy program is a writer's dream. Stuck for a word? Put the cursor next to the word that's not quite right and hit Alt-7; a list of possibilities comes up like magic. There's a full thesaurus in there!

Want to check your spelling? There are two ways to do that. You can have on-line spelling checking, in which case the program beeps at you if you type a word it doesn't recognize and on request gives you a list of words that sound like the one not in its dictionary. You can also put that word in an update dictionary. The procedure is a bit onerous if you're doing it one word at a time; in fact, the on-line spelling checking is too distracting when I'm writing. That's all right. You can turn it off. Then, when you want to review and rewrite, turn it on, and check spelling a screen at a time.

The main dictionary is stored with an extremely sophisticated hashing code for fast access. The update dictionaries are text files, and you can add to them with the SideKick editor. I've updated mine to add all those special dictionaries I've accumulated over the years in The Word Plus (which is still the best off-line spelling checker I've seen). I understand that Borland intends to use the Turbo Lightning system to access many other dictionaries and databases; given the way this one works, I'm very much looking forward to that.

Given a hard disk and plenty of memory, Lightning is certainly fast enough on the Kaypro AT work-alike; and it runs all right on the Zenith Z-150 with Plus Development's Hardcard hard disk. I haven't tested it with a RAM (random-access read/write memory) disk, but I imagine it would go like a bomb. I intend to put my SemiDisk RAM disk into the Kaypro 286i before I start doing any serious writing with that system; a battery-backed RAM disk is faster than a hard disk—and electrons are more reliable than spinning metal.

There's also a way to use Lightning with floppies, but that takes a *lot* more memory; in essence, you have to load all the dictionaries into RAM. Better to get a SemiDisk RAM disk.

Borland has another winner here. Sure, there are plenty of times when you don't need or want a spelling checker and thesaurus; but when you want them, it's enormously convenient to have them right at hand.

The only real problem with Lightning is that this trend toward memory-resident programs can get out of control. Now I have three of the darned things installed on start-up. Where will it end? One of the first things Borland ought to add to the Lightning package is a SuperKey macro that will kill off Lightning, then ask if you want SideKick and SuperKey. Getting Lightning out from in between SideKick and SuperKey is messy, and I expect there will be times when I want all that memory back.

(continued)

At NEC, monitors and printers are not peripheral issues.

All too often, brand-name CPUs are "bundled" with mediocre peripherals — a practice that makes for profitable sales, but does nothing for the system's performance.

In Japan, where most computer peripherals are actually built, NEC is the largest personal computer company — by far. And NEC didn't make it to first place by offering second rate peripherals.

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So before you buy a peripheral from any name company, make sure the company puts more into the peripheral than just its name.

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In the long run, this can't be a problem. The next step in hardware will effectively remove memory limits: standard systems will have megabytes of memory. As operating systems improve, the capabilities given us by SuperKey, Lightning, and SideKick will be built into the operating system. Until then, Borland programs increase my productivity something wonderful.

GOODIES

Once again I'm running low on space, and my desk is covered with a mountain of good stuff that ought to be mentioned. Nothing for it: it's short-shrift time again at Chaos Manor.

One good idea is TurboLink, which is a program that—well, let me quote from the manual: "TurboLink is an automated way to load Turbo Pascal program files into user memory, make them stay resident in memory, and call these programs from a central program which is resident in memory at the same time. This central program can be written in BASIC, BASICA, Compiled BASIC, or Turbo Pascal. TurboLink provides an automatic intelligent interface between the programs. . . . TurboLink eliminates your program size limitations by helping you create a system of programs (up to 576K bytes in length) that execute as a single program. You can accomplish this by calling up to eight 64K-byte resident modules. . ." The rest of the manual is written in similarly concise and clear English. Turbo Pascal hackers will like this program.

Complete Turbo Pascal by Jeff Duntemann (Scott, Foresman, 1985) is the best introduction to Turbo I have ever seen. This book and the Borland Turbo compiler will get you started writing programs even if you've never programmed before. It is well written and extremely well edited. The examples are good, the book is thick, and the writing is clear and explicit. I would have been proud to have written this book.

Not quite as good, but plenty worthy of recommendation, is the *CP/M Programmer's Encyclopedia* by Bruce Brigham (Que, 1984). This gives by example nearly everything you can do with CP/M. Not *quite* everything; it shows no example of how to transfer a file from, say, user area 3 disk B to user area 1 disk M while you are logged on to user area 0 disk A. But you have to get down to that level before it's deficient. There are sections on PIP, STAT, RMAC, DDT, SID, LINK, SUBMIT, and XSUB and then chapters on Pascal MT+, dBASE II, Microsoft BASIC, CBASIC, and other stuff. Appendixes cover file-control blocks and other esoterica. Highly recommended for anyone with a CP/M system.

UNlock 4.7 defeats the latest Prolok and SuperLock type of copy-protection scheme. It's menu-driven and works fine on the programs it's supposed to work on: Lotus 1-2-3, dBASE III, Framework, Symphony, Paradox, and several others. I'll use it to put dBASE III and Framework on Big Kat's hard disk to try them out Real Soon Now. There are also public-domain copy-protection removers, not so well documented, available from bulletin boards or from Workman and Associates.

Meanwhile, apparently the campaign against copy protection is paying off. Living Videotext has just about abandoned copy protection, Infocom has quietly given it up, and other companies are following suit. It can't happen soon enough for me. I agree that piracy is a real problem, and I'm certainly on the side of authors and their publishers getting paid a fair price for their work; but copy protection is not the way to go. It's too easy to break, and its major effect is inconvenience to honest users.

Speaking of Living Videotext, I have a copy of Ready!, which is a new outline processor and editor. Unlike ThinkTank, which I've already recommended, Ready! is a memory-resident program like SideKick. I've only just gotten it. Ready! works fine on the Zenith Z-150 and the Big Kat with or without SideKick and SuperKey. You install it at boot time and after that press Control-5 to invoke it (as you press Control-Alt to invoke SideKick).

(continued)

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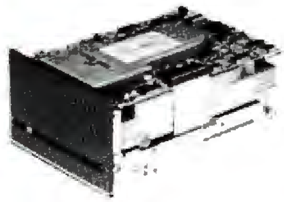

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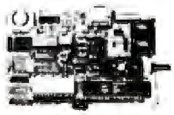

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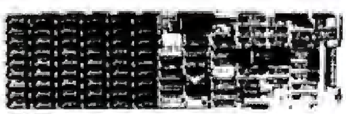

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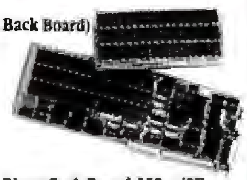

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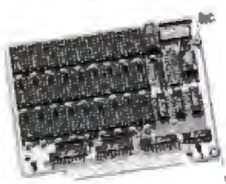

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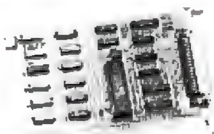

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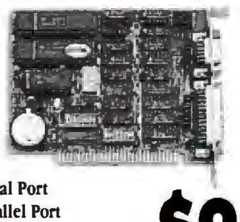

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Ready! can also be put up in extended memory (above the 640K-byte barrier), although that slows things down a bit.

Ready! works like ThinkTank, only better, and it's easier to get at. If you write very much on a PCompatible, you'll probably want it.

As I was finishing that last paragraph, the phone rang: Pierreluigi Zappacosta of Logitech called to tell me I'd been right. That is: about a year ago I tried to persuade PLZ (as he's usually known) to drop the price of Logitech's PCompatible Modula-2 compiler. "Get a lot of them out there. Get people interested in Modula-2," I said. "How can we build interest in the language until there's a good low-cost Modula-2 compiler?"

It took a year, but they're doing that. The new and improved version of the Logitech Modula-2 compiler now sells for $89; for similar amounts, you can buy incremental improvement packages. This isn't a watered-down or crippled version of Logitech's Modula-2 compiler; it's a genuine improvement that runs faster, does more, and costs less.

That's not all. Workman and Associates has a new $49.95 Z80 Modula-2 compiler written by Dave Moore of Australia. It has an integrated editor, and it's fast and complete. If you like

(continued)

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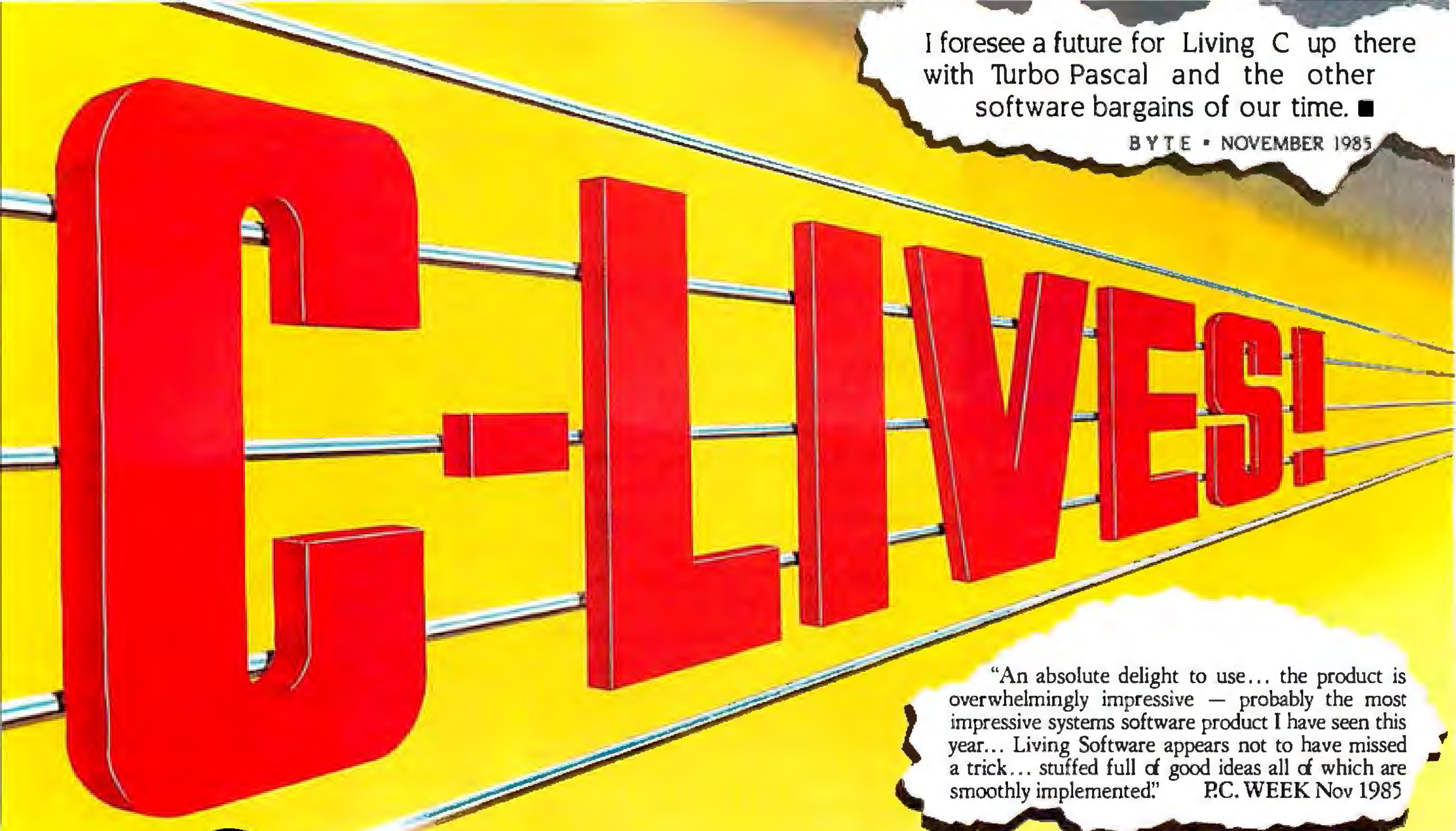

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STRIDE

The Stride (I almost said Sage) 440 is here. We set it up, plugged in the cables, and turned it on. It comes up in p-code. Dr. Michael Hyson, who uses Apple IIe p-code to do advanced robotics work at the Jet Propulsion Laboratories, tried it out. "Fast," he cried. "Really fast."

I have Scenic's native-code Modula-2 compiler for the Stride. This is the compiler developed at Volition Systems before internal stresses tore that group of brilliant hackers into warring factions. The Scenic Modula-2 compiler works splendidly on the Stride, and the combination is staggeringly fast with terrific graphics.

I also have Metacomco's 68000 LISP and Robinson Systems' MOSYS (the Modula-2 operating system). Alas, they're not compatible. I have seen all these marvels working on Stride machines, but we've barely got them going here. What slows us down is p-System. The Stride comes up in p-System, and I find it the original user-hostile operating system. One day I'll get Alex and Mike Hyson to generate a cookbook that will set up MOSYS once and for all and another to get LISP up and running. Then I'll have lots of fun with my Stride.

In fairness, let me point out that many people use Stride machines in business applications, and lots more use them to hack 68000 programs. Carl Helmers, the founding editor of BYTE, likes it so well he has a personalized license plate that reads P-CODE. I've seen amazing things done with Stride machines, and I have no doubt that it won't be long before they're happening here. I'm particularly anxious to compare the new Logitech Modula-2 compiler running on the Kaypro AT with the Scenic/Volition Modula-2 compiler running on the Stride.

WINDING DOWN

I'm out of space, and the stack on my desk is no lower. Sigh. The game of the month is Brøderbund's The Ancient Art of War, which the boys say (and I confirm from my own experience) is about the best strategic computer war game they've encountered. It has a number of different scenarios and levels of opponents, ranging from Crazy Ivan, who acts unpredictably, through Julius Caesar, who is darned hard to beat, to Sun-tzu, who does everything right and makes you *work* just to avoid humiliation. Highly recommended.

Another set of "games" is Hayden Software's series of goodies for the Macintosh. These include Interiors and Masterpieces, which make puzzles of art, and Buildings, which lets you more or less design cities. All instructional and amusing at the same time.

While in Seattle for their computer fair, I went over to Microsoft. They have some of the best debugging tools I have ever seen, and they'll soon be available to hackers. Watch for them. From COBOL and FORTRAN to assembly language, these are tools to drool over.

They also have Quick BASIC, a new version of the BASCOM BASIC compiler. The price is significantly reduced, they've removed most of the known BASCOM bugs, and they've added multiline functions. There are still a few anomalies, and for some reason it won't run on the Tandy 2000 (the old BASCOM would); but Bruce Tonkin, who *really* knows Microsoft BASIC, is enormously pleased with it, although he also notes that it is "aggressively compatible with TopView."

Coming up this weekend is a party that started with a few friends from BIX; others heard, and people are coming from New Hampshire and Seattle. The party now threatens to level the Hollywood hills. Just hope the San Andreas holds off. ■

Jerry Pournelle welcomes readers' comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE *Publications,* POB 372, Hancock, NH 03449. *Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply.*

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How Did Jerry Do?

Dear Jerry,

In "The Debate Goes On..." (August 1983, page 312), you made some predictions about what would happen in two years. Well, it is now more than two years later. I think that your readers would be interested in seeing what you think about how your two-year-old predictions panned out.

Apparently C is a lot bigger than you thought it would be, particularly in commercial software development: You could not have foreseen Turbo Pascal, which has made Pascal extremely popular among hobbyists. As far as I can tell, PL/I has virtually no following. The software house I work for uses PL/I, but I don't know anybody else who does.

Of course, interpreted BASIC comes with most microcomputers, so it remains popular, although I agree with your opinion of it. Your article of two years ago seems oriented toward the CP/M world, but the MS-DOS world is much bigger now. Also, your prediction that "within two years, one will be able to buy the equivalent of a VAX ... for $6000 or so" was a little optimistic. You can get a Micro-VAX, but it costs $20,000 to $30,000. You were right about the amount of RAM people would use; 512K-byte Macs and 640K-byte PCs are now common.

William Meacham
Austin, TX

I was definitely wrong about C; on the other hand, there is now Logitech's Modula-2 for less than a hundred dollars, and although I didn't foresee Turbo Pascal, I did say that one day soon there would be a low-cost Pascal. Indeed, Leor Zolman's BDS C probably had much to do with the interest in C among hobbyists.

Mostly, neither I nor anyone else foresaw just how fast this computer revolution would take off. There are more hobbyists now than when I wrote that column—but the hobbyists no longer dominate the market.

As the machines and languages get better, the difference between "professional" and "amateur" programmers will be about the same as it is between professional and amateur writers.—Jerry

Know Your Dealer

Dear Jerry,

I'd like to take a few minutes to pass on to your readers a small tale of woe about a printer, a computer, and a very large headache.

In October 1983, I made the tumultuous decision to buy my first (and so far, last) home computer. This decision was precipitated by a number of things, not the least of which was my wife's being bored by hearing what "the absolute best" computer to buy was—today—day after day.

It wasn't as though I was utterly naive about computers; heck, I've been in data processing for 12 years now. The question was: How far can I stretch an already overshrunk dollar? How do I get the best for the least?

I made the decision to buy an Apple-like computer. The Apple II+ was still being sold at the time, and the Apple IIe was untried and mostly unsold. Apple was asking too much money for an Apple II+, so I bought the compatible.

I was happy with my decision—in fact, I still am. The problem wasn't with the computer, as I found out many months later; it was with ... well, that's coming.

I ordered a printer—a C.Itoh Model 8510—and a standard printer interface via mail order.

After a while, the printer finally arrived. I hooked everything up, and all did *not* work well. The printer kept dropping characters. It would print for several seconds, then take itself into deselect mode. When I reselected it, it would drop a character. The deselecting of the printer was its way of telling me that *something* was wrong.

I took the printer to a local dealer. It would *not*, no matter how many times we tried to force it, fail. It just kept printing maniacally and, unfortunately, quite normally.

I took it back home. It would not print without dropping characters.

Suspecting the interface card, I took it and the printer to the dealer. Same story as before: It wouldn't fail. Page after page of perfect print. Took it home: It wouldn't work.

Now I was beginning to suspect the computer itself. I had been testing at the dealer's with an Apple IIe. My computer is a Unitron 2200. I took the interface card and printer to the dealer and insisted that it be tested on another Unitron. It would not fail. I took my printer and card home: It wouldn't work.

I took my computer, interface card, and printer into the dealer's. Again, the printer would not fail. Brought them home: The printer kept dropping characters. It was then that I discovered what the dealer never suspected: the interface cable.

At home, the interface cable went across both disk-drive cables, two power cables, and a joystick cable. Naturally, this situation never occurred at the dealer's. By simply moving the printer to the other side of the computer and rerouting the cable so it was near no other cables, the electromagnetic interference that was disrupting the printer vanished. Now it won't fail. Hallelujah!

I'm not sure what the moral of this story is, but perhaps it can serve to warn your readers of two things. One, the most likely solution is the simplest one. Two, nothing is as simple as it looks. This problem took months to solve because of the dealer's lack of insight.

I would offer this caveat: Select your dealer with the same care with which you would select your spouse. You need straight answers from both of them, and you will likely spend as much time with the one as the other.

Wallace Williams
APO, New York

A fascinating story. Murphy's law at work.

We've had similar problems, particularly with an early serial number TRS-80 Model I Level II with expansion box; eventually, the expansion box and cables had to be shielded in aluminum foil. Newer machines are of course shielded due to FCC regulations, but cables are still a very vulnerable spot.

As to dealers: Pournelle's law still applies: "If you don't know what you're doing, be sure to deal only with people who do."

Thanks.—Jerry ■

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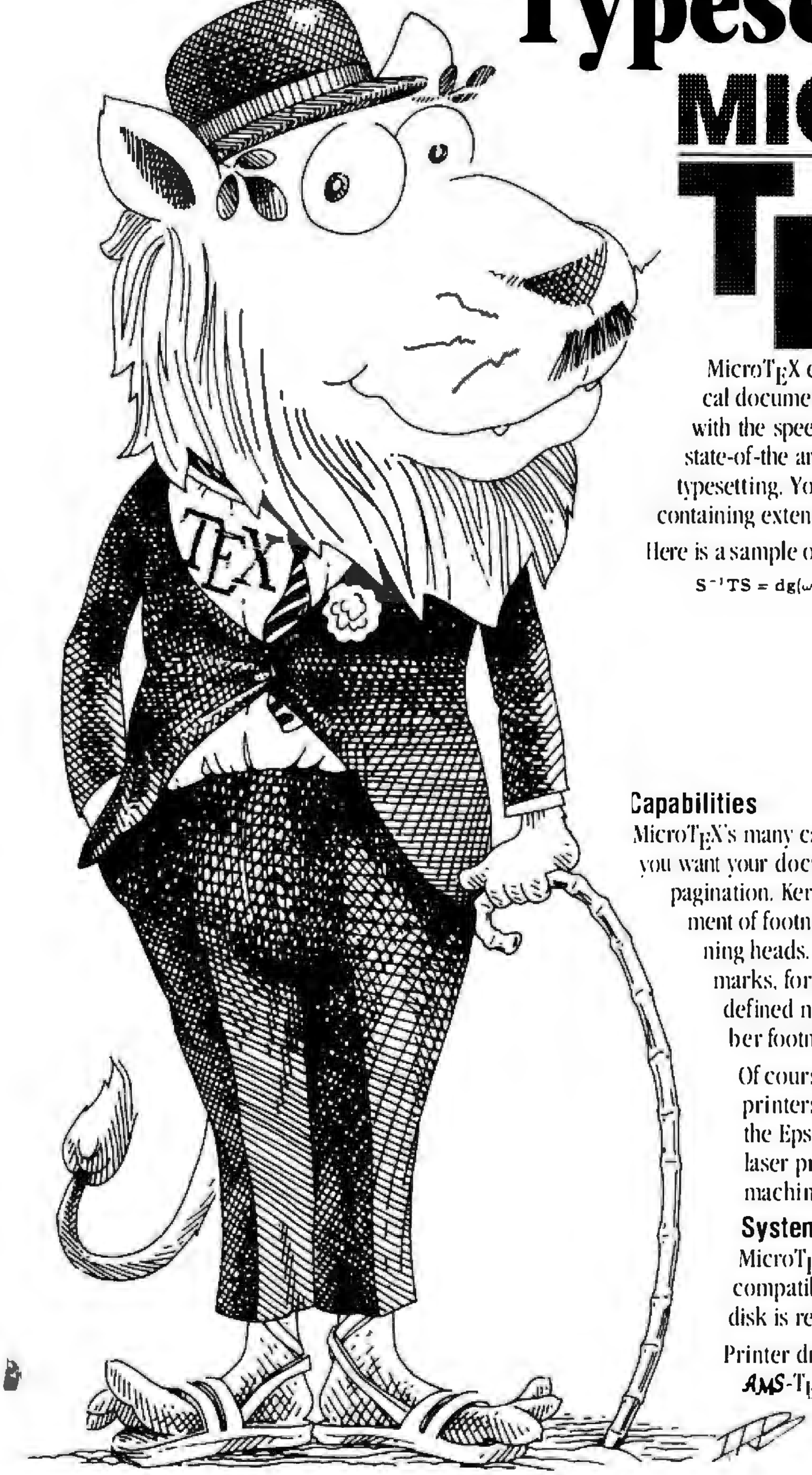

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$$A = \begin{pmatrix} a_{11} & & a_{1n} \\ \vdots & \cdot & \vdots \\ a_{m1} & \cdots & a_{mn} \end{pmatrix}, \quad \left(\int_{-\infty}^{\infty} e^{-x^2} dx\right)^2 = \pi,$$

$$2 \uparrow\uparrow k \stackrel{\text{def}}{=} 2^{2^{\cdot^{\cdot^{\cdot^{2}}}}}\Big\}k, \quad \frac{f(x+\Delta x) - f(x)}{\Delta x} \to f'(x) \text{ as } \Delta x \to 0.$$

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Addison-Wesley publishes several books related to TEX, including the forthcoming five volume Computers and Typesetting, by Donald E. Knuth, Stanford University: The TEXbook, TEX the Program, The Metafont Book, Metafont the Program, and Computer Modern Typefaces.

B·Y·T·E J·A·P·A·N

バイト

Highlights of Two Shows

T-Maker III
iBASE plus
Kan-tamu
TEC BP-10
Facit Opus I
Casio LCS-2400
Sanyo SPX-800
Sanyo CLL-2000D
Sanyo MBC-5800
Ampere WS-1

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Back in October 1985 there were three computer shows in a 10-day period, which left me little time for other things. First I attended the 1985 Software Show, followed by the 1985 Data Show. I just didn't have time to get to the Optical Memory Technology Conference, held at the same time as the Software Show.

SOFTWARE SHOW

The Software Show turned out to be disappointing. For one thing, it's very hard to show off new software products effectively at an exhibition booth where hundreds of other booths are competing for attention. It's also more difficult to attract attention quickly and visually to a software product than, say, a new computer or peripheral. In any case, the show was dominated by CAD/CAM software packages, not terribly impressive, and not really one of my main interests. I saw no particularly noteworthy new products in areas like integrated software packages, word processors, programming languages, or general-purpose utilities.

AT&T was very much in evidence, pushing the UNIX system, which it hopes will become a standard operating system in Japan. Although a Japanese-language adaptation of UNIX ought to eliminate many of the problems associated with other imported operating systems for minicomputers and mainframes, this was not effectively emphasized at the AT&T booth. The people in the booth spoke a curious mix of languages. The temporary exhibition staff recited short speeches by rote (in Japanese), but the centerpiece consisted of a video presentation by, among others, Brian Kernighan (the main creative force behind UNIX) in English, which was unintelligible to most people at the show. In fact the talk was a rather impractical and dull discussion of some UNIX programming tools. Microsoft and ASCII Corporation, its Japanese affiliate, have done much better at earlier shows with their presentations of kanji XENIX. Unfortunately for me, that system is available here only on the new 80286-based NEC PC-98XA. Fujitsu was supposed to have released the 80286 processor card for its FM-16β machine (which I use) by now, but it's been delayed, so I still don't have a UNIX system. Things are not always perfect. . .

Even though they're not really new, having appeared at earlier computer shows, it's worthwhile to mention two popular Japanese-language software packages that were exhibited in a clear, understandable way. One is T-Maker III, an integrated Japanese-language word-processing, graphics, and database-management program from the JSE International group of software companies (the same company that converted dBASE II to enable it to handle Japanese-language text). The second program is a database manager and application-program generator called iBASE plus, from the Ample Software Co. Ltd. It sells for only about $220 and is an easy-to-use, menu-driven system that lets you enter Japanese-language text in a way that's similar to various word-processing programs.

One new telecommunications program attracted my attention. Kan-tamu (apparently an abbreviation of "kanji terminal") is manufactured by Comnex Inc., and it's available for both the NEC and Fujitsu personal computer families (and a few others). Kan-tamu is a fairly primitive program that lets you use your computer as a terminal, but the program also offers file upload and download capability, although it apparently doesn't support any communications protocols. It doesn't let you capture incoming and outgoing text in a disk file, but it does allow on-line Japanese-language input and does allow you to transmit files of Japanese-language characters by first performing "code conversion"; Japanese characters are normally stored within the computer in a 16-bit format. The program won't handle complicated scripts, but it is capable

(continued)

William M. Raike, who has a Ph.D. in applied mathematics from Northwestern University, has taught operations research and computer science in Austin, Texas, and Monterey, California. He holds a patent on a voice scrambler and was formerly an officer of Cryptext Corporation in the U.S. In 1980, he went to Japan looking for 64K-bit RAMs. He has been there ever since as a technical translator and a software developer. He can be contacted c/o BYTE, POB 372, Hancock, NH 03449.

of transmitting a prearranged log-on sequence. Despite its limitations, the program does help open up the world of telecommunications to Japanese personal computer owners in their own language. Bulletin boards are becoming increasingly popular here, but, generally speaking, the Japanese lag behind the U.S. by several years in personal computer communication.

Tokyo Telephone Woes

The biggest problem in telecommunications hasn't been software, although standardization of character sets and codes is an issue; the worst stumbling block has been the antediluvian attitude of the Japanese phone company. Most people are forced to use acoustic couplers, since until very recently it was illegal to attach a modem to your telephone line. Direct-connect modems have only recently started to appear; they allow full-duplex communication at only 300 bps, although I did see a few 1200-bps full-duplex modems and acoustic couplers at the Data Show the following week. Furthermore, many common U.S.-made modems are based on the Bell 103 and 212A standards, while the Japanese phone system (and much of the rest of the world) uses the CCITT (International Consultative Committee for Telegraph and Telephone) standards; the signaling frequencies are different, so they can't "talk" to each other. (I installed some jumpers and a switch in my old Epson acoustic coupler, so I can communicate with modems based on either standard, but I'm limited to 300 bps.) The Japanese phone company recently became a private corporation and its recent liberalization promises to improve the situation. I look forward to an explosive growth in computer telecommunications in Japan over the next few years.

Data Show—Printers

A handful of printers were among the most interesting exhibits at the 1985 Data Show. Tokyo Electric Company's TEC BP-10 laser printer was again on display (it appeared as an OEM product nearly a year ago), but this time TEC announced that it would be available as a consumer product, under the TEC label, in mid-1986 at a price of around $2500. At the same time, TEC unveiled a companion model scheduled to be available a little after that, for about $2000. The less expensive version uses a thermal method for fixing the toner to the paper, while the original BP-10 uses a pressure-fixation method. Interestingly enough, the less expensive machine seems to produce a more pleasing print quality; dense black areas appear with a dull matte finish, while they come out slightly glossy with the pressure-fixation scheme. Another laser printer I hadn't seen before was the Facit Opus 1; neither a price nor a date of introduction was available as of the Data Show, but it's designed for high-volume use (20,000 pages per month at 12 pages per minute). It's bound to be more expensive than the TEC machine, which runs at 10 pages per minute, but the Opus 1 is an extremely compact machine intended for personal and small office use. Both offer extremely high-quality printing, with a density of 300 dots per inch.

In the January 1985 BYTE Japan (page 429), I mentioned that Casio had announced a new type of printer, its liquid-crystal shutter printer called the LCS-2400, for delivery in the second quarter of 1985. The price at that time was supposed to be about $1650. It was on display at this Data Show for the first time, and deliveries were supposed to start at the end of October. Unfortunately, the price is now pegged at about $6000! At the originally announced price, the LCS-2400 sounded like a viable alternative to laser printers; the print quality is nearly as good (about 240 dots per inch), and it's nearly as fast (9 letter-size pages per minute). And the LCS-2400, like most laser printers, lets you download special fonts and form designs for storage in the printer. It seems foolish to think of buying the LCS-2400 at the current price, though, when much more inexpensive laser printers will be available in a few months.

A new printer, not introduced at the show but one I expect to be available in the very near future, promises to be very reasonably priced. It's the still-unnamed laser printer developed by Hitachi and to be sold by Qume. Its performance is rumored to match or exceed that of the TEC printer and may be comparable to Canon's "laser engine."

The Sanyo booth turned out to be one of the more interesting booths at the show. On display, but not in operation while I was there, was the Sanyo SPX-800 LED printer. Like laser printers and Casio's liquid-crystal shutter printer, the SPX-800 is based on the same principles as an electrostatic copying machine (i.e., Xerox and others); the image is produced by exposing a statically charged surface (a drum or belt) to light; a dark toner material then adheres to the exposed areas and the image is transferred to the paper. The difference is in how the drum is exposed to light. In a laser printer, a rotating mirror causes a laser beam to sweep across the drum; the liquid-crystal shutter system replaces the laser and mirror with a fluorescent light and an array of LCD "shutters," eliminating those moving parts in the system that are critical for alignment. The LED printer uses the same idea but replaces the fluorescent light and LCD shutters with an array of light-emitting diodes. The Sanyo LED printer also uses an amorphous silicon drum, which it claims improves drum life and reliability considerably. Sanyo points out that the SPX-800 can print a wider page than most laser printers and is lighter and more compact. It's also faster; Sanyo claims a speed of 20 letter-size pages per minute, without sacrificing resolution: the SPX-800 offers selectable dot densities of 8, 12, or 16 dots per millimeter, which works out to about 200, 300, or 400 dots per inch.

Another Sanyo product that made its debut at the Data Show was the CLL-2000D optical character reader. The interesting point here is that "character" means "handwritten Japanese kanji character." As I've pointed out in this column in the past, Japan is in the midst of a direct leap from handwritten business correspondence straight to word processing, without having had much experience with typewriters in between. And since the CLL-2000D recognizes 2377 different characters, optical recognition is much more difficult than recognizing handwritten characters in English and European languages. Nevertheless, that's what the CLL-2000D claims to do (there was a prototype on display, but I didn't see it working). It sells for about $9300 (at the current exchange rate of 215 yen to the dollar) and is supposed to be able to recognize two kanji characters per second or five alphanumeric characters per second. It connects to a personal computer through an RS-232C serial interface. Japanese-language draft documents are often written on the type of rectangular-grid paper the CLL-2000D requires as its input, so the required standardized spacing and size of the handwritten characters may not be a practical problem, but it's hard for me to imagine how to justify the unit's high cost in light of its limited speed. On the other hand, two characters per second is a respectable rate of input compared to the speed of typists

(continued)

using Japanese-language word-processing programs.

NEW PERSONAL COMPUTER FROM SANYO

Sanyo's IBM PC-compatible computers are not sold widely in Japan, and the company's MBC-6800 computer, an 8086-based machine, has had only limited success here, partly due to its high price. Depending on how well Sanyo can compete with the NEC (and, to a lesser degree, Fujitsu) sales and service networks, its new MBC-5800, introduced at the Data Show, could give it a big boost. This computer is no more technologically sophisticated than, say, the NEC PC-9801 series, and less so than the Fujitsu FM-16β; it's based on the 8086-2 microprocessor, running at 8 MHz, and comes with 256K bytes of RAM (random-access read/write memory) plus 192K bytes of graphics video RAM. Those features are similar to those offered on the NEC PC-9801 machines, except for the amount of built-in RAM (NEC offers 512K in most models, less in others) and the 768K bytes of installable RAM in the Sanyo. It offers 640- by 800-dot graphics and can do graphic scrolling in single-dot units. You have a choice of three models, differing only in their disk-drive configurations and the bundled software. The MBC-5800S has a single floppy-disk drive, the MBC-5800W has two floppy-disk drives, and the MBC-5800H has one floppy-disk drive and one built-in 10-megabyte hard-disk drive. The floppy-disk drives support either 1-megabyte or 640K-byte formats. Sanyo claims the machine can read disks recorded on either NEC PC-9801 series or Fujitsu FM-16β computers, a big plus and the first noticeable move in Japan toward compatibility between computers from different manufacturers. Sanyo bundles Japanese-language versions of both CP/M-86 and MS-DOS 2.11 with the MBC-5800 (except for the single-disk version), along with BASIC, a business graphics package, a simplified display generator, a Japanese word-processing program called JWP, and various utilities.

The main unconventional feature of the MBC-5800 is its built-in voice synthesizer. It's basically an 8-octave, 3-channel programmable sound generator. I listened to it reading arbitrary alphabetic characters I typed at the keyboard, as well as "speaking" preset Japanese sentences. Its pronunciation was quite good; the pacing and articulation made the "speech" easy to understand. However, without substantially more software support, I'm afraid the voice synthesizer will remain only an interesting gimmick, but Sanyo suggests that it will be used for such applications as games or notifying the operator that a printout or data-communication task has been completed. In any case, there should be lots of educational possibilities for voice synthesizers of this quality.

The prices of the MBC-5800 machines, and the bundled software, make them competitive with their NEC and Fujitsu counterparts. The dual floppy-disk version sells for the equivalent of about $1750, while the hard-disk version is about $2950. (Again, prices reflect an exchange rate of 215 yen to the dollar.)

AMPERE IS CURRENT

Ampere Corporation here in Tokyo makes the beautiful and very powerful WS-1 lap-size portable computer; it uses the 68000 microprocessor. Ampere's integrated software package, written entirely in APL, is now in the beta-test stage and looks like it's very easy to learn and use. I hope to report on it further in a later column. Meanwhile, Ampere has informed me that it will soon announce an extremely compact external 3½-inch, 15-megabyte hard-disk drive as a WS-1 accessory; Kusanagi-san, the president of Ampere, told me that you'll be able to daisy-chain up to four of the drives connected to a WS-1.

COMING NEXT

Next month I'll discuss one of two new programming languages created in Japan, and an issue it raises. I'll also tell you about my new laptop portable and how I was able to justify buying it. ■

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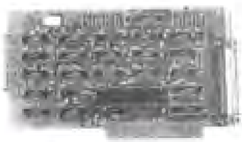

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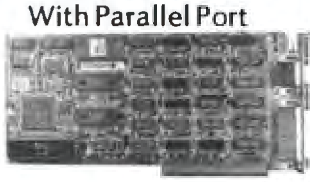

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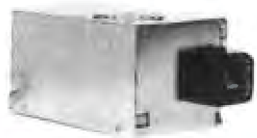

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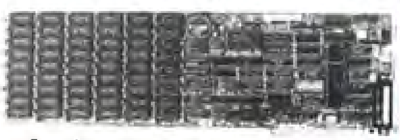

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Tripos—The Roots of AmigaDOS

Metacomco is the British company behind AmigaDOS

BY DICK POUNTAIN

A question that must be puzzling many people in U.S. computer circles is, "What is Metacomco?" When Commodore announced its spectacular Amiga computer, much of the U.S. press failed to point out (and possibly did not know) that the advanced operating system AmigaDOS was in fact written by a small British software house called Metacomco. (For more information on the Amiga, see "The Amiga Personal Computer" by Gregg Williams, Jon Edwards, and Phillip Robinson, August 1985 BYTE, page 83.)

Metacomco is based in Bristol, England, a city that is beginning to rival Cambridge as our potential computing capital (it also houses TDI-Pinnacle, INMOS, and others). Metacomco was founded in 1981 by Derek Budge and Bill Meakin and now employs about 25 people, mainly programmers and other technical staff.

The company's first product was a portable BASIC interpreter written in BCPL, the forerunner of C, which is taught and used extensively at Cambridge University. This interpreter was ported to the 8086 processor and shortly afterward was sold to Digital Research Inc., which still markets its descendant as Personal BASIC. This U.S. link became very important to Metacomco, for the royalties provided a steady source of income during the crucial early years and helped the company establish an office in California, which kept Metacomco in touch with the U.S. computer scene.

In 1983 Dr. Tim King, a Cambridge computer scientist, was engaged by the company as a consultant, and Metacomco's emphasis switched to the 68000 processor, with which King had been working since the first samples came out in 1981. The company produced a series of development tools, also written in BCPL, including a full-screen editor, a macro assembler, and a linking loader. At that time there was no clearly established standard operating system for the 68000, so the next step was to write one. Subsequently, Tripos was born.

The Tripos operating system was based on a multitasking kernel developed as a doctoral thesis project at Cambridge in 1976. ("Tripos" was the name given to the three-legged stools that students sat on in the old days when taking their examinations and has since become the colloquial name for the Cambridge final examinations.) King, then working at Bath University, took the kernel written for a DEC PDP-11 and made it into a full 32-bit multitasking operating system for the Sage microcomputer (which was new at that time). Tripos is BCPL-based in the same way that UNIX is C-based, and it has many innovative features that I will discuss.

Metacomco had also purchased the rights to Cambridge LISP, a powerful LISP interpreter/compiler originally developed for the IBM 370 and then ported to the 68000 at Cambridge. Metacomco produced versions for the ill-fated CP/M 68K and then for Tripos. Reduce 3, a symbolic math system written in LISP, was added to produce a Sage-based workstation that was sold to research institutions in various countries. Customers included SORD in Japan and Bristol neighbor INMOS, who used BCPL for the first stage of bootstrapping its Occam compiler onto the 68000, using Sage computers running Tripos.

In 1984, Tim King joined Metacomco full-time as Research Director, and Sinclair Research launched the QL. Initially, the QL lacked a serious software-development environment, and Metacomco was able to quickly port its development tools, including the BCPL compiler, to it. The company has since extended the range to include an ISO (International Organization for Standardization)-validated Pascal computer, and it markets these products directly, rather than via the manufacturer, largely by mail order.

November 1984 is the crucial date in the AmigaDOS story. Metacomco visited Amiga

(continued)

Dick Pountain is a technical author and software consultant living in London, England. He can be contacted c/o BYTE, POB 372, Hancock, NH 03449.

Corporation (which was still in the midst of finalizing its purchase by Commodore) to discuss the sale of Metacomco's 68000 Pascal compiler for Amiga's new Lorraine machine, as it was then called. During these discussions it was revealed that the Amiga operating system (OS) was way behind schedule and causing some concern. Amiga's stipulations for the Lorraine OS were that it should be multitasking, should support both synchronous and asynchronous I/O, and that the I/O should be stream-based and hardware-independent. Metacomco was already marketing just such an operating system, Tripos, running on the 68000. Amiga agreed to consider Tripos as insurance, in case its already-commissioned system didn't work out.

In February 1985 Metacomco was given the go-ahead, and Tripos was ported to the Lorraine in three weeks flat, thanks to its BCPL portability (although the kernel is written in 68000 code for efficiency). King recalls that when he demonstrated it at the end of February, he turned from the screen to find the whole Amiga staff gathered around applauding; the hardware had suddenly become a real computer. The existing OS was dumped, and the job of turning Tripos into AmigaDOS began.

Fortunately for Metacomco, there was a remarkably close fit between Tripos's internal structure and Amiga's planned software architecture. Tripos is conceptually organized on classic OS lines, with a scheduler, a message-passing system, and a set of device drivers. Amiga's programmers already had ROM (read-only memory) routines to do the jobs of scheduling and message passing and the crucial device drivers for the very special custom chips, the Copper and the Blitter, which handle the graphics, animation, and sound. (For more information on the custom chips, see the interview with Jay Miner entitled "The Amiga's Custom Graphics Chips" conducted by Phillip Robinson, November 1985 BYTE, page 169.) The story might have ended right there had these drivers needed to be written from scratch, given that these were new and unknown custom parts and were probably only partly debugged at the time. The people at Metacomco integrated these parts with the disk-file I/O system, console-text I/O, printer I/O, and command-line processor from Tripos to make AmigaDOS.

The Amiga staff produced the icons/windows front end called Intuition that sits on top of AmigaDOS; we have Metacomco to thank, though, for insisting that an underlying CLI (command-line interface) be always available as a programmers' interface and for more experienced users.

The relationship between Commodore-Amiga and Metacomco has now become quite close. Metacomco's Pascal, LISP, and a much-modified BASIC are all running on the Amiga. The BASIC story is rather complicated in itself. Amiga had already commissioned Microsoft for a version of its much-delayed Macintosh BASIC to be put onto the machine. At the launch in July, however, it was Metacomco's ABASIC that was seen by the press, though certain "ambiguities" may have led people to think it was Microsoft's. At the time of this writing, the language that finally got shipped with the machine still appeared rather vague. [*Editor's note: We have since learned that* ABASIC, *which started out as Metacomco's, will become* Microsoft's.] Metacomco is currently working on enhancing ABASIC to permit procedures with parameters, optional line numbers, and full compilation; the present version is structurally still at the Microsoft version 5.2 level. It does, however, have some astonishingly powerful Amiga hardware support commands, such as TRANSLATE and NARRATE, which respectively convert an ASCII string into a phoneme string and then speak it. All the power of the custom chips is accessible through high-level BASIC statements rather than through PEEKs and POKEs.

TRIPOS/AMIGADOS

The Tripos operating system has some features that are not usually found in

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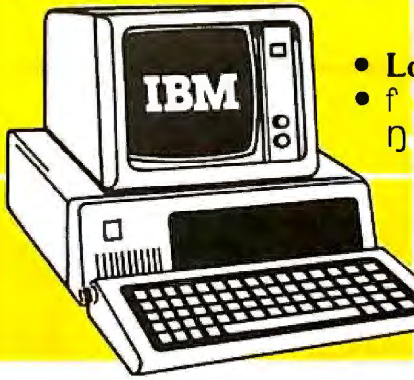
Save



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microcomputer operating systems, particularly in the area of disk-file organization, and these have been inherited by AmigaDOS. Many of these advanced ideas stem from Tripos's origins in a computer science research project; there is much emphasis on doing things the way they should be done, rather than kludging around the way the last guy did it.

Tripos is based on the concepts of multiple tasks and message passing. When an application task is started, it finds a number of other tasks already running. In particular, there will be one for each peripheral device that it needs to talk to, though some of these tasks sleep until awakened by a demand for service from another task. A debugger task also runs continuously in the kernel, which is a great boon to the programmer. An application's environment, greatly simplifed, might look like figure 1.

Every peripheral device is served by its own task. All tasks run concurrently or, strictly speaking, pseudocurrently, since there is only one central processing unit, and the application gets the resources it needs by sending and receiving messages. If a program needs 200 bytes of disk storage, it might send a message to file task 1 requesting this. The file task has its own cache buffer, and it will proceed to get a new block into the cache by in turn communicating with the disk device, which has its own track buffer so that whole tracks are read in at one time. When the file task has the block, it sends a message to the application that the store is now available.

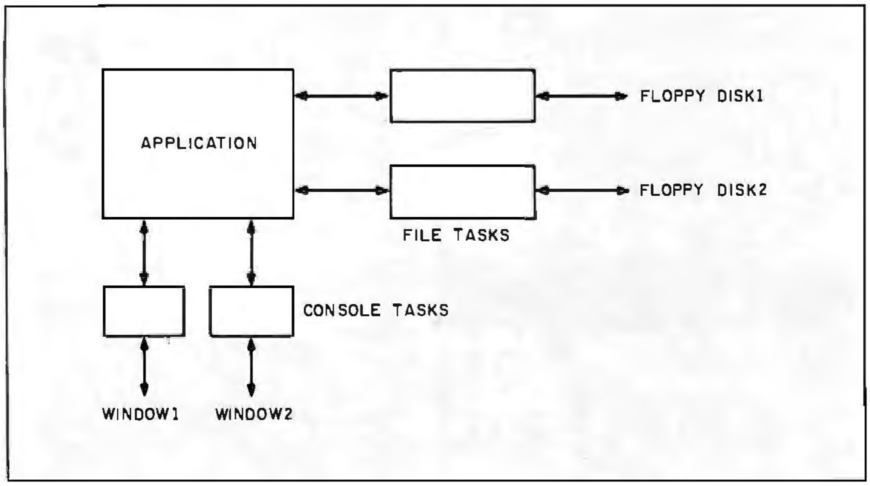

Figure 1: *An example of a simplified application's environment.*

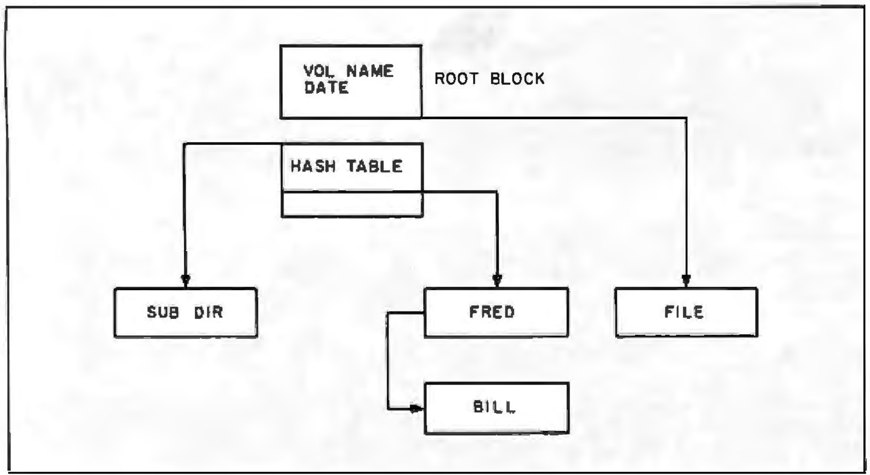

Figure 2: *An example of hash collision. Extension blocks are chained onto the pointed-to block, and the collision is resolved by string matching.*

One consequence of this structure is that, unlike simpler systems such as CP/M and PC-DOS, it's possible for disk activity to occur at seemingly random times, without the user doing anything to provide it; this is quite spooky until you get used to it.

The only limit on the number of tasks that can run is the memory available; it is not a virtual-memory system, but code sharing is used to minimize the memory requirement during multiple invocations of similar tasks. Tasks can be given priorities, and any task can be executed in the background from the command line by typing RUN <taskname>. The CLI is itself a task, and multiple CLIs can be spawned if desired.

The message-passing interface is quite similar to that in UNIX and is identical for all devices and applications; it includes messages like Open, Close, Read, Write, and Seek.

File Structure

It's in the area of disk-file structure that Tripos is truly radical. For starters, there is no directory track on a Tripos disk, and indeed no directory in the usual sense of a table of filenames. Instead, Tripos uses a *root block*, which is placed in the center of the disk surface rather than on track 0 as is usual.

The root block contains the volume name of the disk and the date of creation and last modification. Following this is a *hash table*, via which file or subdirectory names get turned into block numbers. Each block so pointed to can be a directory or a file, leading to a hierarchical directory structure like that in UNIX or PC-DOS 2. In the case of hash collision (perhaps "Fred" and "Bill" both hash to the same block number), extension blocks are chained onto the pointed-to block, and the collision is resolved by string matching (see figure 2).

(continued)

Want to hear a demonstration of Hewlett-Packard's ThinkJet Printer?

Subdirectories have the same structure as the root block, while file headers have a filename, date, and a table of the data-block numbers that constitute the file. The size of the block is fixed (512K bytes in AmigaDOS, 1024K in Sage Tripos), and when a file header runs out of space for its block table, it merely chains on an extension block.

To optimize speed of data access, file headers and subdirectories are allocated inward from the root block, while data blocks are allocated outward, so that consecutive blocks can be kept close together (see figure 3).

This whole scheme has several beneficial consequences, compared to more conventional operating systems. There are no arbitrary limits on anything; files are governed only by the physical storage capacity of the medium. All files are automatically random-access. Moreover, there is no distinction between binary and ASCII files, as files do not need to contain any special control characters like ^Z for end-of-file. All files are the same, just blocks of "stuff."

There is more, however. All the blocks that make up a file contain pointers to the next block in line (enabling efficient sequential access) and also a *back pointer* to their header block. The inclusion of these features means that even if a file header gets completely mangled, it can be reconstructed by the reading pointers in the data blocks; the individual data know their own identity (see figure 4).

Metacomco also has a "disk doctor" program that can reconstruct a disk, both files and directories, from almost any state of damage short of total data loss, and it can do it automatically. This is a very significant step forward in mass-storage security compared to PC-DOS, where the corruption of a directory track can lead to leaps from high buildings.

The only penalties paid, as tradeoffs for all the advantages, are that directory listing and file renaming are slower than in conventional systems, because there is no single place to go to look for filenames; the whole tree structure needs to be traversed to find the names. Metacomco is currently considering caching the directory structure to alleviate this problem, but from my limited experience of the Amiga, it doesn't seem too bad anyway; it's not much slower than an IBM PC by the time the latter's disk-access and screen-updating speeds have taken their toll.

Given the multitasking nature of Tripos, and hence the unpredictable times of disk accesses, measures were necessary to manage disk changing gracefully. Accordingly, Tripos keeps a bit map of the disk usage in memory—the same idea as a PC-DOS FAT (file-allocation table)—which has a bit set for every block in use. As mentioned before, each file task keeps its own block buffer in memory. After disk activity (signaled by the usual red light) there is a three-second time-out period, after which the task automatically flushes its buffers and the updated bit map to disk. If a disk is removed during the time-out period, the bit map on disk will be marked as invalid, and when that disk is reinserted, a validation task in the kernel will automatically be invoked to rebuild the bit map. Only if the disk is removed when the red light is actually on is there any chance of losing data; Amiga and Metacomco debated long and hard about a mechanical locking scheme similar to that on the Macintosh but decided against it after observing the unpopularity of the latter scheme (with everyone except the paper-clip industry, that is).

Tripos knows all about disk volumes and can find a volume in any drive or prompt for it to be inserted as required; no messing about with default drives or logging on. It is, in fact, possible to remove a disk with a file still open, use a new disk, then be prompted by the system to replace the first disk and continue.

As in UNIX, all devices are addressed as files, with a device name replacing the volume name that would be used in a full-file spec. The device CON: may have window-size parameters attached to it, as in CON:20/20/100/100/Fred, which addresses an 80- by 80-character window called Fred. The serial port and printer can be addressed in a similar way.

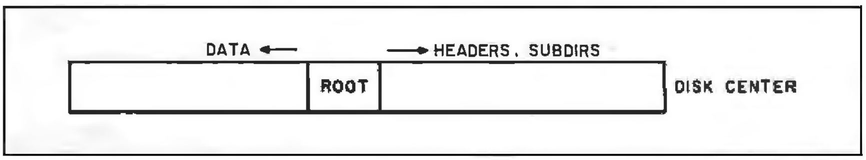

Figure 3: *File headers and subdirectories are allocated inward and data blocks allocated outward to optimize speed of data access.*

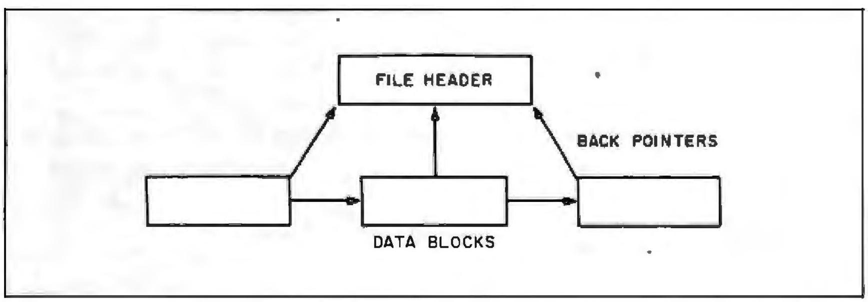

Figure 4: A *file header can be reconstructed by reading pointers in the data blocks.*

CONCLUSION

The relationship between Metacomco and Commodore-Amiga seems to have been mutually beneficial. The Amiga got itself a mature and capable operating system that was designed on sound, though not conservative, principles. Metacomco, on the other

(continued)


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Metacomco maintains its strong links with both Cambridge and Bath universitities.

hand, gained a stronger foothold in the U.S., along with the respect of those in the U.S. computer industry who were already aware of its existence.

Whether or not the Amiga will be the world-shaker that I think it deserves to be must remain the great "wait and see" question of the year. Although some teething problems are emerging, it's likely that they'll be less serious than they might have been had a totally untried OS been adopted.

I've felt for some time that there is insufficient user awareness of just how complex the new-generation, post-Macintosh, operating systems are. The days of "patch it and hope" are gone forever, and we are now deep into the territory of heavyweight software engineering; debugging must now be considered a continuing process, and the chances of a bug-free OS at launch (or even a year later) are pretty remote. Commodore-Amiga is still debating whether or not to commit AmigaDOS to ROM in Macintosh style (first machines are being shipped with a disk-based DOS). Tim King is solidly in favor of keeping a disk-based DOS for precisely these reasons.

As for Metacomco's future plans, it is content for the moment to remain with the 68000, a processor in which the company's accumulated expertise is now paying dividends. The Atari 520ST has attracted Metacomco's attention, and its staff has already put the assembler/editor combination onto it, soon to be followed by Pascal and Lattice C. An IBM PC-based development system, complete with cross-assembler, has just been announced also. The relationship with Lattice arose when it was commissioned to put the compiler onto the Sinclair QL; Metacomco ended up marketing it.

Metacomco still maintains its strong links with both Cambridge and Bath universities (King still teaches a computer science course at Bath) and pays them royalties for work such as the original Tripos kernel. It exemplifies the slow but welcome trend toward fruitful collaboration between academia and commerce that is new to the U.K., although it has been standard practice on U.S. campuses since the beginning of the microelectronics revolution. ■

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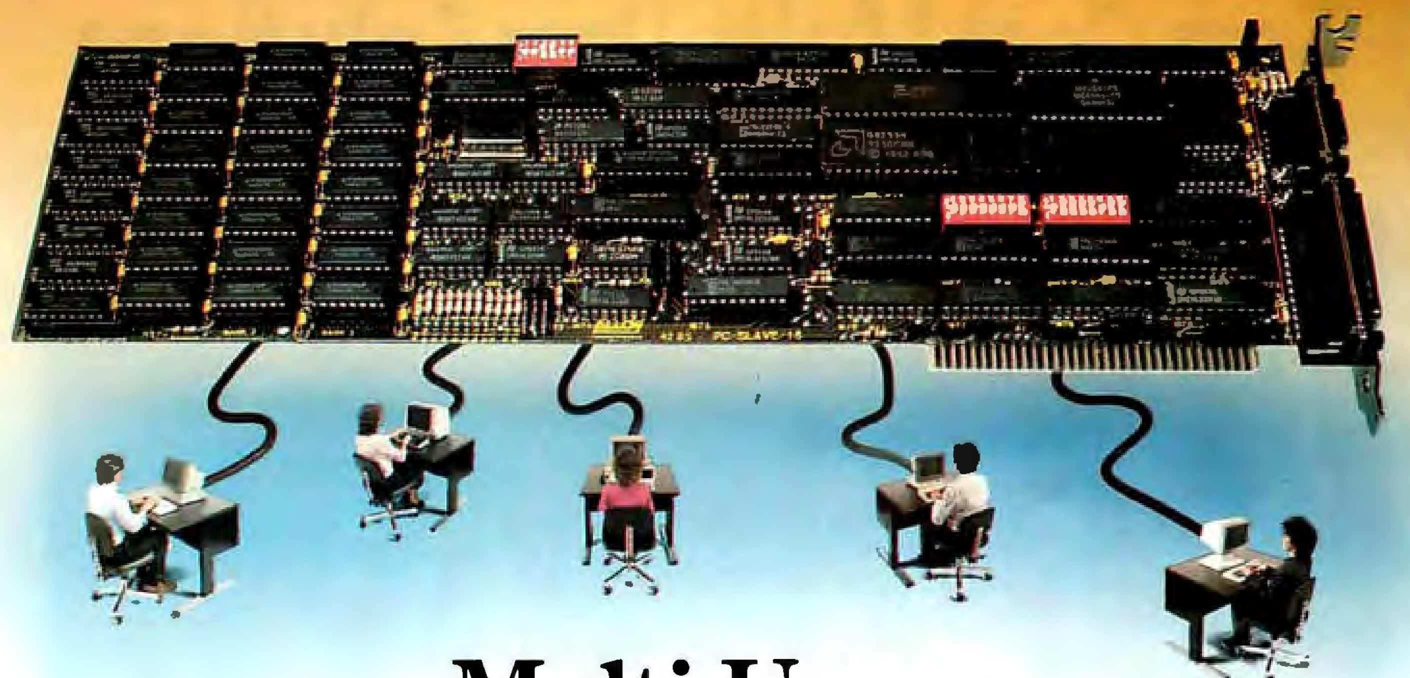

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Programming Tools and the Atari 520ST

Atari 520ST

TDI Modula-2/ST

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BY BRUCE WEBSTER

First of all, I'd like to thank all who have sent comments via BIX (BYTE Information Exchange), CompuServe, MCI Mail, the nets, and (oddly enough) the U.S. Postal Service. Some of the messages have been quite glowing; others have been, er, hot. But I do appreciate them all—it's nice to know that folks out there are actually reading this column and that what I have to say is interesting enough to provoke some response.

The most common request I get is to include some sort of "time stamp" in the column, so that it's clear up front when it is being written. I've done that some in the past, but apparently not consistently or clearly enough. I am writing this in the second half of October, long before you'll be reading it. COMDEX/Fall is still more than a month away, and rumors are just now coalescing into firmer shapes about what Apple will announce at its annual shareholders' meeting in late January—which will be an accomplished fact by the time this sees print.

THE ATARI 520ST

In the October 1985 issue of BYTE, I spoke highly of the Commodore Amiga. Those comments were written in June, a few weeks after having attended the Amiga developers' conference. Back then, I hoped to have my hands on an Amiga within a month or two to give a firsthand report. No such luck. However, a few weeks ago, the system that is seen as the Amiga's main rival did show up: the Atari 520ST. Even as I type this on my Compaq, the ST is running a batch file, performing the linking needed to create a runnable program. The system I have to evaluate has the monochrome monitor and two single-sided (360K-byte) disk drives. Such a system lists for around $1000, although off-the-shelf cost right now would be at least $100 less. Here are some of my first impressions.

First, physical appearance. The ST looks like a home computer, with external components (disk drives, monitor, etc.), lots of thick cables, external power supplies, and an overall design that doesn't allow stacking. In fact, a market for ST cabinets will probably appear quickly, just to reduce clutter and allow a more vertical arrangement of components. And a power strip or outlet expander is a necessity: A two-drive ST with monitor and printer requires five outlets (as opposed to two for an equivalent Mac system). Such a system will have three external power-supply boxes, which (thank heavens) have cables long enough to be dropped out of sight behind a desk or under a table. The ST itself is wide (about 20 inches); when you add a work area to one side for a mouse, you find that you need a lot of horizontal space to set the machine up. For that matter, the whole system takes up more room than any other computer I have (Compaq, Mac, Apple IIe); a custom cabinet of some sort would definitely help out.

Using the ST is easy, especially if you've used the Macintosh. The ST uses GEM (from Digital Research) as its graphics system on top of TOS (the operating system) and GEM Desktop as its user interface on top of GEM. GEM Desktop looks much like the Mac's user interface—so much so, that Digital Research just agreed to make some changes to it to avoid a copyright-infringement suit from Apple. What effect that will have on the ST (or, for that matter, the Amiga, whose Intuition user interface is also Mac-like), I don't know. Atari may have to send out GEM Desktop updates, or it may be able to ignore the whole issue for now.

Though GEM Desktop in its current incarnation looks a lot like the Mac interface, it isn't nearly as powerful or intelligent. All open windows must have the same format (icon versus text; sorted by name, size, type, date); windows are not automatically updated as disks are ejected and inserted; to change a filename, you must select its icon, then select the Show Info option in the File

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Bruce Webster is a consulting editor for BYTE. *He can be contacted c/o* BYTE, POB 1910, Orem, UT 84057.

Atari, like Amiga, learned many lessons from Apple's problems with the Macintosh.

menu, then edit the filename in the resulting window; you cannot recover files thrown into the trash can; and so on. If you don't like the Mac's interface, you'll probably hate GEM Desktop.

Some performance differences between the ST and Mac user interfaces stand out immediately. First, the ST (perhaps because of GEM) is somewhat less responsive to mouse clicks. Often, I have to double-click a program icon several times to get it to run; likewise, if I want to resize a window, I have to point to the resizing box, click, and wait until the dotted outline appears before moving the mouse. Also, as mentioned, updating of windows (as disks are popped in and out of the drives) is not automatic. You have to specifically request it.

On the positive side, overall interface performance appears to be faster than on the Mac. Windows seem to pop up faster, programs load more quickly, and so on. Best of all, once you've booted up, you can pop the system disk out and forget about it. Unlike the Mac, the ST appears to load the entire operating system in and keep it resident, so that you don't always need a system disk mounted somewhere (or do a lot of disk swapping). Of course, that means the operating system is chewing up a pretty fair amount of RAM (random-access read/write memory), especially since GEM and TOS are not in ROM (read-only memory), as they were originally supposed to be.

Okay, so far the first impressions haven't been too positive. Well, they're getting better. Atari, like Amiga, learned many lessons from Apple's problems with the Mac. For example, the ST has a DB-25 "parallel" port, just like the one on the IBM PC and clones, that uses the standard IBM printer cables to hook up to parallel printers. It also has a standard DB-25 serial (RS-232C) port. Why is this a smart move? Well, I unplugged my printer and modem cables from the Compaq and replugged them into the ST. I selected the Print Screen function in the drop-down Options menu, and the ST did a graphics dump of the screen to the Epson RX-80 printer. I then selected the VT52 Emulator desk accessory and was able to call BIX via the Hayes Smartmodem 1200. No hassle, no setup (although printer- and serial-port configuration programs were there for me to use). Very, very nice.

Sheer graphics speed seems to be generally better on the 520ST than on the Macintosh. I picked up and modified a simple graphics benchmark off of ARPANET, apparently written by Fons Rademakers at CERN in Switzerland to compare the Mac with the Apollo workstations. The program draws several thousand lines of a fixed length and (for each run) a fixed angle. A listing of the program and complete results will be given next month (so that Amiga times can be included). Generally speaking, the Atari was quite a bit faster than the Mac. The Mac was faster for true vertical lines, but even a slight skew made the Mac almost 10 times slower than the Atari. Similarly, the Mac was faster for almost-horizontal lines, but as the lines became more slanted, the Mac slowed down by a factor of 30, while the Atari's speed remained relatively constant. Again, look for complete numbers and other benchmarks next month.

As with all new nonclone computers, software for the ST is currently sparse, so I haven't been able to do more to try out the ST. The release of GEMDraw and GEMWrite has been delayed because of the Apple agreement (Digital Research has to make them look less like MacPaint and MacWrite). As a result, Atari has released the freeware program Neochrome, a nice color-oriented painting program that I can't use on my monochrome monitor, and an ST version of Atariwriter. Look for more comments here about the ST as time goes on.

TDI Modula-2/ST

The ST came with Atari's development system, which is Digital Research's C compiler, linker, and 68000 assembler. I tinkered around with it for a while, until I was rescued by the arrival of a native-code Modula-2 compiler from TDI Software Ltd.

TDI Modula-2/ST is a well-done package. First, it comes with a Mac-like program editor that uses both mouse/menu and keyboard commands, so aficionados of both styles will find it pleasing. The editor also has the best "jump to compiler error" feature of any I've seen. When you compile a module, the compiler doesn't stop at the first error but goes through and finds all the errors. When you go back to the editor, it automatically positions you at the first error—shown in the text by @—and prints a message at the bottom of the screen telling you what the error was. You then hit F7 (or use a menu command) to jump to the next error.

The compiler is moderately fast and easy to use. If it can't find the necessary .SYM files, it stops and lets you look on other disks or within folders for the appropriate file. As mentioned above, it finds all errors, instead of stopping at the first one, and produces an error file, <filename>.ERR, which is pretty much worthless by itself, but which the editor uses as described above.

The linker works much the same as the compiler does; that is, if it can't find the necessary file, it brings up a standard GEM file-selection box and lets you go looking for it. Unfortunately, this is another area where GEM suffers in comparison to the Mac: It is tedious to look at another disk drive (you have to go up and edit a filename pattern). Things are further complicated by the fact that folders are true subdirectories, so if you use them to store all your .LNK or .SYM files (of which there are many), the com-

(continued)

piler or linker can't "see" them unless it happens to be in the folder as well. TDI should consider modifying the compiler and linker to allow a default folder to be specified; otherwise, the window becomes crowded with all the files that Modula-2 needs and produces.

The resulting .PGM file is true 68000 machine-language code and acts like any other double-clickable application. Lack of time has kept me from running a full set of benchmarks; look for them in a future column, when I can bench the Mac and the Amiga as well. But the few programs I have written run quickly, so there probably isn't much difference in speed between TDI Modula-2/ST and, say, the Digital Research C compiler that developers are using. If you prefer Modula-2 over C, you should seriously consider getting this product.

PRODUCT OF THE MONTH: TURBOPOWER UTILITIES

Every now and then, you run across a product that is well-done, reasonably priced, and a must buy for someone with the proper interests. Turbo Pascal from Borland International is a classic example of that, selling more than 400,000 copies in a marketplace that had been estimated as having only 30,000 potential buyers. Now, for all those Turbo Pascal owners comes a follow-up must-have package: TurboPower Programmer's Utilities from TurboPower Software. This package costs just $55 and comes with one disk and a 140-page manual. It requires Turbo Pascal 2.0 or later, PC-DOS 2.*x* or 3.0, at least 96K bytes (though the more RAM, the better), and a high degree of IBM compatibility (my Compaq portable seems to work fine).

The first thing that impresses you about TurboPower is the number of programs in the package: nine. What impresses you next is that this is not just one or two useful utilities with some "junk" programs thrown in; all nine programs are useful, and a few are almost worth the price of the package by themselves.

Four of the programs are specific to Turbo Pascal. The Pascal Formatter (PF) tries to clean up your program and put it in some sort of standard (by your definition) format. It can change reserved words to uppercase, lowercase, or first letter capitalized; ditto for standard ID words. It will automatically indent control structures some number of spaces (user-defined) and will left- or right-justify comments. I didn't find this program too useful on my own code (which I carefully format), but it's great for cleaning up some of the strangely formatted (such as all-uppercase-and-left-justified) Turbo Pascal source code that is in the public domain.

The Pascal Structure Analyzer (PSA) reads through your source code (which must be able to compile without errors) and gives you the following information:

- A complete cross-reference of all variables, showing the procedures and functions in which they're used and where they're modified. This gives you valuable information on

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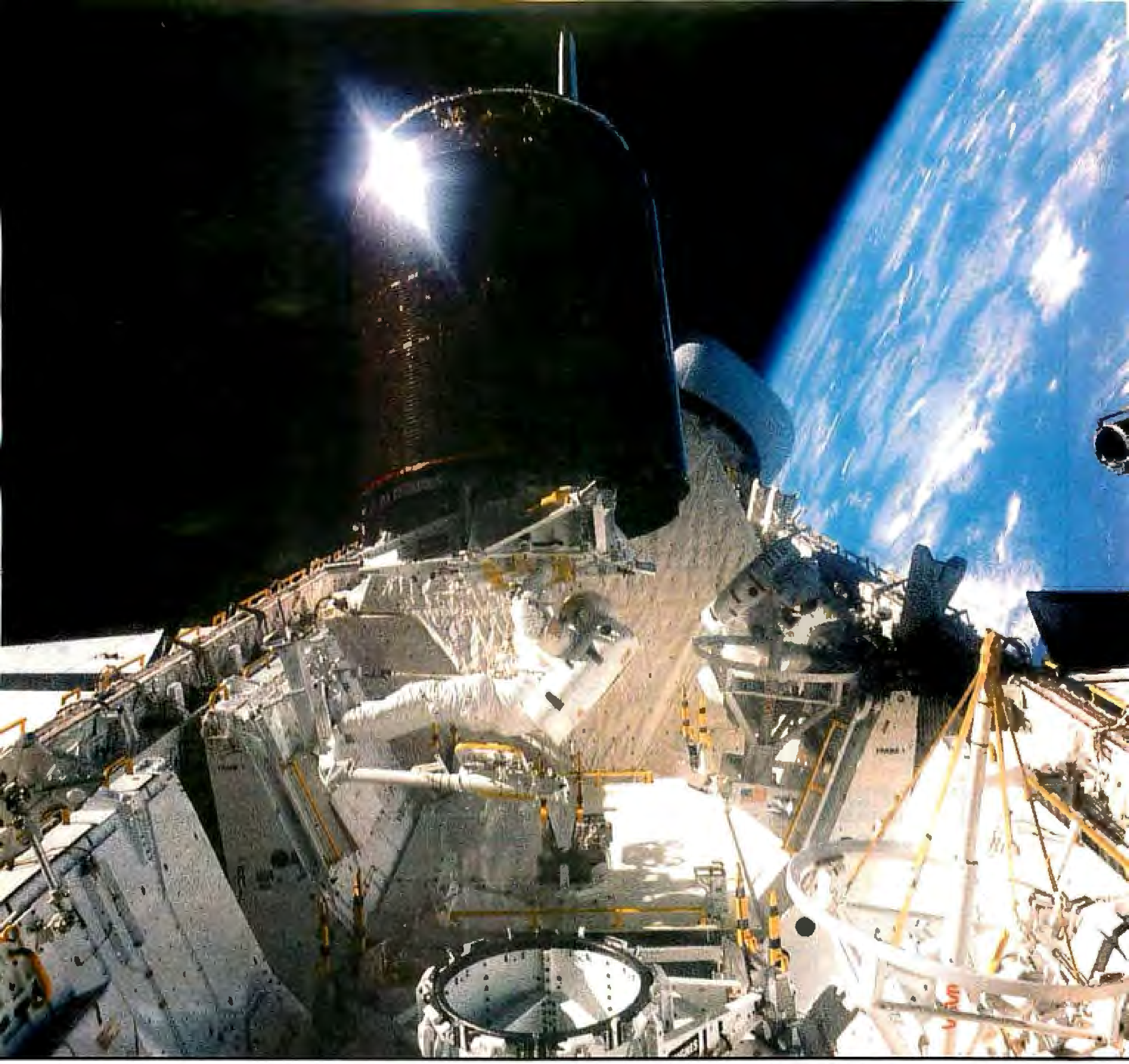

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just where those variables are being used.

- Warnings for variables that are used before they are initialized. This is crucial in Turbo Pascal, which does not preinitialize variables.
- Warnings for variables that are declared but never used. This is usually innocuous—just some extra variables that are no longer needed—but sometimes it points out things you're forgetting to do.
- Warnings for variables that are declared and initialized but never referenced. In other words, these variables are set to some value, but that value is never needed by anything else (assignment statement, procedure/function call, output routine, etc.). Like the previous warning, this may point out what you're forgetting to do.
- Warnings for variables that are modified at a scope level below that of their declaration (two levels down for global variables). When this happens, you may be generating an unexpected side effect.
- Warnings for pass-by-value parameters modified within their function or procedure. This is a sign that you might have meant to declare the parameters as pass-by-address (VAR).
- Warnings for identifiers that match standard Turbo Pascal identifiers, screening out the use of that identifier. For example, if you declare a variable called Val, you disable the Turbo built-in procedure Val within the scope of that variable.
- A program hierarchy that shows you a kind of tree of subroutine calls, letting you see exactly how nested your procedure and function calls are.

Those of you with experience in programming can see just how useful this one program could be in cleaning up code and tracking down bugs. What's *really* nice is that PSA has an interactive mode that lets you quickly select different options and selectively examine the resulting lists. I've run PSA on several source files of varying age and size, and I've been pleasantly and unpleasantly surprised by some things I've discovered.

The last two Turbo-specific programs help you analyze how your program performs. The Pascal Execution Profiler (PEP) uses a resident program and special subroutines added to your source code to produce a histogram showing how much time is being spent in each area of your program, shown as a range of program-counter addresses. You can then reanalyze using a subrange of addresses. Once you know where your program is spending its time, you can use the Find run-time error command in the compiler Option menu with Turbo Pascal to find the appropriate area in your source code. PEP is marvelous for locating where your program is using all its time, so that you can optimize those portions to improve overall performance.

The second analyzer, the Pascal Execution Timer (PET), performs a related, if not exactly equivalent, function. Like PEP, PET uses a resident program and modifications to

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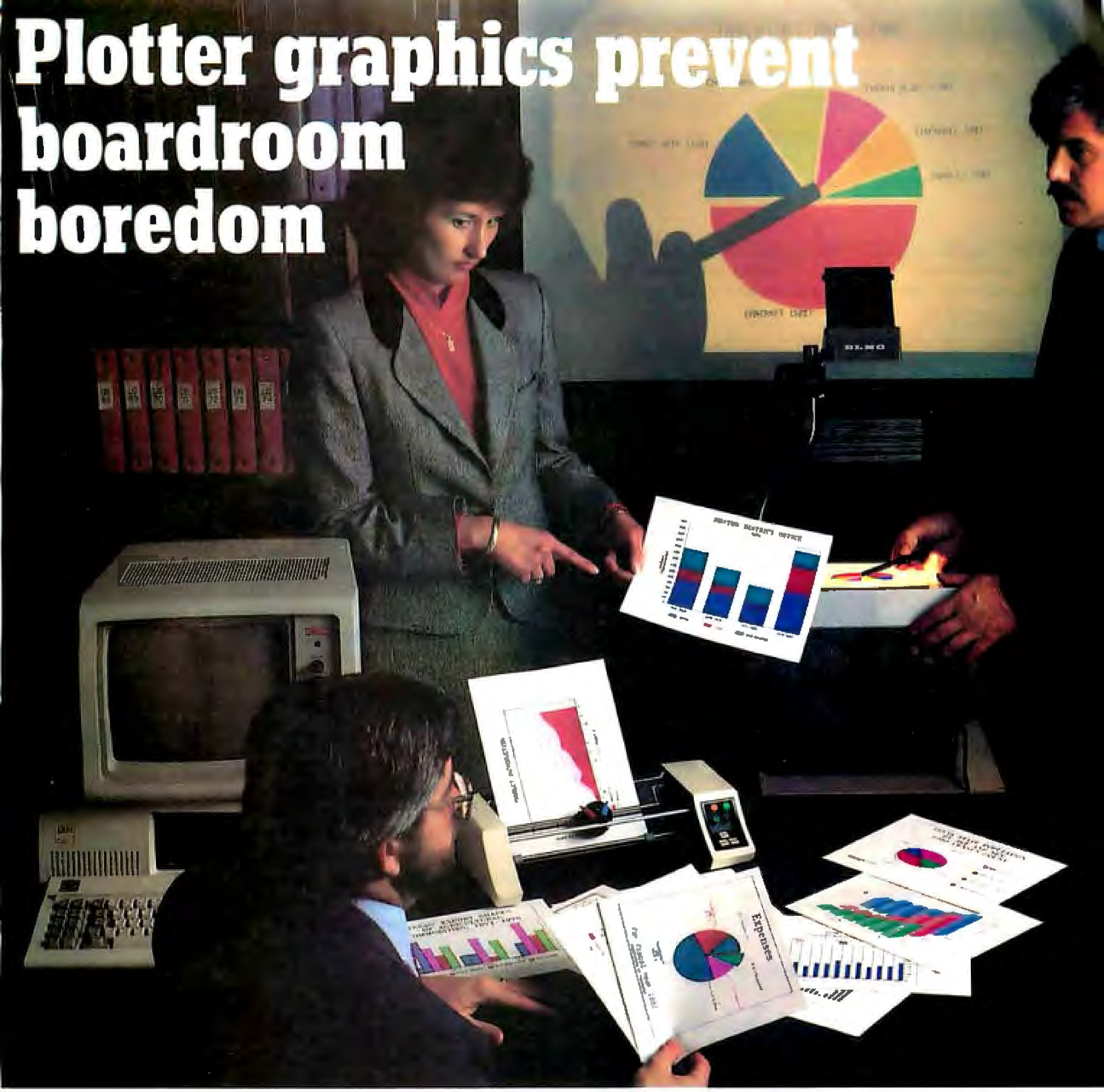

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your source code to do its job, which is twofold. First, it times (to within 200 microseconds) how long each procedure and function takes to execute. Second, it tells you how often each procedure and function is called. Again, this helps you pick apart your code and find places where improvement is needed.

You would almost expect to pay $55 for any one of these four programs; to get all four for that price is a great bargain. But wait! That's not all! There are *five more* programs in this package: MS-DOS utilities to make your life easier. I haven't used them enough to comment much, but here's what they do.

Super Directory (SDIR): This is like DIR, but it is more intelligent and versatile. It can sort by name, extension, date, or size, in either ascending or descending order. It can show hidden files and subdirectories, either in addition to or instead of other files; it will also show only those files modified before or since a given date. Listing options provided by SDIR let you decide how much information is shown and let you automatically direct the listing to the printer.

File Finder (ROOT): This will print a complete subdirectory tree. In addition, it will search for and list a given filename (with wild cards) throughout all the subdirectories on a given drive. Very useful for hard disks.

Command Repeater (REP): An amazing little utility that will repeatedly execute any .COM, .EXE, or .BAT file or MS-DOS command, substituting as parameters text parsed from an input file (which can include output piped from a previous MS-DOS command).

Text File Difference Finder (DIFF): This is useful for finding the differences between two text files. Though it's geared toward Turbo Pascal source-code files, it can be used with any text files. One of its more remarkable features is its ability to create an EDLIN script to recreate the old file from the new (modified) file.

Pattern Match and Replace (RPL): Another amazing program that can massage text and turn it into something quite different. One set of pattern files included turns output from the DEBUG disassemble command into INLINE code for Turbo Pascal.

There is one little problem with this package: Many of the utilities are quite large. SDIR, for example, is more than 30K bytes in size. This can make things sticky for a floppy-based system; if you've got a hard disk, though, you not only have room for the utilities, you can very much use them, especially SDIR, ROOT, and REP.

All things considered, the TurboPower Programmer's Utilities are very worthwhile. And not only can you get this entire package for $55, but for a mere $45 more, TurboPower Software will send you the Turbo Pascal source code for all these programs, allowing you to make your own custom versions. If you buy both the executable and source codes at the same time, the cost is only $95. If this is not one of the all-time great software bargains, I don't know what is. If you own Turbo Pascal, you should

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own the TurboPower Programmer's Utilities; that's all there is to it.

PASCAL FOR THE MACINTOSH

As I have stated before, Apple has been either unable or unwilling to produce a native-code Pascal compiler for the Macintosh, even though it chose Pascal as the standard development language for the Mac. This has merely served to increase the frustration of Mac programmers who have to work in one language (C, FORTH, LISP, assembly language, etc.) and still understand enough about Lisa Pascal to interpret the *Inside Macintosh* manual. And, of course, it hasn't made things any easier for those who write those compilers and interpreters.

Suddenly, two native-code Pascal compilers have appeared: the MacLanguage Series Pascal compiler from TML Systems and the On Stage Pascal compiler from Step-Lively Software. Proving the maxim that great (or, at least, desperate) minds think alike, both compilers claim the following features: fast compilation; output is Macintosh Development System-compatible and can be either object or assembly-language source code; Lisa Pascal compatibility; full access to OS, ToolBox, AppleTalk, and Macintalk; and editor, resource compiler, and linker.

The main difference between the two seems to be price: TML is offering its system for $100; Step-Lively is charging $400. Both are scheduled for release in late 1985, so it will be a few months before I can give a complete report. I do, however, have a beta copy (version 0.7) of the TML package; from the coding I've done so far, it appears to live up to its claims, although the Pascal implementation is a little more sparse than most.

FONTS FOR THE MAC

Shortly after the Macintosh came out, flood of font packages appeared on the market, matched by a similar flood of public-domain fonts. Some were worthwhile, some were interesting, but most weren't much better than those Apple released. And the flood has dropped to a slow drip.

Recently, though, a disk came in the mail with two useful fonts: Boston, designed by Charles Maurer, and International, designed by Paul Rapoport. Maurer says he designed Boston to make the Mac plus Imagewriter compete with his IBM Selectric typewriter. He did well; Boston printed out in high-quality mode is clean, very legible, and (dare I say it) looks almost like the ever-worshiped letter-quality output that businesses demand. I've switched to it for all my correspondence; the 9-point font is readable and lets me get more text on a one-page letter than the usual 10- and 12-point fonts.

Paul Rapoport also had a goal in mind when he designed International. With a background in linguistics, Rapoport bought the Mac thinking that he could use it to prepare manuscripts involving different languages. However, he found that most of the fonts were quite limited in their international letters and diacritical marks. So he designed

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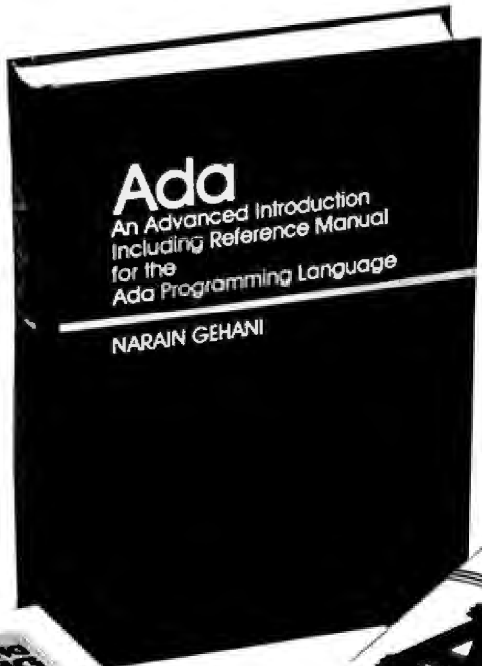

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a special font that handles more than 50 languages, including Germanic, Romance, Gaelic, East European, and many other language families. It can also handle the Romanized version of many non-Roman languages. The font contains the Roman alphabet, 16 special letters (both

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lowercase and uppercase versions), and 28 diacriticals (for both lowercase and uppercase). On top of that, International contains 5 musical and 14 arithmetic symbols. Whew.

Both men have secured copyrights on their fonts and have put them out as shareware. Each designer requests a nominal licensing fee if you like and use his font. Each font is easily worth the money, more so than most fonts I've seen. Their addresses are given in the "Items Discussed" box.

UPDATES

Some months back, I spoke highly of the Mac Bernoulli Box from Iomega. That unit is *still* around; it's been used constantly over the last nine months. During that time, I have not had a single glitch or lost file; one problem that I mentioned turned out to be due to a faulty power supply on the Macintosh, which has since been replaced. Since that Bernoulli Box was one of the first ones, its unblemished record is even more impressive.

In that column, I mentioned that Iomega was planning to release a slave drive for the B-Box. As it turns out, that is not the case. Instead, Iomega chose to pass through the RS-422 signals so that you can hook up the B-Box to the printer port and then hook up your Imagewriter to the B-Box. To help solve the backup problem, Iomega is developing a cartridge-to-cartridge backup program (not unlike the Mac's single-drive DiskCopy program), which should be released by the time you read this. Iomega also has a 20-megabyte AppleTalk Disk Server that has two 10-megabyte half-height 8-inch Bernoulli drives; more on this in a future column.

MacTutor, a magazine geared toward programming the Macintosh, was also mentioned here a few months back, and I described it in glowing terms. The Mac is such a complex machine that actual working code or code fragments are the best aid in learning to rogram it. *MacTutor* is full of examples in a variety of languages (C, Pascal, BASIC, LISP, FORTH, assembly language, FORTRAN, etc.), all with text describing how and why they work. Unfortunately, *MacTutor*'s address was accidentally left out of the column, and more letters have come asking for that address than on any other topic, including a few from Europe and one from Israel. Contact *MacTutor* at POB 846, Placentia, CA 92670, (714) 993-9939.

Annual subscriptions are $24 ($30 in Canada and Mexico and $36 overseas). Back issues are available for $3 each; the October 1985 issue is Volume 1, No. 11. Disks with source code on them are also available for $8 each.

COMING ATTRACTIONS

I just got word that the Amiga will be here in two days. Next month's column will be devoted to a blow-by-blow comparison of the Mac, the 520ST, and the Amiga, with criticisms, benchmarks, and anything else I can come up with. Until then, take care, and I'll see you on the bit stream. ■

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CIRCUIT CELLAR FEEDBACK

Conducted by Steve Ciarcia

ARCHITECTURES

Dear Steve,

Your SB180 article has prompted me to ask some questions that have been simmering in my head for some time now concerning 8- and 16-bit architectures.

It is a readily observable fact that most applications for microcomputers and even minicomputers are programs that manipulate text. With the prominent exception of spreadsheets, most programs do little, if any, arithmetic. Since text is represented in 8-bit format, and there are a number of well-established and efficient routines to do mathematical calculations with 8-bit architectures, what advantages do 16-bit architectures offer? Especially considering that some programs run just as fast, if not faster, on 8-bit systems as they do on 16-bit systems.

Furthermore, how is the memory arranged on the systems that have a true 16-bit external data bus? If it is arranged as an array of 16-bit registers—as opposed to an array of 8-bit registers—it would seem that half of the memory would be wasted in operations involving only 8-bit text manipulations. Moreover, representation of memory as some number of bytes would be misleading; eight 256K-bit memory chips would indeed constitute 256K bytes of memory (no parity) but would be only 128K words.

What's going on here?

RICHARD WHITE
Washington, DC

While it is certainly true that published benchmarks show that a good 4- to 6-MHz Z80 can "beat" an IBM PC, a comparison of 8- versus 16-bit processors must look at many factors that interact with each other. The question of an 8-bit data path versus a 16-bit data path is important. All else being equal, a 16-bit processor will get 2 bytes of data to manipulate in the same amount of time (i.e., clock cycle) as an 8-bit processor. This is one reason why the IBM PC's 8088 processor doesn't have much of an advantage over a Z80; its data path is only 8 bits wide, even though internally the 8088 is a 16-bit processor.

Second, clock speed is important. Obviously, the faster the clock speed, the faster the execution of instructions.

Third, even though the 8080, Z80, 8088, 8086, 80186, 80286, and 80386 are all in the same family of processors and share a similarity of instruction codes, the more advanced processors have more powerful instructions than the 8-bit processors.

Fourth, the speed of any application is also directly related to the skill of the programmer. Given the same processor, two different programmers can produce similar assembly-language programs that operate and process data at substantially different rates. After a certain level of expertise is reached, a programmer's skill in extracting the last iota of performance from a processor becomes more of an art than an exact science.

In general, software development lags behind hardware development by several years. Only recently have we seen software products that take advantage of the architecture of 16-bit processors. The advantages of 16-bit processors are really there, but the changes are evolutionary rather than revolutionary.

In regard to your second point, I think we have a problem with terminology. Traditionally, computers have been classified as 8-bit, 16-bit, and 32-bit (for the most part). And traditionally, these machines have been referred to as having a "word" length of 1, 2, or 4 bytes. Thus, we should refer to an IBM PC AT with 256K bytes of memory as a computer with 128K words of memory.

But times change. With the microcomputer revolution, we started talking about bytes and the 8-bit processor "word" as equivalent. When IBM used the 8088 with its 16-bit internal architecture and 8-bit data bus, it really muddied the waters (remember all the articles about whether or not the 8088 was "really" a 16-bit processor?). My general impression is that "words" are "out" and "bytes" are "in."

Also, I sense some possible confusion about how an 8-bit ASCII value is stored in a 16-bit "word." The upper "half" of the word is not blank or null, with the ASCII character stored in the other "half." An ASCII character takes up 1 byte, period. So, a 16-bit "word" actually contains two 8-bit ASCII characters. Therefore, there is no "wasted" space.

I hope this clears things up.—Steve

SB180 SUPPORT

Dear Steve,

In "Build the SB180 Single-Board Computer, Part 1: The Hardware" (September 1985, page 86), you state that the CPU will address 512K bytes of memory, but the board supports only 256K bytes. The floppy-disk controller supports 3½-, 5¼-, and 8-inch drives, but the jumpers on the board appear to prevent a mixed 5¼- and 8-inch system. Also, the monitor may support 96-tpi 5¼-inch drives, but does the rest of the Z-System provide the same support?

PRESTON BRICKER
LaGrange Park, IL

The decision to limit the SB180 to "only" 256K bytes was based on two considerations: (1) I wanted the entire board to fit on top of a 3½-inch drive (hence, no room for eight more chips). (2) Since all CP/M programs written to date make use of only a 64K-byte address space, the additional RAM would most likely be used as a RAM disk or to implement buffers under CP/M Plus. Only with the advent of the HD64180 is it now possible to write 8-bit programs that can utilize more than 64K bytes.

The first prototype of the SB180 would not handle 5¼- and 8-inch disks simultaneously, but the current version of hardware and software does support them simultaneously. And, yes, the Z-System does support the 96-tpi 5¼-inch drives.
—Steve ■

Over the years I have presented many different projects in BYTE. I know many of you have built them and are making use of them in many ways.

I am interested in hearing from any of you telling me what you've done with these projects or how you may have been influenced by the basic ideas. Write me at Circuit Cellar Feedback, POB 582, Glastonbury, CT 06033, and fill me in on your applications. All letters and photographs become the property of Steve Ciarcia and cannot be returned.

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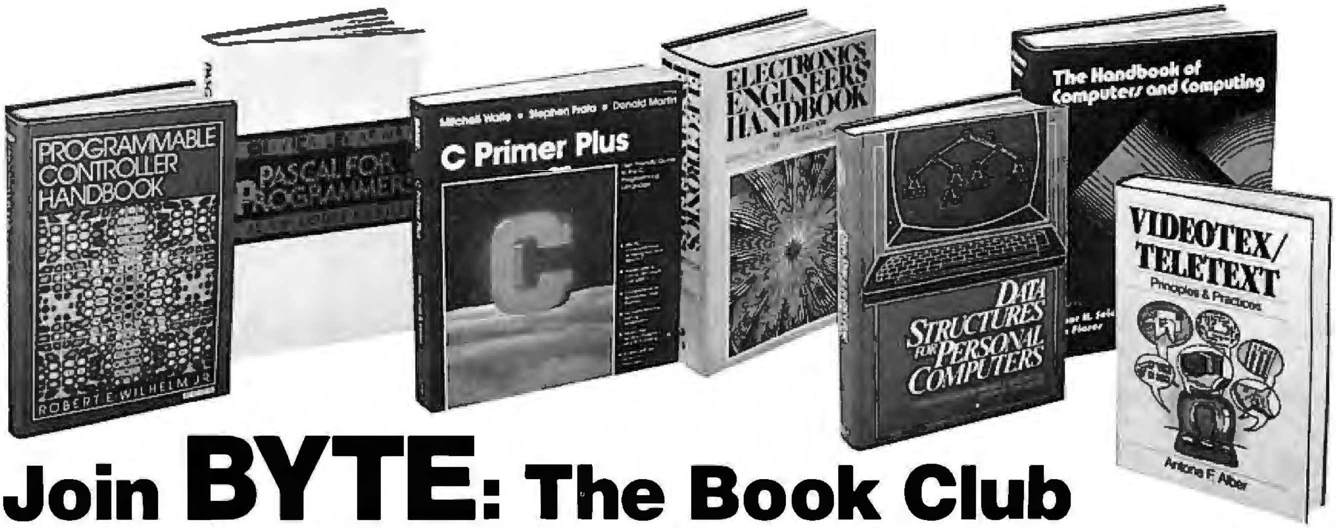

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(continued from page 32)

TOWARD BETTER BENCHMARKS

In the August 1985 Fixes and Updates (page 33), you asked for comments about using Fred Gruenberger's program from *Scientific American* as a benchmark for numerical accuracy. Mr. Gruenberger's article contains a serious error with respect to running his program under Microsoft BASIC on an IBM PC (see figure 2). Apparently, he didn't realize that the exponentiation operator in Microsoft BASIC is only a single-precision operator like SIN(*x*), TAN(*x*), LOG(*x*), etc. Thus, to get double-precision results you must load the double-precision functions by typing BASICA/D when BASICA is initially loaded (see figure 3).

When used correctly, Microsoft BASIC produces exactly the same result for 27 − *y***y*'s as it does for 27 − *y*^2's and almost the same answer for *x*^(2^27), the error being in the ninth significant figure. As a result, Mr. Gruenberger's test is relatively mean-

(continued)

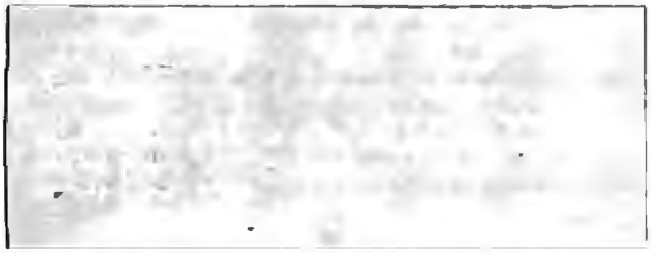

Figure 2: *Results of running Gruenberger's program as published in* BYTE.

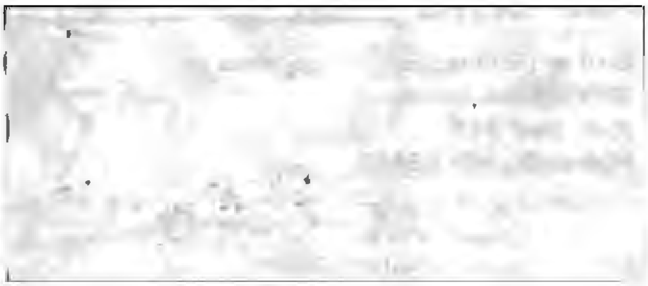

Figure 3: *Results using double-precision functions,* BASICA/D

Listing 2: *Reader Allendoerfer's version of proposed accuracy test.*

```
LIST
10 REM BYTE Accuracy Test
20 DEFDBL X,Y,Z
30 X=1.0000001#
40 Y=X:Z=X

60    Y=Y*Y
70    Z=Z^2
80 NEXT I
90 PRINT "Method A gives";Y
100 PRINT "Method B gives";Z
110 PRINT "Method C gives";X^(2^27)
120 END
Ok
```


ingless to 10 significant figures, and a more informative test ought to be found before BYTE adopts one. Unfortunately, I don't have any better suggestions.

My version of your proposed accuracy test (see listing 2) runs under BASICA and BASICA/D to illustrate my point.

ROBERT D. ALLENDOERFER
East Amherst, NY

DEFINING RELATIONSHIPS IN PICK

I read with interest "Pick, Coherent, and THEOS" by Marc J. Rochkind in *Inside the IBM PCs* (page 231). Mr. Rochkind gave a favorable review of Pick on the IBM PC XT in areas I consider to be critical to the acceptance of an operating system.

It was a shame that Mr. Rochkind could not spend more time with Pick. I believe that he would have had even higher praise had he done so. With the understanding that he spent limited time with Pick, I still feel obligated to point out the following incorrect assumption that Mr. Rochkind asserted.

His article goes on to say that Pick cannot do a relational join unless the item IDs (keys) to the records of the two files in question are equivalent. If this were true, it would be a true limitation to proper database design. As a matter of fact, relationships can be defined where records in a file can be accessed from records in another file, provided that the key to the accessed record is stored somewhere in the other file. Then, fields from this "joined" record can be accessed for reporting, etc. The record keys for these two files need not be identical.

As an example, a database might contain two files, a mailing-list address file and a zip code file. The address file does not contain city or state, but the zip code file does contain city and state. A dictionary definition of "city" for the mailing-address file would look at the zip code field in the address records, read the record from the zip code file whose key is the zip code on the address file, and retrieve the city field. I am ignoring in this example zip codes that pertain to more than one city.

HOWARD M. RESES
Abington, PA

Marc J. Rochkind replies:
Thanks to Mr. Reses for pointing this out.

SPEAKING OF LANGUAGES

I am a professional programmer who writes mainly in assembly language. I have done a considerable amount of high-level coding as well. I have noted several trends in high-level languages that disturb me greatly enough to wonder where the "computer revolution" is going next. My language experience is mainly in BASIC, Pascal, and C.

BASIC, despite snobs who snub it, is by far the most readable language around, except, perhaps, for COBOL. BASIC's plain English syntax is easy to learn, easy to remember, and, most important, easy to type. The major problem with BASIC is not GOTO statements but line numbers. Line numbers prevent BASIC

(continued)

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from being a "real" language. Variations of BASIC that are free of line numbers are a joy to use.

Pascal can best be described as "elegant." It is almost as readable as BASIC and doesn't have line numbers. Pascal's problem is that it wasn't ever intended to be a complete language, and thus it lacks many features of C, BASIC, or its successor, Modula-2. Indeed, Modula-2 is what Pascal should have been in the first place; it will probably become my language of choice.

C is a mess. C is a disaster. C is a language that should never have existed. C is unquestionably powerful, but no more so than Modula-2. The problem with C can be summed up in one word: syntax. C's syntax is by far the "dirtiest" in the entire computer world. C is cryptic to the extreme and totally unreadable. There are several reasons for this, none of which are good. C came from the same people that brought us UNIX, probably the most flexible operating system in existence, but that is all that can be said for it.

C has another fault: lowercase letters. There is a school of thought that programs are more readable if they are written entirely in lowercase letters. I do not subscribe to this school of thought. To me, uppercase letters are by far the more readable. However, to each his own. The problem is that many C compilers allow only lowercase letters, forcing me to run all my source code through an upper-to-lower filter before compilation, every time! This is a stupid oversight in that it is the most trivial of trivial routines to convert all input to the desired case internal to the compiler.

C has become popular mainly because of hype and the fact that it is a powerful language once you become accustomed to its cryptic syntax. As an ALGOL descendant, it shares some common faults with Pascal and Modula-2.

I must say a word about ALGOL descendants in general. ALGOL descendants include C, Pascal, and Modula-2. Despite my liking for Pascal and Modula-2, their design philosophy is all wrong. This is Niklaus Wirth's philosophy that compilers should be kept as simple as possible. Balderdash! On the other hand, neither do I think a compiler should be overly complex. There is a middle road. ALGOL-descendant compilers are just a little too simple. I am referring to double delimiters for many language statements. The parentheses in many statements are superfluous; the variable or quoted string has enough built-in delimiters to separate it from the rest of the program statement. You certainly don't need both a slash (or a parenthesis) and an asterisk to delimit comments; one or the other will do. My pet peeve: semicolons! Each line has built-in delimiter, a CR-LF pair built right into it, without need of the semicolons. All of this forces me to work for the compiler, instead of the compiler working for me.

I have written code for practically every microprocessor known to man, from the 4004 through the 68000. There is no basis in fact for the statement that "assembly language is obsolete." There is a place for both high-level languages and assembly language.

MARK D. PICKERILL
Salinas, CA

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AMIGA

Commodore's introduction of the Amiga has produced a flurry of activity among professional developers and personal computer users within the Amiga conference. The summary this month includes discussion on cables, monitors, printers, and software fixes. One of the hottest topics in the Amiga conference is on the subject of improving the performance of the Amiga by removing the 68000 and replacing it with a 68010 or 68020.

68010/68020 UPGRADE

amiga/amiga68000 #22

An Amiga conference member asked if he could just drop a 68010 into the 68000 socket. This would give a 10 to 80 percent boost in performance! He had one, just sitting up to its bottom in black foam, on the shelf. But there were all these warnings about what would happen to his warranty if he opened the case.

amiga/amiga68000 #26, from rickross [Richard Ross, Eidetic Imaging]

M68010 works! A 68010 plugs directly into the Amiga and no problems were detected in the operation of the system software. Also, for everyone like me who has been trying to judge from the BYTE review photos, the microprocessor is socketed. The performance increase gained by the switch is not phenomenal, and no benchmarks are available, but it did run perceptibly faster. The M68020 has also been tried and seems to work as well.

amiga/amiga68000 #32

A BIX user provides the following:

The company that markets the 68020 piggyback board is Computer System Associates Inc., 7564 Trade St., San Diego, CA 92121, (619) 566-3911. The prices are:

Board only	$ 575
Board plus 68020	975
Board plus 68020 and 68881	1480

For more information, contact Patricia Chouinard at the address above.

I believe that 68000/68010 supervisor code that handles exceptions and certain other privileged functions will have to be modified. User code should work as is.

amiga/tech.talk #39

An Amiga owner describes his adventure in opening his computer and replacing the CPU:

You just got your Amiga and it's already the slow boy on the block, right? You can plug a 68010 into an Amiga (there goes my warranty) and it does go faster. My Sieve benchmark is down to 5.8 seconds from 6.1.

Note: Your warranty will most likely be dead after you do this. Also, there is a lot of RFI shielding inside the Amiga. You get to undo a lot of screws, bend a couple of tabs, and pray a lot. If you aren't a tech type, don't even think about doing this yourself. The 68000 is socketed, but it is partially under the micro-disk drive, so you have to lift it from one end and kind of levitate out the other end (use of your CHI helps). Also, you only take out the screws in the deep wells on the bottom (five in all). Then there are four places where the top grabs the base at the four corners (there were already marks on mine from where it was put together, I guess). Once you have the top off there is a big surprise waiting for you... Another big surprise is that big RFI shield. Yes, it is a $#%±& to get off! There are screws on three sides and two tabs of metal to untwist. Once the shielding is out of the way, your first sight is of the WCS [writable control store] daughterboard. The custom chips and two parallel I/O chips are made with MOS technology.

The CPU is made by Motorola. The main board looks pretty much like the BYTE review photos. The boot ROMs are 27256s! This gives a 32K-byte by 16-bit boot ROM! What are you guys hiding in there? I could put a BASIC interpreter in that much space!

If you attempt to change your CPU, don't blame me if you muff it! If you don't know about how to make yourself static-free, you could really buy yourself some trouble of the worst kind.

Compatibility: I've run *all* of the Workbench demos. Everything seems fine, *but* I'm not making any promises...

amiga/tech.talk #41

The adventurous Amiga owner says that yes, his Amiga boots up, squeaks and everything! All the software he has runs and works great. The only potential problem at this point is how many times the MOVE SR,dest op code is used. This is the only active op-code difference. There is a whole host of new goodies, though, some that make a desire for an MC68881 easier to satisfy.

amiga/tech.talk #43:
a comment to 39

Another BIX subscriber replied that the upgrade produced only a 5 percent increase in throughput. Perhaps fortunate, because the descriptions of the hardware here have indicated that bus bandwidth consumption by the 68000 is low enough to allow other custom DMA chips to steal enough cycles to get their work done. It would appear that inserting a 68020 in the socket would require faster bimmers, etc.

amiga/tech.talk #44:
a comment to 43

Wouldn't think just putting in a 68020 would affect DMA. Same clock speed. Or does the '20 do something different cycle-wise?

amiga/tech.talk #45:
a comment to 44

The author of message 43 replied that the 68020 at the same clock speed will finish an instruction or series of instructions internal to the CPU in less time and start requesting the bus for some ROM or RAM access. He assumed that the DMA chips hold a higher bus priority, so the result will be that the 68020 will often be sitting there in idle awaiting the BUSACK signal. Waste of a 68020. Perhaps that explains why there is only a 5 percent 68010 edge over the 68000.

amiga/tech.talk #46:
a comment to 45

Somebody said that the 68000 only uses every other clock cycle (for memory access, that is). The DMA hardware is fast enough to do four accesses during every clock cycle. Most of the DMA accesses the bus during periods when the 68000 doesn't. If the 68020 doesn't have these quiet periods then there could be problems.

amiga/tech.talk #47:
a comment to 46

Actually, there is a counterargument to that, which is that the 68020, but not the 68010, has an instruction-only cache, which would mean

(continued)

that, in the long run, it would not use the bus anywhere near as much as it should otherwise. So the 68020 is definitely still in the running with some surrounding hardware.

amiga/tech.talk #49:
a comment to 44

The adventurous Amiga owner replied that the MC68020 uses 3-cycle memory accesses instead of 4-cycle. No problem if you don't mind a wait state. . .

amiga/tech.talk #50:
a comment to 47

The adventurous owner added that the MC68010 does have "loop-mode," which works like the MC68020 "cache" for certain op codes. He wanted to really wring his chip out and get some numbers, but his tools to do so were highly limited.

amiga/tech.talk #55, from duck [Dale Luck, Commodore-Amiga]:
a comment to 41

The Exec function GetCC( ) is provided for those that need to get at the condition code register of the 68000. This call is guaranteed to work on a 68000/68010/68020.

There are a couple of areas where the 68010 can cause trouble. The current Exec processes address/bus errors in a 68000-only manner. Calling Supervisor while in Supervisor mode causes the generation of a 68000-style interrupt stack frame. This should not cause any problems for applications since they are all run in User mode. To date we have not seen any code that calls Supervisor( ) while in Supervisor mode.

amiga/tech.talk #57, from duck:
a comment to 55

I mistyped some of my comment. There is a function call in Exec that puts you into *Supervisor* mode and then executes some code that you pointed to with some address register. This is the function that I am referring to as Supervisor( ). The last thing that this code is supposed to do is an rte. That is why a stack frame is hand-constructed when already in Supervisor mode. It turns out not to be a problem because the Amiga designers decided to just let the 68000 create the stack frame by executing a supervisor-privileged instruction. This scheme works regardless of what kind of processor you are running on.

SOFTWARE

amiga/tutorial #83, from rjm [R. J. Mical, Commodore-Amiga]

TITLE: Intuition Changes
Thought you folks might like to know in advance what's coming with the V1.1 release of Intuition.

The horrible requester flash problem is resolved. When you call RefreshGadgets( ) for the gadgets of a requester, they quietly and gently redraw themselves now.

VANILLAKEY: A new event through the IDCMP, which allows you to get keyboard events translated into the default character keymap of the Console Device (the default in the U.S. is ASCII).

INTUITICKS: Allows you to get timer messages 10 times a second, more or less evenly spaced, whenever yours is the active window. There may be more, but I think that's all (not including bug fixes).

amiga/softw.devlpmt #389, from cheath [Charlie Heath, Microsmiths]

Converting Text Files, PC < > Amiga
The next two messages contain C programs that convert text files between IBM and Amiga. They run on the Amiga and can be compiled using the execute file below:

```
.Key file
lc1 -idf1:include/ -idf1:include/lattice/ -oram: <file$t1>
if not exists "ram:<file$t1>.q"
  echo "Compile failed."
  quit 20
  endif
lc2 ram:<file$t1>
alink df1:lib/lstartup.obj,ram:<file$t1>.o LIB
df1:lib/lc.lib,df1:lib/amiga.lib
TO ram:<file$t1>
```

amiga/softw.devlpmt #390, from cheath

```
/****************************************************
* ibmtxt.c
*   This program will convert an Amiga text file so that it can be used
* on an IBM PC. It may also be used for printers that require a
* Carriage Return/Line Feed, rather than just Line Feed, which the
* Amiga provides.
*   The program uses stdin and stdout. For instance:
* ibmtxt <inputfile >outputfile                                  */

#include "lattice/stdio.h"

main()
{
int c;

while( (c = getchar()) != EOF ) {
    if (c == 0x0a)
       putchar(0x0d);
    putchar(c);


/*** End of program ibmtxt.c ***/
```

amiga/softw.devlpmt #391, from cheath

```
/****************************************************
* amigatxt.c
*   This program will convert an IBM text file so that it can be used
* on the Amiga.
*   The program uses stdin and stdout. For instance:
* amigatxt <inputfile >outputfile
* (Use Convert and Read to get file from IBM to Amiga            */

#include "lattice/stdio.h"

main()
{
int c;

while( (c = getchar()) != EOF && c != 0x1A) {
    if ( c != 0x0d )
       putchar(c);
    }

/*** End of program amigatxt.c ***/
```

amiga/softw.devlpmt #265

An Amiga user asks:

When a diskcopy is performed to, say, back up the Workbench disk, is some time stamp or other feature updated on the new disk so that

(continued)

no two Workbench disks are alike? I ask this because if I back up the disk and then place the copy into df0: and type directory, the system gets all confused and says please insert volume Workbench, even though that's what the disk is called. The only way to make the system recognize the new disk is to reboot. Is this a bug, or a protection feature so that you don't use two disks with the same name at the same time?

amiga/softw.devlpmt #270, from pariseau [Bob Pariseau, Commodore-Amiga]:
a comment to 265

Yes, we serialize the disks so that the system can tell the difference between two disks with the same name. This keeps it from writing directory info to the wrong disk, for instance. Note that if you have two disks made in a duplicator (not an Amiga), the system will *not* be able to tell them apart. Swapping Workbench disks is a bit tricky, since the system looks for libraries and such according to the current ASSIGNs for LIBS:, etc.

Swapping a disk other than your boot disk should be easy. Just change your current directory so that commands like DIR won't look for the old disk by default.

CABLES

amiga/softw.devlpmt #249

An Amiga user posts the following:

Serial Cable Warning
The serial port connector on the Amiga has more on it than just standard serial pin-out. If you connected all pins (or too many actually), you would likely *burn* the unit connected to the Amiga. Amiga pin-out: 1) GND, 2) TXD, 3) RXD, 4) RTS, 5) CTS, 6) DSR, 7) SYSTEM GND, 8) CD, 20) DTR, and 22) RI.

Editor's note: The following pins differ from the RS-232C standard:

Pin 21 RS-232C (SQD) is +5 V on Amiga.
Pin 23 RS-232C (SS) is +12 V on Amiga.
Pin 24 RS-232C (TXC1) is 3.58-MHz clock on Amiga.
Pin 15 RS-232C (TXC) is Audio Out of Amiga.
Pin 16 RS-232C (S.RXD) is Audio In to Amiga.
Pin 14 RS-232C (TXC) is –5 V on Amiga.

Use caution when configuring cables for the serial port.

amiga/product.dcsn #187, from pariseau

TITLE: Parallel Port Connection Info
Amiga pin-outs:

1) –STROBE	10) –ACK	19) GND/6
2) D1	11) BUSY	20) GND/7
3) D2	12) PO	21) GND/8
4) D3	13) SEL	22) GND/9
5) D4	14) GND/1	23) +5
6) D5	15) GND/2	24) NC
7) D6	16) GND/3	25) RESET-BAR
8) D7	17) GND/4	
9) D8	18) GND/5	

IBM pin-outs:

1) –STROBE	10) –ACK	19) GND
2) D1	11) BUSY	20) GND
3) D2	12) PO	21) GND
4) D3	13) SEL	22) GND
5) D4	14) –AUTO FEED	23) GND
6) D5	15) –ERROR	24) GND
7) D6	16) –PRIME	25) GND
8) D7	17) –SEL IN	
9) D8	18) GND	

Centronics pin-outs:

1) –STROBE	13) SEL	25) GND/7
2) D1	14) –AUTO FEED	26) GND/8
3) D2	15) NC	27) GND/9
4) D3	16) GND	28) GND/10
5) D4	17) CHASSIS	29) GND/11
6) D5	18) NC	30) GND/12
7) D6	19) GND/1	31) –PRIME
8) D7	20) GND/2	32) –ERROR
9) D8	21) GND/3	33) –GND
10) –ACK	22) GND/4	34) NC
11) BUSY	23) GND/5	35) NC
12) PO	24) GND/6	36) –SEL IN

Amiga-to-IBM connection—Make sure you don't connect the +5 line to ground!
Amiga-to-Centronics connection:

1/13 —> 1/13
14/22 —> 19/27
25 —> 31

(Make sure you don't connect the +5 line to GND!)

amiga/softw.devlpmt #248, from rickross

TITLE: How Is It Done?
Does anyone out there who is using an IBM as a cross-development system for Amiga have the exact pin-outs required for the serial cable used to connect the two machines? I think I am ready to start transferring some files over, but I have been told not to use a ribbon cable, so what do I use? Also, can someone give me (or point me to) some specific information about how to upload source files onto BIX. Once I can get from Amiga to IBM, I will load up some modest examples of how I am using the translate/narrate combination to read text files in C. Crunch, you should consider placing your sprite editor up here in similar form. I bet it would be a really useful icebreaker for a lot of us just starting into Amiga graphics.

amiga/softw.devlpmt #251, from cheath:
a comment to 248

You need four wires between machines plus must fake out IBM CD, etc.

Here is my cable:

1...1
2...3
3...2
7...7

Plus, on IBM side, connect 4 and 5 together, and connect 6, 8, and 20 together.

MONITORS

amiga/tech.talk #115, from pariseau

Typical specs for a monitor that will work are:

(continued)

RGB analog: 0.7 V, 75 ohm terminated
Frequency bandwidth greater than 15 MHz
Frame rate: NTSC-compatible 60 Hz (30 Hz interlaced)
Horizontal scan frequency: 15.7 kHz
Pixel dot pitch less than 0.43

The monitor should be a "dot triad" monitor rather than a "slot" design. A slot monitor, a larger than spec'd dot pitch, or a smaller than spec'd bandwidth will cause smearing of color patterns or moiré effects.

The electrical specs, frame rate, and scan frequency are required for proper performance. Some CAD-style 60-Hz noninterlaced monitors will have a higher scan frequency (only) and will cause an Amiga image to "shear."

Many monitors designed primarily as composite video monitors (basically home TV sets without the channel tuner part) will have a lower bandwidth and will cause fuzzy images. Get the highest bandwidth and the lowest dot pitch that you can afford.

amiga/main #647, from bwebster [Bruce Webster, Contributing Editor, BYTE]

Due to a set of circumstances too involved to go into here, I ended up buying a Sony KV-25XBR monitor/receiver. I've already run the Amiga composite output into it, and I find 80-column text quite readable; a little uncomfortable to read, but no more so than the 80-column text in graphics mode on my Compaq. Would one of you very kind folks at Amiga like to patch up an RGB cable for me, so I can comment in my column about how good that looks, too?

amiga/main #648, from pariseau:
a comment to 647

Now Bruce, how are you going to impart the real flavor of owning a computer to your readers if you have someone else make your cables for you? (grin!) Seriously, though, making an RGB cable is pretty durned easy.

Refer to the pin-outs in the back of the "Intro to Amiga" manual. Pins 3, 4, and 5 go to your monitor R, G, and B (analog) inputs. You must also connect a sync signal. Probably pin 10 (composite sync) is best, but your monitor might just want pins 11 and 12 for Hsync and Vsync. Our plug has grounds on pins 16–20. You might want to run these over to the signal grounds on your monitor (or not, if you're getting lazy).

Do not connect any of the other Amiga pins to your monitor. When facing the rear of your Amiga, pins 1–12 run from left to right across the top row of the connector. Pins 13–23 run from left to right along the bottom row. If you forget, just look into the connector with a strong flashlight and you'll see the numbers printed in the black plastic at the base of the pins.

The trickiest part of all of this is finding a 23-pin D connector to plug into the Amiga. Most folks take a 25-pin D connector (which is a garden variety RS-232C ASCII terminal connector) and snip off the side that would have pin 25 in it.

amiga/tech.talk #111, from jdow [Joanne Dow]:
a comment to 110

The KV-1311CR is not large compared to most color TVs today. It is a 13-inch very square screen with uncannily good contrast, color balance, and resolution. I just bought one and have to purchase the connectors for mating purposes. Right now I am running NTSC video in and the crazy thing doesn't know it can't do 80-column text that way. I hope no one tells it that for a while. At least 'til I can hook up the video.

amiga/tech.talk #114, from jdow:
a comment to 111

Amiga —> KV1311CR interconnections here by pin numbers:

```
 3 -RED    -> 25
 4 -GREEN  -> 26
 5 -BLUE   -> 27
10 -CSYNC  -> 30
16 -GND    ->  8
17 -GND    ->  9
18 -GND    -> 10
19 -GND    -> 11
23 -x
           -> 29 fast-blanking input
           -> 33 RGB/NORMAL mode select
```

I was setting up to use a 75-ohm resistor to join Amiga 23 to Sony 29/33. This proved unnecessary and I have left pins 29 and 33 interconnected as the thing seems to work fantastically well. Very easy to read 80-column mode.

(P.S.: Amiga Gurus, How do I get all 80 columns? All I seem to get running under Workbench is about 76 columns.) The demos are fantastic. Colors are sharp and clear. And the Mandril is hard to believe.

amiga/tech.talk #133, from jdow:
a comment to 130

Pin 1 on the Sony is lowermost leftmost when facing it. I bet that's what is left for you to fix. The results are well worth the effort. (If you shine a flashlight on the pins you will discover that pins 34 and 1 are identified to aid your insertion efforts.)

GURU MEDITATION NUMBERS EXPLAINED

amiga/softw.devlpmt #294

An Amiga user asks:

Speaking of Guru Errors, has anybody figured out what the heck the numbers are supposed to indicate?

amiga/softw.devlpmt #296, from sturner [Scott Turner, L5 Computing]:
a comment to 294

What they are is this: The first number is the 68000 exception number that caused the guru alert. The second number, after the period, is the task "handle" of the process that screwed up. All in all not very useful info. I would have rather had the address from the exception frame myself, but I don't think those guru alerts were meant to be used without ROMWack.

amiga/tech.talk #122, from jdow:
a comment to 118

Clever trick: Run up Boing! without clicking the Workbench to reveal Boing! Then click off the animations window and click on the graphics window. Run up molly and then fields.

Grab the top of the screen and pull down fields to very near the screen bottom. Grab the top of molly the same way and pull it down. Click off the graphics window and pull down the Workbench to reveal the ball.

Finally click to start the ball rotating and bouncing. Now you get to see it real slowly. Note that the sound still works, and you have perhaps 10K of memory left. Back out carefully and nothing will break. It is intriguing to see molly, fields, and the top of the bouncing ball all

(continued)

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at once. It is a clever demo to show the power of the machine to people who've never seen it before.

amiga/softw.devlpmt #157, from gregr [Greg Riker, Electronic Arts]

TITLE: IFF Available
I mentioned that I used IFF files with the SlideShow. Allow me to elaborate. Electronic Arts has a general interest in promoting standards, so we knocked heads with some people at Commodore-Amiga and came up with IFF. IFF is intended to be used by any and all interested developers. It offers a convenient way of allowing programs to exchange data with one another. For example, GraphiCraft will be able to exchange files with DeluxePaint, and other EA products. The design is extensible in that you may add your own types to the standard. There are programs available in C (public domain!) that will read and write graphic images in IFF format.

If you're interested in a copy of the spec, please contact Rob Peck at Commodore-Amiga. He can supply you with a copy of the spec. If you have any problems or need more information, please contact Jerry Morrison at Electronic Arts, (415) 571-7171.

P.S.: IFF covers graphics, audio, text, and is expandable!

amiga/tutorial #65, from pariseau

TITLE: Chip memory versus Fast memory
The Exec AllocMem( ) call allows you to specify whether you want Chip memory, Fast memory, or either. Chip memory is the user RAM inside your Amiga—up to 512K bytes (there's also the 256K of WCS RAM, the bootstrap ROMs, and the little tiny ROM in the keyboard, but I digress). Fast memory is any RAM attached to the expansion bus. Chip memory is the only memory that can be accessed by the custom chips. Fast memory cannot be accessed by the custom chips but does have the advantage of never having any memory contention between custom chips and 68000 (see my note on Memory Speed in Product.dcsn topic). Note that the 68000 can get *anywhere* in the system, as can any processor on the expansion bus that wishes to act as a bus master (love that flat address space!).

Most people are careful to allocate their data structures referenced by the chips in Chip memory when they allocate them dynamically. The problem is that some folks allocate these structures statically (i.e., they compile them into their programs) or place them on the stack.

This will not work if your program ends up in the extension (i.e., Fast) memory. The design goal of the machine is that the DOS and all applications will make a beeline for Fast memory as soon as they see it's there. This maximizes system throughput during high-bandwidth graphics operations.

For instance, your program won't collide with the blitter's accesses to memory, so the blitter will run at full pipelined memory speed. The way this is accomplished is that Fast memory is installed in the memory free list *prior* to Chip memory, so that AllocMem( ) calls that will take either type (such as those used during program start-up) will preferentially get Fast memory.

The problem is that you won't notice this type of bug in your program until you get some Fast memory. The most common cause of problems appears to be Gadget Imagery. Please make sure that you put your Gadget images in allocated Chip memory and *not* on the stack or as part of your program code space. If you have a lot of Gadget images, you may want to move a whole array's worth into Chip memory; then you can reuse the orignal space for some other purpose.

amiga/tutorial #66, from cheath:
a comment to 65

I was just about to ask . . . Does that mean Image structures equals ImageData arrays? I assume also SetPointer sprite images. Is there any way to get a program to *load* static data into Chip memory? I.e., a Hunk type that specifies to "SET THIS HUNK IN CHIPMEM"? Any other cautions (like file buffers)?

amiga/tutorial #84, from rjm:
a comment to 66

Concerning the horror of Chip memory, where pariseau said that the "most common cause of problems appears to be Gadget Imagery," this is because people are using and designing gadgets more than anything else. However, remember that this problem will involve *any* memory accessed by the hardware custom chips. This includes, as cheath pointed out, SetPointer( ) memory for the Intuition pointer, but also includes all of the VSprites and Bobs, anything with bit-map planes, disk buffers, and more. Someday we will have the ability to identify Hunks that should be loaded into specific types of memory. Maybe. Hopefully. pariseau?

PRINTERS

amiga/main #660, from pariseau

TITLE: Hardware Fix for Okimate 20
The folks at Okidata have told us that they have a hardware fix (a new ROM) for the Okimate 20 color printer that eliminates the horizontal white lines that appear when used with the Amiga. If you already have an Okimate 20, you should call (800) OKI-DATA to arrange to swap your ROM. The new Okimate 20 Plug 'N Print package for the Amiga, which starts shipping November 15, includes the corrected ROM—as well as a cable for easy connection, etc.

amiga/main #644, from greggw [Gregg Williams, Senior Technical Editor, BYTE]

TITLE: Adding Auto-linefeed to Printer Driver—Help!
I have a printer that *doesn't* automatically do a linefeed (LF) after a carriage return (CR)—i.e., it expects the software to send it CR-LF at the end of each line. All the Amiga software I've found sends a CR only, so I can't print anything to my serial printer. Does anybody know of a way to get the Amiga to generate CRs and LFs together? Is there a way to patch the printer driver? I'm sure that a number of users have printers with the same problem. Thanks.

amiga/main #645, from pariseau:
a comment to 644

For simple serial printing with an unsupported printer I usually use the Preferences selection for the Diablo C-150. Don't forget to set your printer port selection to Serial. Use "copy yourfile to prt:" to make it all work. Note that prt: goes through the printer device, giving you access to the conversions built in for the supported printers. The DOS handlers ser: and par: go straight to the Exec device driver with no conversion. If you are having problems using prt: with a supported printer, please double-check your Preferences selection. If that doesn't fix it, please let me know.

amiga/tech.talk #16, from rjm

Here's the list of printer drivers that are supported by the machine:

Alpha P-101	Diablo C-150
Brother 15XL	Epson
CBM MPS1000	Epson JX-80
Diablo 630	Okimate 20
Diablo ADV D25	Qume LP 20

(continued)

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Of course, the list is extendable by anyone who cares to write his or her own printer driver. There are a few other drivers that are just around the corner. Watch this conference topic for details.

amiga/tutorial #102, from pariseau

TITLE: Printer Escape Sequences (LONG)
AmigaDOS provides three "handlers" that can be used to do I/O to a printer. These are "par:," "ser:," and "prt:," referring to parallel, serial, and printer, respectively. If you want to do output to the printer using the file system routines, you will Open( ) one of these and do Write( ) calls to it. The CLI commands also expect you to use these strings as file parameters. For instance, you can send a file to the printer handler with the command "copy myfile to prt:". Similarly, you use these handler names when trying to write to the printer from languages like ABasiC. (For compatibility, Microsoft's Amiga BASIC also defines LPT1 to be the same as prt:.)

An AmigaDOS handler is simply a piece of interface code that translates the device-independent file system calls like Write( ) into the appropriate message traffic to the "devices" implemented in Exec, the multitasking kernel of the Amiga. The par: handler uses the device "parallel.device," which is the Exec code that manages the parallel port connector on the back of your Amiga. The ser: handler uses the device "serial.device," which manages the serial port connector.

Simply put, when you do output to par: or ser: you are talking straight through to the hardware—with no intervening levels of interpretation. If you have an Okimate 20 printer connected to your parallel port, then escape sequences sent to par: will reach it directly and will have whatever effect they are defined to have by Okidata.

Printing to par: or ser: is pretty straightforward. Keep in mind that a standard AmigaDOS text file uses LF as a line separator (not CR or CR-LF), and that a file may or may not have an LF at the end. You may want to add a carriage-return character to the ends of your lines (in a simple program you create), or, if your printer offers this option, flip the switch that automatically gives you a CR when the printer receives an LF.

(Note: Input from par: and ser: is somewhat more complex, since they do "buffered" I/O—but I digress.) If you are writing a program, you can avoid all this handler stuff by doing an OpenDevice( ) directly on the Exec device you are interested in talking to. You then pass I/O request blocks to the device using the I/O calls provided by Exec (DoIO( ) and friends). The advantage of talking directly to the device is that you get a lot more flexibility, including things like asynchronous I/O and the ability to set device parameters such as serial baud rate. For more information on how you call the system library and device routines and just what functions are available, please look in the Amiga "ROM Kernel Manual" (which will be in the stores shortly!).

Note that the Preferences tool printer settings have *no effect* on the function of the par: and ser: handlers! (Preferences *is*, however, used to set the default baud rate used by ser:.) Any special function you want your printer to do is *up to you* when you use par: or ser:. *You* must choose the correct escape sequences to send to do even initialization-style functions—such as setting the margins. Obviously, this obliges you to *know* what style printer is connected to your Amiga and whether it is connected to the serial or to the parallel port.

Which brings us to prt:. The prt: handler uses the Exec device "printer.device." The printer device uses the information it finds in the Preferences settings to understand the type of printer you have connected and how you want it to be used. On the basis of the printer port setting you've made in Preferences, the printer device talks to either the serial or the parallel device to reach the printer.

The printer device understands *only its own, printer-independent, escape sequences*. It converts these escape sequences into the printer-specific escape sequences appropriate for the printer currently selected in Preferences. In addition, the Initialize function (which is invoked when you open the printer device or when you send it the Initialize escape sequence) causes the appropriate escapes to be sent to your printer to configure it according to the options you have selected in Preferences. This, for instance, is how your margin settings get sent to the printer.

If you use the printer device (or prt:), you can write code that is largely independent of the type of printer your customers have on their Amigas.

Note that when using the printer device (or prt:), you should *turn off* any option on your printer providing for an automatic CR, LF, or CR-LF to be generated whenever the printer receives an LF. The printer device will provide end-of-line CR-LFs as needed. Also note that, in addition to the alphanumeric printing described here, the printer device provides for black-and-white, gray-scale, and full-color, raster-graphics printing. This function is only available when talking directly to the printer device (not from prt:).

Known Bugs

The V1.0 Serial Device (and thus, ser:) does not read reliably at the higher baud rates. Writes work just fine. The serial device uses Ctrl-S/Ctrl-Q (XON/XOFF) flow control *only* for V1.0.

The V1.0 Printer Device does not correctly interpret length = –1, which is supposed to indicate that you've given the printer a null terminated string. Prt: is not affected by this, since the handler code always feeds the printer device the correct length.

ATARI

Both the Atari and Amiga conferences contain numerous messages comparing the merits and inherent problems of the two computers, but there is, as well, considerable interest in making the most of each machine. This month for the 520ST, we include some technical tips, including instructions on upgrading the computer to 1 megabyte of RAM, mention some minor bugs in GEM/TOS, and cover some of the discussion concerning the compatibility between the color and monochrome systems.

1-MEGABYTE MEMORY UPGRADE

Message 53 in Atari/tech explains how to upgrade the Atari 520ST's 512K-byte memory to 1 megabyte. [*Editor's note: Before attempting the upgrade, we recommend that you check BIX for Gert Slavenberg's latest upgrades and for the comments of those who have attempted the procedure.*] Gert Slavenberg explains that TOS automatically recognizes and uses the added memory. The expansion requires a lot of very delicate soldering and desoldering and resoldering—and of course voids the Atari warranty.

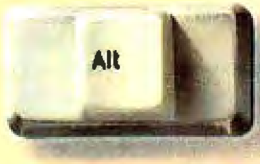
Message 54 provides Gert Slavenberg's complete C source code to create a RAM disk, which requires the 1-megabyte memory expansion. [*Editor's note: You can also download the source code from BYTEnet Listings (617) 861-9764 as STRAMDSK.C or obtain it on disk (see page 350).*]

atari/tech.st #53, from Gert Slavenberg

Warning: This is a hardware modification that will void the warranty of your 520ST. If you do not have the appropriate tools or experience, you have a substantial chance of ruining your 520ST.

(continued)

Pushy, pushy, pushy.



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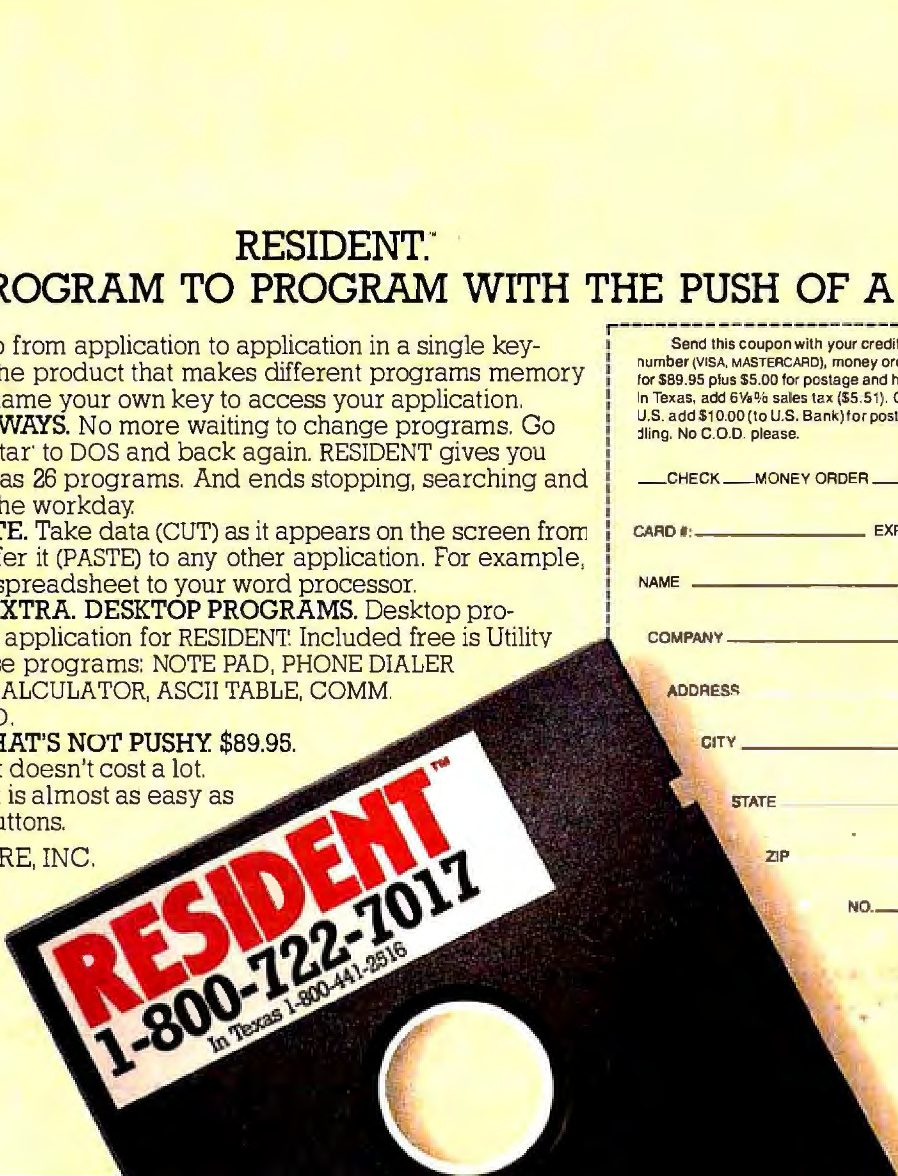

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Proceed at your own risk! I have not checked with knowledgeable sources at Atari to verify if this modification endangers the long-term machine reliability and/or software compatibility (I suspect it may endanger their software compatibility . . . if enough of us do it!).

Tools and components needed:

Sixteen 256K by 1 RAM chips, 150-ns access time type, e.g., NEC 41256C-15.

A good-quality, preferably temperature-controlled, soldering iron, with a miniature tip (tip should be narrow enough to avoid touching two IC pins at the same time), e.g., Weller-type soldering station.

Good-quality resin core solder (thin).

Approximately 4 feet of wire-wrap wire and a good stripper for it. (You will have to route three wires over a sequence of IC pins. The easiest way to do this is to have a stripper allowing you to shift the insulation forward over the wire, solder the next point, measure new length, shift over insulation, etc., until the endpoint). The "No Nik" 0.014 (dark-green handle) wire-wrap stripper is the best tool for this.

Desoldering wick and solder suction tool.

Phillips-type screwdriver (for opening your ST), tweezers, pliers, etc.

A steady hand and self-confidence.

Explanation of the modification:

(Please read the rest of this document before starting. It may save you time and a 520ST.) The current memory inside the 520ST consists of sixteen 256K by 1 RAM chips. Address (A0..A8) lines are common to all those chips.

The WriteEnable line is also common to all chips. Data (in and out) lines are, of course, individual. The RAS (row-address strobe) line is common to all chips. The eight chips forming the high-order byte group have one common CAS line, and the eight forming the low-order byte group have one common CAS line (CAS is used as enable for write operations, such that WriteEnable can be common to both groups).

The high-order group from MSB to LSB consists of U45, 44, 43, 42, 38, 34, 33, and 32. The low-order group is U30, 29, 28, 25, 24, 18, 17, and 16. Note that all chips are adjacent, though the numbering has gaps. RAS0, CAS0H, and CAS0L are supplied from U1 pins 8, 6, and 7, respectively. (The 0 indicates bank 0.)

Bank 1 that you are going to build in will be "piggybacked" on top of the current chips, where all pins of the new chips *except* RAS (pin 4) and CAS (pin 15) are soldered to the old chips' equivalent pins. Thus, they will end up sharing addresses, data, WriteEnable, and power and ground with the existing chips.

All RAS pins of the new chips are wired together and will be supplied with the RAS1 signal generated on pin 18 of U15 (the memory controller, marked 3H-119C or so). The CAS pins of the eight new high-order byte chips (on top of U45..U32) are wired together and supplied from the CAS1H signal generated on pin 22 of U15. Analogously, the CAS pins of the new U30 to U16 are wired together and supplied with CAS1L from pin 21 of U15.

How to go about it:

Step 1: Open up your 520ST, pull off the keyboard connector, and remove the main circuit card from its top and bottom shielding. Make sure to remember which screws go where, and note the keyboard connector orientation.

Step 2: Desolder all of the capacitors adjacent to the existing RAM chips. (*Do not skip this step.* You'll lose time if you do, and worse, the modification will not be reliable since you can't solder pins obstructed by the capacitors reliably [if at all]).

To desolder them, I found it easiest to heat the island on the noncomponent side and bend the wires straight. After doing that on each capacitor, turn over to the component side and heat the islands while pulling the capacitor out with the tweezers.

Step 3: Open up the holes of all the desoldered capacitors, using a combination of desoldering wick and suction tool. Do this from the noncomponent side. If certain holes are difficult to open up, you may want to use a wood splinter (push it through while heating). Be careful to remove all solder debris!

The reason for opening the holes *now* is that they will be less accessible once you've done the other steps! Patience is a virtue.

(Note: Steps 2 and 3 are the only ones that may damage your ST PC board. Be sure not to use excessive force while pulling out the capacitors. If you damage your PC board anyway, cure the problem now and not later.)

Step 4: In this step we will piggyback the new RAMs on top of the old ones. Be sure to connect all pins except pins 4 (RAS) and 15 (CAS). The best way to go about this is to do it chip by chip.

First, bend the pins of the new RAMs such that they are perpendicular to the package (instead of having slightly spread "cowboy legs"). Use pliers to bend pins 4 and 15 such that they come out of the IC package horizontally, and cut off the excess length of pins 4 and 15 (I mean part of the pin, you still need to be able to solder to it!). Make sure that the new RAM fits snugly on top of the old one (in the same orientation!), without intervening space and with the new pins touching the old ones.

Now solder each pin (except the nontouching 4 and 15) to the other RAM's. The best way to do this with the least chance of damage is to touch both the new RAM's pin and the old RAM's pin. Heat them both for a second and add *a little* solder then. Wait till the solder flows. After each IC, check all pins carefully to assure a good connection (use a magnifying glass).

Note: This step is crucial for the long-term reliability of the memory extension. A badly soldered joint may show up later as sporadic memory errors. *Take your time.*

(Note: Until step 6 is finished, do not in any way apply power to your ST. This intermediate state of affairs will damage your memory chips.)

Step 5: Remount all the desoldered capacitors. Bend the pins like they were before resoldering, so that they will not touch the lower shielding. Solder from the noncomponent side.

Step 6: In this step you will route the three wires mentioned earlier. The first wire connects pin 4 (RAS) of all the new RAMs to pin 18 of U15. The second wire connects pin 15 (CAS) of the new U45 to U32 to pin 22 (CAS1H) of U15. The third wire connects pin 15 (CAS) of the new U30 to U16 to pin 21 of U15.

The best way to do this is to use the stripper to remove 5 inches of insulation. Solder the first IC pin to the end of the blank wire, measure the distance to the next pin in sequence, and shift over that amount of insulation. Continue in this fashion until all the pins in sequence are done. Work from U45 to the left, soldering directly to the leftover pins on the new chips.

Make sure that no wire or solder sticks out above the the top plane of the new chips, since they will almost touch the top shielding! Route the wires through the PC board hole below and to the left of U15 to connect to U15 on the noncomponent side.

Step 7: Sit back. Use Brain. Do you feel confident about the quality of your work? No mistakes? Check everything once again if you are but a little uncertain. Applying power with errors might make your ST into a decorative, nonfunctional piece of art. OK. Either rebuild your ST into its shielding and cabinet, or put it onto a surface clear of wires and solder remains and connect it to monitor, disk, and supply.

Boot it. If it boots, you're probably there. Test if the new memory works by looking at the phystop variable ($42E) with SID if you have the developer stuff. It should read $100000. Also note that memcntlr

(continued)

($424) now holds 5 instead of 4, and that v_bas_ad ($44E) now holds $F80000 (screen bit-map origin).

If you don't have the developer stuff, try a single-drive copy and check that you get the whole disk in one buffer instead of two. If the new memory does not seem to exist, use SID to deposit and retrieve words on locations $80000 and up (½ megabyte hexadecimal). If bit errors occur, the ST boot ROM did not detect the extension (it checks all bits of 512 locations by testing a pseudorandom sequence, before accepting a memory bank). Try to pinpoint the faulty chip(s) and remove the error.

If it doesn't boot, you're in trouble. I'm sorry. It is difficult to give hints on what to do here. So many possibilities. Desoldering the new chips probably won't work (if the old ones were functional, the ST would still boot). Check for hidden short circuit on the RAM pins. May also be that you have a flaky new pin connection.

RAM Disk for the 1-Megabyte ST

atari/tech.st #54, from Gert Slavenberg

To stimulate you to do my 1-megabyte modification, I am distributing a primitive RAM-disk program that will alleviate your needs for a second floppy. The program is currently only runnable on the 1-megabyte ST. It is installed as a desk accessory (load it in at boot time; it stays resident), takes over the BIOS disk I/O vectors, and implements the device driver for drive D. The RAM disk is identical to a single-sided standard 520ST floppy. It is extremely fast; when you put the header files and C source on the RAM disk, compilation takes only the compiler/assembler code load time (± 30 seconds). Loading MicroEmacs is almost instantaneous.

Though I feel a little ashamed at distributing this slightly primitive version, it runs reliably and speeds up my own program debug cycle by a factor of 10 or more. If anyone comes up with a more useful program (e.g., using the terminate and stay resident call instead of wasting a desk accessory, and/or creating an arbitrary size RAM disk with valid file structure), please distribute that in public domain, too.

amiga/main #577, from jsan [Jez San, Argonaut Software]

I have already had my ST upgraded to 1 megabyte of RAM. The upgrade is absolutely vital for serious development use (at least while GEM is still in RAM) because the need to use RAM disks or edit large files requires more than the 200K bytes of memory that remain after you boot.

I might add that although the 1-megabyte upgrade involves considerable soldering, the actual parts cost only about $50.

Still, the ST is still very much a closed-architecture machine. Just because you can add RAM by opening the case and piggybacking chips doesn't make it an open-architecture machine. There is no inherent way of "memory mapping" an external piece of hardware easily to the ST. You either have to have an 8-bit parallel DMA device (up to 1.33 megabytes/second), or you can memory-map up to 128K onto the cartridge port, with no read/write line. It's a no-win situation! No peripherals can be attached to the ST without their having on-board intelligence to cope with the ST's limitations. As Sig Hartmann says: Our machine doesn't need to be open architecture because we've supplied everything as standard. I don't agree that he is right, but commercially, he has a point. It's a very simple but effective product.

Bugs and Tips

atari/tech.st #110, from satether [Steve Tether]

TITLE: Minor Bugs in GEM/TOS

I have had my 520ST for about three months now. Ever since I reseated the chips on the motherboard the system has been very reliable. There are a few things, however, that annoy me.

1. Whenever I do a Print Screen, either from the menu or with Alt-Help, the time of day in the system clock gets trashed. I'd like to be able to keep the machine turned on all the time so that programs can find out the time and date (e.g., for use in a tickler-file application).
2. If a printer is not connected when I do Print Screen, the system hangs and I must reboot.
3. If I try to delete a file that is read-only, I get a dialog box that "TOS error 1" has occurred. Not very informative.
4. If I create a folder whose name consists of exactly eight characters without an extension, the system refuses to let me put anything into it. It claims that the folder can't be found.

atari/tech.st #111, from jsan:
a comment to 110

All the bugs you mention are common to all normal TOS owners. They have all been corrected in later versions but have not been released yet. The next TOS will probably be in ROM, in at least a month's time, since even if they were to finish it this week, it still takes one month to commit it to masked ROM.

atari/tech.st #116, from neilharris [Neil Harris, Atari Corp.]:
Nov. 13, 1985: a comment to 110

Steve, we are working on a final release of TOS for the ROMs, which should be finished soon. I believe that we will release that version on disk as well. Aside from being somewhat shorter in length (it has to fit into 192K of ROM in the memory map), it clears up all the problems you reported and a couple of others, particularly the heap management problem that results in your not being able to open windows after leaving the system on for too long and using that feature a lot.

atari/tech.st #108, from cheath [Charlie Heath, Microsmiths]

To use multiple dialog boxes on screen simultaneously, the form_do command cannot be used, since it puts program in wait loop for a specific dialog box. Instead, use objc_find commands, but it is important to note that the application must acquire control over the mouse while waiting for user response; *otherwise the system* will *hang* up if the curser is moved into any "sensitive area" (such as window border, menu area, etc.).

Control over the mouse is acquired by using the window update command with proper parameters.

New Software

atari/tech.st #73

One user tried Hippo-C but found it lacking. The primary problem was the almost complete lack of documentation. Hippo claims full support for the K&R C (except floating point), but several library calls are not there.

For example, how do you allocate dynamic memory? Also, you really need some documentation on GEM, VDI, and AES calls; the manual only gives the routine names, no descriptions even. Second big gripe is that it does not use the GEM interface in any way. The text editor does not even use the mouse.

atari/news.st #89, from bwebster [Bruce Webster, Consulting Editor, BYTE]

I received today the TDI Modula-2/ST package from TDI Software Ltd. in England. After having played with it this evening, I am ready to drop C like a hot rock (not that I'm terribly fond of C in the first place). The compile and link phases are easier and faster than for the C compiler (DRI/Lattice), the editor (included in the package) is the closest thing to

(continued)

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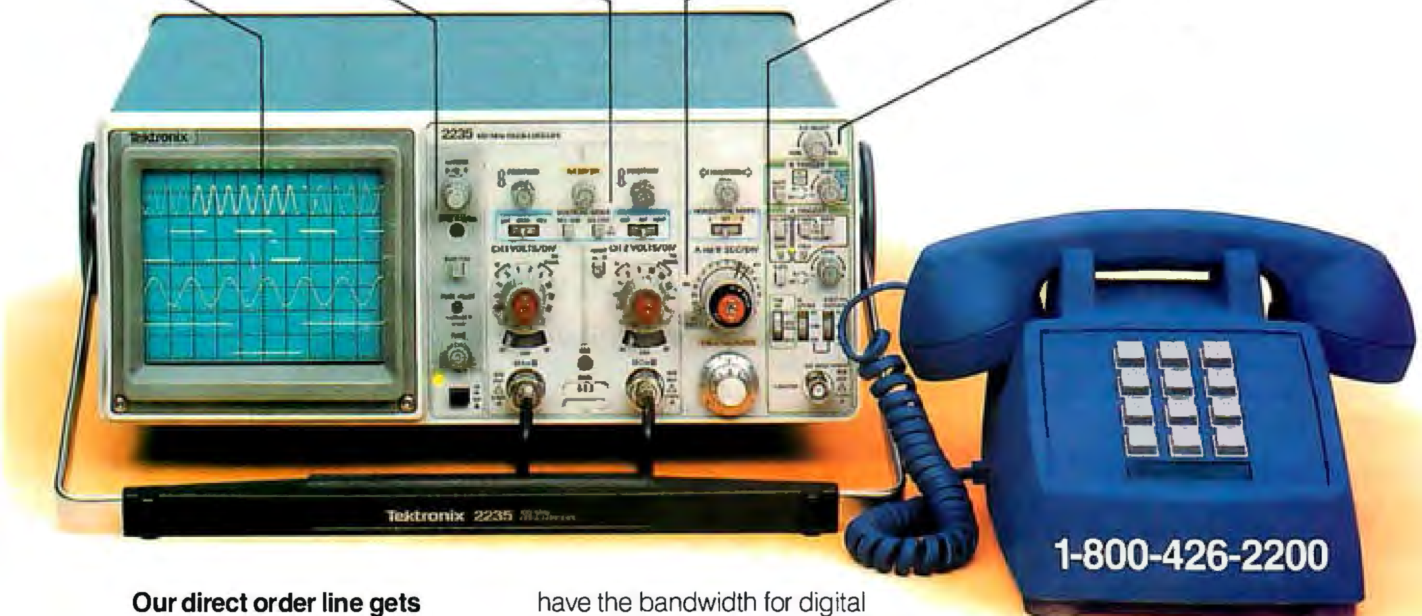

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a Mac-style editor I've seen on the ST (and can be fully driven from the keyboard, for you mousophobes), and it has complete libraries for GEMDOS, AES, and VDI.

I was dreading having to wade through GEM, but now I'm actually looking forward to writing some programs on the ST. The package costs 195 pounds. TDI's U.S. office (they recently merged with Pinnacle) is in Dallas, TX, (214) 340-4941. It produces stand-alone 68000 native-code programs, and it's fast. I'll try to get some benchmarks up here sometime soon, but the graphics demos (which are all working through GEM calls) really zip along, especially the rotating cube (wire-frame, almost flicker-free) and the bouncing lines.

COLOR VERSUS MONOCHROME

amiga/main #623, from bwebster

As far as I know, color software (Neochrome, for example) will not run on the monochrome monitor. If any of you out there know differently, please let me know.

amiga/main #624, from cheath

Programmers must make it work, if they want to. Most of the color software will work in mono, at ½ screen width... Mono-only software, I don't know what happens in color.

atari/tech.st #109, from cheath

It is possible to detect which type of monitor is present and to write conditional code to work for both in the same program, but the calls are different. It is possible to design a single dialog box that may be used by both mono and color; however, in the 320 by 200 mode the dialog box is twice as large on screen as on the monochrome screen. We have had trouble reading the vertical-sync register; the system crashes when we try it.

atari/tech.st #112, from neilharris

Bruce, Neochrome was written to work only in color—it is a *color* drawing program by design. Other programs like Doodle (a freebie) and Degas from Batteries Included, plus the upcoming GEM Paint and GEM Draw, all work fine in color *or* in monochrome. It is up to the software.

DOUBLE-SIDED DRIVES

atari/non.tech.st #81, from bwebster

I was able to trade in one of my single-sided drives for a double-sided drive (which, by the way, only holds 709K, not 750+ as someone else reported). I seem to have a little problem, though: Now that I have one SS drive and one DS drive, how do I copy disks?

atari/non.tech.st #84, from jsan:
a comment to 83

Let's assume that you want to copy files from Disk A, which is SS, onto Disk B, which is DS.

First, open up the Destination Drive, which is Disk B. With its window sitting open in front of you, *drag* Disk A's icon (Source Disk) and let go of it while it is over the top of the open window of B (Destination). Once that's done, the files will be copied, one by one. If there's not enough room, or if there are duplicate files, then no matter ... you'll be kept informed of all things nasty!

atari/non.tech.st #85, from bwebster:
a comment to 84

Ah! You misunderstood my question. I want to make a copy of a given DS disk, i.e., transfer all files onto another DS disk. I know quite well how to copy files from a DS disk to a SS disk and back; the first thing I did after formatting a DS disk was to copy all the files from my two Modula-2 disks (compiler and linker) onto it.

It took forever, too: The ST is not terribly fast when it comes to file-by-file transfers. I'm not sure the ST will let me do what I want to do without unplugging one of the two drives (depending upon which format disk I want to copy).

atari/non.tech.st #86, from jsan:
a comment to 85

Yes, I should think unplugging one of the drives is the quickest way to do it—I can't think of another way offhand!

IBM

This roundup of the activity in the IBM conference features a summary by John Fistere, the conference moderator, of hints for IBM users. Discussions this month include the installation and use of the NEC V20 processor, speeding up the IBM PC AT, and customizing your DOS prompt.

HINTS

ibm.pc/pc.hints #2, from johnf [John Fistere]

A summary of IBM hints from wheelock (Bruce Wheelock) and rmalloy (Rich Malloy, BYTE).

wheelock:

Running programs from a hard disk: In order to avoid the tedious changing directories to get to any program you may have on your disk, write a small .BAT file to do the work for you. Each program you run should have its own .BAT file, and to further keep things organized, these .BAT files and only these files should be in a separate directory named something like \start. (Your autoexec.bat file should have a path statement in it that includes this directory.)

In regard to those batch files, if you put ECHO OFF as the first line in your batch file, you won't have to watch all the commands go by. There is no need, by the way, to put ECHO ON at the end of a batch file. It happens anyway.

My WordStar and Microsoft Word batch files are both set up to do all directory handling, call WordStar/Word, and erase all the .BAK files, if any exist. This is done by:

```
IF NOT EXIST *.BAK GOTO NONE
ERASE *.BAK
:NONE
```

The :NONE, of course, is a .BAT file label. This method keeps me from cluttering up my hard drive with .BAK files, and I don't even have to think about it.

rmalloy offers the following procedures to use SideKick to compose and to receive messages:

I composed this message using Notepad in SideKick. To transfer the message to BIX, do the following:

Enter SideKick (Ctrl-Alt)
Write message
Mark the block you want to transfer by using the Ctrl-K-B and Ctrl-K-K combinations

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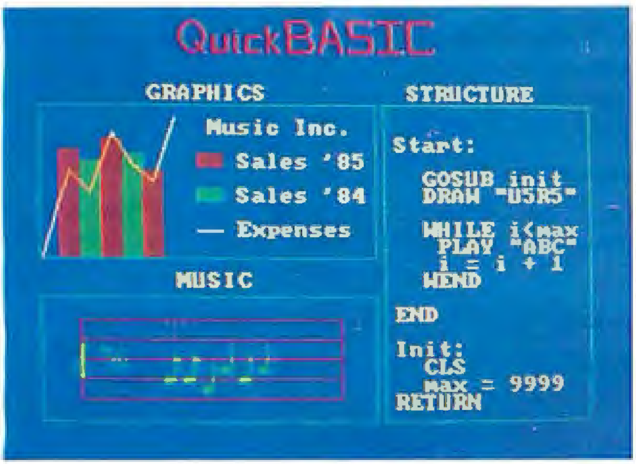

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Press B to indicate that the paste should be done in Block mode (all at once)
Press Esc to return to BIX
Get ready to type a comment
And press your designated paste key (e.g., Alt-P)

One minor problem is that the screen looks like a mess while SideKick is doing its external paste. But BIX seems to do a good job of catching every character that gets pasted.

Also, SideKick has a pretty nifty way of importing data. The procedure:

When there is something on the screen you want to capture, enter SideKick's Notepad (Ctrl-Alt, F2)
Press F4 (this brings you back to the original screen)
Move the cursor to the upper left corner of desired block
Press Ctrl-K-B; repeat with Ctrl-K-K at lower right corner (this brings you back to SideKick)
Move cursor to desired position in SideKick
Press Ctrl-K-C, and voila!

There is the probability that you will be logged off while you are connected and editing a message in SideKick. Richard Shuford suggests typing either "say," "com," or "rep" to the Read: prompt before going into SideKick.

You can also import text to SideKick from the verbose editor without importing the verbose editor prompt.

The blocks you import from the screen are rectangular, so you need but start your block in the first column of actual text. This will bypass whatever prompt is being used in the verbose editor. For example:

```
       |---- -Do a Ctrl-K-B here
input->This is the first line
input->However, this line is much longer, as you can see.
input->While the final line only goes to here.
                          Do a Ctrl-K-K here----- |
```

Then, when you import, you will get:

```
This is the first line
However, this line is much longer, as you can see.
While the final line only goes to here.
```

THE NEC V20 PROCESSOR

ibm.pc/pc.hardware #34, from mhaas [Mark Haas, Contributing Editor, BYTE]

I just read that putting a NEC V20 processor into your IBM PC will increase performance noticeably. Just pop out the ol' 8088 and slip one of these $20 wonders in and away you go. Anyone have any info on this or tried it?

ibm.pc/pc.hardware #37, from cjackson [Craig Jackson]:
a comment to 34

There was a presentation about it several months ago at a Boston Computer Society IBM PC Tech subgroup meeting. The basic answer is it's about 5 percent faster on a general mix. If you have lots of complicated instructions, especially multiplies, it will speed up even more.

ibm.pc/pc.hardware #41 from naro [Richard Naro, Manager of the V-Series Microprocessors for NEC Electronics Inc.]

V20 instruction performance improvements: The multiply/divide instructions are better than three times faster than the similar instructions on the 8088. String instructions are also slightly more than twice as fast. Obviously, applications using a greater percentage of these instructions will show better improvements. Other instructions such as branching, effective address calculation, and multiple bit shifts have minor performance improvements.

ibm.pc/pc.hardware #42:
a comment to 41

A BIX user commented that a friend found good improvement (25 percent) in his Mandelbrot-set program with the V20, as it was using emulated floating-point, which was helped a lot by the faster multiplies. The 8087 version of that program is still faster, so the 8087 is what he'd recommend if you really want to crunch numbers. He heard that the V20 is not compatible with an 8087. Anybody know for sure?

ibm.pc/pc.hardware #43, from naro:
a comment to 42

I know for a fact that the V20 is compatible with the 8087 unless the application code assumed some standard execution time and neglected to use WAIT instructions to keep the two parts in sync. Of course this type software would fail to run on any faster machine, so it is rare and not recommended. Speaking of 8087s, did you know NEC will introduce a CMOS Floating Point Processor that is pin- and software-compatible with the 8087? It will be faster with more instructions with availability some time in the first half of next year.

ibm.pc/pc.hardware #63:
a comment to 34

Another BIX user comments: I have used the V20 on three clones—Corona, Compaq, and Advanced Computer Solutions (also sold as Turbo PC because it supports 8-MHz modes)—with complete compatibility and 8087 support. It speeds things up variably as some of the other messages have said, but I usually find that, subjectively, things are much better than the 5–30 percent usual benchmarks. Text and display-oriented routines are most improved.

I had a problem installing it in an IBM PC with the original IBM disk drives. It would boot from the hard disk okay, but access to the floppies resulted in a hang-up. Seems the IBM BIOS ROM uses an idiotic timing loop based on specific instruction timing.

ibm.pc/pc.hardware #80

Another BIX user said that he had a new V20 in a Seequa Chameleon. It works quite well and is, of course, noticeably faster. It's really easy to install.

ibm.pc/pc.hardware #152, from sanyohacker [Bob Babcock]

Do all V20 chips run at 8 MHz, or are there different versions for higher clock rates?

ibm.pc/pc.hardware #165, from naro:
a comment to 152

They are available in both 5- and 8-MHz versions with 10 MHz to be introduced in the very near future.

ibm.pc/pc.hardware #166, from dr_dan [Dan Lewis]

I have a NEC V20 chip in my Sanyo MBC-555. In general, I've been delighted with the results, except for two things: (1) The orignal Sanyo-supplied floppy-disk FORMAT program no longer works. Presumably,

(continued)

there is some weird time-dependent loop that it depends on, but I don't understand why running FORMAT with the V20 causes the divide overflow to appear on the screen just before returning to the operating system. [*Editor's note: dr_dan says the FORMAT program uses a timing loop.*] (2) My CP/M-86 implementation (KSP Windows for CP/M-86) no longer boots. This one I have no clues on! I know of no reason in my code that it should work on a standard 8088 but not with the V20. If anyone has *any* ideas, I'd love to hear them! Or if anyone has experienced the same problem with V20s and the Sanyo MS-DOS FORMAT program, please let me know! In general, the 8088 emulation in the V20 is a bit more imperfect than simply a timing difference!

ibm.pc/pc.hardware #170, from conniek [Conrad Kageyama]:
a comment to 41

I'm no hardware techie, but I believe that the μPD70108 (V20) is supposed to have dual data buses and 8080 mode, too. I've had the 70108 in my machines for a couple of months and have run into zero problems. There seems to be a perceived improvement in screen writing and batch handling. Most folks I know who have run their own benchmarks are claiming 4–18 percent increase depending on how they were testing. Curiously, the Norton Utilities System Information utility rates a PC with the 70108 as having 1.7 times the performance.

I have always used SideKick and SuperKey, but adding the new Turbo Lightning has caused some problems in starting SideKick at times with the Ctrl-Alt key combination... I recently replaced the 8088 back into that computer and the SideKick problems disappeared.

ibm.pc/pc.hardware #202, from rschnapp [Russell Schnapp]

I just added a V20 to my Columbia 1600-4 (XT clone). I got a speedup of a whopping 5 percent (barely). This was on an arbitrary data movement, arithmetic, and call protocol benchmark written in Turbo Pascal. I'm actually waiting for CP/M-80 emulation.

ibm.pc/pc.hardware #64, from rcook [Rick Cook]

Anyone know of a source for, or have any experience with, the V30? That's the high-speed version of the V20. I'm particularly interested in how well it works with an 8087, clock speedup, and Lattice C on a PC.

ibm.pc/pc.hardware #66, from georgehoffman:
a comment to 64

The V30 is to the V20 as the 8086 is to the 8088; that is, they ain't plug-ins for each other. Or, the V30 is a souped-up 8086, as you like.

ibm.pc/pc.hardware #77, from naro:
a comment to 64

I am happy to send anyone interested in the V20/V30 microprocessors documentation if they send to me their name and address via BIX Mail. In answering the questions raised in message #64, a V20/V30 works with an 8087, executes code faster without modifying the clock or bus cycle times, and will work fine with Lattice C. In fact, if the compiler has a switch to generate 186 instructions, the V20/V30 can take advantage of it, since it contains the full 186 instruction set in addition to some new instructions for bits and bit fields.

Speeding Up the IBM PC AT

ibm.at/at.hardware #20, from dwb [Dave Burleigh]

When my machine is out of warranty, I'm hoping to change the crystal to speed up the 80286 to 8 MHz, and simultaneously, to change my current 80287 to the 8-MHz 80287. I'd like to hear the pros and cons on this move from any of you who have tried it already. Are 150-ns memory chips fast enough for 8-MHz operation? I have an Advantage board populated with 150-ns 256K chips.

ibm.at/at.hardware #23:
a comment to 20

Another BIX user said that he had heard about potential problems with certain copy-protected software that relies on a timing scheme.

ibm.at/at.hardware #25:
a comment to 23

A BIX user responded with the information that any software protected with the SoftGuard protection scheme (such as dBASE III and Framework) will have to be used with the slower crystal installed.

ibm.at/at.hardware #29:
a comment to 20

Another BIX user said that he had his system clock up to 9 MHz with no real problems. He would sometimes get a few "Drive not ready" messages when trying to read from a floppy, but a "retry" would always work. He thought that the AT used one wait state: Did anyone know how to get rid of it? He also thought that it is possible to speed up hard-disk access by changing the interleave factor with the dealer diagnostics disk. Had anyone tried this?

ibm.at/at.hardware #32, from pittore [William Pittore]

I've been using an AT with a dealer-installed Rodime 20-megabyte hard disk for about 8 months now with no disk problems of any kind. I've also installed a 16-MHz crystal so that I'm running at 8 MHz. It's great to develop software on this machine because the turnaround time is so much faster than on the XTs at the office. This machine also has a beta version of the Intel Above Board and an 80287. Both run fine at the higher clock speed. Interesting note: If you check out Sheet 3 of 22 of the AT system board schematic at U96 pin 11 you will see the designation 16 MHZ. It seems that the 12-MHz crystal was an afterthought. Probably because Intel couldn't deliver guaranteed chips.

ibm.at/at.hardware #34, from leroy [Leroy Casterline]

I have been running my AT at 9 MHz (18-MHz crystal) since November with no obvious ill effects. I ran at the standard clock speed after the first drive failure, until my second drive died as well, when I reinstalled the 18-MHz crystal. I have had no software problems at all, although I don't use any SoftGuard-protected software.

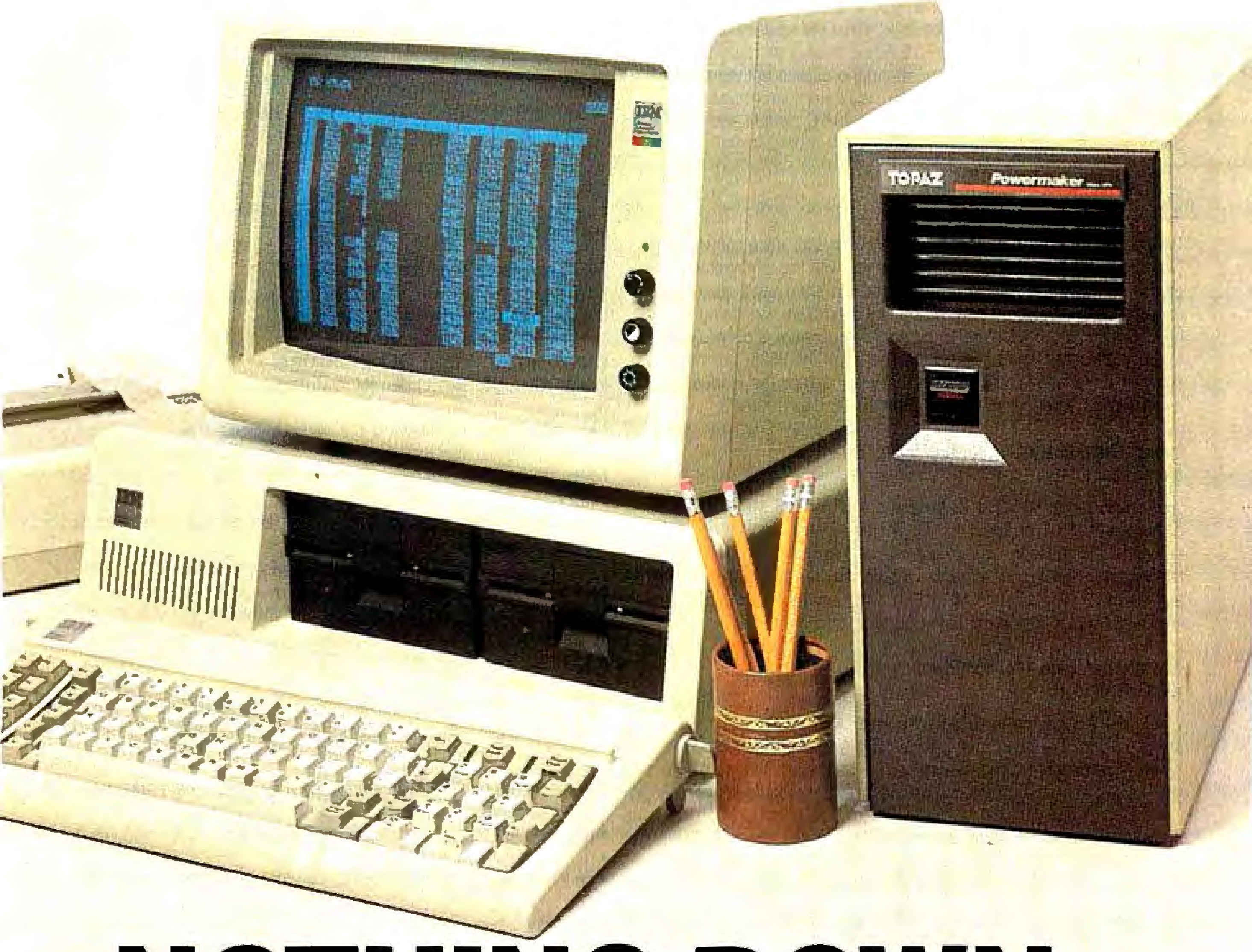
ibm.at/at.hardware #35, from leroy:
a comment to 29

Last time I had a drive failure, I played with changing my interleave factor. I ran benchmarks (copying a 2-megabyte file from one subdirectory to another) with my interleave set to 2 and 3, and with the standard crystal and an 18-MHz crystal. The results were very unimpressive (less than a 1 percent difference, as I recall) at either clock speed. I don't have the table I generated anymore, or I would reproduce it here.

ibm.at/at.hardware #41, from pittore

I recently increased my clock speed to 18 MHz and was curious about the effects it had on the operating temperature of the chips. I happen to have a multichannel thermocouple meter (Analog Devices #2036), and so I mounted a thermocouple on the 80287 and the 80286. The 80287 at the normal 12-MHz crystal ran at 95° F and the 80286 at 90° F. With a 16-MHz crystal the 80287 ran at 112° F and the 80286 at

(continued)



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100° F. At 18 MHz the 80287 ran at 125° F and the 80286 at 108° F. The ambient temperature was about 72° F, so the temperature rise for the 80287 at 18 MHz was about 53°. Since there is probably some thermal loss between the chip mount and the outside of the package, I would imagine that the chip temperature is higher than I measured. The operating range for the 80287 is up to 70° C, so it is about 20° C below the limit, but I wonder if it has some effect on chip life?

ibm.at/at.hardware #42, from leroy:
a comment to 41

I've been running my AT at 9 MHz (18-MHz crystal) since sometime in November, as I recall. I, too, was concerned with the temperature increase on the 80286 but went ahead and did it anyway. I have experienced no ill effects so far and think that if a problem was going to show up, it would have done so by now. Temperature is definitely a factor in chip failures, and I suspect that the life of the 80286 will be somewhat shortened, but I suspect that I will replace the AT due to technological advances long before the 80286 dies (I hope!).

ibm.at/at.hardware #44, from tswart [Ted Swart]:
a comment to 41

Your 80286 ran at 90° F at 12 MHz and 108° F at 18 MHz. This is a difference of 18° F or about 10° C. Chemists usually reckon on a two- to threefold increase in the rate of chemical reactions per 10° C rise in temperature. This suggests that the 80286 may last two to three times as long at 12 MHz as at 18 MHz. This is all very rough, of course, and who really knows. The proof of the pudding is in the eating.

ibm.at/at.hardware #45, from dwb:
a comment to 41

Where did you get the replacement crystal? And what display controller are you using? I've heard that the Hercules and other monochrome graphics cards won't work correctly with a faster crystal in the AT. Have you noticed any other problems, besides the higher temperature?

ibm.at/at.hardware #47, from pittore:
a comment to 45

I believe I purchased the crystals from JDR Microdevices, which advertises in the back of BYTE. I bought two of each just in case. I am currently running the standard IBM monochrome card and monitor and a Hayes 1200B modem. Until last week (when Intel took it back) I also had an Above Board, which also ran fine. So far no disk errors or memory errors have shown up.

ibm.at/at.hardware #52, from robinson [Phillip Robinson, Senior Technical Editor, BYTE]:
a comment to 44

I don't believe solid-state devices will follow that sort of "10° for two- or threefold change" rule at all. It is true that contaminants and dopants (both undesired and desired) will move further in a hot chip. Also, increased heat will cause certain materials, such as some of the electrical metal connections on the surface of the chip, to migrate and thus change the electrical properties of the chip. However, the most probable failure mode due to increased heat is mechanical stress. The wire bonds to the chip and the leads of the package itself are more likely to develop bad joints and poor contact than the chip is to self-destruct through diffusion of materials. Don't worry about that sort of temperature and the shortened life of your chips. Worry instead that your computer may get so hot that a chip may not work properly while you are in the middle of a massive job; the glitch could erase or corrupt your data or program. Chips are cheap, your time is not.

PRINT SCREEN IN BASIC

ibm.pc/pc.software #45, from rmalloy

I can't find the original message, but I believe someone requested a way to do a Print Screen from within BASIC. Here's a very simple, elegant technique that is modeled after a suggestion from Joe Fleming, sysop of the Tampa IBM PC BBS.

```
100 A! = -51973.8
120 B = VARPTR(A)
140 CALL B
160 LPRINT CHR$(12)
```

BASIC apparently stores the number −51973.8 in such a way that when you do a VARPTR on it, you end up with the address of the Print Screen routine. Amazing. But it does work.

CUSTOMIZING YOUR DOS PROMPT

ibm.pc/other #18, from bbl126 [Mike Guffey]

Basic and Advanced Usages of the "prompt" Command

This article assumes the reader has progressed beyond the status of novice DOS user and can decipher some of the less cryptic passages in Microsoft DOS documentation. Where additional instruction might help, another source of information will be cited. Technical explanations of what is happening will not appear here.

Your MS-DOS or PC-DOS (2.1 or above) documentation lists a resident (built-in) command that allows you to change the A> or B> prompt. Depending on your particular documentation, you may be able to use some of this command's features, but probably not all (until you read the article below). This is an overview of just what you can do with the "prompt" command.

Most documentation explains (usually less than lucidly) how to change the basic A> or B> prompt. But some MS-DOS users never realize that in addition to the basic options, they can probably

- cause the prompt to display in reverse video (text in normal video)
- redefine the 10 function keys
- redefine the Ctrl, Alt, and Shift combinations of the 10 function keys
- redefine other keys as well
- perform these "tricks" from the DOS command line or with .BAT files

Basic Nifty Tricks

Why change the DOS prompt from the basic A> or B>? Let's suppose that for some reason or another you have either different versions of DOS on different disks or the DOS COMMAND.COM file on several specific-function disks. It might be nice to know whenever you are at the command level either which version of DOS you are using or which special-function disk you are using. Or perhaps you don't use an onboard clock and might find it handy to display the time each time the prompt is displayed. Or maybe you are simply tired of the humdrum A> or B>.

It is these needs that most DOS documentation addresses. But many of us never read documentation/instructions unless all else fails. So, here are a couple of quick examples of what prompt can do. For additional instruction, read/re-read your DOS documentation or obtain the excellent book *Running MS-DOS* by Van Wolverton (ISBN 0-914845-07-1).

The prompt command has several operators/characters that produce specific results. In order to use them, they are preceded by a dollar sign. Several or all of these operators can be used on the same command line (or within the same .BAT file). When invoked, they are not separated by spaces.

For example, the command

(continued)

Post Office
Will Not
Deliver Without
First Class
Stamp

McGraw-Hill Continuing Education Center
3939 Wisconsin Avenue
Washington, D.C. 20016-2876

```
prompt $t_$v_$p_QMODEM IN A ==> THIS IS DRIVE $n$g
```

might display

```
15:36:03.63
IBM Personal Computer DOS Version 2.11
Current Directory = B:\
QMODEM IN A ==> THIS IS DRIVE B>_
```

A detailed discussion is pointless here. (The operators are listed in your DOS documentation.) You can do several things after reading your own basic prompt documentation. But very seldom will you encounter this information: Typing the prompt command without operators (arguments) will restore the basic A> or B> prompt. (But it will not cancel everything you can achieve with the prompt command.) This is nice to know if you are doing a lot of disk swapping and it no longer becomes important to know some of what the prompt command will tell you. So the above complex display will cease and merely show the current drive if you will type the prompt command on a line by itself and follow it with a <RETURN>.

Intermediate Level Trick

Some of us are always meddling. For those of us who do, there is another feature of the prompt command that will allow the prompt to be displayed in reverse video and the other command-line data in normal video. This will not work in all situations. You will need to be using the normal ANSI.SYS device driver on your initial COMMAND.COM disk.

For example, the command

```
prompt $e[7m$n$g$e[m
```

will cause the normal A> or B> prompt to appear in reverse video. The remainder of the command line (what you enter) will appear in normal video.

Another example

```
prompt $e[7m MSDOS $n$g$e[m
```

might cause the prompt " MSDOS A>" to appear in reverse video. The leading blank makes the display more clear on some monitors. (The "$n" above will cause the letter of the currently logged drive to appear in the command line.) Remember, this trick will not work if you are not using ANSI.SYS in a normal fashion on the COMMAND.COM disk you initially boot the system with. Some users will discover that by playing with the sequences following "$e" above, they may achieve some interesting results on color monitors. The "$e" allows usage of an escape sequence and is beyond the scope of this article. (Hint: [m = [0m.)

Advanced Level Usage

One of the most interesting uses of the prompt command was recently discussed by Harold M. Bauman in his Heath/Zenith column in the June '85 issue of *Computer Shopper*. His techniques apply to almost all IBM compatibles and are explained in less technical fashion below. The prompt command can be used to redefine keys either from the DOS command level or with use of a .BAT file. The keys can either be redefined one at a time or in a sequence of commands, so you can determine the definition of some keys to be anything from a single keystroke to numeric formulas to complex strings of data. (Harold Bauman's column is a little more comprehensive in explaining some of the other possibilities of this technique than the description below.)

This means that in many applications, you do not need commercial or public-domain software to redefine keys. You can do it yourself. But, it will not work with all applications programs, and it may interfere with or override the preset definitions of some software. It may be of use in adding additional keyboard definitions to programs that have only a limited number of specially defined keys. (For example, Symphony only uses about 23 of the possible 40 function [F] key combinations.)

The syntax of the basic redefinition command is as follows:

```
prompt $e[0;n;"def";13p
```

prompt — basic setup, needed in most definitions (also see note 4 in Appendix A)
n — numeric value of key to be redefined (see Appendix B)
"def" — alphanumeric string prompt assigned to the key (quotes required)
13p — places a <RETURN> at string; deletion of 13 ends string without a <RETURN>

Here is an example of what can be done from the command level:

prompt $e[0;68;"DIR /p";13p	redefines F10 to give a paged
prompt	DIR command of logged drive and restores basic MS-DOS prompt

A .BAT file can be created to define keys more simply and without having to worry about getting the syntax exactly right for each definition. The following is an example you might call DEFINKEY.BAT:

```
prompt $e[0;%1;%2;%3;13p
prompt
```

Then, the command sequence

```
DEFINKEY 68 "DIR /p"<RETURN>
```

will achieve the same results as the more complicated example above. This method can allow strings of up to 8 words (alphanumeric combinations separated by spaces) to be defined. (The %1 above is used to allow for the redefined key to be specified. %2 and %3 are for the two "words" in the string.) This .BAT file technique has limitations and may not save you much time.

Commands can also be added to an AUTOEXEC.BAT file to define several keys on start-up. In such situations, the full syntax prompt commands should be used to avoid confusion and to maintain consistency on each start-up.

This undocumented usage of the DOS prompt command has many possibilities limited only by a user's imagination or willingness to experiment. There is more to this "trick" than an alternative to key redefinition software. It is a demonstration of the real power of Microsoft DOS.

Appendix A

When redefining keys with prompt:

1. The new definitions will *not* be recognized by programs or applications that bypass DOS to get keyboard information. BASIC is an example.
2. Use of the prompt command without operators or arguments will not restore the original keyboard definitions. The system must be rebooted.
3. If keys are redefined with the prompt command in a .BAT file, the ECHO command must be on or the redefinitions will not be recognized.
4. After a sequence of redefinitions with prompt, the MS-DOS prompt itself must be redefined (as shown in the Basic section above) or the prompt command (without operators) must be entered. Otherwise, there will be no prompt at the MS-DOS command level and the cursor will blink at the far left column.

Appendix B

Key values used for redefining keys with prompt:

F1 = 59 F2 = 60 F3 = 61 F4 = 62 F5 = 63
F6 = 64 F7 = 65 F8 = 66 F9 = 67 F10 = 68

(continued)


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Shift-F1 = 84 Shift-F2 = 85 Shift-F3 = 86 Shift-F4 = 87
Shift-F5 = 88 Shift-F6 = 89 Shift-F7 = 90 Shift-F8 = 91
Shift-F9 = 92 Shift-F10 = 93

Ctrl-F1 = 94 Ctrl-F2 = 95 Ctrl-F3 = 96 Ctrl-F4 = 97
Ctrl-F5 = 98 Ctrl-F6 = 99 Ctrl-F7 = 100 Ctrl-F8 = 101
Ctrl-F9 = 102 Ctrl-F10 = 103

Alt-F1 = 104 Alt-F2 = 105 Alt-F3 = 106 Alt-F4 = 107
Alt-F5 = 108 Alt-F6 = 109 Alt-F7 = 110 Alt-F8 = 111
Alt-F9 = 112 Alt-F10 = 113 Alt-1 = 120 Alt-2 = 121
Alt-3 = 122 Alt-4 = 123 Alt-5 = 124 Alt-6 = 125
Alt-7 = 126 Alt-8 = 127 Alt-9 = 128 Alt-0 = 129
Alt-- = 130 Alt-= = 131 Alt-A = 30 Alt-B = 48
Alt-C = 46 Alt-D = 32 Alt-E = 18 Alt-F = 33 Alt-G = 34
Alt-H = 35 Alt-I = 23 Alt-J = 36 Alt-K = 37 Alt-L = 38
Alt-M = 50 Alt-N = 49 Alt-O = 24 Alt-P = 25 Alt-Q = 16
Alt-R = 19 Alt-S = 31 Alt-T = 20 Alt-U = 22 Alt-V = 47
Alt-W = 17 Alt-X = 45 Alt-Y = 21 Alt-Z = 44

Home = 71 UpArrow = 72 PgUp = 73 Left Arrow = 75
End = 79 DnArrow = 80 PgDn = 81 Right Arrow = 77
Ins = 82 Del = 83

Ctrl-PrtSc = 114 Ctrl-Left Arrow = 115 Ctrl-End = 117
Ctrl-Home = 119 Ctrl-Rght Arrow = 116 Ctrl-PgUp = 132
Ctrl-PgDn = 118

ibm.pc/other #19, from richard [Richard Shuford]:
a comment to 18

One minor point: the lowercase "p" at the very end of the prompt command is a vital part of the redefinition command, not just part of the sequence to insert a carriage return.

A lot can be done with this style of keyboard redefinition. Long ago I devised a batch file that used this mechanism to change the QWERTY keyboard arrangement to a Dvorak layout (",.pyfgcrl arrangement). If anyone is interested in seeing it, I could post it in this conference.

ibm.pc/other #20:
a comment to 18

Another user added that there is no requirement to use prompt to redefine your keys. He places all his DOS key redefines in a file and then TYPEs the file. This allows him to have several different files with a couple of different key redefines.

ibm.pc/other #26, from richard:
a comment to 20

Quite true. You do not have to use prompt to redefine your keys. But I have found it quite a bit safer. When you put the naked Escape sequences into a file, then later forget what is in that file and issue the TYPE command to examine it, you can end up redefining your keyboard when you don't want to. This can be either annoying or disastrous, depending on what else you are doing at the time. The limited environment space establishes a limit on how many keys can be redefined at a given time. My Dvorak-layout redefinition fills up the space. Once I inadvertently executed the redefinition batch file twice in a row, causing the machine to hang in never-never land. Since that time, I have been careful about executing keyboard redefinitions, although I do execute them every day.

ibm.pc/other #27, from brucester [Bruce McPherson, McPherson Consulting Inc.]:
a comment to 26

You must have the device driver ANSI.SYS installed to allow you to use all these nice features. And another point not mentioned in message #18 was the fact that you must put 00 before all extended scan codes. You *must* be careful, because if you aren't, you can redefine the regular keys on your keyboard and then you're really in trouble!

MACINTOSH

In the Macintosh conference, most of the discussions involve questions and answers to individual problems. This month, we summarize topics such as software packages, public-domain programs, use of a RAM disk, and difficulties with fonts.

SOFTWARE PACKAGES

macintosh/software #27, from bbayer [Barry Bayer]

Has anyone experience with a program called REDRYDER?

macintosh/software #28, from russwin [Russ Winslow]:
a comment to 27

Red Ryder is a program written by Scott Watson who describes it as "a user-supported asynchronous modem communications program for the Apple Macintosh." It seems to be the general consensus that it is the best of its type around. Red is presently in beta test for version 6.0 at the E level (just out), but the C level is perhaps the most solid at the moment (D never came out). There is a "procedure" feature that allows the user to write his own instructions to Red, actually a mini-language that allows one to automate command sequences ranging from simple two-liners (dial up) to complex programs that can automate whole sessions. Red supports XMODEM, Kermit, and ASCII protocols and knows how to deal with the new MacBinary format (goodbye, binhex). Supported emulations are TTY, VT-100 and VT-52.

There is a "Macro Key" feature that allows you to program 10 function keys at a time and record them in files. These support short (40-character) keystroke sequences (which can also be used to call up the larger Procedure files).

Lots of other good stuff, not the least of which is the extensive documentation (60+ pages), the price (he asks $40), and the great support. [Editor's note: You can download Red Ryder from BYTEnet Listings at (617) 861-9764 or from BIX, or you can obtain it from The FreeSoft Company, 10828 Lacklink St., St. Louis, MO 63114, (314) 428-8057.]

XLISP

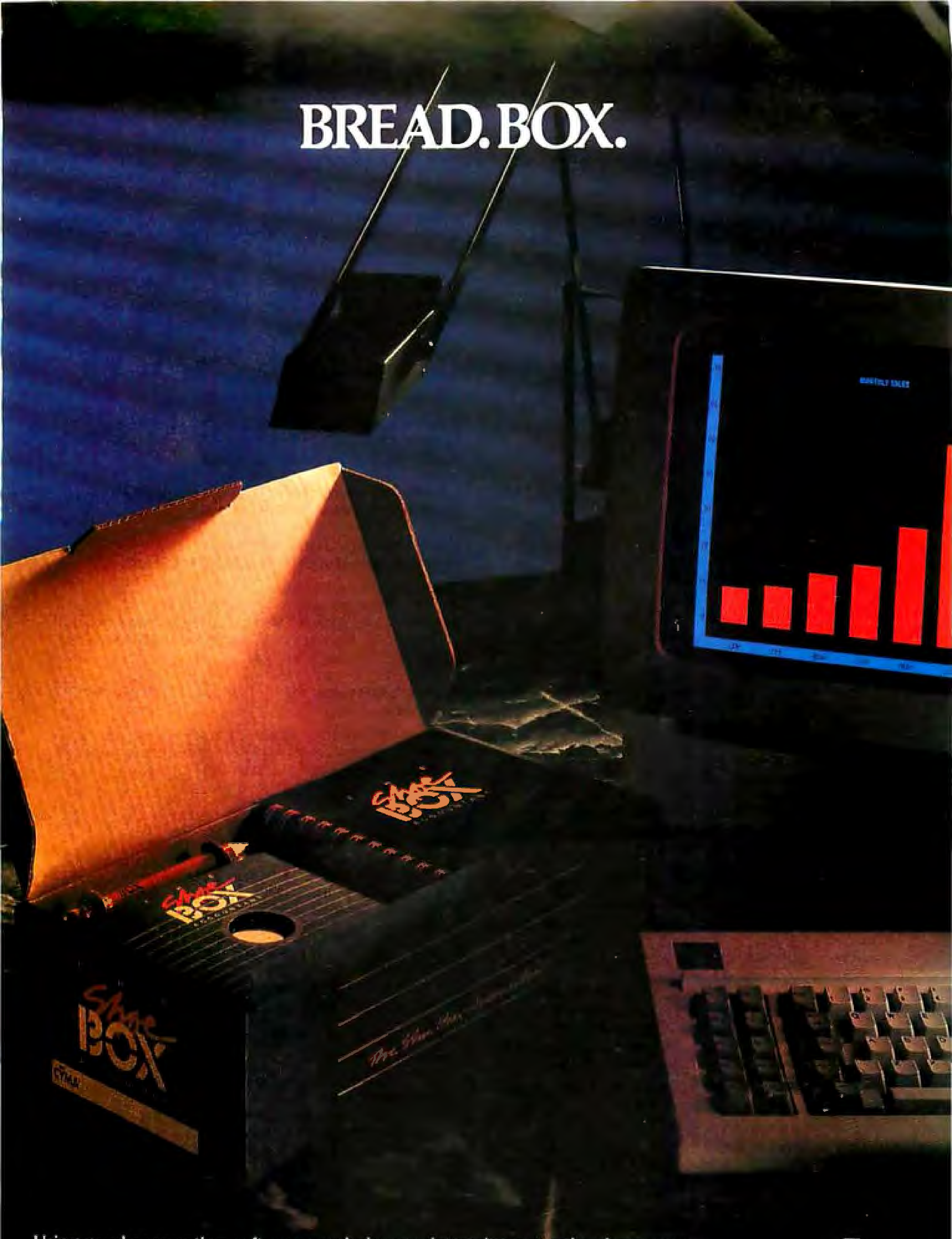
Next, a user asks David Betz (dbetz) about his public-domain XLISP program, particularly its use on 128K-byte Macs.

macintosh/software #51, from dbetz [David Betz]

It turns out that version 1.4 didn't work very well on a 128K Mac either. Version 1.5 fails immediately instead of allowing you to work for a while and then fail. XLISP really needs about 128K of its own to play with. The 128K Mac only allows about 80K for applications programs. I recommend 512K for any version of XLISP. Also, all of the sample LISP code is also on my BBS system. I will upload it also when the upload facility works.

In the next message, David discusses a forthcoming version of XLISP.

(continued)


BREAD. BOX.

macintosh/software #52, from dbetz

XLISP version 1.6 hasn't been released yet. I have distributed a prerelease version for both the Macintosh and the IBM PC, but the final version is still being developed. If you have any suggestions as to what should be included, let me know soon.

RAM Disks on a 512K Mac

macintosh/software #53, from bbayer

TITLE: How to Use All That RAM?
Assume a 512K Mac, no external disk drive, no switcher installed, and a program that will run in a couple of hundred K or three. Let's also assume the product makes but modest data read/write but does bring in modules from disk.

The following are possible:

I. RAM disk loaded with
  A. System Folder
  B. System Folder and Application
  C. Application only
  D. Data Files only
II. TurboCharger

Which of these five possibilities is preferred?

macintosh/software #54, from chrisv [Chris Vagnini]:
a comment to 53

Barry—One thing that is usually *not* good is to put your data files on a RAM disk—unless you're only reading from them—since those are the only files you don't have on a real disk. The fastest, I've found, is to put the System, Finder, Imagewriter (if necessary), and the application on the RAM disk. There is not always room for this, though, so some other configuration would have to be used. Even just the System and Finder in RAM will speed things up a lot if there is no system on the disk you'll run the application from. (Otherwise, the application's disk will become the system disk every time you run it.) TurboCharger will speed things up, too, but it takes time before it "learns" which disk sectors will be used the most. I have not used it much, so I'm not sure exactly how fast it would get with continued use. Hope this helps.

macintosh/software #55 from michaelsouth [Michael South]:
a comment to 53

You usually have to have Finder and System on the same disk. When a program (on a disk) is launched (by Finder), that disk does not become the start-up disk (i.e., the disk whose System file is used) *unless* said disk has a copy of Finder on it.

I think it is possible to get around that, at least with Assimilation's Ramdisk. The idea is to create a RAM disk that has System and your application on it and sort of boot from it. You need two floppies, "A" and "B." "A" has on it System, Finder, Ramdisk, your application, and anything else you'll want in RAM. "B" has System and Finder.

1. Run Ramdisk on floppy "A." Choose "Create Automatically" option. Include System, application, and other files you want. Don't need to include Ramdisk, Finder, or Desktop.
2. Select (click on) the application in floppy "A." Choose "Set Startup" from Special menu. This will cause your application to become the start-up program on the *RAM disk*(!).
3. Now we want to delete Finder from floppy "A." We can only do this if it is not the current start-up disk.
   a. Open Finder on floppy "B" by Option-Command-double-clicking it. This will run it, making floppy "B" the start-up.
   b. Eject floppy "B," insert floppy "A," throw Finder away, and Empty Trash.

To use the RAM disk, reboot the computer using floppy "A." You'll be running the computer without its ever having sniffed a Finder. The consequence is that exiting your application program will kill the system (no Finder to exit to).

Binhex Files

In the question.answr topic, a user asks about the various types of binhex files (text-file representations of Macintosh applications that can be downloaded or uploaded) he's observed on bulletin-board systems.

macintosh/question.answr #20, from frankr [Frank Richards]

There are three generations of binhex floating around:

binhex3 makes/decodes ".hex" files.
binhex4 is ".hqx".
binhex5 uses ".bin" (will handle .hqx as well).

binhex.bas is freeware. [Editor's note: You can download binhex.bas from BYTEnet Listings at (617) 861-9764 or from BIX.]

Fonts with MacTerminal Files

macintosh/question.answr #44, from szpak [Mark Szpakowski]

TITLE: Default Font in MacWrite
This also relates to MacTerminal. Let's say I capture text with MacTerminal, then want to edit it with MacWrite: What is the default font used with MacTerminal, and what's the best way to get MacWrite to match it? Geneva 10 point comes close, but it's still not quite the same.

macintosh/question.answr #45:
a comment to 44

A BIX user responds that if you have the Resource Mover, you can copy the MacTerminal font into the System font resource for general use by all applications. The Resource Editor won't do the job, since you need to name the font in order to have it appear in a menu.

Alternative Screen Buffer

In the tech.talk conference, Michael South raises a question about using the alternate screen buffer: He gets a number of responses that also raise the question of good programming techniques.

macintosh/tech.talk #50, from michaelsouth

TITLE: Finder Launch with 2nd Screen Page
Is there any way to make Finder launch a program with the "Reserve 2nd screen page" bit set?

I saw a trick in a MacAsm demo for making an application relaunch itself with the bit set, but wondered if there was a way to do it in Finder.

macintosh/tech.talk #51, from ephraim [Ephraim Vishniac]:
a comment to 50

"Is there any way to make Finder launch a program with the 'Reserve 2nd screen page' bit set?"

Even if there is, please don't do it! Your program won't run on a Mac XL or on future Macintoshes. A friend of mine is currently attempting the Herculean task of making Megaroids (the only alternate screen program I know of) run on an XL and >512K Macs. Authors can save people a lot of time by *not* building in what they know to be hardware dependencies.

macintosh/tech.talk #53, from frankb [Frank Boosman]:
a comment to 51

(continued)

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". . . [programs using the alternate screen buffer] won't run . . . on future Macintoshes. A friend of mine is currently attempting the Herculean task of making Megaroids (the only alternate screen program I know of) run on an XL and >512K Macs."

I hadn't heard that Apple was going to kill the alternate screen buffer in future Macintosh models, nor that they had issued guidelines to this effect.

As for Megaroids, why did the programmer hard-wire the locations in? The task wouldn't be "Herculean" if he or she hadn't. In fact, there would be no task at all, as I understand it.

"Please don't do it."

Sorry, but people are doing it already. I've seen demos of prototype stuff that blew other animation out of the water. QuickDraw is just too slow in some circumstances to do it any other way. I wouldn't hesitate to, if it meant the difference between smoothness and flicker. . .

macintosh/tech.talk #54, from ephraim:
a comment to 53

In the document "Future Macintosh Architectures" (part of the May software supplement), Apple had a list of questions for developers to ask themselves. Negative responses to the questions indicated probable portability problems. One of the questions was something to the effect "Do you use the alternate screen buffer?" They went on to explain that it was not available on the XL and might not be available on future Macs.

The suggested technique for avoiding flicker is to draw into a nonscreen area, then block-copy into the real screen after syncing with the clock tick.

Megaroids is a difficult problem because the authors did several things that affect portability. One, they used the alternate screen buffer. Also, they used fixed addresses for both the real and alternate screens.

macintosh/tech.talk #55, from michaelsouth:
a comment to 53

I was toying with the idea of using the second screen buffer in order to generate 4-shade gray. Two ticks with page 1, one tick with page 2, which would make page 1 twice as bright as page 2. Of course, if you don't like flicker. . .

128K ON A 512K MAC?

macintosh/tech.talk #56, from ccrawfor [Chris Crawford]

Here's a cute problem I have for which I would appreciate other people's suggestions: I have been using a 128K Mac and have refrained from fattening it because the software I develop must run on a 128K Mac. However, I am getting sick of putting up with skinniness, especially with the price of fattening falling so low. What I would like to have is a Fat Mac that can be made to act like a skinny Mac when I need to test my software.

The first (apparent) solution is to fool the Memory Manager by changing a system global. There is the system global MemTop that points to the top of RAM. I'm not sure I trust this solution; how do I know that the value of MemTop was not used during cold start to set other values related to the operation of the heap? Setting MemTop *after* everybody else has used it may be an exercise in futility. That damn memory manager is just too messy for me to be confident that such a scheme would produce trustworthy test results.

Another strategy is to use some software to fabricate a 128K Mac. For example, Switcher might be used to create a 128K Mac. But how can I be sure that a Switcher segment with 128K allocated to it is functionally identical to a 128K Mac? Similarly, I could use a RAM disk, allocate all but 128K of RAM to the RAM disk, and treat the remainder as a "true" 128K Mac, but again there remains the problem of certitude. Who knows *what* that RAM-disk software is doing? Who knows exactly how much RAM is being used? If either of these two solutions yields a machine with 128K bytes plus, say, a hundred extra bytes, I could ship software that will crash on a regular 128K Mac. Not acceptable!

A third solution I am considering involves a hardware modification. I have asked the techs at the fattening shop if they can devise a simple switch that disables the extra RAM. They seem to think that it's a simple matter of disabling some decoding lines by pulling them high, and that certainly makes sense to me. Two things bother me: (1) How do you disable ¾ of single chip? and (2) I am reluctant to desecrate my Mac with wires and holes in the case and so forth.

Does anybody have any good ideas on this problem?

macintosh/tech.talk #57, from ephraim:
a comment to 56

You're quite right that setting MemTop after the system is up does not give a good 128K simulation. Two problems come to mind immediately: First, the size of the system heap is set during boot depending on the size of memory. So, you'd have a "fat" system heap, but a "skinny" application heap. Second, the screen wouldn't be adjacent to (and taken from) the application heap space. So, your application heap wouldn't be quite the right size either.

A hardware solution seems like the only airtight one.

macintosh/tech.talk #58, from billt [Bill Tuttle]:
a comment to 56

If you have FEdit 3.0 or Apple's old disk utility program, they will write 128K boot blocks to a disk, which when booted will look like a 128K Mac. The Apple utility program does this by holding the option key when you select Write Boot Blocks. I don't remember how FEdit works, but it's in the documentation on it.

macintosh/tech.talk #59:
a comment to 56

A BIX user responds:
Do you have to continue writing for 128K Macs? In the most recent wave of new product announcements, Apple quietly discontinued the 128K Mac. Granted, there are a lot of 128K machines out there, but there is already great pressure on them to upgrade if they want any new software.

macintosh/tech.talk #60, from ccrawfor:
a comment to 58

Thanks for the pointer—I found the documentation on it and the software in the pile of stuff went with the Software Supplement. Looks like you have saved me a passle of trouble! (Maybe I ought to read the documentation next time.)

macintosh/tech.talk #61, from ccrawfor:
a comment to 59

We seriously considered changing the specs for my software to drop the Skinny Mac, but after much humming and hawing we decided to stay with the 128K limit. Two factors entered into this: (1) the belief that many (most?) Macs were purchased before Fat Mac was available and (2) a suspicion that only the elite 30 percent of Skinny Mac owners are fattening their Macs. Nobody knows the real fraction, of course, and it is bound to increase substantially by the time any newly initiated project reaches the marketplace, but none of us felt like betting the farm on such guesswork. ■

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CHORUS

Inquiry 63

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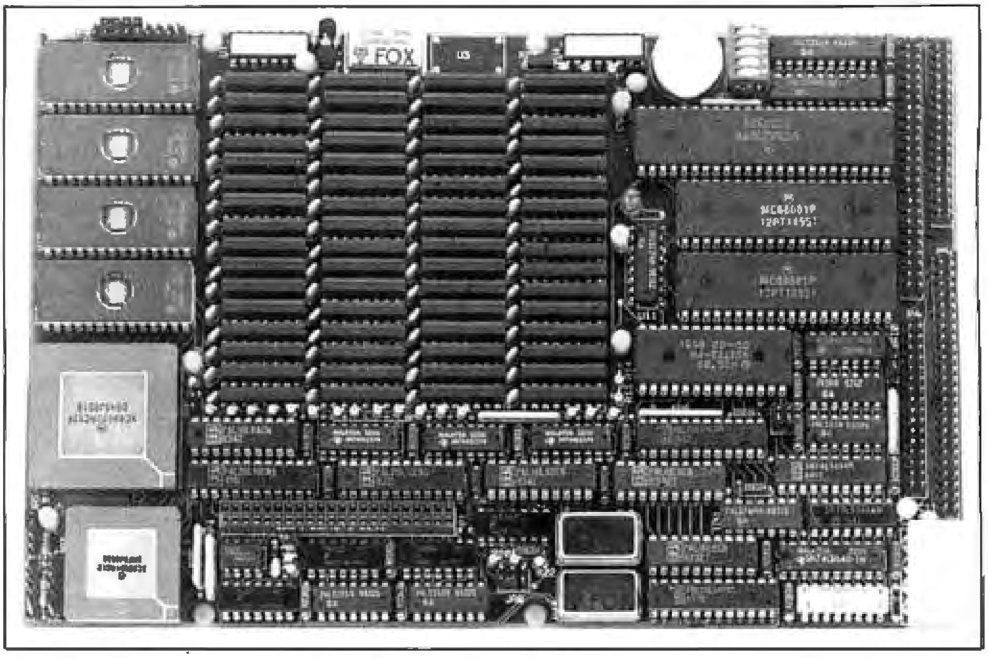
NEW SYSTEMS

Single-Board 68020 System

GMX Micro-20 is a single-board computer based on a 12.5-MHz Motorola 68020 microprocessor. It comes with 2 megabytes of 32-bit wide RAM, up to 256K bytes of 32-bit wide EPROM, and a 5¼-inch floppy-disk controller. It has four serial ports, an 8-bit parallel port, a SASI peripheral interface, and a 16-bit expansion connector for additional I/O interfaces. An MC68881 floating-point processor is optional.

The board measures 8.8 by 5.75 inches and uses the same power connector and supply voltages as a standard 5¼-inch floppy-disk drive. Included with the system are a second board that provides RS-232C level translation and four DB-25 connectors for the serial ports, and a PROM with Motorola's 020Bug monitor/debugger and hardware diagnostics. A PROMable operating system is optional; both the UniFLEX and OS-9 operating systems are available. The GMX Micro-20 costs $2750. For more information, contact GMX Inc., 1337 West 37th Place, Chicago, IL 60609, (312) 927-5510.
Inquiry 565.


The GMX Micro-20 single-board computer.

Transportable AT from Corona

The Corona ATP transportable computer from Corona Data Systems is an IBM PC AT-compatible personal computer based on an 8-MHz Intel 80286 microprocessor with no wait states. It comes in two configurations: The ATP-8-Q includes 512K bytes of RAM and a 1.2-megabyte floppy-disk drive; the ATP-8-Q20 has 512K bytes of RAM, a 1.2-megabyte floppy-disk drive, a 20-megabyte hard disk with an 83-millisecond access time, and an AT-compatible hard-disk controller. Both models have a built-in floppy-disk controller, a parallel port, an RS-232C serial port, and a socket for an 80287 floating-point math coprocessor. There are three AT-compatible expansion slots and two XT-compatible slots.

A 9-inch green-phosphor, nonglare screen is built into the system. It has a 640- by 400-pixel graphics resolution and a 16 by 13 dot-matrix character font in a 16 by 16 dot-matrix cell. Both the ATP-8-Q and ATP-8-Q20 include a color/monochrome video graphics card, so you can add a color monitor, and an AT-style detachable keyboard with an XT interface.

The Corona ATP is 18.8 by 9.6 by 19.8 inches and comes with MS-DOS 3.1 and GW-BASIC 3.1. The ATP-8-Q costs $4286, while the ATP-8-Q20 is $5595. Contact Corona Data Systems Inc., 275 East Hillcrest Dr., Thousand Oaks, CA 91360, (805) 495-5800.
Inquiry 566.

IBM Compatibles from Osborne

Osborne Computer Corporation has introduced three personal computers: the Osborne 2000 PC-Kit, the Osborne 2100, and the Osborne AT. The Osborne 2000 PC-Kit includes an IBM PC-compatible motherboard, a desktop PC-style case, a power supply, and a keyboard. The motherboard has a 4.77-MHz Intel 8088 microprocessor, 64K bytes of RAM, a serial port, and a floppy-disk controller. The system costs $699. Floppy-disk drives, memory upgrades, video boards, and microprocessor upgrades are available separately.

The Osborne 2100 is an IBM PC XT-compatible computer based on a 4.77-MHz 8088. It has 256K bytes of RAM, built-in parallel and serial ports, and five expansion slots. One of those slots is occupied by a multi-output color-graphics card that operates with RGB, composite, or monochrome monitors. With two 360K-byte 5¼-inch floppy-disk drives, the system costs $1695; with a 10-megabyte hard disk, it's $2395. A NEC V20 CP/M emulator package runs with both the Osborne 2000 PC-Kit and the Osborne 2100; the package includes a NEC V20 CPU chip that replaces the standard 8088 and a software CP/M emulator that lets you run CP/M 2.2 while in MS-DOS, so you can run most CP/M-80 software. The V20 emulator package costs $99.

The Osborne AT is an IBM

(continued)

NEW SYSTEMS

PC AT-compatible personal computer that comes with your choice of a 6- or 8-MHz Intel 80286 microprocessor. The system has 512K bytes of RAM expandable to 1 megabyte on the motherboard, a serial and a parallel port, seven AT-c mpatible slots, three PC-compatible slots, and a real-time clock. It also has a 1.2-megabyte 5¼-inch floppy-disk drive and a keyboard. The Osborne AT is bundled with MS-DOS 3.1 and costs $2995. With a 20-megabyte hard disk, it costs $4295. For more information, contact Osborne Computer Corp., 42680 Christy St., Fremont, CA 94538, (415) 490-6885.
Inquiry 567.

Victor Announces 80286 Machine

The Victor V286 is an 80286-based IBM PC AT-compatible computer. The base model, with one 1.2-megabyte floppy drive, 512K bytes of RAM, one parallel and two serial ports, MS-DOS 3.1, and GW-BASIC, retails at an introductory price of $1995. Adding a 20-megabyte hard disk brings the system price up to $2995. Neither system includes a monitor or a video controller.

For further information, contact Victor Technologies Inc., 380 El Pueblo Rd., Scotts Valley, CA 95066, (408) 438-6680.
Inquiry 568.

PERIPHERALS

Modems from Kyocera

Kyocera International has introduced the 1200S stand-alone and the 1200D plug-in card 1200-bps modems for the IBM PC, XT, AT, and compatible personal computers. Both have auto-dial, auto-answer, dial-tone/busy-tone detection capability, and the ability to redial a busy number up to nine times.

The modems come with Microsoft Corporation's Access, a communications software package that uses the X.PC protocol, which lets you connect up to 15 channels through one telephone line. Access has built-in interfaces for several information services, including Dow Jones News/Retrieval, CompuServe, and NewsNet. It also lets you have up to eight working windows on your screen at any time.

The Kyocera 1200S stand-alone unit with Access, an RJ-11 telephone cable, an RS-232C cable, and an AC adapter costs $665. The Kyocera 1200D plug-in card comes with Access and an RJ-11 cable for $495. The modems are also available without software: the 1200S is $495 and the 1200D is $345. An acoustic coupler costs $75. The prices listed include a manual and a two-year limited warranty. Contact Kyocera International Inc., 8611 Balboa Ave., San Diego, CA 92123, (800) 235-1222.
Inquiry 569.

Tools for Microcomputers

MicroComputer Accessories is offering the PC Tool Kit, a collection of 11 tools designed for personal computer repair and maintenance. The kit includes a ¼-inch nut driver with a 3½-inch handle, a 3/16-inch nut driver with a 3½-inch handle, a number 1 Phillips screwdriver with a 3-inch handle, a number 0 Phillips screwdriver with a 2-inch handle, a 3/16-inch flat screwdriver with a 3-inch handle, a ⅛-inch flat screwdriver with a 2-inch handle, a T-15 Torx driver with a 3-inch handle (for Compaq computers), a pair of 4¾-inch tweezers, a 5-inch 3-prong part retriever and extracter, an IC inserter/extracter, and an extra parts tube.

The kit comes in a black vinyl case and costs $29.95. Contact MicroComputer Accessories Inc., 5721 Buckingham Parkway, POB 3725, Culver City, CA 90231, (213) 641-1800.
Inquiry 570.

Double-Sided External Drive for Macintosh

Haba Systems introduced the HabaDisk 800, an external dual-sided 800K-byte floppy-disk drive for the Macintosh. It costs $599.95. For more information, contact Haba Systems Inc., 6711 Valjean Ave., Van Nuys, CA 91406, (818) 901-8828.
Inquiry 571.

Compact Disk Storage System

Tecmar Inc.'s CD Massfile is a CD-ROM drive for the DEC Rainbow, IBM PC, and compatible personal computers. The drive reads disks using the Sony-Phillips physical standard, which means that up to 550 megabytes of information can be stored on and retrieved from a single 4.72-inch compact disk. CD Massfile's average access time is 1.5 seconds with an error rate of 1 bit per 10^{12}.

You can connect one or two CD Massfiles to a computer using one controller card. The CD Massfile costs $1695; the controller card costs $295. For more information, contact Tecmar Inc., 6225 Cochran Rd., Solon, OH 44139, (216) 349-0600.
Inquiry 572.

IBM Disk Drive for DEC Computers

Suitable Solutions' IDRIVE is an external floppy-disk drive for the DEC Rainbow that lets the machine read and write IBM PC- and XT-compatible disks. Using this 48-tpi double-sided disk drive, Rainbow owners can use and produce IBM-format 8- or 9-sector, single- or double-sided disks without reformatting or transferring files.

The IDRIVE uses the Rainbow's C and D drive floppy-disk controller slot; it will run in conjuction with a hard disk. Installation of the IDRIVE requires MS-DOS version 2.05 or higher. The drive costs $395. Contact Suitable Solutions, 467 Saratoga Ave., Suite 319, San Jose, CA 95129, (408) 725-8944.
Inquiry 573.

(continued)

Announcing a radical new idea in PC-AT programming:

FREEDOM

Alsys Ada Compiler for the 80286 Defeats the Tyranny of 640K DOS; Liberates the Full 16MB Memory Capability of the Processor

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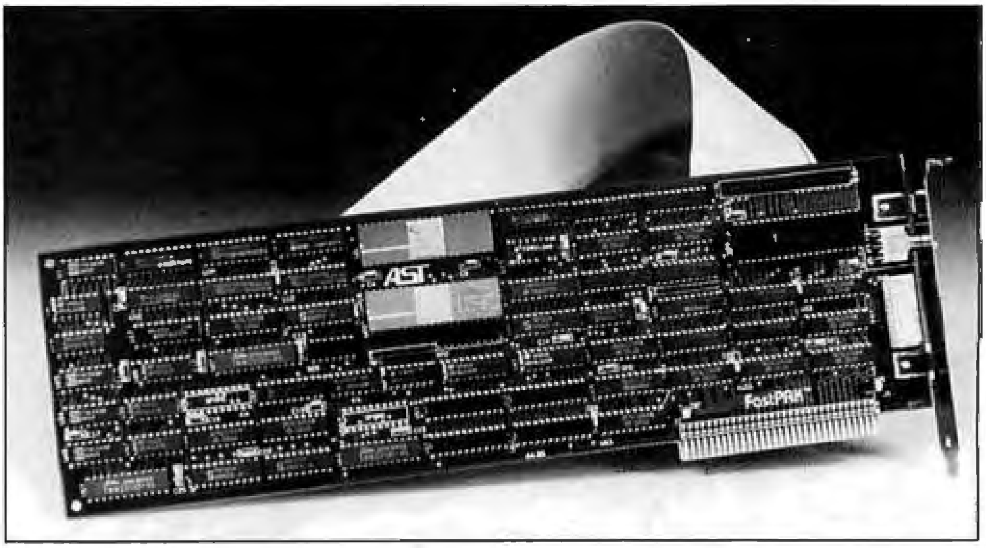
ADD-INS

Half-Card 2400-bps Modem

OmniTel's Encore 2400HB is a 2400-bps internal modem for the IBM PC and compatible personal computers. This 5- by 4-inch short-card modem uses the AT command set and is fully compatible with the Hayes Smartmodem 1200B and 2400 internal modems, the V.22 *bis* standard, and the Bell 212A/103 standard. It has automatic dial and answer capabilities, call progress reporting, and automatic speed selection and fallback.

The Encore 2400HB will run at 300 bps, 1200 bps, or 2400 bps. It has its own microprocessor, and COM ports 1 through 4 are addressable. With a two-year warranty and the Relay communications software package, the Encore 2400HB costs $695. Contact OmniTel Inc., 3090 Oakmead Village Dr., Santa Clara, CA 95051, (408) 986-8236.

Inquiry 574.



AST's *FastPak speed-up card.*

8086 Powers Speed-up Card

AST Research's FastPak is an IBM PC and PC XT add-in card based on a 9.54-MHz Intel 8086 microprocessor. Designed to speed up a standard 8088-based PC, the FastPak includes the new generation of Expanded Memory Specification software and provides a socket for an Intel 8087 numeric coprocessor.

The board has an 8K-byte "two-set" cache that creates two buffers to hold portions of active applications programs. When a block of code is called, the cache system checks to see if it is in one of the buffers, thereby reducing the number of times the 8086 has to read code or data from the PC system memory.

FastPak has a switch that lets you move between FastPak 8086 operation and standard 8088 mode. This insures compatibility with applications software that was designed specifically for the 8088's cycle rate.

FastPak costs $495. For more information, contact AST Research Inc., 2121 Alton Ave., Irvine, CA 92714, (714) 863-1333.

Inquiry 575.

68020 Single-Board Computer Plugs into IBM PC

The IS-68020PC from Intelligent Software is a single-board computer that you can plug into an IBM PC or AT slot. The board is based on a Motorola 68020 microprocessor running at 16.7 MHz. It has half a megabyte of RAM and up to 64K bytes of ROM with 25 I/O lines and two RS-232C ports. A socket provides for an optional 68881 floating-point coprocessor.

The system works either as a direct plug-in board or through a serial link from an MS-DOS host computer. It has debugging tools that work in conjuction with the host PC to provide an evaluation or applications development system. The board works with the Quelo cross-assembler, the Lattice C cross-compiler package, and other development utilities. Files are stored on the host computer's drives.

The IS-68020PC has a processor bus interface with all control signals usable, hardware bus-error handling, interrupt acknowledge and auto-vectoring support, and 128-byte FIFO for PC communication or buffered I/O in the single-board configuration. It costs $3900. Contact Intelligent Software Inc., POB 533, Old Greenwich, CT 06870, (203) 359-5763.

Inquiry 576.

SCSI Controller Interface Card

CMS Inc.'s host adapter card provides an interface between an IBM PC XT, PC AT, or compatible personal computer and up to two disk controllers by using the SCSI (small computer system interface) protocol. The 5- by 3.9-inch card uses one IBM PC I/O slot and interfaces to the host computer via a gold-plated edge connector. It connects to internal drives through a 50-pin header strip or to external SCSI cable through a 25-pin D-subminiature connector.

The host adapter uses 8-bit memory-mapped I/O to communicate with the host and the SCSI protocols to communicate with the SCSI controllers. It has nonvolatile static RAM, EEPROM, and EPROM to let the host computer detect and pass information to and from an SCSI controller. The card costs $99. Contact CMS Inc., 401-B West Dyer Rd., Santa Ana, CA 92707, (714) 549-9111.

Inquiry 577.

(continued)

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Inquiry 374

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C-919

SOFTWARE • IBM PC

MIDI Modules for the IBM PC

Sight & Sound's MIDI Ensemble lets you use an IBM PC and MIDI equipment to record and refine music performances. The package has three main modules: Recorder, Event Editor, and Phrase Editor.

Recorder lets you record and overdub tracks as if using a multitrack tape machine; 255 tracks are available. This module provides automated punch-in and punch-out, phrase markers, a programmable metronome, timing and tempo controls, and interfaces to external controllers.

After recording, you can use Event Editor to display the music and insert, remove, or change notes. The entire 88-note range of pitch can be displayed on the screen. Your selected note or chord is shown on a set of staff lines on the left side of the screen or pictured on an 88-note keyboard at the bottom of the screen.

With the Phrase Editor, you can specify the beginning and end points of music segments and then move, copy, delete, combine, and modify segments. Phrases can be any length, from an entire track to a part of a measure. This module can automatically correct timing errors.

Hardware requirements are an IBM PC or compatible with at least 256K bytes of memory and DOS 2.0 or later, a standard color or monochrome graphics card (color card required for the Event Editor), a Roland DG MPU-401 processing unit, and a Roland DG MIF-IBM interface card. MIDI Ensemble costs $495. Contact Sight & Sound Music Software Inc., 3200 South 166th St., New Berlin, WI 53151, (414) 784-5850.
Inquiry 578.

Regression Modeling

Goodness-of-Fit is an interactive modeling package containing procedures for simple linear and nonlinear regression, stepwise multiple regression, probit regression, principal components analysis, and multicollinearity diagnostics.

You use the program's command processor to perform transformations and design your analysis. It's similar to a word processor but has features intended to facilitate regression procedures. A data manager lets you enter, edit, print, merge, and reformat data files, which are stored in sequential ASCII format.

Transformations can be performed using standard algebraic equations. The program is capable of trigonometric functions, differencing, lagging, sorting, and creating dummy variables.

Goodness-of-Fit runs on an IBM PC, XT, or AT with 128K bytes and two disk drives. It lists for $195. Contact Walonick Associates, 6500 Nicollet Ave. S, Minneapolis, MN 55423, (800) 328-4907; in Minnesota or Canada, (612) 866-9022.
Inquiry 579.

Simulation Language

TurboSim is a language that lets you run large discrete-event simulations on an IBM Personal Computer. Applications include the modeling of manufacturing, distribution, health-care, and information systems.

The program uses Borland International's Turbo Pascal to compile source code into machine-language instructions. TurboSim automatically generates a final report. You can have it provide additional statistics, histograms, and plots, and it can run multiple simulations in an unattended mode.

To use the software, you need Turbo Pascal and an IBM PC with at least 64K bytes of memory. TurboSim sells for $49.95, comes on an unprotected disk, and includes source code, sample programs, and a manual. Contact Micro Simulation, 37 William J. Heights, Framingham, MA 01701, (617) 875-6098.
Inquiry 580.

Circuit Analysis with Single-Element Response

An automated circuit-analysis program for the IBM PC, XT, AT, and compatibles, mCAP implements both nodal and mesh analysis methods in finding solutions to network equations. You have to assign only the node voltages or mesh currents for the network solution. The program then prompts for all entries, which are made from the keyboard, by graphically displaying the circuit elements on the monitor.

Networks can contain resistors, capacitors, inductors, independent and dependent voltage and current sources, operational amplifiers, and linear and ideal transformers. Among mCAP's other features are frequency response, power and power factor correction, delta-wye transformations, and complex arithmetic for AC analysis. Single-element response for DC analysis lets you analyze the circuit response as one element in the array is allowed to vary.

The software costs $395; a demo disk is $15. For more information, contact Techni-Soft Inc., POB 98017, Dept. 112, Baton Rouge, LA 70898, (504) 767-4798.
Inquiry 581.

MIT's UnkelScope

Unkel Software's UnkelScope is a laboratory tool developed at MIT's Department of Mechanical Engineering. It's a data-acquisition, display, processing, and control package designed to save time in the lab by eliminating programming activities.

Level 1 of the software presents a menu-driven interface to take and display data in real time and store it for later analysis. Level 2 (used by students involved in MIT's Project Athena) adds experiment controls, process controllers, digital filtering, FFT-related functions, calibration, conversion, and algebraic operations.

The UnkelScope runs on the IBM PC series or compatible machines with a data-acquisition board from MetraByte, Tecmar, Data Translation, or IBM. It needs DOS 2.0 or later and at least 256K bytes of memory. The software works with an IBM graphics adapter or equivalent and the Hercules graphics card.

Level 1 sells for $325, and Level 2 for $495. Universities can get an unsupported copy of Level 2 for $100. Multiple-copy licenses and site licenses are available. A demo disk is free and requires no data-acquisition board. Contact Unkel Software Inc., 62 Bridge St., Lexin ton, MA 02173, (617) 861-0181.
Inquiry 582.

(continued)

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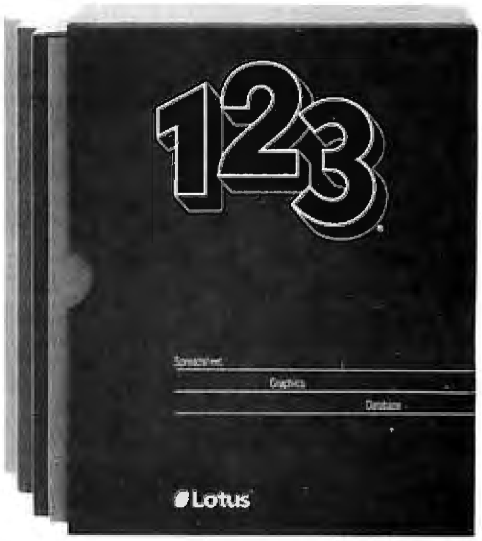

Suggested retail price of new 1-2-3 is $495. 1-2-3 Release 2 requires 256K of memory. The minimum memory requirement for 1-2-3 Release 1A is 192K.

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SOFTWARE • APPLE

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A programmable database compatible with dBASE III, dMac III lets you transfer applications written in dBASE to the 512K-byte Macintosh. The product has a programming language that lets you create dBASE-type applications. A built-in editor and a professional programming editor let you customize your programs and create your own databases.

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The program requires either two floppy-disk drives or a floppy and a hard disk. Retail price for dMac III is $495. The software was developed by Format Software GmbH of Cologne, West Germany, and is available from Datalogica, Matrix Plaza, 1964 Westwood Blvd., Los Angeles, CA 90025, (213) 475-0582.
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Symbolic Math

BrainPower's PowerMath for the Macintosh solves algebra and differential calculus problems, computes indefinite and definite integrals, solves simultaneous linear and nonlinear equations, computes Taylor series, and performs transcendental and logarithmic functions. You can also use it to solve matrix algebra problems, compute factorials, and plot expressions.

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PowerMath is unprotected and sells for $99.95. Although simple problems can be handled on the 128K-byte Mac, 512K bytes are recommended. Contact BrainPower Inc., 24009 Ventura Blvd., Suite 250, Calabasas, CA 91302, (818) 884-6911.
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SOFTWARE • OTHER COMPUTERS

Modula-2, Pascal for Atari 520ST

TDI has developed two packages for the Atari 520ST: a Modula-2 compiler and UCSD Pascal.

TDI Modula-2/ST is accessible from the GEM interface and comes with its own screen editor linked to the compiler. It supports the full GEM interface. Every piece of software written with this Modula-2 is a module and is split into two parts: a definition and an implementation. The definition describes exactly what the module does, which variables and procedures it is importing, and what it is exporting. Implementations of modules can be developed, debugged, and tested. They then become "software chips" that you can use within any software system.

TDI Modula-2/ST costs £195.

UCSD Pascal for the Atari comes with the p-System operating system, which contains the UCSD screen editor, file manager, and disk-recovery utilities. The compiler is the latest version from SofTech Microsystems and incorporates the key features of the language as defined by Niklaus Wirth, with extensions designed for systems developers and software writers. Among the features are multiple code pools, program segmentation, facilities for building in concurrency, and 36-digit packed BCD arithmetic implemented by long integers.

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Inquiry 585.

Technical BASIC

TransEra's TBASIC is a technically oriented BASIC for CAD, scientific, and engineering applications, with an emphasis on graphics and instrument control. It incorporates GPIB syntax and is designed to facilitate adaptation of software written for Hewlett-Packard and Tektronix engineering computers to the PC environment. The language runs under MS-DOS, PC-DOS, CP/M, and UNIX.

TBASIC's instruction set conforms to the ANSI proposed standard. Some of the features are cross-reference facilities for listing variables and referenced line numbers, a command for renaming program variables, MOVE and COPY commands designed to assign new line numbers intelligently, and syntax checking performed as lines are entered.

The language has a full set of binary, scalar, array, matrix, and scientific math functions as well as trig, transcendental, and other operations using both integer and double-precision floating-point data types. It also supports the 8087 coprocessor. Special-purpose array functions perform area, circumference, centroid, and other calculations for polygons.

TBASIC costs $495 for MS-DOS, PC-DOS, and CP/M; for most UNIX machines, it costs $795. Contact TransEra Corp., 3707 North Canyon Rd., Provo, UT 84604, (801) 224-6550.
Inquiry 586.

WHERE DO NEW PRODUCT ITEMS COME FROM?
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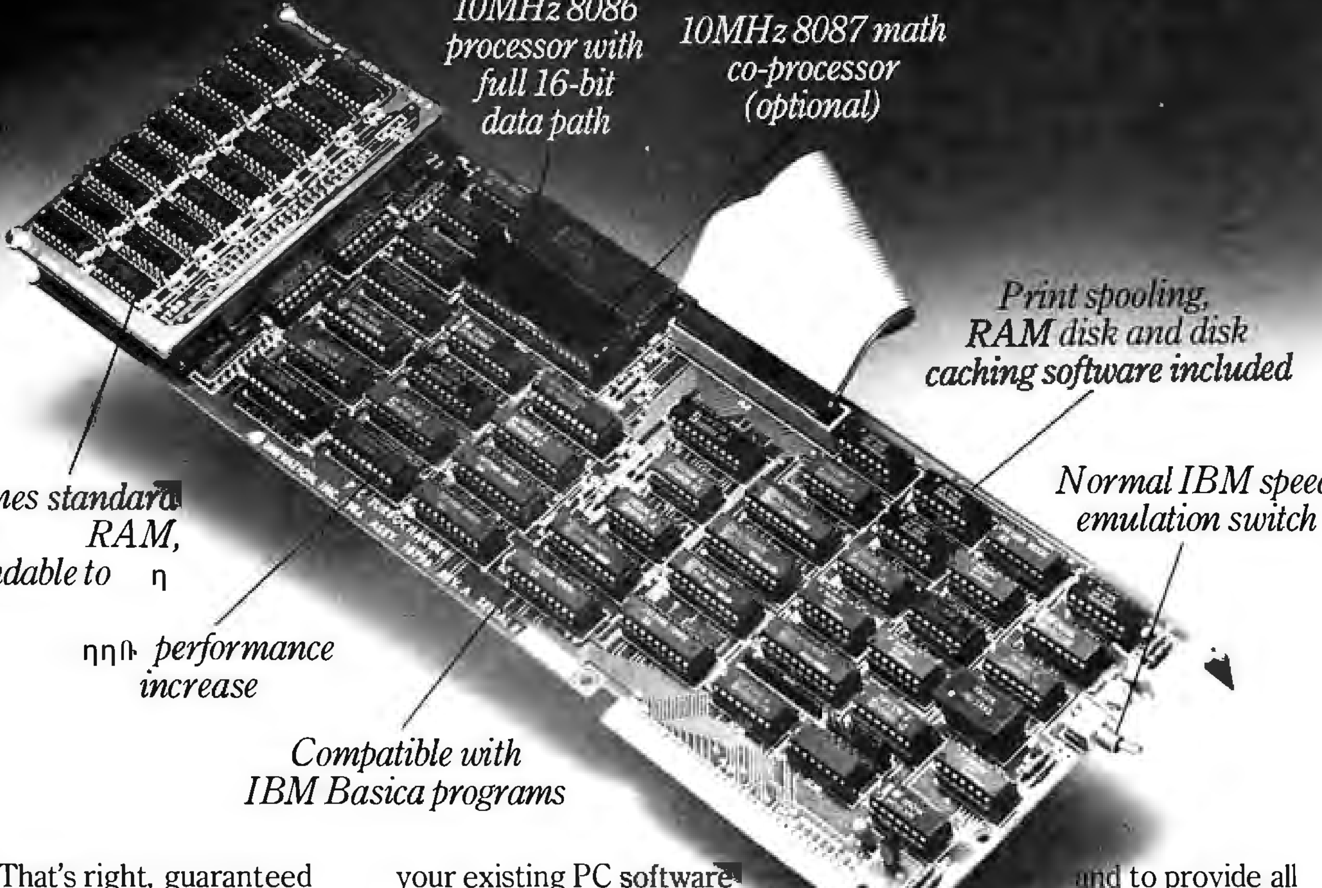

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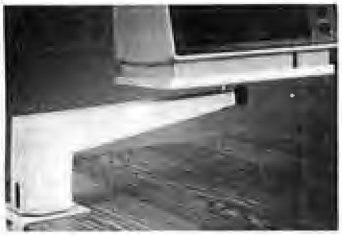

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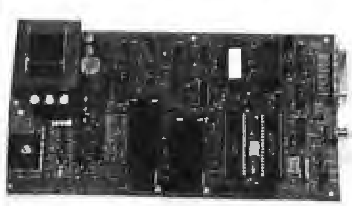

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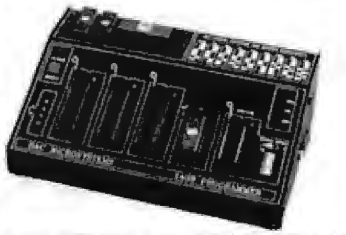

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HM6116LP-3	2K x 8	150ns	CMOS	3.49
HM6116LP-2	2K x 8	120ns	CMOS	6.49
Z-6132	4K x 8	300ns		29.95
HM6264P-15	8K x 8	150ns	CMOS	5.95
HM6264LP-15	8K x 8	150ns	CMOS	6.95
HM6264LP-12	8K x 8	120ns	CMOS	8.95

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TMS4027	4K x 1	250ns		1.45
UPD411	4K x 1	300ns		1.95
MM5280	4K x 1	300ns		1.95
MK4108	8K x 1	200ns		.49
MM5298	8K x 1	250ns		.49
4116-20	16K x 1	200ns		.79
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2118	16K x 1	150ns	5v	3.95
4164-25	64K x 1	250ns	5v	
4164-20	64K x 1	200ns	5v	
4164-15	64K x 1	150ns	5v	
41256-20	256 x 1	200ns		2.69
41256-15	256 x 1	150ns		2.89

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1702	256 x 8	1 us		3.95
2708	1K x 8	450ns		2.49
2758	1K x 8	450ns		5.90
2716	2K x 8	450ns	5v	2.95
2716-1	2K x 8	350ns	5v	3.95
TMS2516	2K x 8	450ns	5v	3.95
TMS2716	2K x 8	450ns		8.95
TMS2532	4K x 8	450ns	5v	3.95
2732	4K x 8	450ns	5v	2.95
2732 A-4	4K x 8	450ns	21v	2.95
2732 A-35	4K x 8	350ns	21v	3.95
2732 A	4K x 8	250ns	21v	5.95
2732 A-2	4K x 8	200ns	21v	8.95
2764	8K x 8	450ns	5v	3.95
2764-25	8K x 8	250ns	5v	4.95
2764-20	8K x 8	200ns	5v	5.95
TMS2564	8K x 8	450ns	5v	9.95
MCM68764	8K x 8	450ns	5v	17.95
MCM68766	8K x 8	350ns	5v	19.95
27128-45	16K x 8	450ns	5v	5.00
27128-30	16K x 8	300ns	5v	5.50
27128-25	16K x 8	250ns	5v	6.00
27256-25	32K x 8	250ns	14v	9.95

74LS00	.23	74LS125	.48	74LS260	.58
74LS01	.24	74LS126	.48	74LS266	.54
74LS02	.24	74LS132	.58	74LS273	1.45
74LS03	.24	74LS133	.58	74LS275	3.30
74LS04	.23	74LS136	.38	74LS279	.48
74LS05	.24	74LS137	.98	74LS280	1.95
74LS08	.27	74LS138	.54	74LS283	.68
74LS09	.28	74LS139	.54	74LS290	.88
74LS10	.24	74LS145	1.15	74LS293	.86
74LS11	.34	74LS147	2.45	74LS295	.98
74LS12	.34	74LS148	1.30	74LS298	.88
74LS13	.44	74LS151	.54	74LS299	1.70
74LS14	.58	74LS153	.54	74LS323	3.45
74LS15	.34	74LS154	1.65	74LS324	1.70
74LS20	.24	74LS155	.68	74LS352	1.25
74LS21	.28	74LS156	.68	74LS353	1.25
74LS22	.24	74LS157	.64	74LS363	1.30
74LS26	.28	74LS158	.58	74LS364	1.90
74LS27	.28	74LS160	.68	74LS365	.48
74LS28	.34	74LS161	.64	74LS366	.48
74LS30	.24	74LS162	.68	74LS367	.44
74LS32	.28	74LS163	.64	74LS368	.44
74LS33	.54	74LS164	.66	74LS373	1.35
74LS37	.34	74LS165	.94	74LS374	1.35
74LS38	.34	74LS166	1.90	74LS377	1.35
74LS40	.24	74LS168	1.70	74LS378	1.13
74LS42	.48	74LS169	1.70	74LS379	1.30
74LS47	.74	74LS170	1.45	74LS385	1.85
74LS48	.74	74LS173	.68	74LS386	.44
74LS49	.74	74LS174	.54	74LS390	1.15
74LS51	.24	74LS175	.54	74LS393	1.15
74LS54	.28	74LS181	2.10	74LS395	1.15
74LS55	.28	74LS189	6.90	74LS399	1.45
74LS63	1.20	74LS190	.88	74LS424	2.90
74LS73	.38	74LS191	.86	74LS447	.38
74LS74	.34	74LS192	.78	74LS490	1.90
74LS75	.38	74LS193	.78	74LS624	3.95
74LS76	.38	74LS194	.68	74LS640	2.15
74LS78	.48	74LS195	.68	74LS645	2.15
74LS83	.59	74LS196	.78	74LS668	1.65
74LS85	.68	74LS197	.78	74LS669	1.65
74LS86	.38	74LS221	.88	74LS670	1.45
74LS90	.54	74LS240	.94	74LS674	9.60
74LS91	.88	74LS241	.98	74LS682	3.15
74LS92	.54	74LS242	.98	74LS683	3.15
74LS93	.54	74LS243	.98	74LS684	3.15
74LS95	.74	74LS244	1.25	74LS685	3.15
74LS96	.88	74LS245	1.45	74LS688	2.35
74LS107	.38	74LS247	.74	74LS689	3.15
74LS109	.38	74LS248	.98	74LS783	23.95
74LS112	.38	74LS249	.98	81LS95	1.45
74LS113	.38	74LS251	.58	81LS96	1.45
74LS114	.38	74LS253	.58	81LS97	1.45
74LS122	.44	74LS257	.58	81LS98	1.45
74LS123	.78	74LS258	.58	25LS2521	2.75
74LS124	2.85	74LS259	2.70	25LS2569	4.20

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8035	5.90	8253-5	7.90
8039	5.90	8255	4.45
INS-8060	16.90	8255-5	4.90
INS-8073	29.90	8257	7.90
8080A	3.90	8257-5	8.90
8085	4.90	8259	5.90
8085A-2	11.90	8259-5	8.90
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8088	19.90	8275	28.90
8089	59.90	8279	6.90
		8279-5	7.90

8100

		8282	6.45
		8283	6.45
8131	2.90	8284	4.90
8155	6.90	8286	6.45
8155-2	7.90	8287	6.45
8156	6.90	8288	12.90
8185	28.90	8289	44.90
8185-2	38.90	8292	12.90

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8202	23.90
8203	38.90
8205	2.90
8212	1.75
8214	3.75
8216	1.75
8224	2.20
8226	1.75
8228	3.45
8237	12.90
8237-5	14.90
8238	4.45
8243	4.45
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8251	3.90
8251A	4.45

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8304	1.90
8307	2.90
8308	2.90
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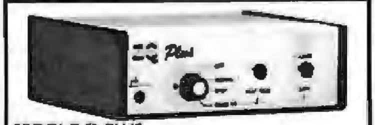

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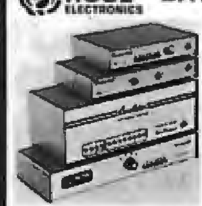

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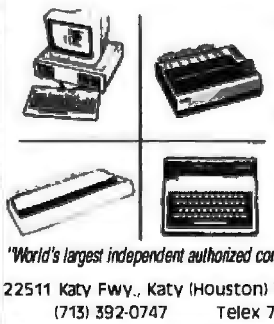

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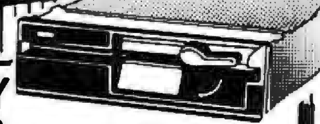

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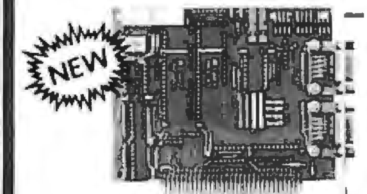

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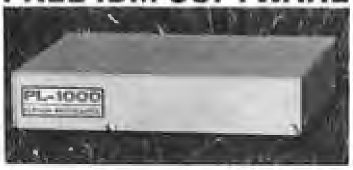

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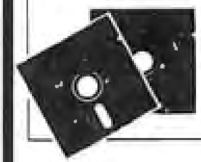

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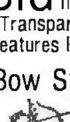

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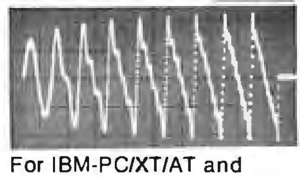

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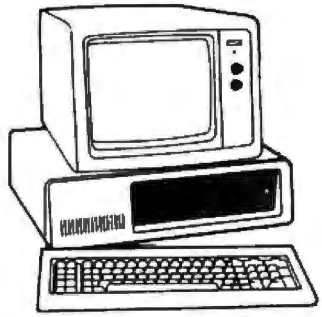

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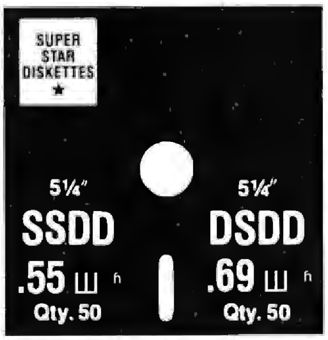
The new IBM diskettes, for example, are one of these. So are IBM 5¼" diskettes. Same for DYSAN, Polaroid and many, many other familiar diskette brand names. Each of these diskettes is manufactured in whole or in part by another company!

So, we decided to act just like the big guys. That's how we would cut diskette prices...without lowering the quality.

We would go out and find smaller companies to manufacture a diskette to our specifications...specifications which are higher than most...and simply create our own "name brand" diskette.

Name brand diskettes that offered high quality at low prices.



Super Star diskettes are sold in multiples of 50 only. Diskettes are shipped with white Tyvec sleeves, reinforced hubs, user ID labels and write-protect tabs.

Boy, did we get lucky. Our Super Star Diskettes are the same ones you've been using for years...without knowing it.

In our search for the low priced, high quality diskette of our dreams, we found something even more interesting.

We found that there are several manufacturers who don't give a hoot about the consumer market for their diskettes. They don't spend millions of dollars in advertising trying to get you, the computer user, to use their diskettes.

Instead, they concentrate their efforts on turning out the highest quality diskettes they can...because they sell them to the software publishers, computer manufacturers and other folks who (in turn) put their name on them. .and sell them for much higher prices to you!

After all, when a software publisher or computer manufacturer or diskette marketer puts their name on a diskette, they want it to work time after time, everytime. (Especially software publishers who have the nasty habit of copy-protecting their originals!)

Super Star Diskettes. You already know how good they are. Now you can buy them...cheap.

Well, that's the story.

Super Star diskettes don't roll off the boat from Pago-Pago or emerge from a basement plant just east of Nowhere.

Super Star diskettes have been around for years. .and you've used them for years as copy-protected software originals, unprotected originals. Sometimes, depending on which computer you own, the system master may have been on a Super Star diskette. And maybe more than once, you've bought a box or two or more of Super Star diskettes without knowing it. They just had some "big" company's name on them.

Super Star Diskettes are good. So good that a lot of major software publishers, computer manufacturers and other diskette marketers buy them in the tens or hundreds of thousands.

We buy them in the millions.

And than we sell them to you.

Cheap.

When every little bit counts, it's Super Star Diskettes.

You've used them a hundred times...under different names.

Now, you can buy the real McCoy, the same diskette that major software publishers, computer manufacturers and diskette marketers buy...and call their own.

We simply charge less.

Super Special!

Store 75 diskettes for only $5.95!

Yep, that's right: order 50 SuperStar diskettes, add $5.95 and we'll include a Media Products DISK MINDER II. .a well made unit that we're impressed with.

It holds 75 diskettes securely and looks nice too!

FRAUD ALERT!

Please be careful!

A lot of the "no-name" diskettes flooding the market at prices of less than $1.00 are what we in the industry call "floor sweepings."

In other words, they're garbage...stuff that six months ago, no self-respecting manufacturer would have sold.

But times got tough and some people's scruples got a little lost in desperation...and so a lot of computer users are getting some really bad disks...and that isn't bargain at all.

So, when the price seems too good to be true...like 39 cents, be careful...very careful!

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FOR FASTEST SERVICE, USE NO-COST MCI MAIL: Our address is DISKORDER. It's a FREE MCI MAIL letter. No charge to you. (Situation permitting, we'll ship these orders in 24 hours or less.)

SHIPPING: 5¼" & 3½" DISKETTES—Add $3.00 per each 100 or fewer diskettes. **OTHER ITEMS:** Add shipping charges as shown in addition to other shipping charges. **PAYMENT:** VISA, MASTERCARD and Prepaid orders accepted. **COD ORDERS:** Add additional $5.00 special handling charge. **APO, FPO, AK, HI & PR ORDERS:** Include shipping charges as shown and additional 5% of total order amount to cover PAL and insurance. We ship only to United States addresses, except for those listed above. **TAXES:** Illinois residents, add 7% sales tax.

MINIMUM ORDER: $35.00.

The Super Star LIFETIME WARRANTY!

Super Star Diskettes are unconditionally warranted against defects in original material and workmanship so long as owned by the original purchaser. Returns are simple: just send the defective diskettes with proof of purchase, postage-paid by you with a short explanation of the problem, and we'll send you the replacements. (Incidentally, coffee stained diskettes and diskettes with staples driven through them don't qualify as "defective".)

WE WILL MEET OR BEAT ANY NATIONALLY ADVERTISED PRICE ON THE SAME PRODUCTS AND QUANTITIES SUBJECT TO THE SAME TERMS AND CONDITIONS.

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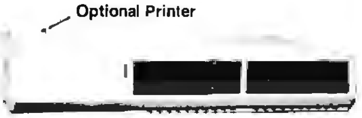
XEROX ~~$2995~~ $299

SUNRISE COMPUTER



The Xerox Sunrise 1810 is by far the best value we have ever seen in a micro computer. This is a self contained battery and AC operated portable. The Sunrise was originally prices at $2995. Xerox has since elected to drop the computer from their product list. California Digital has purchased all the remaining inventory and is making the unit available at a fraction of its original cost.

This portable features a built in 80 column liquid crystal display, 64K of memory along with both RF monitor and television outputs. The internal 300/1200 baud modem includes an auto dial telephone assembly. The units has both centronics parallel and a serial port programmable to 19,200 baud. The self contained micro cassette is capable of capturing data from the keyboard as well as doubling as an recorder for dictating messages.

An optional dual floppy disk drive module, pictured above, is available for only $219. Also available, for $59 is an 80 column printer that mounts in the drive module. The Sunrise features a CP/M operating system which allows the operator to use any CP/M program in Xerox 5¼" disk format and over 5000 CP/M programs available in public domain.

We have avalable a 15 minute tape on the Sunrise Computer. The tape is in VHS format and was produced by Xerox to promote the computer. California Digital is offer the promotional tape at $15. This will be applied towards purchase price of the Sunrise 1810.

Eclipse $179

DATA PRODUCTS

1200 Baud • Hayes Compatible

The Eclipse 1200 is the best value we have ever offered in a fully Hayes Compatible modem. The unit incorporates status lamps, speaker, auto dial and many more features into this compact package.

California Digital is so comfident of your complete satisfaction that we will allow the return of the Eclipse 1200 and apply the full credit towards the purchase price of any other modem.

IBM

MEMORY & SPECIALTY BOARDS

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AST Six Pack64K, serial, par'l, clock/cal.	229
AST Six Pack as above but384k/Byte of mem.	239
AST Advantage 128K	419
AST I/O plus clock/cal.,serial & game port	129
Quadram Quadboard II, 64K memory	279
Quadram QuadLink/Apple files	379
Spectrum card, 64K	239
Multifuncition	219
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Hexace RAM card 576K/byte	199
Hexace multifunction	119

GRAPHIC CARDS

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Hercules Graphic Card	319
Persyst BoB Board super hi-res color.	329
Hexace half slot video card	119
Peacock Color Card, composit/RGB, printer	139
California Comp. SuperVision graphics	379

INTERNAL MODEMS

Modtech UltraLink 1200, 202 half duplex	99
Anchor Auto. Signalman Mk6. 300 baud.	49
Promethus 1200B internal	279

HARDWARE

Tallgrass 60 meg. tape back-up	1459
Kraft IBM JoyStick	35
Microsoft Mouse, serial & paintbrush	145
Mouse Systems PC Mouse	149
8087 co-processor	119
5151 IBM keyboard	199
switch. par'l or serial	59

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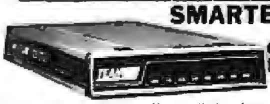
Ashton Tate Framework, spreadsheet +	395
Ashton Tate D/Base III, Data Base Manager	395
Lotus 1-2-3 spreadsheet & more	299
Symphony by Lotus development	419
Redwood Dev. Jr. CAD, plotter	59

1200 BAUD MODEMS

$159

The Universal Data 212A is manufactured for the mini-computer market. This modem is both 300 and 1200 baud auto answer. An industrial quality modem originally priced at $595. NOT Hayes compatible.

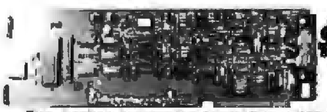
SMARTEAM 1200



$199

The Team 212A offers all the features of the Hayes Smart Modem 1200 for a fraction of the price. Now is your opportunity to purchase a 1200 baud modem at the price of a 300 baud modem.

SIGNALMAN 300 BAUD MARK VI



$49

The Anchor Automation Mark VI is a 300 baud direct connect modem that plugs into any slot of your IBM/PC. This modem supports auto answer and auto dial capabilities. Other features include telephone number storage, send / receive text files, single key-stroke dialing along with many other functions provided on disk. The Mark VI was originally priced at over $300.

UltraLink 1200

$99

The UltraLink is a 1200 baud HALF DUPLEX bell 202 compatible internal modem card for the IBM/PC. This unit operates full duplex at 300 baud.

The UltraLink adds a voice/data demension to your PC. Manufacturers original suggested price on this modem is $795. California Digitals price is only $99.

MODEMS

Eclipse 1200 100% Hayes, with status lamps.	ECP-1200	179.00
Universal Data 212LP, 1200 duplex, line powered.	UDS-212LP	139.00
Universal Data 212A, 300/1200 baud, industrial.	UDS-212A	159.00
Universal Data 103JLP, line powered, auto answer.	UDS-103LP	29.00
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Fujitsu 2400/1200 baud auto everything.	FUJ-1935D	459.00
Team 1200 Hayes Compatible. 300/1200 baud.	TEM-SM1200	199.00
UltraLink 1200 data and voice on same line.	UTL-1200A	99.00
CTS 212AH 1200 baud, auto dial	CTS-212AH	219.00
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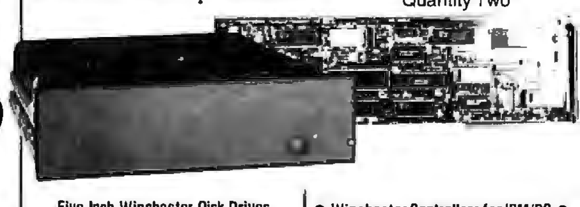
Prometheus 1200 super features	PRM-P1200	319.00
Prometheus 1200B internal PC	PRM-P1200B	279.00
Signalman Mark 12, 1200 baud, Hayes compatible.	SGL-MK12	239.00
Signalman Mark VI, 300 baud internal PC	SGL-MK6	49.00
Hayes Smart Modem 1200 baud, auto dial	HYS-212AD	389.00
Hayes 1200B for use with the IBM/PC, 1200 baud.	HYS-1200B	369.00
Hayes Smartmodem, 300 baud only, auto dial	HYS-103AD	199.00
Hayes Chronograph time & date	HYS-CHR232	199.00
Penril 300/1200 industrial quality	PEN-12AD	395.00

Shugart $239

Quantity Two



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RODIME RO-204E 53 Meg.	1259	1195
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TOSHIBA MK56 70 M. 30mS.	1789	1729
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WESTERN DIGITAL WD/1002	189

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6500

6502	$4.50	6504	$6.75	6522	$5.25
6502A	6.90	6507	9.75	6532	9.50
6502B	9.50	6520	[illegible]	6551	11.50

8000

8035	$ 5.75	8214	$ 3.75	[illegible]	$ 6.75
8039	5.75	8216	1.95	8271	69.95
8080A	2.95	8224	2.20	8275	26.95
8085A	4.90	8226	1.95	8279	8.75
80C85A	9.95	8228	3.40	8282	6.25
8086	24.50	8237	13.75	8283	6.25
8087-2	129.95	8237-5	15.95	8284	5.50
8088	17.50	8238	4.25	8286	6.45
8089	88.95	8243	3.95	8287	6.45
8155	6.75	8250	10.50	8288	11.95
8156	6.75	8251	4.25	8289	44.95
8185	28.95	8251A	5.95	8292	12.95
8202	23.95	8253	6.75	8741	27.95
8203	37.95	8255	4.25	8748	24.50
8205	3.25	8255A	5.95	8749	24.50
8212	1.95	8257	5.75	8755A	[illegible]

Z-80

	2.5MHz	"A" 4.0MHz	"B" 6.0MHz
Z80-CPU	2.25	2.75	6.95
Z80-CTC	2.50	3.75	9.25
Z80-DART	7.50	8.50	17.95
Z80-DMA	8.00	8.95	17.95
Z80-PIO	2.95	3.50	9.50
Z80-SIO/0	8.50	9.50	22.95
Z80-SIO/1	6.50	9.50	—
Z80-SIO/2	8.50	9.50	[illegible]
Z80-SIO/9	8.50	9.50	—

Z8030	$34.95	[illegible]	[illegible]	[illegible]	[illegible]
Z8530	34.95	[illegible]	[illegible]	[illegible]	[illegible]

DISK CONTROLLERS

uPD765	$9.95	1797	$21.95	6843	$28.95
1771	15.95	2791	32.95	8272	19.95
1791	22.75	2793	32.95	1691	6.95
1793	21.50	2795	32.95	2143	6.95
1795	21.50	2797	27.95	9216	[illegible]

CRT CONTROLLERS

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$39.50
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3995
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	14.95
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.95
[illegible]	[illegible]	[illegible] Graphics					34.95

UARTS/USARTS

1602B	$3.95	2350	$ 8.95	IM6403	$ 8.75
1013A	3.95	8250	10.50	TMS5501	14.95
1015A	6.75	IM6402	7.75	2651	8.95

EPROMS

1702(1mS)	$ 3.90	2732A-4 (450nS)	$ 4.50
2708(450nS)	3.65	2732A(250nS)	6.95
2758(5V)	5.50	2732A-2 (200nS)	8.95
2716 (450nS)	1.95	2764 (450nS)	1.95
2716 (350nS)	3.95	2764 (250nS)	2.95
2516 (5V)	2.95	2764 (200nS)	4.95
TMS2716	7.50	TMS2564 (450nS)	9.95
TMS2532	5.60	MCM68764 (450nS)	19.95
2732 (450nS)	1.95	MCM68766 (350nS)	21.95
2732 (250nS)	2.95	27128-3 (300nS)	9.50
2732 (200nS)	[illegible]	27128 (250nS)	[illegible]
CMOS EPROMS		27C32	$5.95
27C16	$4.95	27C64	6.95

STATIC RAMS

2101 (450nS)	$1.89	MK4118	$495
21L02 (450nS)	.99	TMM2016-2(200nS)	3.10
2102-1 (450nS)	.79	TMM2016-15 (150n)	3.95
21L02-2 (250nS)	1.39	TMM2016.1 (100nS)	3.00
2111 (450nS)	2.75	HM6116P-4 (200nS)	4.75
2112 (450nS)	2.75	HM6116P-3 (150nS)	3.25
2114 (450nS)	1.45 8/9.50	HM6116P-2 (120nS)	5.75
2114L-4 (450n)	1.69 8/12.50	HM6116LP-4 (LP)	3.60
2114L-3 (300n)	1.79 8/13.30	HM6116LP-3 (LP)	3.95
2114L-2 (200n)	1.89 8/13.90	HM6116LP-2 (LP)	3.95
2147 (55nS)	4.50	Z6132 (300nS)	32.95
4044-4(450nS)	3.25	HM6264P-15 (150)	14.95
4044-3 (300nS)	3.75	HM6264LP-15 (LP)	16.95
4044-2 (200nS)	4.35	74S189 (35nS)	1.65
UPD410 (100nS)	3.75	93415 (50nS)	3.95
5101 (CMOS)	3.50	93425(50nS)	3.95

DYNAMIC RAMS

4027 (250nS)	$ .99	TMS4416 (200nS)	$6.95
1103 (300nS)	.79	TMS4416 (150nS)	7.75
4116N-2 (150nS)	.85	41256-150(150n)	2.75
4116N-3 (200nS)	.65	41256-200(200n)	2.75
4116N-4 (250nS)	.49	TMS4050(300nS)	1.85
4164N-150 (150n)	9/7.95	TMS4060(300nS)	1.85
4164N-200 (200n)	9/7.50	MM5280(300nS)	1.85
4164N-120 (120nS)	2.95	UPD411 (300nS)	1.85
TMS4164(150nS)	2.95	MM5298(250nS)	1.85

CMOS

4000	$ .26	4028	$ .85	4059	$7.90	4505	6.95
4001	.22	4029	.75	4060	.85	4506	1.10
4002	.22	4030	.39	4068	.39	4507	1.10
4006	.79	4031	3.25	4069	.28	4508	1.90
4007	.22	[illegible]	2.15	4070	.35	4510	.79
4008	.95	4034	1.81	4071	.28	4511	.79
4009	.39	4035	.79	4072	.28	4512	.79
4010	.39	4037	1.95	4073	.28	4514	1.18
4011	.24	4040	.75	4075	.26	4515	1.79
4012	.24	4041	.75	4076	.75	4516	1.19
4013	.35	4042	.65	4077	.35	4518	.65
4014	.75	4043	.85	4078	.35	4520	.75
4015	.39	4044	.69	4081	.29	4555	.95
4016	.35	4046	.80	4082	.29	4556	.95
4017	.65	4047	.89	4085	.95	4566	1.35
4018	.79	4048	.99	4086	.95	80C95	1.50
4019	.39	4049	.35	4093	.45	80C97	.49
4020	.69	4050	.34	4094	2.95	MC14408	12.95
4021	.69	4051	.75	4096	1.90	MC14409	12.95
4022	.69	4052	.75	4099	1.85	MC14410	9.95
4023	.25	4053	.75	4501	.69	MC14411	11.95
4024	.59	4055	3.95	4502	.95	MC14412	12.95
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4027	.45						

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74C02	.29	74C85	1.89	74C175	1.15	74C374	2.35
74C04	.29	74C90	1.15	74C240	1.89	74C901	.59
74C08	.35	74C93	1.15	74C244	1.89	74C922	4.45
74C10	.35	MORE 74C IN STOCK — ALSO IN CATALOG					

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LM300H	.99	NE592	2.70	LM3914	$2.95
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LM304H	1.89	LM709H	1.90	LM3916	2.95
LM305H	.95	LM710	.68	MC4024	3.75
LM306H	4.75	LM711	.75	MC4044	4.35
LM307N	.40	LM715	3.95	RC4131	3.75
LM308CN	.65	LM723N	.55	RC4136	1.19
LM310CN	1.65	LM723H	.75	RC4151	3.75
LM311CN	.62	LM733	.98	CA3023	2.75
LM312H	1.75	LM739	1.65	CA3039	1.25
LM318CN	1.45	LM741CN	.33	CA3046	1.25
LM318H	1.55	LM741H	.40	CA3059	2.85
LM319N	1.19	LM741N	.29	CA3060	2.65
LM320 (see VRs)		LM747	.65	CA3065	1.69
LM324N	.55	LM748	.55	CA3080	1.10
LM339N	.95	LM1014	1.15	CA3081	1.60
LM340(see VRs)		LM1303	1.90	CA3082	1.60
LM348N	.95	LM1310	1.45	CA3083	1.55
LM358CN	.65	MC1330	1.65	CA3086	.80
LM359	1.75	MC1349	1.65	CA3089	2.95
LM360N	2.95	MC1350	1.15	CA3095	3.45
LM370N	4.95	MC1358	1.65	CA3130	1.29
LM373N	3.95	MC1372	6.75	CA3140	1.15
LM376N	3.75	LM1414	1.55	CA3146	1.79
LM377N	1.90	LM1558H	2.99	CA3160	1.49
LM380CN	.85	LM1800	2.35	LM13080	1.25
LM380N	1.05	LM1812	8.10	LM13600	1.45
LM381N	1.59	LM1830	3.40	LM13700	1.45
LM382N	1.35	LM1871	5.45	LF347	2.19
LM383N	1.95	LM1872	5.45	LF351	.60
LM384N	1.75	LM1877	3.20	LF353	.99
LM386N	.89	LM1889	1.90	LF355	1.10
LM387N	1.29	LM1896	1.70	LF356	1.10
LM389N	1.15	ULN2001	1.95	LF357	1.39
LM392N	.69	ULN2003	1.49	TL071CP	.79
LM723N	.48	XR2206	3.75	TL072CP	1.35
LM723H	.55	XR2207	2.90	TL074CN	1.90
NE531	2.65	XR2208	2.40	TL081CP	.59
NE555	.35	XR2211	3.75	TL064CN	1.90
NE556	.65	LM2677P	2.00	TL494	4.10
NE556	1.49	LM2878P	2.25	TL496	1.65
NE561	23.50	LM2900	.83	TL497	3.20
NE564	2.85	LM2901	.99	MC3423	1.49
LM565	.95	LM2903	.69	MC3453	4.95
LM566	1.45	LM2907	2.45	MC3456	1.29
LM567	.65	LM2917	2.85	MC3459	3.75
NE570	3.85	LM3900	.55	MC3469	5.25
NE571	2.90	LM3905	[illegible]	MC3470	7.95

VOLTAGE REGULATORS

7805T Also 8, 12, 15, 24V	.69	7905K Also 12, 15, 24V	1.39
78L05, 12, 15V	.65	79L05, 12, 15V	[illegible]
78M06C	.69	LM309K	1.25
78MG/79MG	1.49	LM317H/K	1.25/3.85
78H05KC	6.75	LM323K	4.85
7805K Also 12, 15, 24V	1.29	LM337K	3.75
7905T Also 8, 12, 15, 24V	.79	LM338K	6.75
		LM350T	4.55
		LM350K	[illegible]

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MC14411	$11.50	[illegible]	$11.25	[illegible]	$ 9.25
BR1941	11.50	5832	3.75	76477	3.75
34702	12.50	AY52376	11.50	76488	5.75
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5307	10.50	2513-002L	9.50	AY38912	7.95
MC4024	3.75	UPD7201	27.95	SSI-263	36.95
8038	3.75	3341	4.50	Votrax	39.95
5369	3.50	11C90	13.25	Digitalker	34.95
58167	12.25	MC15906	2.95	LM13600N	1.95
SP1000 Speech	$9.95	TR1663 5V UART	$4.25		

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ADC0800	$14.95	ADC0817	$9.75	1408L6	$1.95
ADC0804	3.45	DAC0800	4.75	1408L8	2.85
DAC0806	1.90	DAC0808	2.85	DAC100	7.95
ADC0809	4.45	DAC1020	7.95	DAC08	7.95
ADC0816	14.25	DAC1022	5.85	DAC01	6.95
AD7523JN	1.99	LF353N	1.99	LF13201N	1.99

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VERBATIM 525-01 SS/DD	$22.95	$19.95
VERBATIM 550-01 DS/DD (IBM)	27.95	24.95
MAXELL MD-1 SS/DD (All)	19.95	17.95
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MAXELL DISKS for AT (96tpi)	46.95	43.95
DYSAN 104/1D SS/DD (All)	27.95	25.95
DYSAN 104/2D DS/DD (IBM)	34.95	31.95
ACP SS/DD (All)	14.95	12.95
ACP DS/DD (IBM)	17.95	15.95
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MAXELL 3½" MICRODISK (MAC)	33.00	[illegible]
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VERBATIM 8" SS/DD	28.95	28.95
VERBATIM 8" DS/DD	36.95	36.95
DYSAN 8" SS/DD	[illegible]	[illegible]
DYSAN 8" DS/DD	[illegible]	[illegible]

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Toshiba ND04E-G for "AT" 99.50
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IDC TYPE	ACP NO	NUMBER OF CONTACTS 10	20	26	34	40	50
Solder Header	IDHxxS	.79	1.20	1.65	2.10	2.40	3.00
Rt Angle Solder Header	IDHxxSR	.79	1.20	1.65	2.10	2.40	3.00
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Ribbon Header	IDMxx	—	5.25	5.95	6.75	7.25	8.25
Ribbon Edgecard	IDExx	1.70	2.15	2.50	2.60	3.70	3.95
Wirewrap Header	IDHxxW	1.80	2.90	3.75	4.25	4.95	6.50
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7401	.18	7447	.65	74125	.42	74177	.69
7402	.18	7448	.68	74126	.44	74179	1.34
7403	.18	7450	.19	74128	.49	74180	.75
7404	.18	7451	.19	74132	.45	74181	1.75
7405	.23	7453	.19	74136	.75	74182	1.15
7406	.49	7454	.19	74141	.85	74184	2.25
7407	.49	7459	.25	74142	2.95	74185	2.25
7408	.24	7460	.37	74143	3.70	74190	.67
7409	.19	7470	.29	74144	2.95	74191	.67
7410	.19	7472	.29	74145	.59	74192	.67
7411	.24	7473	.33	74147	1.49	74193	.67
7412	.38	7474	.34	74148	1.19	74194	.67
7413	.34	7475	.38	74150	1.09	74195	.67
7414	.49	7476	.34	74151	.55	74196	.75
7416	.49	7479	4.60	74152	.67	74197	.86
7417	.49	7480	.69	74153	.53	74198	1.15
7420	.19	7482	.95	74154	1.19	74199	1.15
7421	.35	7483	.45	74155	.69	74221	1.19
7422	.45	7485	.55	74156	.69	74251	.75
7423	.58	7486	.35	74157	.59	74273	1.65
7425	.29	7489	1.95	74158	1.65	74276	1.69
7426	.29	7490	.35	74159	1.59	74279	.75
7427	.25	7491	.65	74160	.79	74283	1.40
7428	.55	7492	.45	74161	.69	74284	2.90
7430	.18	7493	.35	74162	.69	74285	2.90
7432	.29	[illegible]	.65	74163	.69	74290	1.49
7437	.25	7495	.50	74164	.69	74298	1.49
7438	.29	7496	.69	74165	.69	74365	.55
7439	.58	7497	2.70	74166	.85	74366	.55
7440	.19	74100	1.50	74167	2.75	74367	.55
7441	.79	74107	.24	74170	1.25	74368	.55
7442	.45	74109	.37	74172	4.75	74390	1.45
7443	1.15	74116	1.45	74173	.69	74393	1.33
7444	1.15	74121	.29	74174	.69	[illegible]	2.25
7445	.68	74122	[illegible]	74175	.69		

74LS00

74LS00	$ .15	74LS113	$ .38	74LS247	$ .74
74LS01	.15	74LS114	.39	74LS248	[illegible]
74LS02	.15	74LS122	.45	74LS249	[illegible]
74LS03	.15	74LS123	.95	74LS251	.59
74LS04	.24	74LS124	2.75	74LS253	.59
74LS05	.25	74LS125	.49	74LS257	.59
74LS08	.27	74LS126	.49	74LS258	.59
74LS09	.28	74LS132	.59	74LS259	2.95
74LS10	.25	74LS136	.39	74LS260	.59
74LS11	.33	74LS138	.59	74LS261	2.49
74LS12	.33	74LS139	.59	74LS266	.55
74LS13	.39	74LS145	1.19	74LS273	1.45
74LS14	.59	74LS148	1.38	74LS275	3.29
74LS15	.33	74LS151	.55	74LS279	.59
74LS20	.26	74LS153	.55	74LS283	.68
74LS21	.29	74LS154	1.49	74LS290	.88
74LS22	.29	74LS155	.69	74LS293	.78
74LS26	.29	74LS156	.69	74LS295	.99
74LS27	.29	74LS157	.69	74LS298	.89
74LS28	.29	74LS158	.69	74LS324	1.75
74LS30	.25	74LS160	.69	74LS347	1.05
74LS32	.33	74LS161	.69	74LS348	1.95
74LS33	.53	74LS162	.69	74LS352	1.25
74LS37	.35	74LS163	.69	74LS353	1.25
74LS38	.39	74LS164	.69	74LS363	1.29
74LS40	.25	74LS165	.90	74LS365	.48
74LS42	.44	74LS166	1.90	74LS366	.48
74LS47	.74	74LS168	1.15	74LS367	.45
74LS48	.74	74LS169	1.15	74LS368	.45
74LS51	.25	74LS170	1.40	74LS373	1.39
74LS54	.29	74LS173	.67	74LS374	1.33
74LS55	.29	74LS174	.67	74LS375	.89
74LS73	.39	74LS175	.67	74LS377	1.38
74LS74	.34	74LS181	1.95	74LS385	1.95
74LS75	.39	74LS190	.85	74LS386	.45
74LS76	.39	74LS191	.85	74LS390	1.15
74LS78	.39	74LS192	.78	74LS393	1.15
74LS83	.59	74LS193	.78	74LS395	1.15
74LS85	.69	74LS194	.69	74LS399	1.47
74LS86	.39	74LS195	.69	74LS424	2.95
74LS90	.54	74LS196	.79	74LS668	1.75
74LS92	.54	74LS197	.79	74LS670	2.29
74LS93	.54	74LS221	.89	81LS95	1.45
74LS95	.75	74LS240	.95	81LS96	1.45
74LS96	.89	74LS242	.95	81LS97	1.45
74LS107	.39	74LS243	.95	81LS98	1.45
74LS109	.39	74LS244	1.25	25LS2521	2.85
74LS112	.39	74LS245	1.45	25LS2569	3.50

74S00/PROMS*

74S00	[illegible]	74S74	[illegible]	[illegible]	[illegible]	[illegible]	$1.19
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
74S04	[illegible]	74S112	[illegible]	74S174	1.19	[illegible]	[illegible]
[illegible]	[illegible]	74S113	[illegible]	74S175	1.19	74S372	[illegible]
[illegible]	[illegible]	74S114	[illegible]	[illegible]	[illegible]	74S374	[illegible]
[illegible]	[illegible]	74S124	2.00	[illegible]	[illegible]	[illegible]	[illegible]
74S10	[illegible]	74S132	1.39	[illegible]	[illegible]	74S471*	[illegible]
74S11	[illegible]	74S133	[illegible]	[illegible]	[illegible]	74S472*	[illegible]
[illegible]	[illegible]	74S134	[illegible]	74S240	[illegible]	74S473*	[illegible]
[illegible]	[illegible]	74S135	[illegible]	74S241	[illegible]	74S474*	[illegible]
[illegible]	[illegible]	74S136	1.30	74S242	[illegible]	74S475*	[illegible]
74S30	[illegible]	74S138	[illegible]	74S243	[illegible]	74S570*	[illegible]
[illegible]	[illegible]	74S139	[illegible]	74S244	[illegible]	74S571*	[illegible]
[illegible]	[illegible]	74S140	[illegible]	74S251	[illegible]	74S572*	[illegible]
74S40	[illegible]	74S151	[illegible]	74S253	[illegible]	74S573*	[illegible]
74S51	[illegible]	74S153	[illegible]	74S257	[illegible]	74S940	[illegible]
74S64	[illegible]	74S157	[illegible]	74S258	1.19	74S941	[illegible]
74S65	[illegible]						

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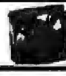

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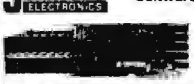

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Five Key Software Programs! *RAM Disk!*

The JE868 is functionally compatible with the Apple II language card and can be utilized with all software that can be used with a standard 16K card. The JE868 requires no modifications to your Apple computer. Five key software programs are included. Memory Management System, utilities, diagnostics, demos, and RAM disk emulators for DOS 3.3, CP/M and Apple Pascal. Also features DOS relocator. Complete w/instructions. (Note: CP/M-Versions 2.2 or earlier — PASCAL-Versions 1.1 or earlier)

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JE880 (PRT-1) **$59.95**

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The JE883 provides the user with up to 64K of additional or buffered memory (18 pages of information). Using the parallel jumper cable supplied, the JE883 will attach to the JE880 (above). Parallel Card needed for operation. The JE883 includes a standard parallel input with both parallel and serial (RS232) buffered outputs. With these features you may access and buffer information to two types of printers (one serial, one parallel) simultaneously. Complete with instructions.

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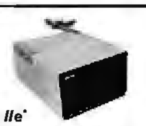

• Belt driven • 143K formatted storage • Color matches Apple Computer • Works with Apple Controller or other Apple-compatible controllers (JE875) • Complete with connector — just plug into your disk controller card • 35 tracks • Size: 6"W x 3⅝"H x 8-9/16"D • Weight: 4 lbs.

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ADD-IIc **$129.95**

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Key: a = Apple II or II+ b = Apple *IIe*

APF-1	Cooling Fan with surge protection • Key: (a,b)	$ 39.95
KHP4007	Switching Power Supply • Key: (a,b)	$ 39.95
JE614	Numeric/Aux. Keypad — 11 accessible functions • Key: (b)	$ 49.95
JE860	16K RAM Card (Note: CP/M Versions 2.2 or earlier) • Key: (a)	$ 39.95
JE864	80-Column plus 64K RAM • Key: (b)	$ 69.95
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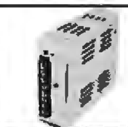

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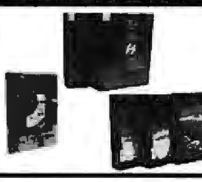
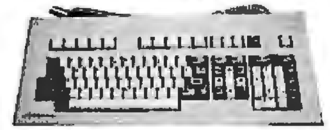
DATA BOOKS



30009	Intersil Data Book (1985). Complete Line (1075 pages)	$9.95
30013	Zilog Data Book (1985). Microprocessors and Support Chips (1045 pages).	$9.95
210830	Intel Memory Components Hndbk. (1983/84). Contains all Applications Notes, Article Reprints, Data Sheets & other design information on Intel's RAMs, DRAMs, EPROMs, E²PROMs and Bubble Memories (880 pages)	$14.95
230843	Intel Microsystem Components Hndbk. (1983/84). Contains Data Sheets on all of Intel's Microprocessors & peripherals — 2 volumes (2575 pages)	$19.95
30022	National Logic Data Book Set (1984). Volumes I & II (3485 pages). Contains information on National's TTL product line and CD4000 family. This includes 7400, 74L, S, AS, LS and ALS Series devices, and MM54HC / 74HC / 54HCT / 74HCT High Speed Micro CMOS family, MM54C / 74C family, and CMOS LSI / VLSI	$24.95

IBM* Accessories

IBM PC/XT Compatible Keyboard



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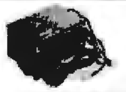

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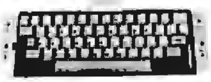

• SPST keyswitches • 20 pin ribbon cable connection • Low profile keys • Features: cursor controls, control, caps (lock), function, enter and shift keys • Color (keycaps): grey • Weight: 1 lb. • Pinout incl. • Size: 13⅛"L x 4¼"W x ¾"H

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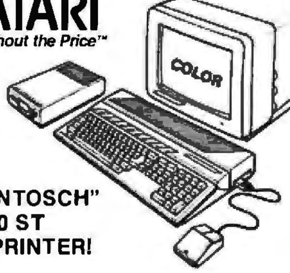

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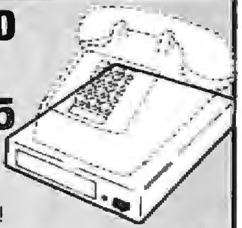

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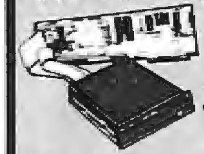

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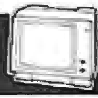

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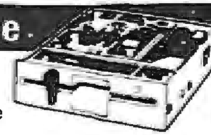

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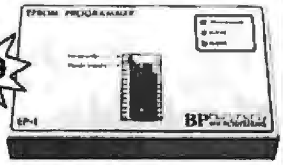

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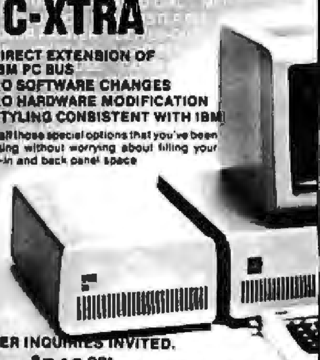

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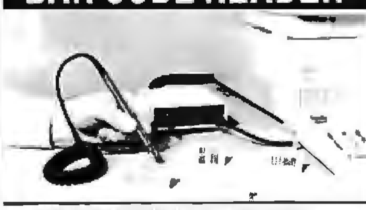

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• +5V-15A/−5V-.5A
• +12V-4.2A/−12V-.5A
XT 150 watt
• Whisper fan
• Hi-output 150 watt
• 4 DC connectors
• +5V-15A/−5V-.5A
• +12V-5.5A/−12V-.5A
AT 200 watt
• 200 Watt power
• Exterior AC switch
• 4 DC power conn
• +5V-20A/−5V-.5A
• +12V-7.7A/−12V-.5A
XTC-Black
• Rear Mount
• Rear On/Off switch
• extra AC outlets
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• +12V-4A/−12V-.5A
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5V=Single 5 Volt Supply 21V PGM=Program at 21 Volts

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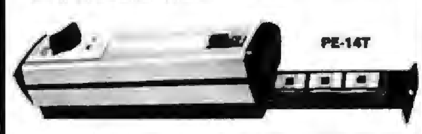

Model	Timer	Capacity Chip	Intensity (uW/Cm²)	Unit Price
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74LS09	.18	74LS192	.69
74LS10	.16	74LS193	.69
74LS11	.22	74LS194	.69
74LS12	.22	74LS195	.69
74LS13	.26	74LS196	.59
74LS14	.39	74LS197	.59
74LS15	.26	74LS221	.59
74LS20	.17	74LS240	.69
74LS21	.22	74LS241	.69
74LS22	.22	74LS242	.69
74LS27	.23	74LS243	.69
74LS28	.26	74LS244	.69
74LS30	.17	74LS245	.79
74LS32	.18	74LS251	.49
74LS33	.28	74LS253	.49
74LS37	.26	74LS256	1.79
74LS38	.26	74LS257	.39
74LS42	.39	74LS258	.49
74LS47	.59	74LS259	1.29
74LS48	.69	74LS260	.49
74LS51	.17	74LS266	.39
74LS73	.29	74LS273	.79
74LS74	.24	74LS279	.39
74LS75	.29	74LS280	1.98
74LS76	.29	74LS283	.59
74LS83	.49	74LS290	.89
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74LS107	.34	74LS367	.39
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74LS112	.29	74LS373	.79
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74LS126	.39	74LS390	1.19
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74HCT27	.69	74HCT244	2.19
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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	1.75
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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
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74S00	.29	74S163	1.29
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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

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	1.39	7905K	1.49
7812K	1.39	7912K	1.49

TO-92 CASE

78L05	.49	79L05	.69
78L12	.49	79L12	.69

OTHER VOLTAGE REGS

LM323K	5V 3A	TO-3	4.79
LM338K	Adj.5A	TO-3	3.95
78H05K	5V 5A	TO-3	7.95
78H12K	12V5A	TO-3	8.95
78P05K	5V 10A	TO-3	14.95

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

IC SOCKETS

	1-99	100
8 PIN ST	.13	.11
14 PIN ST	.15	.12
16 PIN ST	.17	.13
18 PIN ST	.20	.18
20 PIN ST	.29	.27
22 PIN ST	.30	.27
24 PIN ST	.30	.27
28 PIN ST	.40	.32
40 PIN ST	.49	.39
64 PIN ST	4.25	CALL
ST=SOLDERTAIL		
8 PIN WW	.59	.49
14 PIN WW	.69	.52
16 PIN WW	.69	.58
18 PIN WW	.99	.90
20 PIN WW	1.09	.98
22 PIN WW	1.39	1.28
24 PIN WW	1.49	1.35
28 PIN WW	1.69	1.49
40 PIN WW	1.99	1.80
WW=WIREWRAP		
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	3.75
LM322	1.65	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	1.40	CA3081	.99
LM336	1.75	CA3082	.99
LM337K	3.95	CA3086	.80
LM338K	3.95	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	4.60	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
CEN36PC	RT ANGLE PC MOUNT	4.95

FEMALE

IDCEN36/F	RIBBON CABLE	7.95

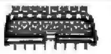
INTERSIL

ICL7106	9.95
ICL7107	12.95
ICL7660	2.95
ICL8038	4.95
ICM7207A	5.95
ICM7208	15.95

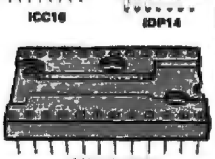
DIP CONNECTORS

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)	IDPxx	---	.95	.95	---	---	---	1.75	---	2.95

FOR ORDERING INSTRUCTIONS SEE D-SUBMINIATURE BELOW


ICC16


IDP14


AUGAT 24ST

DIODES/OPTO/TRANSISTORS

1N751	.25	4N26	.69
1N759	.25	4N27	.69
1N4148	25/1.00	4N28	.69
1N4004	10/1.00	4N33	.89
1N5402	.25	4N37	1.19
KBP04	.55	MCT-2	.59
KBU8A	.95	MCT-6	1.29
MDA990-2	.35	TIL-111	.99
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

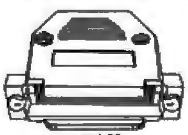
D-SUBMINIATURE

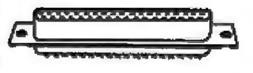
DESCRIPTION		ORDER BY	CONTACTS 9	15	19	25	37	50
SOLDER CUP	MALE	DBxxP	.82	.90	1.25	1.25	1.80	3.48
	FEMALE	DBxxS	.95	1.15	1.50	1.50	2.35	4.32
RIGHT ANGLE PC SOLDER	MALE	DBxxPR	1.20	1.49	---	1.95	2.65	---
	FEMALE	DBxxSR	1.25	1.55	---	2.00	2.79	---
WIRE WRAP	MALE	DBxxPWW	1.69	2.56	---	3.89	5.60	---
	FEMALE	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

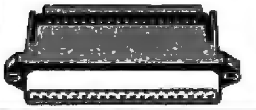
ORDERING INSTRUCTIONS: INSERT THE NUMBER OF CONTACTS IN THE POSITION MARKED "xx" OF THE "ORDER BY" PART NUMBER LISTED.
EXAMPLE: A 15 PIN RIGHT ANGLE MALE PC SOLDER WOULD BE DB15PR.

MOUNTING HARDWARE $1.00


MTG HDWR


HOOD25


DB37S


IDB37S

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
HP5082-7760	COM CATHODE	.43"	1.29
TIL-311	4x7 HEX W/LOGIC	.270"	9.95
HP5082-7340	4x7 HEX W/LOGIC	.290"	7.95

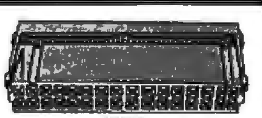
DIFFUSED LEDS

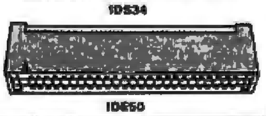
		1-99	100-UP
JUMBO RED	T1¾	.10	.09
JUMBO GREEN	T1¾	.14	.12
JUMBO YELLOW	T1¾	.14	.12
MOUNTING HDW	T1¾	.10	.09
MINI RED	T1	.10	.09

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	IDExx	1.75	2.25	2.65	2.75	3.80	3.95

FOR ORDERING INSTRUCTIONS SEE D-SUBMINIATURE ABOVE


IDS34


IDE50

SWITCHES

SPST	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
SPST	TOGGLE ON-OFF	.49
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	1.29

RIBBON CABLE

CONTACTS	SINGLE COLOR 1'	SINGLE COLOR 10'	COLOR CODED 1'	COLOR CODED 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

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GOLD CONTACTS SPACED AT .1" CENTERS

5/$1.00

It was a pleasure to place an order with your people. I found the response pleasant and helpful and the answers prompt and correct. The delivery on my most recent order was fast, correct and well packed. I already had faith in the quality since my family has been using some of your products for several years with no problems.

Sincerely, J.D. Hattaway

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250ea: 2.5", 4.5", 5.0"
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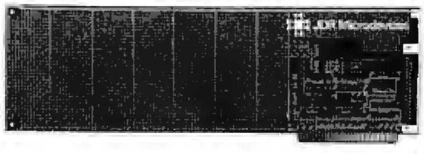
100 feet	$4.30	250 feet	$7.25
500 feet	$13.25	1000 feet	$21.95

Please specify color: Blue, Black, Yellow or Red

WIRE WRAP PROTOTYPE CARDS
FR-4 EPOXY GLASS LAMINATE
WITH GOLD-PLATED EDGE-CARD FINGERS



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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 FOIL PADS	$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

EMI FILTER $4.95
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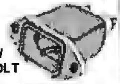

6 FOOT LINE CORDS

LC-2	2 CONDUCTOR	.39
LC-3	2 CONDUCTOR	.99
LC-HP	3 CONDUCTOR W/STD FEMALE SOCKET	1.49

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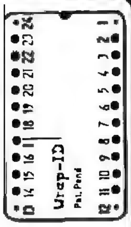
3.15" SQ	ROTRON	14.95
3.63" SQ	ETRI	14.95
3.18" SQ	MASUSHITA	16.95

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)

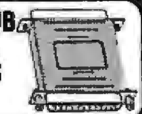


ID WRAP 24

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



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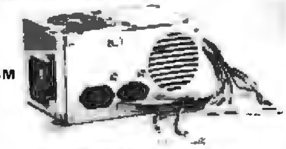
PS-IBM $99.95
- FOR IBM PC-XT COMPATIBLE
- 130 WATTS
- +5V @ 15A, +12V @ 4.2A -5V @ .5A, -12V @ .5A
- ONE YEAR WARRANTY



PS-IBM

PS-130 $99.95
- 130 WATTS
- SWITCH ON REAR
- FOR USE IN OTHER IBM TYPE MACHINES
- 90 DAY WARRANTY

PS-130

PS-A $49.95
- USE TO POWER APPLE TYPE SYSTEMS
- +5V @ 4A, +12V @ 2.5A -5V @ .5A, -12V @ .5A
- APPLE POWER CONNECTOR

PS-A

PS-SPL200 $49.95
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PS-11951 $29.95
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- 5.0" x 8.0" x 2.0", 1.6 LBS.

PS-SPL200

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	.80
2200	16V	.70	2200	16V	.70
4700	25V	1.45	4700	16V	1.25

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FROM 1 OHM TO 10 MEG. OHM

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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

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WBU-D	.38 x 6.50"	1	100	—	—	—	2.95
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
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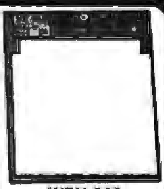
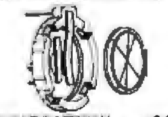


WBU-208

LITHIUM BATTERY
AS USED IN CLOCK CIRCUITS



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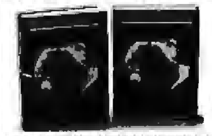

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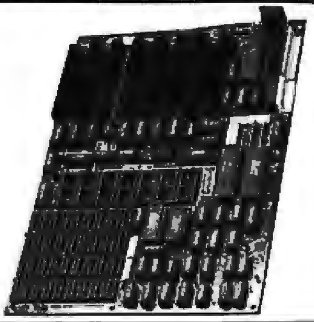

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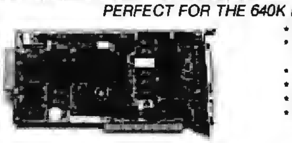

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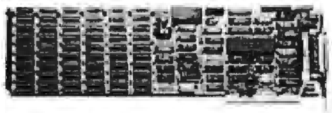

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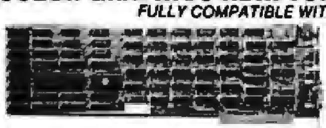

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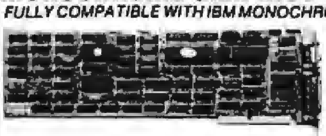

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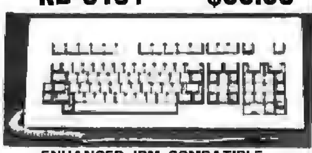

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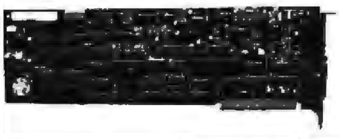

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U·N·C·L·A·S·S·I·F·I·E·D A·D·S

WANTED: Nonprofit project for abused children seeks tax-deductible donation of IBM PC, Apple, etc., with peripherals to assist in training and record keeping. David Eiffert, East Bay Youth Project, 15919 Hesperian Blvd., San Lorenzo, CA 94580, (415) 276-1881.

WANTED: Cancer Research Society (CRS) Inc. seeks donations of PCs and printers to develop a computer center vital to our research programs. Will pay shipping and provide tax receipt. CRS, POB 271, Redlands, CA 92373-0081, (714) 794-5254.

WANTED: Apple or Commodore 64 hardware for alternative grade school. Tax-deductible receipt available. Juniper Sundance, Pleasant Ridge School, 321 East Decker St., Viroqua, WI 54665.

WANTED: Engineering school computer club that works with Apple computers seeks correspondence with U.S. clubs. Pedro Martins, P.O. Box 292, 29001 Vitória ES, Brazil.

WANTED: Amiga users group would like to trade member-developed and public-domain software. Jack Deckard, 3808 Laguna Dr., Columbus, OH 43232.

WANTED: Society for psychical research needs public-domain program to improve or to measure psychic ability of humans. Donations of equipment or information in magazines welcome. Instituto de Pesquisas Bioenergéticas, Av. Borges de Medeiros 901, 90.000 Porto Alegre RS, Brazil.

WANTED: Gospel missionary organization needs tax-deductible donation of several CP/M or MS-DOS computers for word processing and record keeping. Will pay shipping and provide receipts. World Indigenous Missions, 1287 East Common St., New Braunfels, TX 78131-0337, (512) 629-0863.

NEEDED: I need contact with Cromemco LISP users to help me with problems. Jan Dings, Via delle Capannelle, 5, I-56015 Oratoio, Pisa, Italy.

WANTED: Technical information and schematics of the PCC 2000 hardware for S-100 evolution. Will pay postage. Jean-Claude Gryparis, 5 Rue d'Anjou, 59700 Marcq en Baroeul, France.

WANTED: Sinclair QL user would like to exchange information, ideas, advice, and public-domain or user-written programs with other QL users. Arno Tuominen, SF-93140 Kipinä, Finland.

WANTED: Exchange with Computhink Eagle 32 (68000) computer users. I need documentation, schematics, and public-domain software. I am trying to install CP/M-68K; will provide a BIOS. Jeff Shaw, POB 32900, San Jose, CA 95152, (408) 258-4059.

WANTED: *Interfacing to S-100 IEEE-696 Microcomputers* (Sol Libes and Mark Garetz, 1981) to buy or borrow; also, documentation of Micromation disk controller, Godbout Econoram VIIIA, and Percom I/O boards. Fred Ordway, 2901 Telestar Court, Falls Church, VA 22042, (703) 560-3292.

WANTED: Schematic drawings and documentation for the WD-900 Pascal MicroEngine single-board computer by Western Digital. R. Tim Coslet, 1235 Wildwood Ave. #200, Sunnyvale, CA 94089-2714.

WANTED: Correspondence with persons using P-LISP on Apple II computers to exchange ideas, programming tips, techniques, and experiences. David Riippa, 6605 West 138th Ave., Holland, MI 49423.

FOR SALE: Zenith Z-100 microcomputer system with 198K, two DS/DD drives, and more. Has monochrome monitor, but has color capability. $2500. Midshipman Joe Steffan, 35th Company, U.S. Naval Academy, Annapolis, MD 21412, (301) 267-5001.

WANTED: Copy of service manual or schematics for the Tava PC motherboard (the Tava board, not the Faraday motherboard). Will pay reasonable fee. Write first. Daniel G. Krause, Box 8521, Virginia Beach, VA 23450.

FOR SALE: Comprint 912 parallel printer, uses electrostatic paper: $100; 6 rolls 8½-inch paper for Comprint: $40; Apple II parallel-interface card for Comprint: $50. $175 takes all. You pay shipping. Gordon Nelson, 12005 Millstream Dr., Bowie, MD 20715, (301) 464-0732.

FOR SALE: IBM System/34 5340-E34 with 128K CPU, three 5251 VDU terminals, 5256 matrix printer, and 5211 line printer. Will sell as package. Armco Pacific Ltd., #31-01 OCBC Centre, Chulia St., Singapore 0104, Telex: RS 35215 (ARMPAC).

FOR SALE: Two new Intertec Data Systems/Compustar Model 30 video-processing units. Any reasonable offer accepted. William R. Bartmon, Bartmon, Shapiro and Associates Inc., 660 Madison Ave., New York, NY 10021, (212) 888-9380.

FOR SALE: SYM-1 single-board computer, Beta 32K memory board, FDC disk controller, disk drive with power supply, manuals, and books: $350. Soroq IQ-120 terminal with Star 300-bps modem: $275. Steve Shoyer, 1480 Gunpowder Rd., Rydal, PA 19046, (215) 576-0335.

FOR SALE OR TRADE: Osborne 1 with extra 12-inch Zenith monitor, two disk drives, 5-inch black-and-white monitor built in, and more. Good condition. Buyer pays shipping. $1500, best offer, or trade for 512K Macintosh. Scott Sitra, 3403 Southill Circle, Austin, TX 78703, (512) 450-1083.

FOR SALE: Collection of *Compute!* from July 1980 to June 1984. Good condition. Best offer. Tim Bowker, 525 Lohnes Dr., Fairborn, OH 45324.

FOR SALE: 80-megabyte Okidata 3300 Winchester drive and C3-B Ohio Scientific computer, plus SMD controller for S-100s or PCs, Scientific Atlanta rack, C3-OEM computer, and boards. Four 8-inch DS/DD disk drives. Best offer. Phillip Woellhof, 20 Shady Hill, Fairfield, CT 06430, (203) 254-1659.

FOR SALE: Olivetti M20 with 160K, 12-inch integral monitor, dual drives, and more. Best offer over $900. John Love, 2508 Teakwood Lane, Plano, TX 75075, (214) 867-0962, evenings.

FOR SALE: Apple Super Serial card for Apple II series, Applemouse card, manuals, and more. $150. Ed Cundy, Lyme Rd., Hanover, NH 03755, (603) 643-5004.

FOR SALE: DEC Rainbow 100B, 256K, two 400K disk drives, black-and-white monitor, keyboard, color graphics installed, and documentation. $1800. Jim Weston, 297 Bartlett St., Bridgeport, CT 06606, (203) 374-3155.

FOR SALE: BYTE, issue 1 to August 1980. Mint condition. Best offer. Tseng, 67-05 Austin St., Forest Hills, NY 11375.

NEEDED: Commodore 128 users to start group. David Haynes, 17 Silo Square, Lewisburg, WV 24901.

FOR TRADE: Apple IIe with disk drive wanted. Will trade Adam computer with 80K RAM, joystick, Atari 2600 module, keyboard, printer, and more. Tom Vinson, 3705 Buena Creek Rd., Vista, CA 92083.

FOR SALE: The first 10 years of BYTE. Excellent condition. Best offer over $500 takes all. I pay shipping. Harold Wood, 2002 Rookwood Rd., Silver Spring, MD 20910, (301) 589-4171.

FOR SALE: Zenith Z-100, 192K, one 48-tpi DS/DD, one 96-tpi DS/DD, one 8-inch DS/DD, one Gemini-10X, ZVM-133 color monitor, and more. Best offer. Jim Odom, 8020 24th St., Vero Beach, FL 32960, (305) 562-6379.

FOR SALE: Taxan 440 ultra-high resolution (720 by 400) color monitor for the IBM PC: $495; Persyst BoB board: $395; Okidata 92: $295. John Birck, 458 East 600 N, Orem, UT 84057, (801) 224-4809.

WANTED: Computer science major seeks correspondence about Commodore, Apple IIe, or IBM. Johnathan Jones, 1426 St. Marks Ave., Apt. 1, Brooklyn, NY 11233, (718) 773-5983.

FOR SALE: 20-megabyte Bernoulli Box cartridge disk system: $2750. I will install in San Francisco Bay area. Stephen Prosper, 35 Walter St., Apt. 2, San Francisco, CA 94114, (415) 558-9032.

UNCLASSIFIED ADS MUST *be noncommercial, from readers who have computer equipment to buy, sell, or trade on a onetime basis. All requests for donated computer equipment must be from nonprofit organizations. Programs to be exchanged must be written by the individual or be in the public domain. Ads must be typed double-spaced, contain 50 words or less, and include full name and address. This is a free service; ads are printed as space permits.* BYTE *reserves the right to reject any unclassified ad that does not meet these criteria. When you submit your ad* (BYTE, *Unclassified Ads,* POB 372, *Hancock,* NH 03449), *allow at least four months for it to appear.*

FOR SALE: Cromemco CS-3 with 10-megabyte hard disk and 256K RAM, plus various S-100 memory and interface boards. Persci and Wangco disk drives, and more, all with manuals. Make offer. Larry Yori, 1275 Kleppe Lane #14, Sparks, NV 89431, (702) 358-0937.

WANTED: TeleVideo TPC I 8-bit portable microcomputer. Marlow Marchant, Brigham Young University, 230 SNLB, Provo, UT 84602, (801) 378-6489.

WANTED: Semionics REM board, also any firmware, public-domain software, manuals, and documentation. Lewis A. Stone, 114 South 170th St., Seattle, WA 98148.

FOR SALE: DEC PDP-11–compatible Heathkit H-11A (LSI-11/2), KEV-11 coprocessor 64K memory, 8-inch dual drive, Heath/Zenith H-9 and H-29 terminals, Diablo 630 printer, paper tape punch/reader, and more. Complete documentation. Asking $6000. G. Brewer, 5 Bataan Ave., Eatontown, NJ 07724, (201) 389-1720.

FOR SALE: Actrix computer, two SS/DD disk drives, monitor, modem, and dot-matrix printer all built into one case. Detachable keyboard. Includes tractor feed, carrying case, and more. $1295. Charlotte Courey, 505 Ogemaw, Oscoda, MI 48750.

FOR SALE: Zenith Z-100 All-In-One computer with two DS/DD disk drives, 128K RAM, 8- and 16-bit capable. $2700 or make offer. Roy Pieczulewski, 4874 South U.S. 23, Greenbush, MI 48738.

FOR SALE: Zenith Z-150-52 IBM-compatible with two disk drives (360K) with 320K RAM and 2.0 ROMs. Five expansion slots, power supply, and manuals. $1750 includes shipping. Bob Small, 354 Teakwood Dr., Satsuma, AL 36572, (205) 675-9742.

FOR SALE: Epson HX-20 notebook computer with built-in microcassette, built-in microprinter, LCD screen, 16K RAM, external cassette cables, books, and manuals. Excellent condition. $250 or best offer. Paul J. Polillo, 1003 North Broad, Galesburg, IL 61401, (309) 343-6223.

FOR SALE: Altos 586, ½-megabyte memory, 30-megabyte hard-disk drive, 1-megabyte floppy drive, Altos II terminal, and more. $8500. John Shoemaker, 860 North Lafayette, Mesa, AZ 85201, (602) 834-1665.

FOR SALE: Axiom GP-100 TI II dot-matrix printer with direct-connect interface to the TI-99/4A. Other interfaces available for different computers. Speech synthesizer for TI. Like new. Shawn Buterbaugh, R.D. 2, Box 188, Clymer, PA 15728.

WANTED: Computer enthusiasts of any type, from all over the globe, with intent of communication and starting a club. John Cogley Jr., 550 Old Clairton Rd., Pittsburgh, PA 15236.

FOR SALE: Tandy Model 16, 68000, 256K, two disk drives, graphics board, Daisy Wheel II printer, and more. $3500. Donald A. Kadunc, 5642 Whitecraigs Court, Dublin, OH 43017, (614) 764-4789, evenings.

FOR SALE: Digital computer: PDP-11/23, 16-bit processor, multifunction board with 16K, two serial lines, 32K memory, RX01 controller, and floppy-disk drive. $1600 or best offer. Also, CIP and CII 8P OSI computers: $350. Arnetha Haynes, Box 173, Greenville, NH 03048, (603) 878-3352, evenings.

FOR SALE: Perkin-Elmer Fox-1100 computer terminal. Excellent for accessing databases and computer programming. $250. John Echevarrieta, 2116 84th St., Brooklyn, NY 11214, (718) 331-6496.

FOR SALE: *Kilobaud Microcomputing* through June 1982. Best offer. D. Bahr, Bahr Technologies, 1842 Hoffman St., Madison, WI 53704, (608) 244-0500.

TRADE: IBM PC and Commodore 64 public-domain programs. Please send a list of what you have and what you want. SASE appreciated. Also have electronic components to trade for public-domain disks. Timothy McIlwee, 37W168 Hilly Lane, Dundee, IL 60118.

FOR SALE: Ohio Scientific C3-A mainframe computer, Texas Instruments 810 dot-matrix high-speed printer, and Intertec Data Systems terminal. Sherry Maturin, (318) 367-3232, days.

FOR SALE: TRS-80 Model III, 48K RAM, two disk drives, RS-232C board, modem, cassette recorder, miscellaneous computer books and magazines, manuals, and more. $1200 or offer. Kevin Gregg, 4310 15th St. NW, Washington, DC 20011, (202) 726-4519. ■

B·O·M·B

BYTE's Ķ R Ķ ঘ RĶ Rl· Box

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BOMB *Results*

NOVEMBER REMEMBRANCES

Steve Ciarcia's "The World's Smallest 1200-bps Modem" wins. According to Webster: "Memories" was next. Third is Jerry Pournelle's "Old Favorites and New Ones" followed by Bruce Webster's "Extending Turbo Pascal." Mark Bridger and Mark Goresky will split $100 for "High-Resolution Printer Graphics." Sixth goes to Phillip Robinson's "The Amiga's Custom Graphics Chips." and Stefan Demetrescu wins $50 for "Moving Pictures."

IBM ISSUE SPECIALTIES

Stephen R. Fried's comparison entitled "The 8087/80287 Performance Curve" placed first in "Inside the IBM PCs" (Fall 1985). He wins $100. In second place, and the winner of $50, is Paul Dunphy, who wrote "IBM PC Interrupt Service Routines." Marcus Kolod's "IBM PC Disk Performance and the Interleave Factor" came in third. Staffer Mark Dahmke's "IBM Compatibility Issues" deserves mention. Congratulations to all.

R·E·A·D·E·R S·E·R·V·I·C·E

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